L2 processing of English relative clauses and long-distance wh-dependencies: evidence from L1-French and L1-Persian speakers

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Impact of Covid-19

This project was carried out during the Covid-19 pandemic period, which made in-person data collection impossible. Therefore, the data for the three studies discussed in Chapters 3, 4, and 5 were collected online using Internet-based platforms (see Chapter 2 for details).

Statement of Authorship

The Candidate confirms that the present project is original and has not been submitted for examination elsewhere. The Candidate further certifies that this thesis does not, to the best of his knowledge, infringe on anyone's copyright or violate any proprietary rights, and that material sourced from other authors has been cited and credited accordingly. Copies of such material has been made openly available in the Appendices.

The Candidate acknowledges the contribution of Professor Florence Myles and Dr. Laurel Lawyer as co-authors of Studies 1 and 2, which are presented in Chapters 3 and 4, respectively. Study 3 was authored solely by the Candidate and is presented in Chapter 5.

Dedication

This project coincided with the Iranian women's uprising against prejudice, bigotry, and oppression. As an act of solidarity with the brave and strong women in Iran, I would like to dedicate this thesis to women, life, and freedom.

Abstract

The study of adult second language (L2) acquisition has sometimes resulted in theories that suggest representational deficits post-puberty. According to the Representational Deficit Hypothesis, L2 users (tend to) fail to interpret complex syntactic structures in L2 in a native-like manner since they under-use syntactic information compared to native (L1) users. However, most studies supporting a representational deficit account tend to conflate syntactic deficits with processing limitations. That is, it remains unclear if the observed non-target-like behaviour by adult L2 users reflects syntactic or processing issues. The current project aimed to investigate the nature of non-target-like L2 behaviour in English relative clauses (RCs) by L2 readers of L1-French and L1-Persian. This project opted to examine the processing of RCs to ensure the highest degree of comparability with previous research, since RCs have already been studied extensively in previous studies and the literature is replete with different accounts of the way L2 readers process and acquire English RCs.

Three Studies of resumption acceptability (Study 1), RC disambiguation (Study 2), and long-distance wh-dependencies (Study 3) are presented. The results of all studies suggest that potential L1-L2 differences at an advanced proficiency do not reflect a syntactic deficit but indicate processing limitations. More specifically, in Study 1, the Persian readers resorted to an L1-based resumption strategy by accepting resumptive RCs more frequently to ease processing constraints associated with direct object and object-of-preposition RCs. However, they displayed a similar pattern of acceptability ratings as the native English and French readers with respect to the choice of relativiser used in different RC types. In Study 2, all three groups favoured a non-local over a local interpretation when RC ambiguities were presented in isolation, and when RCs were embedded in contexts, they tended towards a null interpretation (i.e., sometimes local, other times non-local interpretation). Finally, Study 3 showed that both native and L2 readers of English prioritise lexical subcategorisation over abstract syntactic

information while forming long-distance wh-dependencies. Overall, the native and the two L2 groups showed similar processing behaviour across the three Studies, especially at an advanced proficiency, thus suggesting that L1-L2 differences are not qualitative in nature. Taken together, the presented Studies challenge traditional accounts of L2 acquisition and processing that suggest syntactic impairments in L2. Instead, this project suggests the ability to process complex syntactic structures such as RCs remains intact in an L2, and the observed deficits in the past are likely the result of L1, proficiency, and working memory constraints.

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Table of Contents

List of Tables

List of Figures

List of Abbreviations

DO RC	Direct Object Relative Clause
GenSLA	Generative Second Language Acquisition
GJT	Grammaticality Judgment Task
IH	Interpretability Hypothesis
SPR	Self-paced Reading
SU RC	Subject Relative Clause
OP RC	Object-of-preposition Relative Clause
RC	Relative clause
RDH	Representational Deficit Hypothesis
SSH	Shallow Structure Hypothesis
SLA	Second Language Acquisition
WM	Working Memory
WMC	Working Memory Capacity

Chapter 1: Introduction

1.1. Overview

Relative clauses (RCs) are one of the most complex and extensively studied structures which pose considerable learning difficulty to second language (L2) readers (Biber et al., 1999; Gibson, 1998; Hawkins, 1989; Hawkins & Chan, 1997; Huddleston & Pullum, 2006; Keenan & Comrie, 1977; Kidd, 2011; Lapole, 2014; Myles, 1995; Safir, 1986; Tezel, 1999; Tsimpli & Dimitrakopoulou, 2007). Many studies have explored the L2 acquisition of RCs and the way L2 grammars potentially differ from native (L1) grammars. Where differences are observed between L1 and L2, theories divide as to the potential source of non-target-like behaviour. According to the Representational Deficit Hypothesis (RDH), the syntactic representations of RCs are fundamentally different in L1 and L2 (Hawkins & Hattori, 2006; Tsimpli & Dimitrakopoulou, 2007), and unlike native readers, L2 readers face consistent difficulty when reading complex RCs in an L2, such as those that are syntactically ambiguous (Clahsen & Felser, 2006; Papadopoulou & Clahsen, 2003, 2006) and those that involve long-distance wh-dependencies (Marinis et al., 2005). According to the RDH, L2 grammars do not provide the kind of morphosyntactic knowledge that is necessary to interpret RCs in a native-like manner. However, as will be discussed in this Chapter, the RDH tends to disregard individual differences in L2 processing and confounds potential syntactic deficits with processing limitations (Gass, 1979; J. Hawkins, 2009; Hitz, 2012; Tezel, 1999). There is a wealth of L2 processing research that suggests L2 readers match native readers at an advanced proficiency, given sufficiently large cognitive resources (Hopp, 2014; Pliatsikas & Marinis, 2013), thus questioning the RDH's argument that L1 and L2 grammars are qualitatively different. Therefore, it is unclear whether L2 syntactic representation and processing of RCs decline in L2 or if L1-L2 differences are due to confounding processing limitations (Cunnings, 2022). This project contributes to the debate by comparing and contrasting both the morphosyntactic representation and processing of English RCs by native and L2 readers of L1-French and L1-

Persian. The findings have important and potentially worthwhile implications for a range of L2 acquisition (Hawkins & Chan, 1997; Tsimpli & Dimitrakopoulou, 2007) and processing theories (Clahsen & Felser, 2006, 2018; Cunnings, 2017; Dussias & Piñar, 2010; Felser, 2019; Hopp, 2014).

The reason for focusing on L2 English readers of L1-French and L1-Persian was to enable a more comprehensive account of L2 acquisition and processing that holds for L2 learners with L1 backgrounds as distinct as French and Persian. There are significant syntactic similarities and differences among English, French, and Persian RCs. For instance, whilst French is similar to English in that it grammatically disallows resumptive RCs (Dickens, 2018; Hawkins, 1989; Myles, 1995; Poletto & Sanfelici, 2017; Rowlett, 2007), resumptive pronouns are grammatical in direct object and object-of-preposition RCs in Persian (Abdollahnejad & Marefat, 2017; Taghvaipour, 2005; Zahedi et al., 2012). In addition, English and French allow both wh-pronouns and invariant complementisers to function as potential relativisers (Hawkins & Chan, 1997; Hermas, 2014). By contrast, the only type of relativiser in Persian is an invariant complementiser, and wh-pronouns are not allowed (Karimi, 2005). Furthermore, in the case of ambiguous RCs with potential antecedents that are either local or distant to their subcategorising verb, French (Dekydtspotter et al., 2008) and Persian readers (Marefat et al., 2015) tend to prefer a distant over a local antecedent, unlike native English readers that favour a local interpretation (Cuetos & Mitchell, 1988; Frazier & Clifton, 1996). Overall, there are significant differences in both the derivation and interpretation of RCs in English, French, and Persian. As such, by investigating the L2 syntactic representation and processing of English RCs by L1-French and L1-Persian readers, this project aims to contribute to a more comprehensive and insightful account of L2 acquisition of RCs.

The structure of this thesis is as follows: this Chapter introduces the critical RC structures in this project and offers a contrastive analysis of RC derivations in English, French, and Persian.

This Chapter also reviews previous literature on the associated theoretical background and relevant L2 research. Chapter 2 presents the research design and general methodology, providing information about the participants recruited, the data collected, and the instruments used. Chapter 3 examines L2 syntactic knowledge of different English RC types by three groups of native English, L1-French, and L1-Persian readers, investigating the acceptability of resumptive pronouns and different relativiser forms in English RCs. Chapter 4 compares the way native and L2 readers (of L1-French & L1-Persian) resolve ambiguous English RCs in real-time and examines if there are qualitative differences between native and L2 disambiguation strategies. Chapter 5 investigates the processing of long-distance wh-dependencies by advanced L1-French and L1-Persian readers, in addition to a group of native English controls, and assesses whether RC formation in English is characterised by access to abstract information such as syntactic copies. Chapter 6 provides a summary of the findings and relates them to the findings of previous research, outlines its limitations, and concludes with suggestions for further research.

1.2. Different types of relative clauses

In its most basic sense, an RC is a linguistic construction that either alone or in combination with a noun denotes some unit of thought (Dryer, 2005), as in examples *(1)* below, where *who walks fast* is adding more information to the discourse entity *the girl*.

1) *The girl* [*who walks fast*] *is playing guitar.*

World's languages form RCs using different syntactic strategies by appealing to the constructs of head and head directionality (Cinque, 2020; Dryer, 2005; Hawkins, 2007). Heads are the same discourse entity referred to by both the RC and the modified noun; however, not all RCs have an overt head, and the linear ordering of the head and the RC might vary cross-

linguistically: RCs follow the head in certain languages such as English, French, and Persian, whereas they precede the head in other languages such as Chinese, Japanese, or Indonesian.

1.2.1. Heads and head directionality

Relative clauses can be distinguished based on the presence or absence of the head noun and its syntactic characteristics (Cinque, 2020; Dryer, 2005). Not all RC types explicitly modify a noun, and even within those RCs that do, the location of the head is not fixed to a certain structural position. Headless RCs are sometimes labelled as free since they involve structures that can function independently, as opposed to headed RCs which are often characterised as being ordinary since they are more frequent than headless RCs (Abdollahnejad & Marefat, 2017). The former category refers to the class of RCs that do not have an explicit and uniquely identifiable antecedent in the discourse, such as *(2)* below, where *what I see* functions as the direct object of the verb *like*. This stands in contrast to the latter category of RCs that represent embedded clauses, as in *(1)* above, which modify a head noun (*the girl*) in the matrix clause (*the girl is playing guitar*). This project does not aim to explore the acquisition and processing of headless RCs.

2) I like [*what I see*].

A further distinction on RC types can be made based on the location of the head. For instance, in Persian, the head always appears outside the RC as shown in *(3)* (Abdollahnejad & Marefat, 2017, p. 136) with the head *ketãb-i* appearing to the left of the RC *ke u piʃnæhãd kærd*, but this is not necessarily the case in all languages. For example, in (4) (Couro & Langdon, 1975, pp. 187-186) from Mesa Grande (spoken by Diegueno Mission Indians in Southern California), the head *gaat* (cat) occurs inside the same clause between the RC subject and verb.

3) ketãb-i [*ke u piʃnæhãd kærd*]=*rã xærid-æm*

book-DEM that she suggested bought-1SG

'I bought the book that she suggested'

4) ['*ehatt gaat akewii*]=*ve=ch chepam*

[dog cat chase]=DEF=SUB get.away

'the cat that the dog chased got away'

More generally, the directionality of the head may vary cross-linguistically. For instance, similar to Persian and English, French RCs involve heads that appear to the left of the embedded clause, as shown in *(5)* with *la cave* (the cellar) appearing on the left periphery of the RC *à laquelle je descendais* (to which I descended) (Rowlett, 2007, p. 190). By contrast, in some other languages such as Mandarin, RCs always precede the head, as in *(6)* (Del Gobbo, 2005, p. 288) where the head noun *na-ge nanhai* (that boy) follows the RC *dai yangjing de* (that wears glasses).

5) la cave à laquelle je descendais

the cellar to which I descended

'the celler I was going down to'

6) dai yangjing de na-ge nanhai

wear glasses that that boy

'the boy that wears glasses'

1.2.2. Restrictive and non-restrictive relative clauses

Within headed RCs, there are two semantic subcategories: restrictive and non-restrictive RCs (Alexiadou et al., 2000; Carnie, 2013, p. 384; Cinque, 2020, p. 5). As the title suggests, restrictive RCs restrict the meaning of the RC as the modifier of the head noun to a uniquely identifiable referent, whereas non-restrictive RCs add parenthetical commentary information

about a noun whose reference is already established in the discourse (Dietrich, 2007; Poletto & Sanfelici, 2017). Consider *(7)* and *(8)* as examples of restrictive and non-restrictive RCs, in English respectively (from Dickens, 2018, p.5).

7) *I think books that are blue are ugly.*

8) *I think books, which are heavy and outdated, are ugly.*

The restrictive RC *that are blue* in *(7)* narrows the set of *books* intended by the reader as being *ugly* to those that are *blue*. By contrast, the non-restrictive RC *which are heavy and outdated* in *(8)* does not change the set of referents for *books* and provides additional information that the reader believes all print books are *heavy*, *outdated*, and *ugly*. Restrictive RCs denote properties that combine with the meaning of the head noun and function to identify the referent intended by the head amongst the set of potential discourse referents, whereas non-restrictive RCs do not contain properties that combine with the head noun and tend to add non-essential parenthetical information to the discourse referent already identified by the head.

Restrictive RCs are different from non-restrictive ones at a phonological, semantic, and syntactic level: they are not separated with intonation from the rest of the sentence, they provide information about the head noun which is central in its identification, and they modify their antecedents unlike non-restrictive RCs whose head might not be easily identifiable in the discourse (Prentza, 2012). This project does not aim to examine the acquisition and processing of non-restrictive RCs.

1.2.3. Relativised elements in restrictive relative clauses

Delving deeper into RC types, one can identify further subcategories for restrictive RCs based on the syntactic function of the relativised element (Keenan & Comrie, 1977). The relativised element can play the syntactic function of, amongst others, subject (SU), direct object (DO),

and object of preposition (OP) within the embedded clause, as illustrated in *(9)* below (Labelle, 1990, p. 97). The gap in each example indicates the position in the embedded clause where relativisation has occurred.

9) a. La fille qui __ court Subject (SU)

The girl that __ runs

b. La fille que le garcon embrasse __ Direct object (DO)

The girl that the boy kisses __

c. La fille à qui la dame fait un sourire __ Object of preposition (OP)

The girl to whom the lady smiles __

To summarise, RCs can be divided into headless and headed categories depending on the presence of some head noun, and within the latter group, further subcategories can be made according to the semantic nature of the information added to the head noun. Restrictive RCs function to delimit the intended referent from amongst a set of referents in the discourse, whereas non-restrictive ones provide non-essential and parenthetical information about the head noun. Additionally, depending on the syntactic function of the relativised element, further subcategories can be identified within headed RCs. The relativised element can have the syntactic function of subject, direct object, and object of preposition within the RC. Importantly, the afore-mentioned RC types modify nouns in slightly different ways (Cinque, 2020; Poletto & Sanfelici, 2017), leading to the hypothesis that they might result in different acquisitional and processing patterns (Hawkins, 1989; Keenan & Comrie, 1977; Luzi, 2012; Myles, 1995). For instance, non-restrictive RCs provide extra information that is often new to the discourse, which tends to occur later in the sentence than old information in SVO languages such as English. Therefore, non-restrictive RCs are processed more easily in English in the object position compared to restrictive RCs, which typically involve less processing difficulty

in the subject position (Gibson et al., 2005). In order to narrow down its scope, this project does not aim to investigate L2 acquisition of headless RC types, but examines the processing of SU, DO, and OP restrictive RCs, as well as ambiguous non-restrictive RCs.

Relying on a Minimalist syntactic framework, the next section provides a detailed analysis of RC formation in English, French, and Persian – the native languages of the participants in this project.

1.3. A Minimalist view of relativisation in English, French, and Persian

According to the Minimalist Program (MP), the language faculty is composed of grammatical modules such as Lexicon (LEX), Morphology, and Syntax, which are connected by the so-called interfaces to other cognitive components responsible for language processing (Chomsky, 2000). The LEX is connected to a computational system (C_{HL}) with a set of syntactic devices such as Merge, Move, and Agree that combine lexical items into linguistic expressions, interpret these expressions semantically, and assign them a phonological spell-out (R. Hawkins, 2005, p. 124). The C_{HL} connects the lexicon to the conceptual-intentional system via Logical Form (LF) interface and the articulatory-perceptual system via the Phonetic Form (PF) interface, respectively. The lexicon itself is composed of well-defined matrices of phonological (e.g. [-back]), semantic (e.g., [+animacy]) and morphosyntactic features (e.g., [-past]) that amount to units of grammar. Chomsky (1995) divides morphosyntactic features into interpretable and uninterpretable features. Interpretable features are those that make an essential contribution to the meaning (e.g., [tense]), whereas uninterpretable features have a purely syntactic role (e.g., [agreement]). Of the two featural types, only uninterpretable morphosyntactic features are accessible to C_{HL}. That is, syntactic computations such as movement operations are motivated by the need to eliminate those features that are uninterpretable at the interfaces (see below for an example).

1.3.1. Relative clause formation in English and French

English and French RCs are subject to locality conditions and are assumed to be formed by means of wh-movement (Sportiche, 1981). It is assumed within Minimalism that each morpheme heads its own syntactic category containing a subset of morphosyntactic features. The Complementiser (C) node in English and French contains the uninterpretable Extended Projection Principle (EPP) and (wh) features that drive wh-operator movement operations to a position higher in the corresponding syntactic tree – the specifier position of the complementiser phrase or spec (CP). The [EPP] feature mandates that the specifier position be filled with a syntactic constituent in the embedded Tense Phrase (TP), and the [wh] feature regulates the precise morpheme that undergoes movement (R. Hawkins, 2005; Radford, 2009). If the C contains a [+wh] feature, as in *(10a)*, an overt wh-word such as *who* with an interpretable [+wh] feature moves to spec (CP), whereas in the case of a C [-wh], as in *(10b)*, the element undergoing movement is a silent morpheme with a null [^{0}wh] feature (Hermas, 2014).

10) a. The man [$_{CP}$ *who*$_{i}$ $_{[wh]}$ [$_{C\ [+wh]}$] [$_{TP}$ *I was talking to <who*$_{i}$*>*]]

b. The man [$_{CP}$ Op$_{i}$ $_{[0wh]}$ [$_{C\ [-wh]}$ *that*] [$_{TP}$ *I was talking to <Op*$_{i}$*>*]]

Importantly, the precise form of English relativisers does not depend on the syntactic position of the relativised element within the TP. That is, English allows both wh-words such as *who* and the invariant complementiser *that* to function for human referents as potential relativisers in different RC types, such as SU, DO, and OP RCs (Keenan & Comrie, 1977). This is illustrated in *(11)* (Dickens, 2018, pp. 14–18):

11) a. The boy who / that <Op> saw you (SU)

b. The boy who(m) / that you saw <Op> (DO)

c. The boy who(m) / that you gave the key to <Op> (OP)

Furthermore, English OP RCs allow preposition stranding with relativisers, where a wh-morpheme moves to the spec (CP) alone and leaves its DP complement stranded at its base position (as in *11c*).

Similarly to English, French involves wh-movement operations in different RC structures, i.e., wh-words such as *lequel* (which) – more frequently used in non-restrictive RCs – and its allomorphs *qui* are displaced from the positions where they are interpreted as in *(12)*. In addition to the possibility of gender and number inflection for *lequel*, there is an added level of complexity in selecting the correct RC pronoun in French RCs, namely the fusion between the prepositions and the wh-operator *lequel*. In French, since the prepositions *à* and *de* typically contract with the determiners *le* and *les*, they do so in *lequel* RCs, leading to forms such as *auquel* (*à + lequel*) and *duquel* (*de + lequel*) (Rowlett, 2007, p. 190). Unlike in English, no PP stranding is allowed in French and the only grammatical option to form OP RCs is through a pied piping strategy, whereby the entire PP moves to spec (CP) (Dickens, 2018, p. 33).

12) a. la femme$_i$ [$_{CP}$ *avec laquelle*$_{i\ [wh]}$ [$_{C\ [+wh]}$] [$_{TP}$ *Jean veut se marier <avec laquelle*$_i$*>*]]

the woman with whom Jean wants self marry <with which>

b. la femme$_i$ [$_{CP}$ *avec qui*$_{i\ [wh]}$ [$_{C\ [+wh]}$] [$_{TP}$ *Jean veut se marier <avec qui*$_i$*>*]]

the woman with whom Jean wants self marry <with which>

"The woman Jean wants to marry"

Despite the similarity in wh-movement operations between English and French RCs, the distribution of relativisers in French RCs is different from that in English and is tied to the syntactic function of the relativised element (Dickens, 2018; R. Hawkins, 1989; Rowlett, 2007). Object-of-preposition RCs in French are obligatorily relativised by relative pronouns such as those in *(12)* above, whereas DO and SU RCs take the overt complementisers *que* and

qui as in *(13)* and *(14)* below (for evidence why *qui* in SU RCs is not considered a wh-word, see Rowlett, 2007, p. 192). In addition, there is no relative pronoun for the direct object position (no *lequel* is possible).

13) la fille$_i$ [$_{CP}$ Op$_{i\ 0wh}$ *que* $_{[-wh]}$ [$_{TP}$ *j'aime* <Op$_i$>]] (DO RC)

the girl that I love

14) la fille$_i$ [$_{CP}$ Op$_{i\ [0wh]}$ *qui* $_{[-wh]}$ [$_{TP}$ <Op$_i$> court]] (SU RC)

the girl that runs

Finally, standard English and French RCs do not syntactically allow a resumptive strategy (Dickens, 2018; R. Hawkins, 1989). A resumptive pronoun is a pronoun variable appearing in a position where movement has occurred (Pérez-Leroux, 1995). Resumptive RCs in English and French are not syntactically allowed and are typically judged ungrammatical by native readers of these languages (Keffala & Goodall, 2011).[1] The example below illustrates the ungrammaticality of resumption in French and English RCs.

*15) *la boîte que je **l'**ai trouvée.*

16) *The box that I have found **it**.

In summary, English and French RCs are formed by wh-movement and allow the use of either an invariant complementiser [^{0}wh] or a wh-pronoun [+wh]. French differs from English in that it involves finer-grained syntactic restrictions on the distribution of relativisers. As for

[1] Resumptive pronouns are associated with non-standard English and French, and only occur in complex RCs, such as those involving additional cognitive load taxing working memory. Examples include, among others, RCs with a long distance between the relativised position and extracted wh-word, as well as those that have double-embedded structures (Alexopoulou & Keller, 2007). It is assumed in this project, particularly in Chapter 3 which investigates resumption acceptability, that resumption is ungrammatical in in the experimental items used in Study 1, since none of the items involved factors such as those above which are associated with the grammaticality of resumptive pronouns in wh-movement languages.

resumption, neither English nor French allows resumptive RCs. This is quite different in Persian RCs, a topic which is explored in the next section.

1.3.2. Relative clause formation in Persian

In contrast to English and French, Persian is a pro-drop, SOV, and scrambling language, which does not respect island conditions (Raghibdoust, 1993, pp. 55-68), and is therefore considered to be a wh-in-situ language (Karimi, 2005). Unlike English and French, Persian RCs are not formed by means of wh-movement operations (Karimi, 2005; Karimi & Taleghani, 2007). Following Karimi and Taleghani (2007), it is assumed in this project that Persian RCs contain a base-generated null wh-operator [^{0}wh] at spec (CP) that agrees with a C head containing a [-wh] feature. Furthermore, unlike English and similarly to French, Persian does not allow PP stranding and all OP RCs involve pied piping PPs. Moreover, all RC types in Persian are obligatorily introduced by the invariant complementiser *ke* (Aghaei, 2006). An example of OP RC in Persian is provided below[2]:

17) mærd -i$_i$ [$_{CP}$ Op $_{[0wh]}$ [$_{C[-wh]}$ *ke*] [$_{TP}$ *beh* (***u***$_i$ / ***-ef***$_i$) *pul dãd-æm*]]

man-RES that I money to **him** gave-[1SG]

'the man that I gave money to'

As evident in the above example, Persian RCs may contain syntactically allowed resumptive pronouns that reflect the relativised head within the embedded clause. The resumptive pronouns in Persian RCs can be realised by either an overt and independent pronoun such as *u*

[2] Restrictive RCs in Persian are typically distinguished from non-restrictive ones by the attachment of the suffix *-i* to the relativised head, henceforth shown by -RES in gloss (Taghvaipour, 2005)

(him/her) or a verbal clitic such as *-eʃ* (him/her), coindexed with the relativised head (Taghvaipour, 2005). According to Taghvaipour (2005), no resumption is allowed in Persian SU RCs (for counterexamples, see Abdollahnejad & Marefat, 2017, p. 144), whereas inserting a resumptive pronoun is optional in DO and obligatory in OP RCs, respectively. It is assumed in this project that resumption in Persian RCs resembles (uninterpretable) verbal agreement features typically expressed by subject and object clitics. Persian has obligatory subject and optional object verbal clitics.

In fact, where TP agreement features are overtly attached to the verb, resumption is redundant in Persian RCs and where verbal clitics are missing, resumption is obligatory. As far as SU RCs are concerned, the agreement features of the subject are already obligatorily indicated on the verb and inserting an overt resumptive is syntactically redundant. This is consistent with the observation that resumptive pronouns in SU RCs are ungrammatical (Taghvaipour, 2005) unless with an increased focus interpretation (Abdollahnejad & Marefat, 2017). In addition, using object clitics is optional and is typically associated with informal Persian, as is the use of resumption in DO RCs (Abdollahnejad & Marefat, 2017). Furthermore, using both an overt resumptive pronoun and verbal object clitic does not seem to be grammatical in Persian, as illustrated below, where a gap *(18a)* or resumption *(18b)* is grammatical, but using both a resumptive pronoun besides a verbal object clitic is questionable at best *(18c)*. And finally, resumptive pronouns are obligatory in OP RCs and this can be linked to the lack of verbal clitics in the oblique case (the case assigned to the DP complements of prepositions). Following Adger (2003), it is assumed in this study that resumption is specifically a PF phenomenon, i.e., the uninterpretable agreement features of the verb are converted to overt phonetic realisations as resumptives in Persian RCs, doubling the features of the extracted morpheme.

18) a. mærd-i ke mæn __ did-æm.

man-RES that I __ saw-[NOM$_{1SG}$]

‘the man that I saw’

*b. mærd-i ke mæn **u**-ra did-æm.*

man-RES that I **him** saw-[NOM_{1SG}]

‘the man that I saw’

c. ???*mærd-i ke mæn **u**-ra did-æm-**ef**.*

man-RES that I **him** saw-[NOM_{1SG}]-**[ACC 3SG]**

‘the man that I saw’

The following table provides a summary of the syntactic properties of SU, DO, and OP RCs in English, French, and Persian. Wh-movement in English and French to spec (CP) is triggered by the presence of an [EPP] feature at C, whereas there is no wh-movement in Persian RCs, hence the lack of an [EPP] feature. In addition, the relativising word involves an agreement relationship between the C and its specifier in terms of a [wh] feature in English, French, and Persian, but whereas English and French RCs can initiate with either a wh-morpheme [+wh/^{0}wh] or an invariant complementiser [-wh], Persian does not syntactically allow wh-morphemes to function as relativisers [-wh]. Finally, TP agreement features remain covert in English and French and no resumption is allowed, whereas agreement might be overtly realised as resumptive pronouns in Persian.

Table 1

Summary of syntactic properties of English, French, and Persian RCs

	RC type	spec (CP)	C	TP
English	SU	[+wh/^{0}wh]	[EPP, +/-wh]	gap
	DO	[+wh/^{0}wh]	[EPP, +/-wh]	gap
	OP	[+wh/^{0}wh]	[EPP, +/-wh]	gap
French	SU	[^{0}wh]	[EPP, -wh]	gap
	DO	[^{0}wh]	[EPP, -wh]	gap
	OP	[+wh]	[EPP, +wh]	gap
Persian	SU	[^{0}wh]	[-wh]	resumption
	DO	[^{0}wh]	[-wh]	resumption
	OP	[^{0}wh]	[-wh]	resumption

The learning task for the L1-French readers does not consist of learning new features but ascertaining how these features are expressed in English. As for L1-Persian readers, however, the learning task involves the acquisition of an [EPP] feature at C and a [wh] at spec (CP) that motivate wh-movement, in addition to the pre-emption of an L1-based resumptive strategy that overtly spells out the TP agreement features in Persian.

The next section summarises the literature on both the acquisition and processing of RCs in detail.

1.4. Previous L2 research on relative clauses

This section begins with a discussion of the syntactic representation of resumptive RCs (section 1.4.1) and continues with reviewing previous research on the real-time processing of different

RC types, particularly focusing on RC ambiguities (section 1.4.2.1) and long-distance wh-dependencies (section 1.4.2.2).

1.4.1. Resumption

Many studies have been carried out to investigate the L2 acquisition of RCs and whether L2 grammars allow resumptive pronouns in languages where the only syntactically licit option is a gap strategy (Belikova & White, 2009; Hawkins & Chan, 1997; Lardiere, 2008; Tsimpli & Dimitrakopoulou, 2007). The results have suggested significant differences between L1 and adult L2 readers, leading some to the conclusion that the uninterpretable features of resumptive pronouns are no longer accessible in adult L2 acquisition and resist resetting to appropriate L2 values (Tsimpli & Dimitrakopoulou, 2007). For example, Tsimpli and Dimitrakopoulou, (2007) administered a grammaticality judgment task to explore the acceptability of resumptive pronouns in L2 English wh-interrogatives by L1 Greek readers. Unlike English, resumption represents a cluster of uninterpretable verbal agreement features in Greek wh-interrogatives and is obligatory in subject and optional in object positions. The materials consisted of structures of the type below (Tsimpli & Dimitrakopoulou, 2007, p. 227):

19) a.	*Who do you think that Jane likes ___ / *him?*	Object-extraction
b.	*Who have you suggested ___ / *he should not resign?*	Subject-extraction

The participants included a group of native English reader controls and two groups of L1-Greek L2-English readers divided by proficiency: intermediate and advanced. The results showed that despite a clear development in the rejection of resumptive pronouns in the two learner groups, the rates of resumption acceptability in both subject and object extraction structures were significantly higher for the L2 participants than for the native English reader control group. In addition, whereas the advanced group judged resumptive subject extraction structures significantly more acceptable (32.6%) than resumptive object extraction structures (21.4%),

the intermediate readers judged resumption almost equally acceptable in subject (38.3%) and object extraction sites (40.5%). Tsimpli and Dimitrakopoulou argued that resumption as a cluster of uninterpretable features is likely to cause learnability problems for L2 learners at even an advanced proficiency, and L2 readers are likely to transfer the status of resumptive pronouns from their L1 to L2. Tsimpli and Dimitrakopoulou conclude that their findings support the Interpretability Hypothesis (IH), according to which the uninterpretable features of L1 resist resetting to L2 appropriate values due to critical period effects, and L2 readers operate based on the uninterpretable features of their L1.

However, these results should be interpreted with caution. That the L2 readers' rate of resumption acceptability in Tsimpli and Dimitrakopoulou (2007) was higher than the native English readers' does not warrant the conclusion that the underlying grammatical representations are necessarily different. It is possible that the observed reliance on resumption acceptability was motivated by L2 processing limitations, and the L2 participants were not sufficiently advanced to behave like native readers in terms of acceptability of resumptive RCs. Previous research suggests that given sufficient working memory capacity (WMC; Hopp, 2014), proficiency (Hopp, 2006), and linguistic exposure (Pliatsikas & Marinis, 2013), L2 readers are likely to display native-like processing behaviour. In fact, in a replication of Tsimpli and Dimitrakopoulou (2007), Leal-Méndez and Slabakova (2014) showed that only those L2 readers who were not sufficiently advanced in L2 English and who frequently accepted a resumptive pronoun in their L1 were likely to transfer an L1-based resumption strategy to L2 English. By contrast, those L2 readers who enjoyed more than 6 years of immersion experience in an English-speaking country and who did not typically accept a resumptive over a gap strategy in their L1 were unlikely to accept a resumption strategy in L2 English.

In a similar vein as Tsimpli and Dimitrakopoulou (2007), Marefat, and Abdollahnejad (2014) investigated the status of resumptive pronouns in English L2 RCs by 4 different proficiency

groups of L1 Persian readers: elementary, low-intermediate, high-intermediate, and advanced. They administered a grammaticality judgment task on SU, DO, and OP RCs in English. As discussed in section (1.3), resumptives are ungrammatical in Persian SU, optional in DO, and obligatory in OP RCs. The results indicated a clear development by proficiency in rejecting resumptive RCs: Acceptability rates of resumptive pronouns were significantly lower among the advanced group (SU: 18%, DO: 28%, OP: 24%) than among the elementary group (SU: 65%, DO: 75%, OP: 64%). Additionally, the authors reported no statistically significant difference in SU RC resumption acceptability between the advanced group and the native readers, whereas a significant difference was observed in the resumption acceptability of DO and OP RCs between the native and the advanced L2 readers. Marefat and Abdollahnejad argued that their findings were compatible with the IH, since they found no difference in resumption acceptability in SU RCs between advanced and native readers, but the advanced readers were more likely than native English readers to accept resumptive pronouns in DO and OP RCs, mirroring the status of resumptives in L1 Persian.

However, these results are also open to interpretation. Marefat and Abdollahnejad reported an advantage for a gap over resumption for both the advanced L2 and the native English readers. Both groups significantly preferred gapped over resumptive RCs, suggesting that the L2 participants' occasional reliance on a resumptive strategy does not necessarily indicate syntactic deficits. The mere observation of L1-L2 performance differences does not necessarily justify the conclusion that the underlying grammars are fundamentally different (Dekydtspotter et al., 2006). L2 readers might resort to a resumptive strategy to facilitate WM constraints (J. Hawkins, 2009), since inserting a resumptive pronoun in place of the relativised element enhances the availability of the extracted morpheme in WM by highlighting its morphosyntactic features (Lewis et al., 2006), and even native readers of [- resumptive] languages sometimes use a resumptive strategy to lighten the processing burden on the

underlying parsing system (Tezel, 1999). Early research on L2 acquisition of English RCs has shown that even L2 English readers of [- resumption] L1 backgrounds might resort to a resumptive strategy to facilitate processing limitations (Gass, 1979; Tezel, 1999), and this is more likely to be observed in relatively complex syntactic environments such as OP and DO RCs than in SU RCs. Thus, the relatively higher acceptability of resumption in DO and OP RCs is not necessarily informative as to the (in)accessibility of uninterpretable features in L2 acquisition. In fact, some studies have suggested that native readers of [-resumptive] L1s may resort to a resumption strategy to conserve processing resources, especially when processing becomes difficult (Hawkins, 1989; Radford, 2009). Given the hypothesis that L2 readers are more susceptible to cognitive resource limitations than monolingual readers (Hopp, 2014), L2 readers are equally (if not more) likely than native readers to adopt a resumption strategy to reduce processing burden on the underlying parsing mechanism. This is especially true for those L2 readers whose L1 allows resumption (Gass, 1979), suggesting that inserting a resumptive pronoun in RCs potentially reflects an L2 developmental stage in the acquisition of RCs regardless of L1, which may persist longer in L2ers whose L1 grammaticalises resumption (Hitz, 2012).

Overall, previous research supporting the IH on resumption acceptability has disregarded individual differences and confounded potential syntactic deficits with processing limitations. A more fruitful investigation of accessibility to uninterpretable features in L2 English RCs should involve an investigation of the potential role of individual differences in WM, proficiency, and immersion experience and concentrate not only on resumption but also on other morphosyntactic phenomena that are motivated by uninterpretable features (e.g., preference for different relativiser forms). In addition to resumptive pronouns, the distribution of relativisers (*that,* wh-pronouns) is motivated by uninterpretable features [EPP, wh] at C. An investigation of preference for the potential form of relativiser alongside resumption

acceptability can help illuminate the degree to which uninterpretable features are accessible in L2 acquisition of English RCs. This is the main focus of Study 1 and is explicated in detail in Chapter 3.

The next section reviews previous research investigating the real-time processing of relative RCs, beginning with those studies that examined RC disambiguation strategies in section (1.4.2.1) and continuing with those that investigated the processing of long-distance wh-dependencies in the next section (1.4.2.2)

1.4.2. Previous research on L2 processing of relative clauses

In addition to the syntactic representation of RCs, many studies have investigated the way in which readers process RCs in real-time. In fact, early parsing theories were developed, in large part, to account for the processing of RCs, particularly those that were syntactically complex (Crain & Steedman, 1985; Cuetos & Mitchell, 1988; Frazier, 1978; Frazier & Clifton, 1996; Frazier & Fodor, 1978; Gibson et al., 1996). Similarly, most influential research on L2 parsing models have focused on the processing of complex RCs (Clahsen & Felser, 2006, 2018; Hopp, 2014; Papadopoulou & Clahsen, 2003, 2006). Therefore, to contribute to the debate, this project focused on two such RC types: *(a)* those that are syntactically ambiguous between a local and non-local interpretation, and *(b)* those that involve a long distance wh dependency.

1.4.2.1. Relative clause disambiguation

There is increased interest in the way native and L2 readers resolve structural ambiguities in real-time, and it is generally assumed that investigating L2 disambiguation can provide insight into the processes underlying parsing preferences. Specifically, sentences containing relative clause (RC) ambiguities such as (20) have featured prominently in the native and L2 processing literature (e.g., Clahsen & Felser, 2006; Goad et al., 2021; Hopp, 2014). In (20), the relative

clause (RC) *who was on the balcony* has two potential host sites for its attachment. Preference for attaching the RC to a higher noun in the complex DP, *the servant*, is referred to as DP1 attachment or disambiguation towards DP1, and preference for attaching it to the lower DP in the syntactic tree, *the actress*, is referred to as DP2 attachment or disambiguation towards DP2. Previous research shows that attachment preferences are subject to cross-linguistic parametric differences (Papadopoulou, 2006), and while French (Colonna & Pynte, 2002; Dekydtspotter et al., 2008; Pynte & Colonna, 2000) and Persian (Marefat et al., 2015) readers prefer to attach the ambiguous RC to DP1, no agreement exists on RC attachment preferences in English. Some studies suggest that English readers have a mild DP2 attachment preference (Gilboy et al., 1995), while others report null (neither DP1 nor DP2) and sometimes DP1 attachment in English (Carreiras & Clifton, 1993; Swets et al., 2007).

20) Someone shot the servant $_{DP1}$ of the actress $_{DP2}$ [$_{RC}$ who was on the balcony]

As for L2 processing, some studies suggest that L2 readers do not have a strong attachment preference while reading RC ambiguities in L2 and do not attach the RC to either DP1 or DP2 (Clahsen & Felser, 2006, 2018). These studies maintain that L2 readers face consistent difficulty interpreting ambiguous RCs in a native-like manner and instead over-rely on non-syntactic information such as discourse-level cues to interpret RC ambiguities (Pan et al., 2015). By contrast, other studies argue that since L2 readers are processing a non-native language when reading ambiguous RCs in an L2, they are likely to operate on L1 parsing preferences in order to ease processing limitations. These studies suggest that with increased proficiency, L2 readers progress from a lack of strong attachment preferences (neither DP1 nor DP2 attachment) to attachment preferences found in their L1 (Fernández, 1999; Frenck-Mestre, 1997) and ultimately to native-like interpretations of ambiguous RCs (Frenck-Mestre; Hopp, 2014). According to this line of theorising, given sufficient proficiency, L2 readers overcome

the challenge of parsing a non-native language and match native readers in RC attachment preferences.

1.4.2.1.1. Native processing of RC ambiguities and context effects

According to the Garden-path model (Frazier, 1978), readers have a universal tendency to attach the RC *who was on the balcony* in *(20)* to the second determiner phrase (DP2) *the actress* rather than to the first DP (DP1) *the servant* (Frazier, 1978). This follows from a universal parsing principle to attach the incoming linguistic load to the phrase currently being processed (Frazier, 1978; Gibson et al., 1996). In line with this principle, several studies have reported shorter reaction times (RTs) in English for RCs that are disambiguated towards DP2 than those disambiguated towards DP1 (Cuetos & Mitchell, 1988; Frazier & Clifton, 1996). However, the universality of DP2 attachment has been called into question with studies that show a DP1 preference in other languages such as French (Dekydtspotter et al., 2008) and Persian (Marefat et al., 2015). If DP2 attachment follows from a universal parsing principle, the observation that French and Persian readers, for example, favour DP1 attachment remains unexplained (Cuetos & Mitchell, 1988). Furthermore, some studies suggest that RC attachment preferences are generally very mild (Gilboy et al., 1995), and even English natives might display variable attachment preferences, i.e., sometimes DP1 and other times DP2, depending on a variety of factors such as the RC length (Carreiras & Clifton, 1993; Swets et al., 2007) or individual differences in the size of cognitive resources (e.g., as measured by WMC; Kim & Christianson, 2017). In fact, according to Frazier and Clifton (1996), RCs are processed in non-deterministic ways, and ambiguous RCs are never strongly attached to either DP1 or DP2.

To explain attachment preferences in languages other than English, the literature is replete with theories that have suggested the application of another parsing principle that competes with a universal DP2 attachment strategy but favours DP1 attachment (Cuetos & Mitchell, 1988;

Gibson et al., 1996; Hemforth et al., 2000). For example, according to Gibson et al. (1996), RC attachment preferences are determined by two syntactically motivated principles. The first is a recency principle that favours DP2 attachment and is motivated by WM considerations, similarly to the universal DP2 attachment strategy in the Garden path model (Frazier, 1978) that strives to ease processing limitations. On the other hand, according to Predicate Proximity, ambiguous RCs are preferably attached as close as possible to the head of the predicate phrase, i.e., the verb, under the assumption that the head of the predicate phrase and its arguments are important in sentence comprehension. Predicate Proximity favours attachment to DP1 in English as it is an internal argument of the verb. According to Gibson et al. (1996), the relative weightings of the two opposing principles are determined by the degree of configurationality of the language under consideration (Gibson et al., 1996, p. 50). In languages such as French and Persian that allow non-complement morphemes such as adverbs and negators to appear to the left of the head of the predicate phrase (White, 2003, p. 29), predicate proximity is stronger, since the verb's arguments are highly activated and can attract new elements, hence raising the possibility of attachment to the verb's internal argument (i.e., DP1). By contrast, in languages with a relatively rigid word order such as English where verbal arguments appear to the right of the head of the predicate phrase, predicate proximity is not strongly activated, and new elements are more likely to be attached to non-complement arguments (i.e., DP2).

Even though Predicate Proximity suggests an additional parsing principle not explicated in the Garden Path model, the two parsing models both assume that RC disambiguation is determined at the first instance by syntactically motivated principles and non-syntactic information has little impact on initial parsing preferences. Not all processing theories agree that parsing follows necessarily from syntactic principles, however. According to constraint-satisfaction theories, all types of information including contextual biases constrain the interpretation of ambiguous structures at the same time (e.g., MacDonald & Christiansen, 2002), and the

presence of a DP1-supporting context facilitates a DP1-attached interpretation, while the presence of a DP2-supporting context facilitates a DP2-attached interpretation (Papadopoulou & Clahsen, 2006). According to the Referential Hypothesis (Crain & Steedman, 1985), attachment preferences are likely to be impacted by preceding discourse context that biases readers towards a contrastive focus interpretation, i.e., one in which the reader is focused on the distinction between the potential referents for the two DPs. Specifically, according to the Referential Hypothesis (Crain & Steedman, 1985), ambiguous RCs with contexts that introduce more than one referent for DP1 are attached to DP1, whereas those with contexts introducing more than one referent for DP2 are attached to DP2 (Papadopoulou & Clahsen, 2006; although, see Zagar et al., 1997).

In summary, there is conflicting evidence whether strong attachment preferences exist, and no agreement has been reached on the role of contextual information on parsing preferences. However, given that previous studies have suggested that RC attachment preferences are subject to cross-linguistic parametric differences (Papadopoulou, 2006), it seems reasonable to ask whether the impact of context on attachment preferences is also moderated by a language's general syntactic structure. One interesting class of languages to explore the impact of preceding discourse context that biases readers towards a contrastive focus interpretation is scrambling languages such as Persian. Karimi (2005) argues that the phrase structure of Persian is different from that of non-scrambling languages, and it involves an additional Focus Phrase node where extracted elements move into in order to receive a contrastive focus interpretation. That is, unlike non-scrambling languages such as English and French where RCs occur under the node Complementiser Phrase (Rowlett, 2007), RCs in Persian may move to a higher position that accommodates elements brought to focus by the previous context. Given that Persian involves syntactic constituency relations that are impacted by discourse-level cues, it is reasonable to ask whether Persian readers are more sensitive to the impact of previous

context. However, no studies to date have examined whether Persian readers show increased susceptibility to discourse-level cues when interpreting RC ambiguities.

Overall, unlike English readers that may favour DP2 attachment, French and Persian readers are likely to prefer DP1 attachment while processing RC ambiguities, yet since Persian is a scrambling language that syntactically accommodates focused elements, Persian readers may be more likely than English and French readers to integrate contextual information in their parsing preferences (Table 2).

Table 2

English, French, and Persian compared with respect to attachment preferences and possibility of scrambling

Language	Attachment	Scrambling
English	DP2	No
French	DP1	No
Persian	DP1	Yes

1.4.2.1.2. L2 Processing of RC ambiguities and context effects

RC ambiguities have been studied extensively in the L2 processing literature. Some previous studies have failed to find a strong attachment strategy in L2, even when the readers of both L1 and L2 have been reported to have similar attachment preferences. These studies did not show a strong attachment preference and argued that L2 readers favour null attachment (Felser et al., 2003; Papadopoulou & Clahsen, 2003), which culminated in the Shallow Structure Hypothesis (SSH; Clahsen & Felser, 2006, 2018; Felser, 2019) that argues that L2 parsing is syntactically shallower than native parsing. In other words, what the SSH suggests is that L2 readers (over)rely on non-syntactic information such as contextual information to interpret RC ambiguities (Pan et al., 2015), and the observation that L2 readers do not show a strong

attachment preference can be construed as evidence that unlike native readers, L2 readers fail to establish a syntactic agreement relationship in *(20)*, repeated below as *(21)*, between the RC antecedent (either DP1 or DP2) and the RC verb (*was*).

21) Someone shot the servant $_{DP1}$ of the actress $_{DP2}$ [$_{RC}$ *who* ***was*** *on the balcony*]

For example, Pan et al. (2015) investigated in a self-paced reading (SPR) task L2 English RC attachment preference in short paragraphs by intermediate-to-advanced L1-German (DP1 language) and L1-Chinese (DP2 language) readers of L2-English. Half of their experimental sentences had context conditions that involved more than one referent for DP1 (DP1-supporting), and the other half had context conditions that introduced more than one referent for DP2 (DP2-supporting). According to Pan et al., (2015), their results showed that contextual manipulations influenced RTs for the L2 group only, and unlike native readers, both L2 groups favoured DP1-attachment in a DP1-supporting context and DP2 attachment in a DP2-supporting context. Pan et al. (2015) concluded that L2 readers are more likely to recruit contextual information in RC disambiguation, in contrast to native readers, supporting the SSH. However, Pan et al.'s (2015) study design and interpretations are not without limitations. First, Pan et al. did not directly investigate attachment preferences in decontextualised RC ambiguities. Therefore, it is not all that clear how the addition of contextual information might have influenced baseline attachment. Second, an argument can be made that the L2 participants were not advanced enough to display native-like parsing preferences. Some studies have suggested that only very highly advanced L2 participants might be capable of displaying native-like RC ambiguity resolution strategies due to the additional processing load in L2 (Frenck-Mestre, 2002; Hopp, 2006). Third, Pan et al. (2015) reported that the native English group had an overall null attachment preference, which is inconsistent with the SSH's claim that native readers have a robust attachment preference (either DP1 or DP2) regardless of

context. Finally, it could be argued that the findings of Pan et al.' (2015) study are not easily generalisable to other L2 readers, since they did not investigate the way individual differences might affect L2 disambiguation (Kim & Christianson, 2017).

In contrast to the SSH, capacity approaches to L2 processing suggest that null attachment in RC disambiguation is not a generic feature of L2 parsing (Fernández, 1999; Frenck-Mestre, 2002) but is also observed in native parsing of RC ambiguities (Carreiras & Clifton, 1993; Swets et al., 2007). Capacity approaches argue that while L2 readers of low proficiency levels might fail to form a dependency relationship between the RC verb and the RC antecedent and therefore display null attachment, the lack of strong attachment at high proficiency levels does not necessarily indicate qualitatively different parsing in L2. Similar to native readers, highly proficient L2 readers might display variable attachment preferences, sometimes attaching the RC to DP1 and other times to DP2 (Cunnings, 2017), thus resulting in an overall null effect. In fact, there is evidence that with increased proficiency, L2 readers progress from null attachment to disambiguation preferences resembling the processing of similar structures in their L1 (Frenck-Mestre, 1997), and given even higher proficiency, L2 readers converge on native-like interpretations of RC ambiguities (Fernández, 1999; Frenck-Mestre, 2002; Hopp, 2006).

For example, Fernández (1999) administered a pencil-and-paper test to examine whether RC attachment in L2 processing is different from that in native processing. The participants included two groups of L1-Spanish (DP1 language) L2-English (DP2 language) individuals: *(a)* those exposed to L2-English before the age of 10 (early learners), and *(b)* those exposed to L2-English after the age of 10 (late learners). According to Fernández (1999), late learners preferred attachment to DP1, mirroring attachment preferences in their L1. By contrast, early learners displayed variable parsing preferences, some favouring attachment to DP1 and others to DP2 (Fernández, 1999).

Similarly, Frenck-Mestre (1997) recorded eye-movements while native English (DP2 language) and L1-Spanish (DP1 language) learners of L2 French (DP1 language) read French RC ambiguities. According to Frenck-Mestre (1997), all participants were low-proficiency learners of L2 French (average self-ratings of overall proficiency at a level of 5 out of 10), and the results suggested that both Spanish and French readers preferred DP1 attachment, whereas English readers favoured DP2 attachment. According to Frenck-Mestre (1997), the readers transferred RC attachment preferences from their L1, Spanish readers favouring DP1 attachment and English readers DP2 attachment. In a later study, however, Frenck-Mestre (2002) examined RC disambiguation in L2 French by highly proficient native English readers (self-ratings of overall proficiency at a level of 7 or better out of 10) that enjoyed an average of 3 years immersion. According to Frenck-Mestre (2002), the results suggested a DP1 attachment preference, the same pattern found in the native French group. Frenck-Mestre (2002) concluded that L2 readers initially transfer their native processing preferences while reading RC ambiguities in L2, yet given sufficiently high proficiency, they converge on native-like parsing preferences.

Besides the influence of L1, capacity approaches to L2 processing argue that L2 readers are additionally subjected to capacity-based cognitive resource limitations in terms of the amount of information that WM can process in an L2 (Hopp, 2014; Kim & Christianson, 2017). Working memory is a multi-component cognitive system responsible for the temporary storage and processing of information (Baddeley et al., 2009). However, despite the agreement among capacity approaches to L2 processing that RC disambiguation in L2 is impacted by cognitive resource limitations, little consensus exists on the precise role of WMC in RC attachment preferences. Some studies suggest that only high WM L2 readers can match native readers in terms of RC attachment preferences (Dussias & Piñar, 2010), while others argue that high WMC is associated with the capacity to entertain both DP1 and DP2 interpretations

(MacDonald et al., 1992). According to the Capacity Constrained Parsing Model (MacDonald et al., 1992), high WM individuals maintain multiple syntactic representations in their memory, and as such they are likely to entertain both DP1 and DP2 attachment interpretations. On the other hand, Traxler (2007) argues that high WMC is associated with DP1 attachment, since attachment to a linearly closer antecedent (i.e., DP2) is less costly and low WM readers attach to DP2 to minimise the chances of exceeding WM limits (see Swets et al, 2007, for a different view). Overall, there is little consensus on the way in which WMC restricts parsing preferences. Specifically, the potential role that WMC plays in L2 RC disambiguation is relatively unexplored (Hopp, 2014; Kim & Christianson, 2017).

To summarise, capacity models of L2 processing argue that the tendency to underuse syntactic information in L2 RC disambiguation is not a generic feature of L2 processing, and given high proficiency and WMC, L2 readers may display native-like RC parsing preferences. By contrast, the SSH predicts few L1 effects and argues that L2 readers are less sensitive to syntactic information, tending to rely on non-syntactic biases to interpret RC ambiguities. To contribute to this debate, Chapter 4 presents the results of Study 2 that investigated the impact of context on native and L2 RC disambiguation strategies by L1-French and L1-Persian readers.

1.4.2.2. Processing of long-distance wh-dependencies

Similarly to the case of RC ambiguities, many studies have investigated L2 processing of long-distance RCs, yet no agreement has been reached on the source of L1-L2 parsing differences (Dussias & Piñar, 2010; Juffs, 2005; Juffs & Harrington, 1995; Marinis et al., 2005). For illustration, consider *(22)* (Marinis et al., 2005, p. 61).

22) The nurse who the doctor argued <who> *that the rude patient had angered* <who> *is refusing to work late*.

The Minimalist Program (Chomsky, 1995) mandates that after moving to the clause initial position, a copy of the wh-morpheme *what* is left at its base -- following *had angered*. According to the Trace Reactivation Hypothesis (TRH; Nicol & Swinney, 1989), processing a wh-dependency that crosses a verb such as *argued* in *(22)* above involves reactivating the extracted wh-morpheme at the interclausal boundary prior to *that*. However, there is no agreement on the psychological reality of syntactic copies denoted by <*who*> at the clausal boundary in *(22)* (Pickering & Barry, 1991), and more broadly, it is not clear how L2 parsing of wh-dependencies might be impacted by proficiency (Pliatsikas & Marinis, 2013) and cognitive resource limitations, particularly constraints on WM (Cunnings, 2022).

Whether L2 readers are able to parse long-distance wh-dependencies in a native-like fashion is the subject of ongoing debate. Some L2 processing theories attribute L1-L2 parsing differences in forming long-distance wh-dependencies to proficiency and WM effects (Cunnings, 2022; Dussias & Piñar, 2010), and suggest that L1-L2 parsing differences disappear at high levels of proficiency and WMC. On the other hand, others suggest that unlike native parsing, L2 parsing of wh-dependencies involves constructing a less detailed syntactic representation, and L1-L2 parsing differences persist at high levels of proficiency and WMC (Marinis et al., 2005).

1.4.2.2.1. Working memory limitations in processing wh-dependencies

Previous research suggests that L2 processing of non-local dependencies is moderated by the limitations of the underlying cognitive system, particularly constraints on WM (Hopp, 2014; Kim & Christianson, 2017). In fact, there is evidence that differences in WM measures engender different parsing patterns (Cunnings, 2022; Hopp, 2014; Kim & Christianson, 2017). According to the capacity-based view of WM (Just & Carpenter, 1992), readers are limited in the number of words and phrases that can be maintained in WM at one time, or alternatively in how many information sources (e.g., syntax only vs. syntax plus semantic subcategorisation

information) are utilised during parsing. This view characterises L1-L2 processing differences in terms of differences in WMC and argues that only L2 readers of high enough WMC, as measured in reading span tasks, for example, can match native readers in processing complex syntactic structures (Dussias & Piñar, 2010). According to computational approaches to L2 processing, L2 readers draw on a non-native and unroutinised language (Hopp, 2014; McDonald, 2006), and lowering the load on WM leads to increasing L2 proficiency (Miyake & Friedman, 1998) and native-like processing of wh-dependencies (Dussias & Piñar, 2010). For example, Dussias and Piñar (2010) examined the role of plausibility information and WMC in L2 parsing of subject- and object-extraction structures as in *(23)* and *(24)* (Dussias & Piñar, 2010, p. 452). The participants were proficient native Chinese readers of L2 English and a group of English native controls, who were required to complete an SPR task involving subject- and object-extractions.

23) a. Who did the police declare <who> *killed the pedestrian?* Subject (Implausible)

b. Who did the police declare the pedestrian killed <who>*?* object (Implausible)

24) a. Who did the police know <who> *killed the pedestrian?* Subject (Plausible)

b. Who did the police know the pedestrian killed <who>? object (Plausible)

In half of the conditions, the extracted wh-morpheme was an implausible object of the subcategorising verb (*who did the police declare*), while in the other half it was a plausible object (*who did the police know*). Dussias and Piñar (2010) reported longer RTs for both groups following the matrix verb in subject-extraction structures, suggesting that both native English and L2 readers found subject-extractions more difficult to process than object-extractions. They further showed that native English readers displayed longer RTs in subject-extraction structures when the wh-morpheme was a plausible direct object of the verb *know* in *(24b)*

compared to when it was an implausible direct object of the verb *declare* in *(23a)*, suggesting that the readers recovered faster from an implausible parse *(23a)* than a plausible one *(24b)*. By contrast, according to Dussias and Piñar, it was only L2 readers of high WMC (as opposed to low WM L2 readers) that resembled English native readers in their ability to utilise plausibility information in this manner. Dussias and Piñar concluded that WMC is an important individual differences measure in L2 processing of wh-movement dependencies.

However, the capacity-based view of WM has not been unchallenged, and a growing body of research conceptualises the role of WM in language processing in terms of the quality (as opposed to quantity) of operations performed in forming syntactic dependencies (Cunnings, 2027, 2022; Lewis et al., 2006; Van Dyke & Johns, 2012). Cunnings (2017) argued that L2 readers of lower WMC do not necessarily face persistent difficulty in attempting wh-movement operations, but rather the primary source of L1-L2 processing differences is due to the ability to successfully retrieve information that has been constructed during processing from memory. L2 readers are argued to be more likely than native readers to display non-target-like processing behaviour when retrieval becomes exceedingly difficult as a result of similarity of linguistic representations. Psycholinguistic evidence suggests that successful sentence comprehension requires skilled memory retrieval (Lewis et al., 2006; Van Dyke & McElree, 2006), whereby a set of (extra) linguistic cues are compared against the features of all items in memory and the item that provides the best match wins the competition and is highly activated. However, according to the interference-based models of WM (e.g., Lewis et al., 2006), those items that partially match the retrieval cues may also be retrieved, hence causing similarity-based interference.

For example, in an eye-tracking task, Cunnings and Fujita (2021), following Gorden et al.'s (2001, 2004, 2006) work on L1 processing of RC structures, manipulated whether the local subject and object were proper names or definite descriptions, as below (ibid, p. 8). The

participants were native English readers and intermediate-to-advanced L2 English readers of various L1 backgrounds, including Chinese, Japanese, Korean, French, Greek, Bulgarian, Romanian, and German.

25) *a. The boy that* <who> *saw the girl/Rebecca the other day, walked through the park*
Subject

b. The boy that the girl/Rebecca saw <who> *the other day, walked through the park.*
Object

Cunnings and Fujita (2021) reported that while reading times were not affected in subject-extraction structures due to the similarity of nouns, longer reading times were observed at the relative clause region (*that the girl/Rebecca saw the other day*, *that saw the girl/Rebecca the other day*) in object-extractions with matched NPs (two description NPs) compared to object-extractions with unmatched NPs (one description, one proper NP). No significant RT difference was reported between the L1 and L2 readers. Cunnings and Fujita (2021) concluded that retrieval operations are facilitated in both native and L2 parsing of wh-dependencies when memory traces are sufficiently distinguishable.

However, the results by Cunnings and Fujita (2021) should be interpreted with caution. First, according to Troyer et al. (2016), there is a positive relationship between the amount of information denoted by an NP and the ease of its retrieval for establishing wh-dependencies, and since description NPs are more informative than proper names, sentences with proper names are not necessarily easier to process than sentences with description names (Cohen, 1990). In fact, some studies have even suggested that the presence of dissimilar nouns within a wh-dependency leads to additional L2 parsing difficult (Xia et al., 2022). A second point is that Cunnings and Fujita (2021) did not systematically investigate the impact of L1 due to sample size issues, and thus the reported results do not provide a nuanced picture of the impact

of L1 on L2 processing of RCs. For instance, Chinese L2 readers may behave differently compared to the other L2 groups, given that previous studies have suggested a reliable object RC advantage in Chinese (for review, see Lau & Tanaka, 2021).

It is also worth noting that in both studies by Cunnings and Fujita (2021) and Dussias and Piñar (2010) the copy of the extracted morpheme <*who*> was adjacent to the subcategorising verb, and as such, the observed processing difficulty could be because the readers postulated a copy of the extracted wh-morpheme or because they attempted to integrate it as a verbal argument by relying on subcategorisation information. Therefore, those studies do not provide unequivocal evidence as to whether parsing wh-dependencies is mediated by syntactic copies or is a function of the verb's lexical subcategorisation information.

1.4.2.2.2. Intermediate copies in long-distance wh-dependencies

According to the Shallow Structure Hypothesis (SSH; Clahsen & Felser, 2006, 2018), whereas native readers utilise abstract syntactic information such as the phonologically null copy of extracted wh-morphemes, L2 readers prioritise other information types such as the verb's argument structure while forming wh-dependencies. The SSH argues that L1-L2 parsing differences in establishing wh-dependencies lie in the ability to utilise different information sources. For illustration, consider *(26)*, repeated from *(22)* (Marinis et al., 2005, p. 61).

26) a. The nurse who the doctor argued <who> *that the rude patient had angered* <who> *is refusing to work late*. VP-extraction

b. *The nurse who the doctor's argument about the rude patient had angered* <who> *is refusing to work late*. NP-extraction

According to the TRH (Nicol & Swinney, 1989), readers reactivate the extracted wh-morpheme <*who*> at the interclausal boundary prior to *that* in *(26a)*. By contrast, since the

sentence in *(26b)* illustrates a case of extraction across an NP (*argument*), no reactivation of the wh-morpheme is assumed to take place prior to *about*. Theories of syntactic complexity that take distance between the fronted wh-morpheme and its thematic position as the primary metric for processing difficulty predict faster RTs for VP-extraction than for NP-extraction sentences (Gibson, 2000), since the dependency distance is minimised by the intermediate copy of *who.*

Marinis et al. (2005) investigated L2 processing of long-distance wh-dependencies by L2 readers of L1-Greek, German, Chinese, and Japanese. The participants were required to complete a self-paced reading (SPR) task involving long distance wh-dependencies such as *(26a)* and *(26b).* Their results showed that reaction times (RTs) were facilitated for the L1-English participants when the intermediate copy was present (*26a*) compared to when it was not (*26b*). By contrast, they reported no such effect for any of the L2 groups, thus suggesting that regardless of the native language, L2 parsing of complex wh-structures involves a less detailed syntactic representation that does not take into account abstract syntactic categories such as intermediate copies of the extracted wh-morpheme. Marinis et al. (2005) argued that L1-L2 parsing differences in forming wh-dependencies reflect an increased tendency by L2ers to compute a shallow syntactic analysis of the L2 input that does not take into account syntactic copies of extracted wh-morphemes.

However, Marinis et al.'s (2005) results are open to interpretation. First, the assumption that intermediate copies have a psychological reality is questionable (Sag & Fodor, 1995), and according to the Direct Association Hypothesis (DAH; Pickering & Barry, 1991), all readers integrate fronted wh-morphemes directly with their lexical subcategoriser by using the verb's argument structure (Branigan & Pickering, 2017; Pickering & Barry, 1991). Second, Marinis et al. (2005) reported that their participants were at an upper intermediate proficiency level, raising the possibility that they might not have been sufficiently advanced to display native-

like processing. In fact, Pliatsikas and Marinis (2013) replicated Marinis et al.'s (2005) study on two groups of L1-Greek L2-English readers: one with only classroom exposure to L2 English and another with a mean of 9 years of naturalistic exposure. They reported that the group with limited exposure to English showed similar parsing behaviour as Marinis et al.'s participants (2005). However, the group with more naturalistic exposure behaved like English native readers, such that their processing of long-distance RCs was facilitated by the presence of the intermediate copy *who*. Third, the argument that L2 parsing of wh-dependencies is universally characterised by a lack of sensitivity to abstract syntactic information does not adequately account for the complexity of L2 processing. There is a wealth of research that suggests L2 parsing of wh-dependencies is affected by the presence/absence of wh-movement in L1 (e.g., Juffs, 2005; Juffs & Harrington, 1995). The SSH does not adequately explain how the possibility of wh-movement in L1 impacts the parsing of wh-dependencies in L2. Furthermore, the assumption that native readers always access the copy of the extracted wh-morpheme is questionable. Ferreira, Christianson, and colleagues have shown that linguistic representations constructed during native processing can also lack syntactic accuracy, precision, and detail. According to the theory of good-enough (GE) language processing (Christianson et al., 2001; Ferreira & Patson, 2007), linguistic representations in native processing are only good enough for the task at hand and become syntactically elaborated only if motivated by the task requirements (H. Karimi & Ferreira, 2016).

Overall, there is no agreement on the nature of L1-L2 parsing differences in establishing wh-dependencies, and while some suggest that L2 parsing involves a less detailed syntactic analysis of wh-dependencies, others argue that L1-L2 parsing differences disappear at high levels of L2 proficiency and WMC.

1.5. The Current Study

The current project aims to bring together research carried out on L2 syntactic representation and processing of English RCs by seeking answers to the following research questions (RQs) treated exclusively at three different individual research studies in this thesis.

RQ1) Is there a difference between L1 French and L1 Persian readers in terms of acceptability of resumptive pronouns in L2 English RCs?

RQ2) If there is evidence for an L1-based transfer of resumption to L2 English RCs, is this motivated by syntactic deficits or by processing limitations? To investigate this question, the following sub-questions were formed:

   a. Is there a difference between L1-English, L1 French, and L1 Persian readers in terms of acceptability of RCs with different relativiser forms (e.g., *who* relatives versus *that* relatives) that are motivated by a [wh] feature?
   b. Do L1 French and L1 Persian readers show evidence of the acquisition of wh-movement operations in L2 English RCs motivated by an [EPP] feature?
   c. Do individual differences in L2 proficiency, immersion experience, and WMC impact L2 readers' judgment of English RCs?

RQ3) Do L1-French and L1-Persian readers display null attachment preferences in L2 English (neither DP1 nor DP2) in isolated RC ambiguities (as suggested by the SSH) or transfer a DP1-attachment preference from their L1 (as suggested by capacity approaches to L2 parsing)?

RQ4) Are there any differences among L1-English, L1-French, and L1-Persian readers in the way contextual manipulations impact English RC disambiguation preferences, and if so, can these differences be attributed to potential L1 effects?

RQ5) Do individual differences in L2 proficiency and WMC significantly impact RC disambiguation in isolated and contextualised ambiguous RCs in L2 English?

RQ6) Is there any difference between native English and L2 readers in whether they access the intermediate copy of the extracted wh-morpheme when parsing long-distance wh-dependencies?

RQ7) How is access to intermediate copy of the extracted wh-morpheme affected by factors such as L1 [+/-wh], L2 proficiency and WM limitations?

The above research questions are addressed in the context of three articles for publication and presented in Chapter 3 (Questions 1& 2), Chapter 4 (Questions 3, 4, & 5), and Chapter 5 (Questions 6 & 7). Note that the empirical studies in Chapters 3, 4, and 5 have been submitted for publication. The citation information is as follows:

Chapter 3:

Solaimani, E., Myles, F., & Lawyer, L., (revise & resubmit). Testing the Interpretability Hypothesis: evidence from acceptability judgments of relative clauses by Persian and French learners of L2 English. *Second Language Research.*

Chapter 4:

Solaimani, E., Myles, F., & Lawyer, L., (under review). Is L2 parsing qualitatively different from native parsing at advanced levels of proficiency? Evidence from relative clause disambiguation. *Applied Psycholinguistics.*

Chapter 5:

Solaimani, E. (under review). L1 and L2 processing of long-distance wh-dependencies: is syntactic parsing involved? *Linguistic Approaches to Bilingualism*.

Chapter 2: Method

2.1. Overview

The data collection process for this project coincided with the Covid-19 pandemic and a national UK lockdown, making in-person data collection impossible. The only feasible option was to recruit participants remotely using online web-based platforms. To this aim, most of the data were collected using Prolific (www.prolific.co), which enables researchers to publish their experiments and seek participants at cost. Based on Prolific's published demographic information in 2020, more than 35% of the sample signed up to complete experiments are from the UK, followed by 28% from the US. Prolific allows researchers to apply screening criteria to select the participants that best fit the purposes of their research.

2.2. Participants

There were 3 groups of participants for this project, namely *(a)* L1-French, L2-English, *(b)* L1-Persian, L2-English, and *(c)* native readers of English as the control group. For the L2 readers of English, the following options were selected on Prolific to fine tune the desired selection criteria: *age, current country of residence, first language,* and *approval rate*. Decisions were made to allow only people with the minimum age 18 who are residents in the UK, US, Canada (only for the Persian readers), Australia, or New Zealand, to sign up. The age range was chosen to allow for a more mature population in terms of language development and to examine the potential impact of a wide range of proficiency levels and immersion experience. In addition, only those participants who spoke either French or Persian as their native language and who had a Prolific history of a minimum of 50% acceptable approval rate were invited. Finally, two other criteria were applied to restrict the sample. Only those participants who reported to have been raised monolingual and who spoke only one additional language besides their native language were invited, i.e., people who were raised bilingual and who spoke more than two languages fluently were not allowed to sign up for this project. The above criteria significantly reduced the Prolific sample size to 9 eligible participants for L1 Persian readers. Thus, the

remaining data for the L1-Persian group were collected through advertisement on social media. Each participant – whether recruited through Prolific or social media– was paid a total of £10.18 (£5.13 for part one and £5.03 for part two; see below) for their participation.

Overall, data for this study came from 167 individuals, 44 of whom spoke English as their native language (Mean Age: 34.23; Range: 20 – 51; SD: 9.93), while for the remaining 123 subjects, English was a second language. Fifty-two participants were native readers of French (Mean Age: 29.84; Range: 18.58 – 42.42; SD: 5.43), and 71 spoke Persian as their native language (Mean Age: 33.51; Range: 18.25 – 59.67; SD: 8.2). While a majority of 49 French participants reported to have been born and raised in France (93.88%), 2 individuals were born and raised in Switzerland and 1 in Cameroon. The Persian group all reported to have been born and raised in Iran, and thus they all spoke Farsi as their native language (Karimi, 2005). As for the English native readers, 41 reported to have been born and raised in the UK (93.18%), 1 (2.27%) in Canada, 1 (2.27%) in Kenya, and 1 (2.27%) in the US. The following table provides further details for the L2 groups in terms of age of arrival (AoA) and time spent in an English-speaking country (immersion experience in months).

Table 3

Language learning experience for the L2 groups

L2 groups	AoA[a]			Immersion[b]		
	M	*SD*	*Range*	*M*	*SD*	*Range*
L1-French	23.1	3.4	16 – 29	80.81	47.55	4 - 221
L1-Persian	28.66	6.72	16 – 41	58.24	81.64	0.1 - 524

[a] in years

[b] in months

2.3. Instruments

The data were collected in two separate parts. In part one, a language history questionnaire was first administered to collect information on participants' native language, number of years living in an English-speaking country, and number of other languages known. Second, a Grammaticality Judgment Task (GJT) was administered to examine acceptability of resumptive pronouns and different relativiser forms in SU, DO, and OP RCs in English. As the final task in part one, the participants completed a c-test to yield a measure of their English proficiency. After completing part 1, the link to part 2 was sent to each participant within 3 days, where they initially completed a self-paced reading (SPR) task on RC ambiguities, followed by a reading span task to yield a measure of WMC. Finally, the participants completed an additional SPR task that involved isolated RC ambiguities and long-distance wh-dependencies (Figure 1).

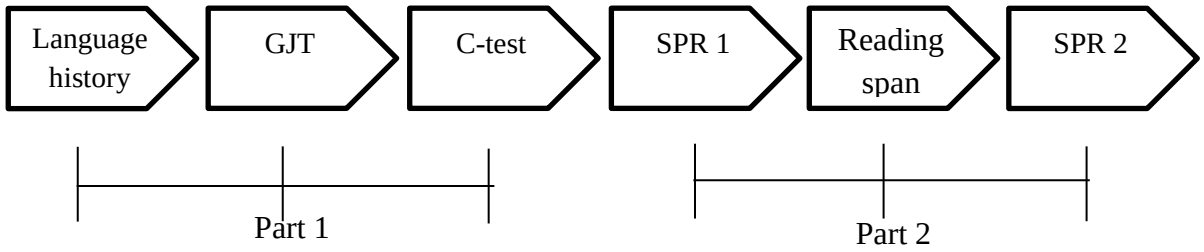

Figure 1. Building block of data collection

All participants recruited for this project completed Part 1, but this number dropped significantly in Part 2. Of the total of 44 native readers that completed Part 1, 23% (n = 10) did not attempt Part 2 due to drop-out, making the sample size of native controls 34 in Part 2. Additionally, of the 34 participant who attempted Part 2, 1 participant failed to submit their responses for SPR 1, whereas all other participants in the control group completed the reading span task and SPR 2. Thus, the total number of native readers that complete Part 1 was 44, while this number was 33 for SPR 1 and 34 for the reading span task and SPR 2.

As for the L2 groups, the attrition rates were 34% for the L1-French (18 individuals) and 42% for the L1-Persian participants (30 individuals), making the total number of L2 participants that

attempted the second Part of this project 75 (34 L1-French & 41 L1-Persian). Among the 75 L2 participants, 3 of the L1-French readers and 5 of the L1-Persian readers failed to submit their responses for SPR 1, whereas the rest completed SPR 2. Furthermore, while all the L1-French readers completed the reading span task, only 23 L1-Persian readers completed this task. Therefore, while the total number of L2 readers that completed Part 1 was 123 (52 L1-French & 71 L1-Persian), this number was reduced to 75 for SPR 2 (34 L1-French & 41 L1-Persian) for SPR 2 and 67 for SPR 1 (31 L1-French & 36 L1-Persian). The number of L2 participants that completed the reading span task was 57 (34 L1-French & 23 L1-Persian).

2.3.1. Consent Form and Language History Questionnaire

Prior to the GJT, the participants entered a web link on Qualtrics (a web-based platform to run survey studies) to be informed that their participation was voluntary and that they had the right to withdraw at any point with no penalty. They were briefed on the purpose of the study and then were required to tick a box to show their consent for participation.

Subsequently, the participants answered a question about their native language which determined the presentation of the following questions. In case they indicated that they were non-native readers of English, a series of questions followed on age of arrival (AoA; the age at which they started living in an English-speaking country), years of immersion experience, and the length of time spent living in a country where English was not the major means of communication. On the other hand, if the participants indicated that they were native readers of English, they were redirected to the last question, namely their experience living in countries where a language other than English was more dominant.

2.3.2. Grammaticality Judgment Task

Following the language history questionnaire, the participants were required to judge the acceptability of 56 sentences by deciding if the structures were grammatical. There were three

critical syntactic phenomena investigated in this task: *(a)* relativisation strategy (gap, resumption), *(b)* relativiser forms (*that*, *who*), and *(c)* subject-verb agreement in RCs following a complex DP (*DP1-of-DP2*). Grammaticality judgments have been commonly used as a data collection tool to examine interpretations on particular structures which do not frequently occur in natural production (Loewen, 2009). In such cases, some form of direct elicitation such as GJTs is necessary. Additionally, GJTs provide an accurate picture of the underlying syntactic representation (Shiu et al., 2018) as they allow an investigation of not only what the participants deem acceptable but also what they consider to be deviant from the grammar of the target language (Mackey & Gass, 2016). Furthermore, GJTs are comparatively easy to administer and are easily implemented on web-based platforms such as Qualtrics. Finally, previous studies have shown that that performance on GJTs is sensitive to subject-related factors such as WMC (McDonald, 2006), proficiency (Gass, 1983), and length of exposure to the target language (García Mayo, 2003), all of which were included as covariates in the statistical analysis, thus making GJTs an invaluable instrument in this project.

2.3.2.1. Allotted Time

Even though GJTs have been extensively used in SLA research (Mackey & Gass, 2016), no consensus exists on the precise nature of the construct they tap into. The topic of time constraints has been closely linked to the construct validity of GJTs, since GJT research has generally found that even though L2 performance on speeded and untimed GJTs are highly correlated (Bader & Häussler, 2010), performance on untimed GJTs is better than that on timed GJTs (Ellis, 2005; Gutiérrez, 2013; Loewen, 2009; Zhang, 2015). One often-cited explanation for this is that L2 readers can access explicit knowledge of L2 while completing untimed GJTs (Shiu et al., 2018). According to Ellis (2005), there are three stages involved in performing GJTs, namely *(a)* semantic processing, where the participants read the sentences for meaning, *(b)* noticing, where they identify the potential source of ungrammaticality, and *(c)* reflection,

where they reflect on whether their initial detection of the ungrammatical word(s) is correct or not. If L2 readers are allowed sufficient time, they are likely to go through all the three stages, whereas timed GJTs allow for fewer stages. This has led some researchers to argue that timed and untimed versions of GJT draw on different knowledge pools (Ellis, 2005; Shiu et al., 2018; Vafaee et al., 2017). Untimed GJTs are more likely to draw on explicit knowledge of L2, whilst timed GJTs lend themselves better to a measure of implicit knowledge.

According to Lardiere (2008), the fundamental aim of SLA is to develop some sort of implicit L2 knowledge, and as such, most previous studies have used timed GJTs to obtain a measure of implicit L2 knowledge (Hawkins & Chan, 1997; Tsimpli & Dimitrakopoulou, 2007). However, in light of current SLA theorising, administering a timed GJT does not allow to adequately locate the source of L1-L2 differences. Non-target-like L2 performance on timed GJTs can be attributed to either syntactic deficits or processing constraints associated with the processing of timed GJTs (McDonald, 2006). Put differently, there is an increased likelihood that L2 processing limitations and syntactic deficits be confounded in timed GJTs. Therefore, it was decided in this project to use an untimed GJT (Schachter & Yip, 1990).

However, the time each participant took to complete this task was recorded to allow between-group comparisons and identify outliers (Bley-Vroman & Masterson, 1989). The following table compares the three groups in terms of the time spent completing the GJT as well as the corresponding internal consistency measure (Cronbach's alpha). As evident, the Persian readers spent the longest on this task, and the Cronbach's alpha was larger for the English and French readers compared to the Persian readers. This might be due to the fact that the Persian readers were required to read and type in a non-native script and that they were less proficient than the L1-English and L1-French groups (see section 2.3.3).

Table 4

Time spent completing GJT per group and corresponding Cronbach's alphas

Group	Size	Mean[a]	Range	SD	Cronbach's alpha
L1 English	N=44	1129.85	469 – 4233	627.16	0.92
L1 French	N = 52	1404.09	620 – 3678	651.39	0.87
L1 Persian	N = 71	4900.39	1024 – 8226	10617.6	0.66

[a] in seconds

2.3.2.2. Task Modality

Precious studies suggest that GJT performance is influenced by task modality (Johnson, 1992; Wong, 2001). According to Wong (2001), L2 readers experience more difficulty completing aural rather than written GJTs due to the higher processing load associated with aural stimuli (Johnson, 1992). Given that the primary purpose of the GJT in this project was to assess L2 morphosyntactic representation, the critical structures were presented in written form to minimise any potentially confounding factors associated with the processing of aural stimuli (Schachter & Yip, 1990). Furthermore, using a written GJT helped increase the backward comparability of this project, as previous studies on L2 syntactic representation of RCs also involved written GJT stimuli (Hawkins & Chan, 1997; Tsimpli & Dimitrakopoulou, 2007).

2.3.2.3. Instructions and Presentation

The participants were instructed to read each sentence carefully and decide if the sentences were grammatically acceptable. The instructions advised the participants to leave columns 2 and 3 empty in case they judged a sentence to be grammatical. By contrast, if they judged a sentence to be ungrammatical, they were required to provide more information about the nature of ungrammaticality by typing in column 2 about what they considered to be the error and in column 3 about how they would correct the sentences. The instructions specified that in case

they judged a word or phrase to have been placed extraneously, the participants needed to type in *extra* in column 3 and leave column 2 empty.

Initially, 3 examples appeared on the first page so that the participants do not confuse the notion of grammaticality with that of plausibility or appropriateness. This was aimed to reduce the likelihood of collecting ungrammatical responses on the grounds that the sentences were considered semantically implausible or stylistically inappropriate. The instructions made it clear that the focus of the research was on the formal properties of the structures and that the participants should not base their judgments on whether the sentences made sense to them. In addition, the participants were encouraged to base their judgments on their intuition and not on the instructions they received at school or other educational settings.

2.3.2.4. Conditions

The main focus of this task was to *(a)* assess knowledge of subject-verb agreement on RCs following complex DPs (*DP1-of-DP2*; 10 items), and *(b)* examine the acceptability of resumptive pronouns and different relativiser forms (*that*, *who*) in SU, DO, and OP RCs (42 items). Of the total of 56 items, 4 were fillers, 10 were aimed to assess knowledge of subject-verb (SV) agreement, and 42 to examine relativisation strategy (gap, resumptive) and different relativiser forms (*that*, *who*). The latter RCs involved relativisation from SU, DO, and OP RCs, each appearing in 14 items, 4 of which involved *that* and 10 *who* as the relativiser per each RC type. The uneven numbers for *that* and *who* RCs reflected the higher frequency of *who* RCs for [+human] referents, since all RCs in this study involved relativisation of a [+human] discourse referent. Half of the experimental sentences were grammatical, and the other half were ungrammatical due to either subject-verb agreement error or the presence of a resumptive pronoun. The following table illustrates the conditions:

Table 5

Conditions in Grammaticality Judgment Task

Condition	Grammatical	Ungrammatical
SV	*The pupils of the teacher who were unhappy with the test results were absent today.*	*The pupils of the teacher who**was** unhappy with the test results were absent today.*
SU	*The bodybuilder who was running the other day did not attend the meeting.*	*The bodybuilder who **he** was running the other day did not attend the meeting.*
DO	*The journalist who the woman criticised was becoming really angry.*	*The journalist who the woman criticised **her** was becoming really angry.*
OP	*The professor who you submitted your assignments to gave me a very low score.*	*The professor who you submitted your assignments to **him** gave me a very low score.*

2.3.2.5. Length and Randomisation

Of all the sentences, 10 lists were randomly created to reduce potential ordering effects, namely the possibility that the specific ordering of the stimuli confounds the results. All the experimental items were represented across each list, and upon clicking on the Qualtrics link, each participant was randomly directed to respond to the items on only one of the lists. An additional option in Qualtrics allowed to represent each list evenly, so that the number of times each list was shown during the whole experiment was unbiased.

2.3.2.6. Scaling and Scoring

The scores assigned to grammatical and ungrammatical judgments were coded as 1, .5, or 0. Regardless of grammaticality, all the items that were judged to be grammatical were coded as

1, indicating that the participants accepted the RCs to be grammatical. By contrast, items judged to be ungrammatical were coded as either 0 or .5. Those items that were rejected based on reasons unrelated to the experimental manipulations were coded as .5, since it is possible that the participants rejected the RCs due to an implicit recognition of the non-target-like relativisation strategy used. By contrast, those items that were judged to be ungrammatical due to resumption. the form of relativiser, or subject-verb agreement, were coded as 0, since the participants explicitly indicated that they did not accept the relativisation strategy used. Items left blank were excluded from further analysis. A higher score on each item indicated relatively higher acceptability of the RCs (minimum: 0, maximum: 1).

2.3.3. C-test

Following the GJT, the participants completed a c-test to yield a measure of their English proficiency. A c-test is a variant of cloze task in which the second half of every second word is mutilated, and the participants are expected to fill in the truncated words to reconstruct the passage (Dörnyei & Katona, 1992; Klein-Braley & Raatz, 1984). There is considerable evidence that c-tests are a reliable and valid measure of general language proficiency, and some studies have suggested that c-tests tap into both lower and higher order processing skills (for review, see Trace, 2020), although this has not been completely uncontroversial (e.g., see Park, 1998). Previous studies have suggested that c-tests compensate for the potential shortcomings of cloze tasks, e.g., varying interpretability based on the starting point of deletion, reportedly low concurrent validity, and inconsistency in scoring, and that they are a relatively efficient testing instrument with high levels of accuracy (Dörnyei & Katona, 1992). C-tests allow to examine general language proficiency in a significantly shorter time period (e.g., 15 minutes) than is required in standardised language proficiency exams, which is ideal for research purposes in which general language proficiency is treated as a covariate.

2.3.3.1. Instructions and Presentation

The c-test was constructed on Ibex Farm (a web-based platform to run psycholinguistic experiments), and the passages were displayed against a white background. The instructions specified that that there were 5 text passages, containing 100 gaps in total where parts of some words were deleted and that the participants were required to fill in the gaps using their keyboard. The task began with two practice items.

2.3.3.2. Length

In order to reduce text bias, 5 text passages with different topics were included in this task, each containing no more than 101 words, as shown in Table 6, below.

Table 6

Number of words in each c-test passage

	Passages				
	1	2	3	4	5
Word Count	65	86	67	101	82

Following Keijzer (2007), the ordering of the passages reflected their difficulty as measured by the type-token ratio (number of different words divided by the total number of words). The decision to order the passages from the least to the most difficult was made to reduce participant boredom and increase attentiveness (Dörnyei & Katona, 1992; McKay, 2019), and thus no randomisation was applied.

2.3.3.3. Scoring and Scaling

The c-test aimed to measure general language proficiency, and as such the readers' overall score – the composite of scores on all the passages -- was the outcome variable. The responses were assessed on a 9-point scale, corresponding to the depth of L2 knowledge associated with

the word to be supplied for each item, ranging from 0 for a left-blank item to 9 for an item where the elicited and expected response matched completely. To operate on a finer-grained measure, the following categorisation was used (see also Keijzer (2007): where both the lexical item and word class were incorrect, a score of 1 was given, but where the answer matched the expected response in terms of only word class, a score of 2 was awarded. Conversely, where the elicited and the expected response matched in their lexical root only (and not in word class), a score of 3 awarded, since the ability to produce words related in meaning appears at a later stage of L2 development than the ability to produce words related in terms of form only (Wolter, 2002). In case the responses contained an agreement error, a score of 4 was given, and if all of the above were correct yet there were slight errors with the response, the participants were graded 5. A score of 6 was awarded to any acceptable responses containing spelling mistakes, whereas if exactly the correct word was provided with spelling mistakes, a score of 7 was awarded. An acceptable variant without any spelling errors was awarded a score of 8 (see Table 7).

Table 7

C-test scoring categories

Category for scoring	Score	Expected or acceptable response	Response by participant
1 = incorrect lexical stem and incorrect word class	1	th**em**	th**at**
2 = incorrect lexical stem but correct word class	2	under**stand**	under**estimate**
3 = correct lexical stem but incorrect word class	3	predic**tions**	predic**table**
4 = correct lexical stem, correct word class, agreement error	4	ens**ures**	en**sure**
5 = all of above correct, but still slightly wrong	5	th**ey**	th**ese**
6 = acceptable variant with spelling error	6	ar**ts**	ar**ithmetic**
7 = correct word spelling error	7	under**stand**	under**stad**
8 = acceptable variant	8	medi**cine**	medi**a**
9 = correct word	9	underg**raduate**	underg**raduate**

The following table compares the scores obtained for each group based on the scoring method described above. The scores reported below are the arithmetic average of the participants' performance across all items. As evident, the Persian readers had a lower proficiency compared to the English and French readers.

Table 8

C-test scores and internal consistency estimates

		Passages					
		1	2	3	4	5	Overall
L1-English (N = 44)	Mean	8.25	7.78	6.84	7.64	7.7	7.64
	SD	0.46	0.62	1.28	0.68	1.3	.58
	Alpha	-	-	-	-	-	.85
L1-French (N = 52)	Mean	8	7.68	5.10	7.09	7.16	7.01
	SD	0.95	1.08	1.73	0.99	1.24	1
	Alpha	-	-	-	-	-	.93
L1-Persian (N = 71)	Mean	7.41	7.02	5.02	6.27	5.83	6.31
	SD	1.06	1.38	1.77	1.40	1.73	1.22
	Alpha	-	-	-	-	-	.93

2.3.3.4. Timing

One of the limitations of internet-based data is that the participants may access online resources to find the correct answers. While this is very difficult to control and might potentially compromise reliability, other information may be collected to identify outlies. As far as the c-test was concerned, the time participants spent on each passage was recorded to enable outlier detection (Table 9).

Table 9

Time spent completing each c-test passage and internal consistency per group (in minutes)

		Passages					
		1	2	3	4	5	Overall
L1-English	Mean	1.03	3.46	3.39	2.55	2.23	12.66
	SD	1.48	1.91	2.27	1.07	0.98	1.64
L1-French	Mean	3.2	3.79	4.54	3.55	2.69	17.77
	SD	1.86	1.69	3.36	2.14	1.15	1.82
L1-Persian	Mean	4.81	12.9	8.55	10.87	5.82	42.95
	SD	2.85	9.34	11.09	2.89	2.98	8.02

2.3.4. Self-paced Reading Tasks

Following previous research on L2 processing, this project administered 2 online self-paced reading (SPR) tasks to investigate the way in which readers process RCs in real-time (Clahsen & Felser, 2006; Ferreira & Henderson, 1990). Unlike eye-tracking measures, it is not possible in an SPR paradigm to record regressive eye movements, and therefore, RTs in an SPR task reflect both initial processing and re-analysis efforts (Dussias, 2010). By contrast, eye-tracking measures provide a more nuanced measurement of the underlying processing mechanism as they allow the recording of both initial fixations and regressive eye movements. In addition, one potential problem with online experiments, and especially with participants completing experiments from their personal devices, is that reaction times ae dependent on their keyboards (Hilbig, 2016). However, despite the advantages of eye-tracing and the limitations of online experiments, the only feasible option during the Covid-19 pandemic was an Internet-based SPR paradigm. For the very same reason, collecting EEG data was not feasible, since that would require attaching electrodes to the participants' scalps in a lab-based environment.

The main focus of the first SPR task was on RC disambiguation in context, and therefore the items appeared in short paragraphs. By contrast, the second SPR task focused on *(a)* isolated RC ambiguities, and *(b)* long-distance wh-dependencies, and the items were presented in isolation. It was assumed in both SPR tasks that elevated RTs relative to a control condition reflect processing difficulty (e.g., see methods in Clahsen & Felser, 2006; Felser, 2019; Juffs & Harrington, 1995).

2.3.4.1. Instruction and Presentation

Similar to the previous task, the two SPR tasks were constructed on Ibex Farm and the stimuli were displayed against a white background. The instructions specified that the participants were required to complete this task only on a laptop or a desktop computer (not on mobile phones or tablets), and that they would read sentences that initially consisted of dashes which covered the words but they needed to press the spacebar for the words to replace the dashes. The instructions insisted that the participants needed to focus on the meaning and there would be questions at the end of each item to assess comprehension. There were 2 practice items before the experiment began, and the participants were encouraged to contact the researcher with any questions before proceeding to the critical items.

2.3.4.2. Conditions

Self-paced reading task 1. The primary focus of this task was on RC ambiguities that could be structurally attached (by means of subject-verb agreement) to either DP1 or DP2. The disambiguating copula (*was* vs. *were*) was counterbalanced across the different conditions to minimise the chances of the critical word impacting reaction times. The critical RCs were preceded by contextual information that biased attachment to either DP1 or DP2. Thus, the two critical factors were attachment (DP1, DP2) and context (DP1-supporting, DP2-supporting), amounting to a 2 by 2 design, as below (every item appeared in 9 regions as indicated by the //

notation). The experimental items, illustrated in the following table, contained 6 sentences per condition (4 * 6 = 24) and were interspersed with 43 fillers.

Table 10

Conditions in SPR 1

Attachment	Context	Example
DP1	DP1	An economist was researching an article on a big national newspaper. // Some journalists in the newspaper's head office were having an argument with their editor. // Some journalists were very diligent, // but others were a bit lazy. // The economist liked // the journalists of the editor // who // were // thinking about the report.
DP1	DP2	An economist was researching an article on a big national newspaper. // Some journalists in the newspaper's head office were having an argument with their two editors. // One of the editors was very diligent // but the other one was a bit lazy. // The economist liked // the journalists of the editor // who // were // thinking about the report.
DP2	DP1	An economist was researching an article on a big national newspaper. // Some journalists in the newspaper's head office were having an argument with their editor. // Some journalists were very diligent // but others were a bit lazy. // The economist liked the journalists of the editor // who // was // thinking about the report.
DP2	DP2	An economist was researching an article on a big national newspaper. // Some journalists in the newspaper's head office were having an argument with their two editors. // One of the editors was very diligent // but the other one was a bit lazy. // The economist liked // the journalists of the editor // who // was // thinking about the report.

Twenty of the experimental items were taken from Pan et al. (2015) and 4 were adapted from Papadopoulou and Clahsen (2006). The context prior to the ambiguous sentence in the items from Papadopoulou and Clahsen (2006) were reduced in length to increase comparability with the other items from Pan et al. (2015). The experimental items and fillers were distributed across 4 lists (number of conditions) in a Latin square design. Each list contained 6 sentences for each condition (4 * 6 = 24) and no list contained more than one item from each condition. The items in each list were interspersed with the fillers and pseudorandomised. All the experimental items and half of the fillers were followed by a comprehension question to ensure that the participants were attentive to the task. An automatic warning message appeared on the screen in case the participants selected the incorrect option.

Self-paced reading task 2. In contrast to the first SPR task, the focus of the second SPR task was on *(a)* isolated RC ambiguities, and *(b)* long-distance wh-dependencies. The RC ambiguity items appeared in 2 and the long-distance wh-dependencies in 6 conditions (8 conditions in total), interspersed with 10 fillers. The reason for including fewer fillers than in the first SPR task was that the experimental items in the different conditions were also meant to act as fillers for each other. Put differently, the item structures were more varied in SPR 2 compared to SPR 1, and as such there was a reduced likelihood that the participants would manage to identify the purpose of the study.

All RC ambiguity items were taken from Felser et al. (2003) and were temporarily ambiguous at the relative pronoun *who*. Number agreement was manipulated such that either DP1 or DP2 appeared in singular and the other one in plural, resulting in two experimental conditions, with attachment (DP1, DP2) as the within-subjects factor. The disambiguating copula (*was* vs. *were*) was counterbalanced across the different conditions to minimise the chances of the critical word influencing reaction times. Overall, as far as RC ambiguity items were concerned, there were 12 experimental items and 46 fillers. The fillers were composed of 10 items with similar

length and complexity to the critical experimental items, in addition to 36 items involving long-distance wh-dependencies which acted as critical items for the Study presented in Chapter 5. As for the long-distance dependencies, of the total of experimental items, 24 had definite description NPs (matched), taken from Marinis et al. (2005), and 12 had a mixture of proper names and definite descriptions (unmatched). A 2 x 2 design was adopted with sentences containing matched NPs, with Extraction Type (Extraction, Non-extraction) and Phrase Type (VP, NP) as the within-subjects factors, resulting in 4 experimental conditions. In the extraction conditions, the initial NP (*the nurse*) was followed by a relative clause, introduced by the wh-morpheme *who*, which functioned as the direct object of the embedded clause verb (*had angered*). In the extraction-VP condition, the extraction of *who* crossed a verb (*argued*) and created an intermediate copy prior to *that*, whereas the extraction-NP condition involved a wh-movement crossing a noun (*argument*) with no intermediate copy present. By contrast, the non-extraction conditions did not involve a similar movement of the wh-morpheme, even though they have the same number of words as in the extraction conditions up to the embedded clause. Two additional unmatched conditions were also added to explore the impact of similarity-based interference. These conditions had similar NPs and verbs as the extraction-VP and extraction-NP structures, with the added difference that the embedded clause subject was a proper name, whereas the other NPs remained definite descriptions (Table 11). Thus, in assessing processing preferences of long-distance wh-dependencies, there were 36 experimental items and 22 fillers. The filler items were composed of 10 items with similar length and complexity as the critical experimental items as well as 12 items designed to examine RC attachment preferences. The experimental conditions in SPR 2 are illustrated in Table 11, below.

Table 11

Conditions in SPR 2

Condition	Example
DP1-attachment	I watched // the fans of the singer // who // were // dancing funny // and looking happy.
DP2-attachment	I watched // the fans of the singer // who // was // dancing funny // and looking happy.
Extraction (VP), matched	The nurse who // the doctor argued // that // the rude patient // had angered // is refusing to work late.
Extraction (NP), matched	The nurse who // the doctor's argument // about // the rude patient // had angered // is refusing to work late.
Non-extraction (VP), matched	The nurse thought // the doctor argued // that // the rude patient // had angered // the staff at the hospital.
Non-extraction (NP), matched	The nurse thought // the doctor's argument // about // the rude patient // had angered // the staff at the hospital.
Extraction (VP), unmatched	The politician who // the journalist stated // that // John // had fascinated // is calling a press conference.
Extraction (NP), unmatched	The politician who // John's statement // about // the journalist // had fascinated // is calling a press conference.

It should be noted that since the above presentation of the experimental materials required that the stimuli from one experiment served as fillers for the other, the majority of the sentences were long, complex, and including RCs. This might have rendered each SPR task quite tedious, thus the observation that the attrition rates in this project were relatively high.

2.3.5. Reading Span Task

Following the first and prior to the second SPR task, the participants completed a reading span task (Daneman & Carpenter, 1980) designed on Ibex Farm to provide a measure WMC. Reading span tasks have been regarded as reliable and valid measure of WMC (Conway et al., 2005; Van Dyke & Johns, 2012).

2.3.5.1. Item Presentation

A critical feature of WM span tasks is that they interfere with rehearsal, since performance on span tasks should not reflect the amount of effort taken to rehearse the to-be-remembered information. Otherwise, the tasks is likely to be a measure of short-term memory capacity, which unlike WM span tasks, includes only a storage component (Conway et al., 2005). By contrast, when WM span tasks are administered, each stimulus should be presented immediately upon the completion of the previous stimulus in order to discourage rehearsal. Thus, in this project, it was decided that the stimulus presentation should not be self-paced and the pace of stimulus presentation was already programmed within the operating system. A critical question, therefore, was how fast the speed of stimulus presentation should be.

In order to find the optimum speed for presentation, a pilot study was carried out to find the optimum time duration for the presentation of each sentence (i.e., processing component) and to-be-remembered letter (i.e., storage component). Initially, these were set to be 4000 and 2000 ms., i.e., each stimulus sentence remained on the screen for 4000 ms., and after the participants decided if the sentence was meaningful or not (*people are giving and cheerful at Christmas time* vs. *the newspaper wrote that the prosecutor's dish was not based on fact)*, a letter appeared on the screen for 2000 ms. The results showed that out of the 8 participants with English as their native language, 6 (75%) achieved the maximum possible WM capacity score. A similar picture obtained for the L2 group participants, with 5 (50%) out of 10 among the Persian readers and 3 (75%) out of 4 among the French readers achieving a perfect score. Thus, it was

decided to reduce the time duration for the presentation of each sentence stimulus (processing component) to 3000 ms. and for the presentation of each letter (storage component) to 500 ms.

2.3.5.2. Procedure

This task was created on Ibex Farm, where participants were required to read individual sentences on the screen and decide whether they were sensible, while remembering a letter for later recall which appeared after their decision. After a series of sentences, the participants recalled the to-be-remembered letters regardless of the order in which they were presented. There were 15 items, each consisting of three, 4, 5, 6, and 7 sentences that were 10 to 14 words in length. The items were presented in ascending order, i.e., items with three sentences appeared first and items with seven sentences appeared last. The participants were required to indicate if the sentence was meaningful and memorise a letter that subsequently appeared on the screen for 500 ms. The participants received a warning message if their answer was incorrect. Upon reading all the sentences of an item, i.e., after reading 3, 4, 5, 6, or 7 sentences, a new page was displayed to prompt the participants to recall the letters. The following example illustrates an instance of a 3-sentence item used in this task. Each // symbol indicates the end of a screen page shown to the participants.

1) *Andy was stopped by the police because he crossed the yellow heaven.* //

   Makes sense? Yes / No *//*

   (In)correct! Please wait for the next item. //

   L //

2) *During winter, you can easily find a room at the beach at a low price.* //

   Makes sense? Yes / No *//*

   (In)correct! Please wait for the next item. //

   U //

3) *the newspaper wrote that the prosecutor's dish was not based on fact //*

Makes sense? Yes / No //

(In)correct! Please wait for the next item. //

C //

Please enter the letters: …… //

2.3.5.3. Scoring

An all-or-nothing scoring procedure was used (Conway et al., 2005), i.e., a score of one was awarded for each letter correctly recalled for each item, irrespective of the order. Conway et al. (2005) showed that different approaches to scoring, i.e., whether or not to consider the match between the order of presentation and responses is of no primary importance, since the results of different scoring methods tend to be strongly correlated. After each participant attempted all items, their recall scores on each sentence were added together, and then divided by the total number of sentences, 75.

2.3.5.4. Output variables

Working memory is responsible for the active maintenance and processing of information. In the reading span task, sentences appeared on the screen in groups of 3, 4, 5, 6, and 7 and the participants were required to decide if each sentence was sensible. Following each sentence, a letter appeared on the screen which the participants were required to memorise for later recall. Thus, the first outcome variable was accuracy, reflecting the extent to which each participant's decisions regarding the sensibility of sentences were accurate. Accuracy scores indicate the extent to which each participant was attentive to the task. The second outcome variable in this task was the percentage of correct recalls of the to-be-remembered letters, indicating the storage capacity of WM in the face of processing information (Conway et al., 2005). The following table provides details of the time taken for each group to complete the reading span

task and the associated Cronbach's alpha (the results of the storage components are presented in the following chapters).

Table 12

Descriptive statistics on the reading span task

Group	Mean (minutes)	Range	SD	Cronbach's alpha
L1 English (N=32)	17.29	7.37-14.99	4.39	0.92
L1 French (N = 34)	22.9	8.57-21.08	5.17	0.87
L1 Persian (N = 23)	34.27	14.92-33.45	10.91	0.88

Chapter 3: Testing the Interpretability Hypothesis: evidence from acceptability judgments of relative clauses by Persian and French learners of L2 English

Abstract

Many studies have explored the L2 acquisition of relative clauses (RCs) and whether L2 readers transfer a resumptive strategy from L1 to L2. While evidence seems to suggest that there are significant L1-L2 differences in the processing of RCs, relatively little is known about the source of non-target-like L2 behaviour. The present study investigates the grammatical acceptability of different RC types in L2 English and whether reliance on a resumptive strategy is a syntactic or processing issue. The participants included 71 L1-Persian L2-English, 52 L1-French L2-English, and 44 native English readers, who completed a proficiency c-test, a grammaticality judgment task, and a reading span working memory (WM) task. Unlike French, which is similar to English in the syntactic derivation of RCs, Persian is a structurally wh-in-situ language that syntactically allows resumption in direct object and object-of-preposition RCs. The results showed that unlike L1-French readers, L1-Persian readers were more likely to accept resumptive pronouns in L2 English RCs; however, both L1- and L2-groups overwhelmingly preferred a gap over a resumptive strategy. The results suggest that given sufficiently high proficiency and long immersion experience, L2 readers can match native readers in terms of RC syntactic representations, suggesting that the issue faced by learners is a processing issue rather a representational one as suggested by the Interpretability Hypothesis (Tsimpli & Dimitrakopoulou, 2007).

3.1. Introduction

Many studies have explored the L2 acquisition of relative clauses (RCs) and the way L2 grammars potentially differ from native grammars. Where differences are observed between L1 and L2 performance, theories divide as to the potential source of non-target-like behaviour. On the one hand, representational deficit accounts such as the Interpretability Hypothesis view a subset of morphosyntactic features, namely uninterpretable features, as being impossible to acquire in an L2 and posing learnability issues even at a highly advanced proficiency state (Tsimpli & Dimitrakopoulou, 2007). By contrast, Full Access accounts argue that adult L2 acquisition is essentially similar to L1 acquisition, in that they both fully draw on the same inventory of morphosyntactic features embedded in the language faculty (Lardiere, 2008; Schwartz & Sprouse, 2017). According to this line of theorising, non-target-like L2 behaviour at an advanced proficiency state reflects processing issues and given sufficient L2 proficiency, linguistic exposure, and individual working memory (WM), L2 grammars can match native grammars in terms of the complexity of the underlying linguistic system (Hopp, 2006). The present study aims to contribute to the debate by investigating L2 acquisition of English RCs by L1-Persian and L1-French readers. By appealing to a generative syntactic framework (Chomsky, 2000; Hornstein et al., 2005), this study specifies the learning task for the L1-Persian readers as requiring both the pre-emption of L1-based and acquisition of L2-specific uninterpretable features. By contrast, the L1-French readers do not need to acquire new uninterpretable morphosyntactic features and only need to modify the features that already apply in their L1.

3.2. A Minimalist View of Relativisation in English, French, and Persian

According to the Minimalist Program (MP), the language faculty is composed of grammatical modules such as Lexicon (LEX), Morphology, and Syntax, which are connected by the so-called interfaces to other cognitive components responsible for language processing (Chomsky,

2000). The LEX is connected to a computational system (C_{HL}) with a set of syntactic devices such as Merge, Move, and Agree that combine lexical items into linguistic expressions, interpret these expressions semantically, and assign them a phonological spell-out (R. Hawkins, 2005, p. 124). The C_{HL} connects the lexicon to the conceptual-intentional system via Logical Form (LF) interface and the articulatory-perceptual system via the Phonetic Form (PF) interface, respectively. The lexicon itself is composed of well-defined matrices of phonological (e.g. [-back]), semantic (e.g., [+animacy]) and morphosyntactic features (e.g., [-past]) that amount to units of grammar. Chomsky (1995) divides morphosyntactic features into interpretable and uninterpretable features. Interpretable features are those that make an essential contribution to the meaning (e.g., [tense]), whereas uninterpretable features have a purely syntactic role (e.g., [agreement]). Of the two featural types, only uninterpretable morphosyntactic features are accessible to C_{HL}. That is, syntactic computations such as movement operations are motivated by the need to eliminate those features that are uninterpretable at the interfaces (see below for an example).

3.2.1. RC Formation in English and French

English and French RCs are subject to locality conditions and are assumed to be formed by means of wh-movement (Sportiche, 1981). It is assumed within Minimalism that each morpheme heads its own syntactic category containing a subset of morphosyntactic features. The Complementiser (C) node in English and French contains the uninterpretable Extended Projection Principle (EPP) and (wh) features that drive wh-operator movement operations to a position higher in the corresponding syntactic tree – the specifier position of the complementiser phrase or spec (CP). The [EPP] feature mandates that the specifier position be filled with a syntactic constituent in the embedded Tense Phrase (TP), and the [wh] feature regulates the precise morpheme that undergoes movement (R. Hawkins, 2005; Radford, 2009). If the C contains a [+wh] feature, as in *(1a)*, an overt wh-word such as *who* with an interpretable

[+wh] feature moves to spec (CP), whereas in the case of a C [-wh], as in *(1b)*, the element undergoing movement is a silent morpheme with a null [^{0}wh] feature (Hermas, 2014).

1) *a. The man* [$_{CP}$ *who*$_{i}$ $_{[wh]}$ [$_{C\ [+wh]}$] [$_{TP}$ *I was talking to <who*$_{i}$*>*]]

   b. The man [$_{CP}$ Op$_{i}$ $_{[0wh]}$ [$_{C\ [-wh]}$ *that*] [$_{TP}$ *I was talking to <Op*$_{i}$*>*]]

Importantly, the precise form of English relativisers do not seem to depend on the syntactic position of the relativised element within TP. That is, English allows both wh-words such as *who* and the invariant complementiser *that* to function for human referents as potential relativisers in different RC types, such as subject (SU), direct object (DO), and object-of-preposition (OP) RCs (Keenan & Comrie, 1977). This is illustrated in *(2)* (Dickens, 2018, pp. 14–18):

2) *a. The boy who / that <Op> saw you* (SU)

   b. The boy who / that you saw <Op> (DO)

   c. The boy who(m) / that you gave the key to <Op> (OP)

Furthermore, English OP RCs allow preposition stranding with relativisers, where a wh-morpheme moves to the spec (CP) alone and leaves its DP complement stranded at its base position (as in *2b*).

Similarly to English, French involves wh-movement operations in different RC structures, i.e., wh-words such as *lequel* (which) – more frequently used in non-restrictive RCs – and its allomorphs *qui* are displaced from the positions where they are interpreted as in *(3)*. In addition to the possibility of gender and number inflection for *lequel*, there is an added level of complexity in selecting the correct RC pronoun in French RCs, namely the fusion between the prepositions and the wh-operator *lequel*. In French, since the prepositions *à* and *de* typically contract with the determiners *le* and *les*, they do so in *lequel* RCs, leading to forms such as

auquel (*à + lequel*) and *duquel* (*de + lequel*) (Rowlett, 2007, p. 190). Unlike in English, no PP stranding is allowed in French and the only grammatical option to form OP RCs is through a pied piping strategy, whereby the entire PP moves to spec (CP) (Dickens, 2018, p. 33).

3) *a. la femme*$_i$ [$_{CP}$ *avec laquelle*$_i$ [wh] [$_{C}$ [+wh]] [$_{TP}$ *Jean veut se marier <avec laquelle*$_i$*>*]]
the woman with whom Jean wants self marry <with which>
b. la femme$_i$ [$_{CP}$ *avec qui*$_i$ [wh] [$_{C}$ [+wh]] [$_{TP}$ *Jean veut se marier <avec qui*$_i$*>*]]
the woman with whom Jean wants self marry <with which>
The woman Jean wants to marry"

Despite the similarity in wh-movement operations between English and French RCs, the distribution of relativisers in French RCs is different from that in English and is tied to the syntactic function of the relativised element (Dickens, 2018; R. Hawkins, 1989; Rowlett, 2007). Object-of-preposition RCs in French are obligatorily relativised by relative pronouns such as those in *(3)* above, whereas DO and SU RCs take the overt complementisers *que* and *qui* as in *(4)* and *(5)* below (for evidence why *qui* in SU RCs is not considered a wh-word, see Rowlett, 2007, p. 192).

4) *la fille*$_i$ [$_{CP}$ Op$_i$ 0wh *que* [-wh] [$_{TP}$ *j'aime* <Op$_i$>]] (DO RC)
the girl that I love
5) *la fille*$_i$ [$_{CP}$ Op$_i$ [0wh] *qui* [-wh] [$_{TP}$ <Op$_i$> court]] (SU RC)
the girl that runs

Finally, standard English and French RCs do not syntactically allow a resumptive strategy (Dickens, 2018; R. Hawkins, 1989). A resumptive pronoun is a pronoun variable appearing in a position where movement has occurred (Pérez-Leroux, 1995). Resumptive RCs in English and French are not syntactically allowed and are typically judged ungrammatical by native

readers of these languages (Keffala & Goodall, 2011). The example below illustrates the ungrammaticality of resumption in French and English RCs.

6) **la boîte que je **l'**ai trouvée.*

*The box that I have found **it**.

In summary, English and French RCs are formed by wh-movement and allow the use of either an invariant complementiser [^{0}wh] or a wh-pronoun [+wh]. French differs from English in that it involves finer-grained syntactic restrictions on the distribution of relativisers. As for resumption, neither English nor French allows resumptive RCs. This is quite different in Persian RCs, a topic which is explored in the next section.

3.2.2. RC Formation in Persian

In contrast to English and French, Persian is a pro-drop, SOV, and scrambling language, which does not respect locality conditions (Raghibdoust, 1993, pp. 55-68). Additionally, unlike English and French, Persian RCs are not formed by means of wh-movement operations (Karimi, 2005; Karimi & Taleghani, 2007). Following Karimi and Taleghani (2007), it is assumed in this study that Persian RCs contain a base-generated null wh-operator [^{0}wh] at spec (CP) that agrees with a C head containing a [-wh] feature. Furthermore, unlike English and similarly to French, Persian does not allow PP stranding and all OP RCs involve pied piping PPs. Moreover, all RC types in Persian are obligatorily introduced by the invariant complementiser *ke* (Aghaei, 2006). An example of OP RC in Persian is provided below[3]:

[3] Restrictive RCs in Persian are typically distinguished from non-restrictive ones by the attachment of the suffix *-i* to the relativised head, henceforth shown by -RES in gloss (Taghvaipour, 2005).

7) *mærd -i_i* [$_{CP}$ Op $_{[0wh]}$ [$_{C[-wh]}$ *ke*] [$_{TP}$ *beh* (***u***$_i$ */ **-ef***$_i$) *pul dãd-æm*]]

man-RES that I money to **him** gave-[1SG]

'the man that I gave money to'

As evident in the above example, Persian RCs may contain syntactically allowed resumptive pronouns that reflect the relativised head within the embedded clause. The resumptive pronouns in Persian RCs can be realised by either an overt and independent pronoun such as *u* (him/her) or a verbal clitic such as *-ef* (him/her), coindexed with the relativised head (Taghvaipour, 2005). According to Taghvaipour (2005), no resumption is allowed in Persian SU RCs (for counterexamples, see Abdollahnejad & Marefat, 2017, p. 144), whereas inserting a resumptive pronoun is optional in DO and obligatory in OP RCs, respectively. It is assumed in this study that resumption in Persian RCs resembles (uninterpretable) verbal agreement features typically expressed by subject and object clitics. Persian has obligatory subject and optional object verbal clitics.

In fact, where TP agreement features are overtly attached to the verb, resumption is redundant in Persian RCs and where verbal clitics are missing, resumption is obligatory. As far as SU RCs are concerned, the agreement features of the subject are already obligatorily indicated on the verb and inserting an overt resumptive is syntactically redundant. This is consistent with the observation that resumptive pronouns in SU RCs are ungrammatical (Taghvaipour, 2005) unless with an increased focus interpretation (Abdollahnejad & Marefat, 2017). In addition, using object clitics is optional and is typically associated with informal Persian, as is the use of resumption in DO RCs (Abdollahnejad & Marefat, 2017). Furthermore, using both an overt resumptive pronoun and verbal object clitic does not seem to be grammatical in Persian, as illustrated below, where a gap *(8a)* or resumption *(8b)* is grammatical, but using both a resumptive pronoun besides a verbal object clitic is questionable at best *(8c)*. And finally, resumptive pronouns are obligatory in OP RCs and this can be linked to the lack of verbal

clitics in the oblique case (the case assigned to the DP complements of prepositions). Following Adger (2003), it is assumed in this study that resumption is specifically a PF phenomenon, i.e., the uninterpretable agreement features of the verb are converted to overt phonetic realisations as resumptives in Persian RCs, doubling the features of the extracted morpheme.

8) *a. mærd-i ke mæn __ did-æm.*

man-RES that I __ saw-[NOM_{1SG}]

'the man that I saw'

*b. mærd-i ke mæn **u**-ra did-æm.*

man-RES that I **him** saw-[NOM_{1SG}]

'the man that I saw'

c. ???*mærd-i ke mæn **u**-ra did-æm-**eʃ**.*

man-RES that I **him** saw-[NOM_{1SG}]-**[ACC 3SG]**

'the man that I saw'

It is important to acknowledge that the assumption of the lack of movement following Agree between the operator at spec (CP) and C might be debatable. After reviewing data from Irish, McCloskey (2002) argues that movement follows Agree between an uninterpretable operator feature on C and the relativised element, such that the form of relativiser at C registers an application of wh-movement in Irish into its specifier position: where resumption is observed, a merge operation is assumed without movement, but with a gapped RC, only a movement operation is suggested to take place. However, we argue that such analysis fails to successfully account for the range of wh-phrases in Persian, and the operator at spec (CP) in Persian RCs does not result from movement of an element at spec (TP) but is base-generated. This is supported by the observation that the wh-operator in Persian interrogatives may surface overtly at spec (CP) as a scope marker, as in *(9)* (Karimi & Taleghani, 2007, p. 178), where the overt

wh-phrase *chi* ‘what’ in the matrix clause marks the scope of the wh-phrase in the embedded clause:

9) *chi fekr mi-kon-I* [*u ki-râ did*]*?*

What thought DUR-do-[NOM2$_{2SG}$] she who-[ACC] saw

Who do you think she saw? Lit: what do you think who she saw?

Additionally, unlike the case of Irish, in which the relativiser form is sensitive to the type of syntactic operation between the operator at spec (CP) and the head C (merge in the case of resumptive RCs as opposed to merge & move in gapped RCs; McCloskey, 2002), the only relativiser form allowed in Persian RCs is an invariant complementiser *ke* 'that'. That the form of complementiser *ke* which initiates RCs (Aghaei, 2006) is always the same regardless of the animacy, gender, grammatical function, or number of the head (Rahmany et al., 2013). suggests the need for a uniform account of RC derivation in Persian. Given that unlike English and French, Persian does not respect island constraints (Raghibdoust, 1993), following Karimi and Taleghani (2007), it is assumed in this paper that Persian RCs are not formed by wh-movement.

The following table provides a summary of the syntactic properties of SU, DO, and OP RCs in English, French, and Persian. Wh-movement in English and French to spec (CP) is triggered by the presence of an [EPP] feature at C, whereas there is no wh-movement in Persian RCs, hence the lack of an [EPP] feature. In addition, the relativising word involves an agreement relationship between an uninterpretable [wh] feature on C and an interpretable one in English, French, and Persian, but the specific values are different in the three languages in SU, DO, and OP RCs. Finally, TP agreement features remain covert in English and French and no resumption is allowed, whereas agreement might be overtly realised as resumptive pronouns in Persian.

Table 13

Summary of syntactic properties of English, French, and Persian RCs

	RC type	spec (CP)	C	TP
English	SU	[+wh/^{0}wh]	[EPP, +/-wh]	gap
	DO	[+wh/^{0}wh]	[EPP, +/-wh]	gap
	OP	[+wh/^{0}wh]	[EPP, +/-wh]	gap
French	SU	[^{0}wh]	[EPP, -wh]	gap
	DO	[^{0}wh]	[EPP, -wh]	gap
	OP	[+wh]	[EPP, +wh]	gap
Persian	SU	[^{0}wh]	[-wh]	resumption
	DO	[^{0}wh]	[-wh]	resumption
	OP	[^{0}wh]	[-wh]	resumption

The learning task for L1-French readers does not consist of learning new features but ascertaining how these features are expressed in English. As for L1-Persian readers, however, the learning task involves the acquisition of an [EPP] feature at C and a [wh] at spec (CP) that motivate wh-movement, in addition to the pre-emption of an L1-based resumptive strategy that overtly spells out the TP agreement features in Persian.

3.3. Previous Research on L2 Resumption

Many studies have been carried out to investigate the L2 acquisition of wh-structures and whether L2 grammars allow resumptive pronouns in languages where the only syntactically licit option is a gap strategy (Belikova & White, 2009; Hawkins & Chan, 1997; Lardiere, 2008; Tsimpli & Dimitrakopoulou, 2007). The results have suggested significant differences between

L1 and adult L2 readers, leading some to the conclusion that the uninterpretable features of resumptive pronouns are no longer accessible in adult L2 acquisition and resist resetting to appropriate L2 values (Tsimpli & Dimitrakopoulou, 2007). For example, Tsimpli and Dimitrakopoulou, (2007) administered a grammaticality judgment task to explore the acceptability of resumptive pronouns in L2 English wh-interrogatives by L1 Greek readers. Unlike English, resumption represents a cluster of uninterpretable verbal agreement features in Greek wh-interrogatives and is obligatory in subject and optional in object positions. The materials consisted of structures of the type below (Tsimpli & Dimitrakopoulou, 2007, p. 227):

10) *a. Who do you think that Jane likes ___ / *him?* Object-extraction

*b. Who have you suggested ___ / *he should not resign?* Subject-extraction

The participants included a group of native English reader controls and two groups of L1-Greek L2-English readers divided by proficiency: intermediate and advanced. The results showed that despite a clear development in the rejection of resumptive pronouns in the two learner groups, the rates of resumption acceptability in both subject and object extraction structures were significantly higher for the L2 participants than for the native English reader control group. In addition, whereas the advanced group judged resumptive subject extraction structures significantly more acceptable (32.6%) than resumptive object extraction structures (21.4%), the intermediate readers judged resumption almost equally acceptable in subject (38.3%) and object extraction sites (40.5%). Tsimpli and Dimitrakopoulou argued that resumption as a cluster of uninterpretable features is likely to cause learnability problems for L2 learners at even an advanced proficiency, and L2 readers are likely to transfer the status of resumptive pronouns from their L1 to L2. Tsimpli and Dimitrakopoulou conclude that their findings support the Interpretability Hypothesis, according to which the uninterpretable features of L1

resist resetting to L2 appropriate values due to critical period effects, and L2 readers operate based on the uninterpretable features of their L1.

However, these results should be interpreted with caution. That the L2 readers' rate of resumption acceptability in Tsimpli and Dimitrakopoulou (2007) was higher than the native English readers' does not warrant the conclusion that the underlying grammatical representations are necessarily different. It is possible that the observed reliance on resumption acceptability was motivated by L2 processing limitations, and the L2 participants were not sufficiently advanced to behave like native readers in terms of acceptability of resumptive RCs. Previous research suggests that given sufficient WMC (Hopp, 2014), proficiency (Hopp, 2006), and linguistic exposure (Pliatsikas & Marinis, 2013), L2 readers are likely to display native-like processing behaviour. In fact, in a replication of Tsimpli and Dimitrakopoulou (2007), Leal-Méndez and Slabakova (2014) showed that only those L2 readers who were not sufficiently advanced in L2 English and who frequently accepted a resumptive pronoun in their L1 were likely to transfer an L1-based resumption strategy to L2 English. By contrast, those L2 readers who enjoyed more than 6 years of immersion experience in an English-speaking country and who did not typically accept a resumptive over a gap strategy in their L1 were unlikely to accept a resumption strategy in L2 English.

In a similar vein as Tsimpli and Dimitrakopoulou (2007), Marefat, and Abdollahnejad (2014) investigated the status of resumptive pronouns in English L2 RCs by 4 different proficiency groups of L1 Persian readers: elementary, low-intermediate, high-intermediate, and advanced. They administered a grammaticality judgment task on SU, DO, and OP RCs in English. As discussed in section 2, resumptives are ungrammatical in Persian SU, optional in DO, and obligatory in OP RCs. The results indicated a clear development by proficiency in rejecting resumptive RCs: Acceptability rates of resumptive pronouns were significantly lower among the advanced group (SU: 18%, DO: 28%, OP: 24%) than among the elementary group (SU:

65%, DO: 75%, OP: 64%). Additionally, the authors reported no statistically significant difference in SU RC resumption acceptability between the advanced group and the native readers, whereas a significant difference was observed in the resumption acceptability of DO and OP RCs between the native and the advanced L2 readers. Marefat and Abdollahnejad argued that their findings were compatible with the Interpretability Hypothesis, since they found no difference in resumption acceptability in SU RCs between advanced and native readers, but the advanced readers were more likely than native English readers to accept resumptive pronouns in DO and OP RCs, mirroring the status of resumptives in L1 Persian.

However, these results should also be interpreted with caution. Marefat and Abdollahnejad reported an advantage for a gap over resumption for both the advanced L2 and the native English readers. Both groups significantly preferred gapped over resumptive RCs, suggesting that the L2 participants' occasional reliance on a resumptive strategy does not necessarily indicate syntactic deficits. The mere observation of L1-L2 performance differences does not necessarily justify the conclusion that the underlying grammars are fundamentally different (Dekydtspotter et al., 2006). L2 readers might resort to a resumptive strategy to facilitate WM constraints (J. Hawkins, 2009), since inserting a resumptive pronoun in place of the relativised element enhances the availability of the extracted morpheme in WM by highlighting its morphosyntactic features (Lewis et al., 2006), and even native readers of [- resumptive] languages sometimes use a resumptive strategy to lighten the processing burden on the underlying parsing system (Tezel, 1999). Early research on L2 acquisition of English RCs has shown that even L2 English readers of [- resumption] L1 backgrounds might resort to a resumptive strategy to facilitate processing limitations (Gass, 1979; Tezel, 1999), and this is more likely to be observed in relatively complex syntactic environments such as OP and DO RCs than in SU RCs (Gibson, 1998). Thus, the relatively higher acceptability of resumption in DO and OP RCs is not necessarily informative as to the (in)accessibility of uninterpretable

features in L2 acquisition. Given the hypothesis that L2 readers are more susceptible to cognitive resource limitations than monolingual readers (Hopp, 2014), L2 readers are equally (if not more) likely to adopt a resumption strategy to reduce processing burden on the underlying parsing mechanism. This is especially true for those L2 readers whose L1 allows resumption (Gass, 1979), suggesting that inserting a resumptive pronoun in RCs potentially reflects an L2 developmental stage in the acquisition of RCs regardless of L1, which may persist longer in L2ers whose L1 grammaticalises resumption (Hitz, 2012).

Overall, the research motivating the Interpretability Hypothesis to date has focused on resumption acceptability, disregarding individual differences and confounding potential syntactic deficits and processing limitations. A more fruitful investigation of accessibility to uninterpretable features in L2 English RCs should involve an investigation of the potential role of individual differences in WM, proficiency, and immersion experience and concentrate not only on resumption but also on other morphosyntactic phenomena that are motivated by uninterpretable features (e.g., preference for different relativiser forms). In addition to resumptive pronouns, the distribution of relativisers (*that*, wh-pronouns) is motivated by uninterpretable features [EPP, wh] at C. An investigation of preference for the potential form of relativiser alongside resumption acceptability can help illuminate the degree to which uninterpretable features are accessible in L2 acquisition of English RCs.

3.4. The Present Study

The present study aims to bridge this gap by investigating the way readers of L1-French and L1-Persian syntactically represent and process RCs in L2 English, specifically seeking answers to the following questions:

(1) Is there a difference between L1 French and L1 Persian readers in terms of acceptability of resumptive pronouns in L2 English RCs?

(2) If there is evidence for an L1-based transfer of resumption to L2 English RCs, is this motivated by syntactic deficits or by processing limitations? To investigate this question, the following sub-questions were formed:

   a. Is there a difference between L1-English, L1 French, and L1 Persian readers in terms of acceptability of RCs with different relativiser forms (e.g., *who* relatives versus *that* relatives) that are motivated by a [wh] feature?
   b. Do L1 French and L1 Persian readers show evidence of the acquisition of wh-movement operations in L2 English RCs motivated by an [EPP] feature?
   c. Do individual differences in L2 proficiency, immersion experience, and WMC impact L2 readers' judgment of English RCs?

The first question investigates whether L2 readers of [+ resumption] (e.g., Persian) L1s transfer a resumptive strategy from their L1 to L2, whereas the following questions help examine the potential source of such transfer. According to the Interpretability Hypothesis, unlike L1 French readers, L1 Persian readers should not only display relatively high acceptability of resumptive RCs in L2 English, but they should also be equally likely to display non-target-like behaviour with respect to different relativiser forms. Specifically, since Persian does not allow wh-pronouns as relativisers, L1 Persian readers should favour *that*-relatives to *wh*-relatives, and resumption acceptability should be higher in *that*-relatives than in *who*-relatives. Similarly, previous studies have shown that the acquisition of wh-movement in English OP RCs is preceded by the base-generation stage of relativiser, where no movement is assumed to take place and L2 readers resist the presence of a stranded preposition at the end of OP RCs (*the guy who I was talking to*; Klein, 2001). As such, it was expected under the Interpretability Hypothesis that the rates of rejecting OP RCs based on the presence of an overt preposition should be higher for the L1-Persian than for the L1-French and L1-English groups (Lardiere, 2008), i.e., according to the Interpretability Hypothesis, the Persian readers were expected to

refer to the stranded preposition as the source of ungrammaticality more frequently compared to the other two groups. This is because the Interpretability Hypothesis predicts that Persian readers, unlike French readers, will face consistent difficulty learning the wh-movement property of English RCs. Lastly, according to the Interpretability Hypothesis, the source of non-target-like acceptability of ungrammatical RCs in L2 English is inaccessibility of uninterpretable features and does not necessarily depend on individual differences. However, if L2 and L1 resumption are similar phenomena that are motivated by processing limitations rather than syntactic deficits, highly advanced L2 readers with long immersion experience and high WMC should display less non-target-like acceptability behaviour.

3.4.1. Method

3.4.1.1. Participants

All the data for this study were collected online (see below for details) from two groups of L2 learners of English: 52 French-speaking learners (mean age = 30, range = 19 - 42) and 71 Persian-speaking learners (mean age = 34, range = 18 - 59). In addition, 44 native English readers (mean age = 34, range = 20 - 51) served as the control group. All the L1-French, L1-English, and 11 L1-Persian participants were recruited through Prolific (www.prolific.co). The remaining L1-Persian readers were recruited through advertisements on social media. All of the participants were paid for their participation, reported having normal or corrected-to-normal vision, were residing in an English-speaking country at the time of the experiment, and were naive with respect to the purpose of the experiment. Table 14 provides a summary of the participants' biographical information collected through a language history questionnaire. It also presents the scores from individual differences tasks that were run to match the groups on factors hypothesised to modulate the processing of resumptive RCs (see next section for details).

Table 14

Participants' biographical information and individual differences scores

	AoA[a]		Immersion[b]		Proficiency[c]		WMC[d]	
Groups	*M*	*Range*	*M*	*Range*	*M*	*Range*	*M*	*Range*
L1-English N = 44	--	--	--	--	7.64	6.09 – 8.54	.85	.20 – 1.00
L1-French N = 52	23.1	16 – 29	85.06	4 - 221	7.03	4.21 - 8.64	.86	.47 – 1.00
L1-Persian N = 71	28.66	16 – 41	58.24	.1 - 524	6.31	2.88 - 8.31	.73	.35 - .96

[a] age of immigration to an English-speaking country (in years)

[b] months lived in an English-speaking country

[c] possible range: 0 – 10

[d] possible range: 0 – 1

3.4.1.2. Pre-tests

a. *Proficiency: C-test.* To determine the participants' general proficiency level in English, all completed a c-test (Keijzer, 2007), where they were required to complete 5 mutilated passages (Cronbach's alpha: .95). There was a reliable difference in proficiency among the three groups ($F_{(2, 164)} = 23.93$, $p < .001$), and the L1 English group scored higher than the L1 French ($\beta = .61$, $t_{(164)} = 2.90$, $p = .01$, $d = .53$) and the L1 Persian groups ($\beta = 1.35$, $t_{(164)} = 6.80$, $p < .001$, $d = 1.16$). Furthermore, the L1 French group was more advanced and had higher immersion experience than the L1 Persian readers (proficiency: $\beta = .73$, $t_{(164)} = 3.89$, $p < .001$, $d = .71$; immersion: $\beta = 26.29$, $t_{(121)} = 2.03$, $p = .04$, $d = .37$).

b. Working memory: Reading span task. Following the procedure described in Conway et al. (2005), the participants were also required to complete a reading span task (Daneman &

Carpenter, 1980) to yield a measure of their WMC. All the L1 French and L1 English participants attempted the reading span task. By contrast, only 23 L1 Persian readers completed this task, despite the fact that all completed the other tasks in this study. Overall, the Cronbach's alpha for reading span task was .90. There was a reliable difference in WMC among the three groups ($F_{(2, 74)} = 3.38$, $p = .04$), and whereas the L1 English and the L1 French groups performed equivalently ($t_{(74)} = .25$, $p = .81$), the L1 Persian readers had (marginally) lower WMC than the L1 English ($\beta = .12$, $t_{(74)} = 2.28$, $p = .07$, $d = .73$) and L1 French readers ($\beta = .12$, $t_{(74)} = 2.48$, $p = .04$, $d = .79$).

3.4.2. Resumption acceptability: grammaticality Judgment

The main task involved a GJT where the participants were required to provide judgments on gapped and resumptive RCs. The materials for this task comprised 42 experimental and 14 filler sentences. The RC structures always had [+human] heads relativised from the subject (14 RCs), direct object (14 RCs), and object-of-preposition positions (14 RCs). Given that the relativised element must be carried unattached longer in OP and DO RCs compared to SU RCs, more processing difficulty was expected in OP and DO RCs (Traxler et al., 2002). According to Gibson (1998), the number of discourse referents that intervene between the surface position of an extracted morpheme and its canonical position determines processing difficulty. Therefore, OP RCs, in which a subject and a direct object occur between the extracted morpheme and its subcategorising verb, pose the highest processing challenge, followed by DO RCs, in which only one discourse referent (i.e., the subject) intervenes between the two. By contrast, SU RCs are easiest to process in English since the extracted morpheme and its subcategorising verb are adjacent and no additional referents intervenes between the two.

Out of the 14 items per each RC type, 4 involved *that* and 10 *who* as the relativiser. Half of the experimental sentences were grammatical, and the other half were ungrammatical due to the presence of a resumptive pronoun. Ten lists were randomly constructed to reduce potential

ordering effects, and participants were randomly assigned to one of the lists. The participants were required to judge the grammaticality of each sentence (grammatical, ungrammatical) and make the necessary corrections if they judged a sentence to be ungrammatical (for a full list of the sentences, see Appendix A & also the OSF link[4]). The GJT used in this study was untimed, following current theory, which suggests non-target-like L2 performance on timed GJTs can be attributed to either inaccessibility to (uninterpretable) functional features or to processing constraints associated with the online parsing of timed GJT stimuli (McDonald, 2006).[5]

The scores assigned to grammatical and ungrammatical judgments were coded as 1, .5, or 0. Regardless of grammaticality, all the items that were judged to be grammatical were coded as 1, indicating that the participants accepted the relativisation strategy used. By contrast, items judged to be ungrammatical were coded as either 0 or .5. Those items that were rejected based on reasons unrelated to the experimental manipulations were coded as .5, since it is possible that the participants rejected the RCs due to an implicit recognition of the non-target-like relativisation strategy used. By contrast, those items that were judged to be ungrammatical due to resumption or the form of relativiser were coded as 0, since the participants explicitly indicated that they did not accept the relativisation strategy used. Items left blank were

[4] https://osf.io/cyjdv/?view_only=5aa161de8e284baf94af38778d2703d7

[5] We appreciate an anonymous reviewer's comment that embedding level can be used to manipulate the processing difficulty of different RCs, e.g., double-embedded RCs (e.g., *the administrator who the intern who the nurse supervised had bothered*) are more difficult to process than singly-nested RCs (e,g., *the intern who the nurses supervised*). However, to increase comparability with previous studies on resumption acceptability that used only singly-nested RCs (Marefat, & Abdollahnejad, 2014);Tsimpli & Dimitrakopoulou, 2007), the level of embedding was controlled in this study and no centre-embedding RCs were used.

excluded from further analysis. A higher score on each item indicated relatively higher acceptability of the RCs (minimum: 0, maximum: 1).

3.4.3. 4.3. Procedure

The data were collected online using the Qualtrics software, version (2020), and Ibex Farm (Zehr & Schwarz, 2018). The study was administered in two separate sessions, with approximately 5 days in between. Initially, all the participants were required to complete a language history questionnaire on Qualtrics, the proficiency c-test on Ibex Farm, and the GJT on Qualtrics. Subsequently, the highly advanced L2 readers were invited to complete the reading span task (Daneman & Carpenter, 1980) on Ibex Farm to yield a measure of their WMC.

3.5. Results

The data were analysed for the grammatical acceptability of each RC type, including the relativisation strategy (gap, resumption), syntactic position of the relativised element (SU, DO, OP), and the preferred form of the relativiser used (*that*, *who*) as the within-groups factors and native language (L1-English, L1-French, L1-Persian) as the between-groups factor. Nested linear mixed effects models were constructed using the *lmerTest* package in R (Bates et al., 2015; Kunzetsova et al., 2017; R Core Team, 2020). The models were evaluated with the same random effects structure and included by-subject and by-item adjustments to the intercept. The models were fitted with the maximum random effects structure that converged (Barr et al., 2013). Since none of the models with random slopes converged successfully, the random effects structure of the models included random intercepts only (Vasishth et al., 2020). The analyses were constructed hierarchically, and the statistical models were compared using likelihood ratio tests to determine whether additional parameters significantly improved model fit. Treatment contrasts were set to allow comparisons across different levels of the categorical

variables, with gap, SU RC, the invariant complementiser *that*, and L1-English as the reference levels for the relativisation strategy, RC type, relativiser form, and native language, respectively. The c-test proficiency scores, reading span scores, and responses on immersion experience were standardised, and the RT data were log transformed to reduce skewness and minimise potential outlier effects. Effect size estimates of *Cohen's d* were calculated using R's *effectsize* package (Ben-Shachar et al., 2020). The raw acceptability scores per each condition are shown in Table 15, with the possible range of 0 (completely unacceptable) to 1 (completely acceptable).

Table 15

Acceptability per relativisation strategy (gap, resumption), RC type (SU, DO, OP) and relativiser (that, who)

		Gap						Resumption					
		SU		DO		OP		SU		DO		OP	
Group		*that*	*who*	*that*	*who*	*that*	*who*	*that*	*who*	*that*	*who*	*that*	*who*
English	Mean	.83	.98	.85	.92	.87	.92	.01	.05	.04	.03	.05	.04
N = 44	SD	.37	.12	.32	.23	.30	.20	.08	.20	.17	.13	.18	.19
French	Mean	.69	.98	.73	.78	.74	.89	.14	.05	.04	.03	.05	.05
N = 52	SD	.46	.11	.45	.39	.42	.28	.34	.21	.20	.16	.20	.22
Persian	Mean	.67	.95	.70	.78	.73	.81	.19	.13	.27	.26	.26	.30
N = 71	SD	.45	.16	.42	.28	.41	.27	.38	.32	.42	.40	.42	.41

Initially, between-groups comparisons were constructed to examine whether there was a reliable difference among the 3 groups in resumption acceptability (section 5.1). This was followed by within-groups comparisons to assess each group's data more closely and explore potential interactions among resumption acceptability, RC types, and relativiser choice (section

5.2). Next, we examined the way the participants corrected resumptive OP RCs in those structures that were judged ungrammatical in order to assess potential evidence for the base-generation of the wh-morpheme (section 5.3). Finally, we sought to assess the hypothesis that resumption acceptability is moderated by individual differences in proficiency, immersion, and WMC (section 5.4).

3.5.1. Between-groups comparisons

To address the hypothesis that the three L1 groups use different relativisation strategy, two models were constructed: one with only the relativisation strategy (gap, resumption) as the fixed factor and another with the relativisation strategy and its interaction with native language. There was a main effect of relativisation strategy and all groups preferred gapped over resumptive RCs ($\chi^2_{(1)} = 1159.8$, $p < .001$). In addition, an interaction was observed between relativisation strategy and native language ($\chi^2_{(4)} = 362.95$, $p < .001$): whereas no reliable difference in resumption acceptability was observed between L1-English and L1-French readers ($t_{(215)} = .67$., $p = .98$), L1-Persian readers were more likely to accept resumptive RCs than L1-English ($\beta = .19$, $t_{(215)} = 8.28$, $p < .001$, $d = .68$) and L1-French readers ($\beta = .17$, $t_{(215)} = 7.94$, $p < .001$, $d = .62$).

3.5.2. Within-groups comparisons

To further explore the potential factors that might impact resumption acceptability, a sequence of separate within-groups analyses was constructed on each group's data to assess the potential interaction between resumption, RC type (SU, DO, OP) and relativiser form (*that*, *who*). All groups preferred gapped over resumptive RCs (L1-English: $\beta = .87$, $\chi^2_{(1)} = 1165.3$, $d = 1.80$; L1-French: $\beta = .78$, $\chi^2_{(1)} = 846.79$, $d = 1.60$; L1-Persian: $\beta = .57$, $\chi^2_{(1)} = 675.83$, $d = 1.25$; all ps $< .001$). In addition, all groups showed a reliable interaction between the relativisation strategy and the form of relativiser (L1-English: $\chi^2_{(2)} = 27.01$; L1-French: $\chi^2_{(2)} = 67.35$; L1-Persian: χ^2

$_{(2)}$ = 59.95; all ps < .001), and found gapped RCs to be more acceptable with *who* than with *that* (L1-English: β= .09, $t_{(392)}$ = 5.26, d = .44; L1-French: β= .17, $t_{(392)}$ = 8.34, d = .33; L1-Persian: β= .15, $t_{(392)}$ = 7.91, d = .47; all ps < .001).

Furthermore, a significant interaction was observed between the relativisation strategy and RC type both for the L1-French and L1-Persian groups (L1-French: $\chi^2_{(4)}$ = 34.5, p < .001; L1-Persian: $\chi^2_{(4)}$ = 64.97, p < .001). Specifically, the L1-French data showed little difference in acceptability between different resumptive RCs (all ts < 1.5), but gapped SU RCs were judged by the L1-French readers to be more acceptable than gapped DO RCs (β= .14, $t_{(393)}$ = 5.73, p < .001, d = .51). In addition, gapped OP RCs were judged to be more acceptable than gapped DO RCs by the L1-French readers (β= .08, $t_{(395)}$ = 3.42, p < .001, d = .31). As for the L1-Persian group, resumption was judged to be more acceptable in DO and OP than in SU RCs (DO: β= .11, $t_{(407)}$ = 4.95, p < .001, d = .11; OP: β= .14, $t_{(414)}$ = 6.07, p < .001, d = .65). In addition, gapped SU RCs were judged to be more acceptable than gapped DO (β= .12, $t_{(425)}$ = 5.23, p < .001, d = .12) and gapped OP RCs (β= .07, $t_{(438)}$ = 3.05, p = .03, d = .07). There were no other reliable effects (all ps > .32).

To summarise, the results showed that L1-Persian readers were more likely than L1-French and English controls to accept resumptives in English RCs. However, other evidence seems to point to some striking commonalities among the different L1 groups: all three groups overwhelmingly preferred gaps over resumptives and displayed an identical pattern with respect to the interaction between the relativisation strategy and the potential form of relativiser. Even though the only form of relativiser in Persian is an invariant complementiser, resumption acceptability in L1-Persian L2-English did not seem to be influenced by the potential form of the relativiser used. This is illustrated in the following figure: whereas all three groups preferred the wh-operator *who* over the invariant complementiser *that* in

grammatical RCs, there is not a reliable difference in acceptability between resumptive *who* and resumptive *that* RCs.

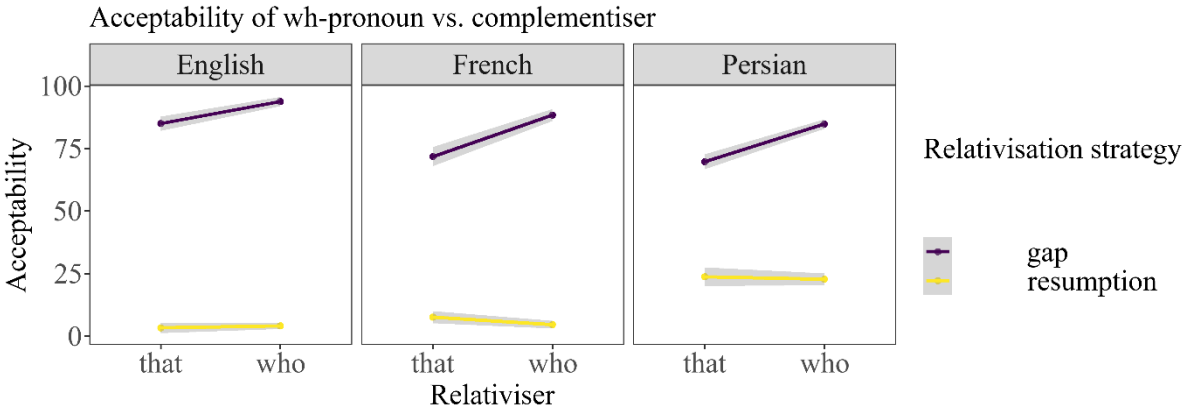

Figure 2. RC acceptability in different groups

3.5.3. Correction Data on OP RCs: Evidence for Wh-movement?

The above results suggest that both the L1 French and L1 Persian readers did not reject *who* RCs and similarly to native readers, showed a reliable preference for gapped *who* over gapped *that* RCs. It remains unclear, however, if the above acceptability of *who* RCs reflects underlying wh-movement operations or signals the base-generation of the wh-morpheme *who*. Recall that while French is a wh-movement language that allows both wh-pronouns (in OP RCs) and invariant complementisers (in SU and DO RCs) to function as potential relativisers, Persian is a wh-in-situ language and does not allow RCs with wh-pronouns. An argument can be made that the above pattern does not necessarily indicate wh-movement and the relativiser *who* is base-generated in the L2 grammar of the L1 Persian group in this study. That is, the L1-Persian readers might have reset the null [wh^0] of L1-Persian C to the [+wh] of L2-English without having to acquire the C [EPP] feature that motivated the movement of a wh-morpheme. In order to explore this possibility, we focused exclusively on OP RCs and the way different L1 groups attempted to correct those structures that were judged ungrammatical.

Given the assumption that preposition-stranding is not allowed in French and Persian OP RCs (Poletto & Sanfelici, 2017), we expected that L2 readers who have not yet acquired wh-movement would face additional difficulty in correcting RCs with stranded prepositions. Previous evidence suggests that L2 readers have a tendency to drop obligatory prepositions before acquiring wh-movement in L2 English RCs (Klein, 2001), and the observation of correction attempts to delete the stranded preposition is a signature for the base-generation of wh-operators (Lardiere, 2008). However, our data showed less than 3% of OP RCs were rejected based on the presence of the preposition (Persian: 2.82%, French: 1.61%, English: .03%). There was no significant interaction between the number of preposition deletion attempts and the native language of the participants ($\chi^2_{(2)} = 2.71$, $p = .26$), supporting the conclusion that the reason for rejecting ungrammatical OP RCs was not the stranded preposition, despite the fact that both L1-French and L1-Persian disallow preposition stranding in OP RCs. Thus, little evidence was found that the wh-morpheme was base-generated.

3.5.4. Individual Differences

Finally, focusing on individual differences in proficiency, WM, and immersion experience, the L2 data showed a significant interaction between proficiency and relativisation strategy (L1-French: $\chi^2_{(2)} = 11.89$, $p < .005$; L1-Persian: $^2_{(2)} = 102.24$, $p < .001$), such that the more proficient L2 readers were less likely to accept a resumptive strategy (L1-French: $\beta = .03$, $t_{(1821)} = 2.56$, $p = .01$, $d = .06$; L1-Persian: $\beta = .10$, $t_{(2819)} = 9.93$, $p < .001$, $d = .26$). As for WMC, the L1-English readers showed a reliable interaction between WMC and resumption acceptability ($\chi^2_{(2)} = 7.02$, $p = .03$), and higher WMC was associated with a significant reduction in acceptability of resumptive RCs for the L1-English readers ($\beta = .20$, $t_{(1252)} = 2.65$, $p < .05$, $d = .06$). However, the L2 readers did not show a similar interaction (L1-French: $\chi^2_{(2)} = 1.52$, $p = .47$; L1-Persian: $\chi^2_{(2)} = 2.72$, $p = .26$). Furthermore, there was a marginal interaction between immersion and resumption acceptability both for L1-French and L1-Persian readers (L1-

French: $\chi^2_{(2)} = 4.61$; L1-Persian: 4.60; both ps < .10). Those L2 readers who had more immersion experience were less likely to accept resumptives in L2 English RCs (L1-French: $t_{(2032)} = 4.38$, p = 06, d = .05; L1-Persian: $t_{(2851)} = 2.99$, p = .04, d = .05). The correlation coefficient was weak between immersion and proficiency (r = .08, $t_{(1885)} = 3.40$, p < .05) and moderate between WMC and proficiency (r = .28, $t_{(3186)} = 16.15$, p < .001)

In summary, evidence suggests that higher proficiency and longer immersion experience helps L2ers of both L1-French and L1-Persian readers approximate native English readers in rejecting resumptive RCs. However, there was little evidence that L2 resumption acceptability interacted with WMC, even though the L1-English data suggested that high WMC is associated with low rates of acceptability of resumptive RCs.

3.6. Discussion

The purpose of the current study was to investigate whether native English readers and L1-French and L1-Persian L2 learners of English accept syntactically ungrammatical resumptive pronouns in SU, DO, and OP RCs, and to examine if such potential non-target-like acceptability can be attributed to inaccessibility of uninterpretable features. The main results of the experiment can be summarised as follows: *(a)* both the native and L2 readers showed overwhelmingly higher acceptability of grammatical RCs with a gap than ungrammatical RCs with a resumptive pronoun; *(b)* between-group comparisons showed little difference in resumption acceptability between L1-English and L1-French readers, whereas L1-Persian readers were more likely than the other groups to accept resumptive pronouns in English DO and OP RCs; *(c)* the pattern of acceptability rates for the preferred form of relativiser (*that*, *who*) was similar among the three groups: all preferred *who* over *that* in grammatical RCs, with little difference in acceptability observed between *that* and *who* in resumptive RCs; *(d)* L2 resumption acceptability was negatively correlated with L2 proficiency and immersion, with little effect of WMC.

Several studies on the processing of resumptive RCs have shown that L2 readers are more likely than native readers to accept resumption in English RCs. However, as resumption acceptability is closely related to cognitive resource limitations, results from these studies do not provide unequivocal evidence as to the difficulty in acquisition of the underlying uninterpretable morphosyntactic features. To eliminate this potential confounding factor, we explored the learnability of two sets of uninterpretable features, namely those that drive resumption (TP agreement features) and those that lead to wh-operator movement (EPP and wh). According to the Interpretability Hypothesis, both the pre-emption of an L1-based resumptive strategy and the acquisition of wh-movement in L2 English pose learnability issues to L2 English readers (Tsimpli & Dimitrakopoulou, 2007) who do not have the same morphosyntactic phenomena in their L1. Therefore, under the Interpretability Hypothesis, the Persian readers should have different acceptability patterns compared to the native English and French groups, such that the Persian readers should not only be more tolerant of resumptive RCs but also show non-target-like behaviour with respect to the choice of relativiser.

Comparing different groups' acceptability rates on resumptive RCs and the preferred form of the relativiser, we found that L1-Persian readers were more likely than L1-French and L1-English readers to adopt a resumption strategy in English RCs, potentially reflecting the morphosyntactic properties of their native language. This was the pattern observed for DO and OP RCs, which (may) syntactically require a resumptive pronoun in the equivalent Persian structures. Thus, one hypothesis might be that L1-Persian readers transfer their L1-based resumption strategy along with the corresponding uninterpretable features into L2-English RCs. However, other evidence collected in this study does not support this conclusion. DO and OP RCs are more complex than SU RCs (Keenan & Comrie, 1977), and while it might seem plausible to assume an L1-based transfer account, it is equally likely that the L1 Persian readers in this study resorted to a resumptive strategy to counter processing limitations in DO and OP

RCs. The L1-Persian readers in this study had lower proficiency scores than the L1-French and L1-English readers, and as such, it is not all that surprising that the rate of resumption acceptability was higher among L1-Persians. Similar explanations have been proposed with respect to the acceptability of resumptive pronouns in L1-English grammars (Hofmeister & Norcliffe, 2013), and given the hypothesis that L2 readers are more susceptible to cognitive resource limitations than monolingual readers (Hopp, 2014), L2 readers should be more likely to adopt a resumption strategy in DO and OP RCs. In fact, resumption acceptability in this study was negatively correlated with WMC for the L1-English readers, thus supporting the hypothesis that resumption helps facilitate processing limitations. This argument is bolstered by the observation that the acceptability of resumption RCs in L2 English was negatively associated with proficiency and immersion experience, and those L2 English readers that were highly proficient and lived for relatively long periods in an L2 environment were less likely to accept resumptives in L2 English RCs.

However, unlike the L1-English readers, the L2 readers in this study did not display a relationship between WMC and resumption acceptability. This might seem surprising under the hypothesis that L2 readers are more susceptible to cognitive resource limitations than monolingual readers (Hopp, 2014). We argue that a closer look at the L2 data might help explain the results. In this study, only the highly advanced L2 readers were required to complete the reading span task, and thus the lack of a statistically significant interaction between resumption acceptability and WMC cannot be generalised to all L2 readers and should be interpreted with caution. In fact, after trimming the WMC data to exclude participants with response accuracy below 70% (Conway et al., 2005), there remained only 14 L1-Persian readers, in contrast to 32 L1-French and 31 L1-English readers. While the analysis of the L1-Persian data still showed a (non-significant) negative relationship between resumption acceptability and WMC ($\beta = .12$, $t_{(506)} = 1.04$, $p = .26$), the high WMC individuals were less

likely to accept resumptive RCs in L2 English. It might well be the case that the sample size was too small to reach statistical significance. It should also be pointed out that the GJT in this study was untimed and allowed the L2 readers sufficient time to make their grammaticality judgments. This might have helped the L2 readers overcome real-time processing limitations, given that WM effects are more likely to appear under time constraints that require increased cognitive control (Hopp, 2014). Clearly, more research is required to investigate the relationship between WMC and resumption in L2 readers.

The results of this study are not compatible with the Interpretability Hypothesis that questions L2 readers' ability to successfully acquire movement operations, since the L2 readers showed a similar pattern of results with respect to the acceptability of different relativiser forms. Under the Interpretability Hypothesis, uninterpretable morphosyntactic features remain inaccessible and pose learnability issues in L2 acquisition, thus the impossibility of target-like performance in both resumption (motivated by agreement features) and preference for the relativiser form (motivated by EPP and wh features). Given that little difference was observed among the three groups in acceptability between *that* and *who* RCs, it seems reasonable to argue that the L2 readers of both L1-French and L1-Persian backgrounds have access to uninterpretable features in the L2 acquisition of English RCs and were capable of successfully acquiring the respective morphosyntactic phenomena.

It is noteworthy, however, that an argument can be made that all of the GJT materials in this study involved RCs with human referents, which might confound the interpretation of the observed native-like acceptability rates for the L2 speakers. In fact, in Tsimpli and Dimitrakopoulou's (2007) study, animacy of pronoun had a significant effect. Advanced learners behaved native-like by rejecting resumptive [+animate] resumptive pronouns but were more tolerant in the case of [–animate] *it,* showing a strategy of conforming with the target language input in the case of semantically 'heavy' material which they rejected and allowing

the less specified pronoun to appear in dependencies. It could be argued that the L1 Persian speakers have received positive evidence in the L2 environment that *who*-relatives are more frequent and semantically heavier than *that*-relatives for human referents, and managed to achieve native-likeness by resorting to the interpretable feature of [+/- human], not necessarily acquiring the uninterpretable [EPP, wh] features. We suggest that while this proposal can successfully explain the higher acceptability rates of *who* than *that* in grammatical gapped RCs, it falls short of adequately explaining the pattern of results observed in ungrammatical resumptive RCs. Resumption in Persian always appears with an invariant complementiser and if L1 Persian speakers were operating based on their L1 uninterpretable features, *that* resumption RCs should have been favoured compared to *who* resumption RCs. However, similar to English and French speakers, L1 Persian speakers did not display a preference for either *that* or *who* in resumptive RCs, which remains unexplained under the Interpretability Hypothesis.

In addition, since resumption is optional in Persian RCs, it might be argued that the native-like acceptability pattern observed in DO and OP RCs by the Persian readers does not necessarily suggest that they have learned the relevant morphosyntactic properties of relativisation. In fact, given that resumption is optional in Persian DO RCs, it is possible that the Persian readers perceive the empty element at the foot of the dependency as a null resumptive rather than a variable. However, we argue that while it is true that the Persian readers might have treated gaps in DO RCs as null resumptives, this explanation falls short of accounting for the target-like acceptability pattern observed in OP RCs, which unlike DO RCs, require a resumptive pronoun to be grammatical in Persian. That is, contrary to DO RCs in Persian where resumption is optional, a gap strategy is ungrammatical in Persian OP RCs, and if Persian readers relied on their L1, they should have been more tolerant of resumptive pronouns in OP rather than DO RCs. This is not supported by the data, however, and the acceptability rates of resumptive RCs

were very similar in resumptive DO (Mean = .26; SD = .40) and OP RCs (Mean = .28; SD = .40). Nevertheless, we agree that other structures such as those violating islands might provide more direct evidence on whether the Persian learners have acquired movement (e.g., see Hawkins & Chan, 1997), and therefore the findings need to be interpreted with caution, especially as far as wh-movement is concerned.

Overall, the results suggest that the L1-French speakers in this study have successfully acquired the wh-movement and the [- resumption] property of L2 English RCs. The L1-French speakers seemed to face little difficulty pre-empting the increased syntactic complexity of French RCs which restricts the distribution of relativisers. They seem to have acquired the [+wh] feature in SU and DO RCs, which allows English SU and DO RCs to begin with an overt wh-operator, unlike the case of relativisers in L1 French which allows only an invariant complementiser in SU and DO RCs. As for Persian speakers, the data seem to suggest that they do not face considerable difficulty with an overt wh-pronoun as the relativiser, and this is unlikely to be base generated. Thus, it seems reasonable to argue that the Persian readers have acquired both the wh-operator movement and the syntactic ban on resumptive pronouns in L2 English RCs, although this should be interpreted with caution. If it were the case that they were operating on L1-Persian uninterpretable features, they should have displayed higher acceptability rates for *that* RCs than for *who* RCs, since Persian does not allow wh-morphemes to function as relativisers. However, the results showed that not only did the L1-Persian speakers predominantly favour a gap over a resumptive strategy, they also showed a differential pattern of preference in grammatical RCs for the form of relativiser, displaying significantly higher acceptability rates for *who ... gap* RCs than *that ... gap* RCs, similar to native speakers. L1-Persian L2-English speakers' occasional reliance on a resumptive strategy does not seem to be a syntactic issue but is potentially motivated by processing limitations, as per the observation that resumption acceptability interacted with proficiency and immersion experience. As L2

speakers become more proficient in L2, they forgo of resumption and approximate native-like grammars.

3.7. Conclusion

The results of this study lend support to the Full Access Hypothesis, according to which, L2 grammars have unconditioned access to the full inventory of the morphosyntactic features of the language faculty but may occasionally display L1-based residual effects in syntactically complex environments. Both the L1-French and L1-Persian readers in this study behaved similar to the native English readers by overwhelmingly preferring gaps to resumptives in English RCs and showing little evidence for an L1-based transfer of the distribution of relativisers. However, whereas it was only sufficient for the L1-French readers to transfer their L1-based ban on resumptive RCs to L2 English, the residual impact of the [+resumption] property of L1 Persian led to higher acceptability of similar structures in L2 English RCs. This is not necessarily an indication of potential syntactic deficits but rather is observed in DO and OP RCs which are more syntactically complex than SU RCs. While more research is required to investigate the potential interrelationship in L2 acquisition between L1 transfer and universal cognitive resource limitations, the results of this study seem to suggest little evidence that L2 grammars are necessarily defective and thus do not support the Interpretability Hypothesis. Rather, we find that given sufficiently high proficiency levels and linguistic exposure, L2 grammars can potentially match L1 grammars in terms of the complexity of the underlying linguistic system. We argue that L1-L2 performance differences can be countered by increased proficiency and linguistic experience.

Chapter 4: Is L2 parsing qualitatively different from native parsing at advanced levels of proficiency? Evidence from relative clause disambiguation

Abstract

There is increased interest in the way native and second language (L2) readers parse structural ambiguities, yet there is little agreement on the source of L1-L2 parsing differences. Specifically, relative clause (RC) ambiguities have been studied extensively in the L2 processing literature, yet no consensus exists on the degree to which L2 processing is impacted by contextual information. This study contributes to the debate by investigating the impact of context on L2 RC disambiguation, taking into account the potential role of L1, proficiency, and working memory capacity in parsing preferences. We report the results from two self-paced reading tasks, where context was operationalised in terms of preceding sentences that biased parsing preferences. The participants included 31 L1-French and 36 L1-Persian readers who were highly advanced in L2 English, in addition to 32 English native controls. The results showed that the effect of context on L2 parsing was a function of both L1 and proficiency. Despite L1 effects and reliance on context at lower proficiency levels, more proficient L2 readers patterned like native reader controls and did not show context effects on their disambiguation preferences. The results suggest that L1-L2 parsing differences disappear at a highly advanced proficiency level.

4.1. Introduction

There is increased interest in the way native and L2 readers resolve structural ambiguities in real-time, and it is generally assumed that investigating L2 disambiguation can provide insight into the processes underlying parsing preferences. Specifically, sentences containing relative clause (RC) ambiguities such as *(1)* have featured prominently in the native and L2 processing literature (e.g., Clahsen & Felser, 2006; Goad et al., 2021; Hopp, 2014). In *(1)*, the relative clause (RC) *who was on the balcony* has two potential host sites for its attachment. Preference for attaching the RC to a higher noun in the complex DP, *the servant*, is referred to as DP1 attachment or disambiguation towards DP1, and preference for attaching it to the lower DP in the syntactic tree, *the actress*, is referred to as DP2 attachment or disambiguation towards DP2. Previous research shows that attachment preferences are subject to cross-linguistic parametric differences (Papadopoulou, 2006), and while English natives have a preference for DP2 attachment (Frazier & Clifton, 1996; Gilboy et al., 1995), French (Dekydtspotter et al., 2008) and Persian (Marefat et al., 2015) readers prefer to attach the ambiguous RC to DP1.

1) *Someone shot the servant* $_{DP1}$ *of the actress* $_{DP2}$ [$_{RC}$ *who was on the balcony*]

Some studies suggest that L2 readers do not have a strong attachment preference while reading RC ambiguities in L2 and do not strongly attach the RC to either DP1 or DP2 (Clahsen & Felser, 2006, 2018), unlike native readers. These studies maintain that L2 readers face consistent difficulty interpreting ambiguous RCs in a native-like manner and instead over-rely on non-syntactic information such as discourse-level cues to interpret RC ambiguities (Pan et al., 2015), contrary to native readers who strongly prefer to attach ambiguous RCs to either DP1 or DP2. By contrast, other studies argue that since L2 readers are processing a non-native language when reading ambiguous RCs in an L2, they are likely to operate on L1 parsing preferences in order to ease processing limitations. These studies suggest that with increased

proficiency, L2 readers progress from a lack of strong attachment preferences (neither DP1 nor DP2 attachment) to attachment preferences found in their L1 (Fernández, 1999; Frenck-Mestre, 1997) and ultimately to native-like interpretations of ambiguous RCs (Frenck-Mestre; Hopp, 2014). According to this line of theorising, given sufficient proficiency, L2 readers overcome the challenge of parsing a non-native language and match native readers in RC attachment preferences.

Focusing on highly advanced L1-French and L1-Persian readers of L2 English, this study contributes to the debate by investigating the impact of discourse level contextual information on L2 RC disambiguation, taking into account the potential role of L1, proficiency, and cognitive resource limitations in working memory capacity (WMC).

4.2. Native processing of RC ambiguities and context effects

According to the Garden-path model (Frazier, 1978), readers have a universal tendency to attach the RC *who was on the balcony* in *(1)* to the second determiner phrase (DP2) *the actress* rather than to the first DP (DP1) *the servant* (Frazier, 1978). This follows from a universal parsing principle to attach the incoming linguistic load to the phrase currently being processed (Frazier, 1978; Gibson et al., 1996). In line with this principle, several studies have reported shorter reaction times (RTs) in English for RCs that are disambiguated towards DP2 than those disambiguated towards DP1 (Cuetos & Mitchell, 1988; Frazier & Clifton, 1996). However, the universality of DP2 attachment has been called into question with studies that show a DP1 preference in other languages such as French (Dekydtspotter et al., 2008) and Persian (Marefat et al., 2015). If DP2 attachment follows from a universal parsing principle, the observation that French and Persian readers, for example, favour DP1 attachment remains unexplained (Cuetos & Mitchell, 1988). Furthermore, some studies suggest that RC attachment preferences are generally very mild (Gilboy et al., 1995), and even English natives might display variable attachment preferences, i.e., sometimes DP1 and other times DP2, depending on a variety of

factors such as the RC length (Carreiras & Clifton, 1993; Swets et al., 2007) or individual differences in the size of cognitive resources (e.g., as measured by WMC; Kim & Christianson, 2017). In fact, according to Frazier and Clifton (1996), RCs are processed in non-deterministic ways, and ambiguous RCs are never strongly attached to either DP1 or DP2.

To explain attachment preferences in languages other than English, the literature is replete with theories that have suggested the application of another parsing principle that competes with a universal DP2 attachment strategy but favours DP1 attachment (Cuetos & Mitchell, 1988; Gibson et al., 1996; Hemforth et al., 2000). For example, according to Gibson et al. (1996), RC attachment preferences are determined by two syntactically motivated principles. The first is a recency principle that favours DP2 attachment and is motivated by WM considerations, similarly to the universal DP2 attachment strategy in the Garden path model (Frazier, 1978) that strives to ease processing limitations. On the other hand, according to Predicate Proximity, ambiguous RCs are preferably attached as close as possible to the head of the predicate phrase, i.e., the verb, under the assumption that the head of the predicate phrase and its arguments are important in sentence comprehension. Predicate Proximity favours attachment to DP1 in English as it is an internal argument of the verb. According to Gibson et al. (1996), the relative weightings of the two opposing principles are determined by the degree of configurationality of the language under consideration (Gibson et al., 1996, p. 50). In languages such as French and Persian that allow non-complement morphemes such as adverbs and negators to appear to the left of the head of the predicate phrase (White, 2003, p. 29), predicate proximity is stronger, since the verb's arguments are highly activated and can attract new elements, hence raising the possibility of attachment to the verb's internal argument (i.e., DP1). By contrast, in languages with a relatively rigid word order such as English where verbal arguments appear to the right of the head of the predicate phrase, predicate proximity is not strongly activated, and new elements are more likely to be attached to non-complement arguments (i.e., DP2).

Even though Predicate Proximity suggests an additional parsing principle not explicated in the Garden Path model, the two parsing models both assume that RC disambiguation is determined by syntactically motivated principles and non-syntactic information has little impact on parsing preferences. Not all processing theories agree that parsing follows necessarily from syntactic principles, however. According to constraint-satisfaction theories, all types of information including contextual biases constrain the interpretation of ambiguous structures at the same time (e.g., MacDonald & Christiansen, 2002), and the presence of a DP1-supporting context facilitates a DP1-attached interpretation, while the presence of a DP2-supporting context facilitates a DP2-attached interpretation (Papadopoulou & Clahsen, 2006). According to the Referential Hypothesis (Crain & Steedman, 1985), attachment preferences are likely to be impacted by preceding discourse context that biases readers towards a contrastive focus interpretation, i.e., one in which the reader is focused on the distinction between the potential referents for the two DPs. Specifically, according to the Referential Hypothesis (Crain & Steedman, 1985), ambiguous RCs with contexts that introduce more than one referent for DP1 are attached to DP1, whereas those with contexts introducing more than one referent for DP2 are attached to DP2 (Papadopoulou & Clahsen, 2006; although, see Zagar et al., 1997).

In summary, there is conflicting evidence whether strong attachment preferences exist, and no agreement has been reached on the role of contextual information on parsing preferences. However, given that previous studies have suggested that RC attachment preferences are subject to cross-linguistic parametric differences (Papadopoulou, 2006), it seems reasonable to ask whether the impact of context on attachment preferences is also moderated by a language's general syntactic structure. One interesting class of languages to explore the impact of preceding discourse context that biases readers towards a contrastive focus interpretation is scrambling languages such as Persian. Karimi (2005) argues that the phrase structure of Persian is different from that of non-scrambling languages, and it involves an additional Focus Phrase

node where extracted elements move into in order to receive a contrastive focus interpretation. That is, unlike non-scrambling languages such as English and French where RCs occur under the node Complementiser Phrase (Rowlett, 2007), RCs in Persian may move to a higher position that accommodates elements brought to focus by the previous context. Given that Persian involves syntactic constituency relations that are impacted by discourse-level cues, it is reasonable to ask whether Persian readers are more sensitive to the impact of previous context on parsing preferences. However, no studies to date have examined whether Persian readers show increased susceptibility to discourse-level cues when interpreting RC ambiguities.

Overall, unlike English readers that may favour DP2 attachment, French and Persian readers are likely to prefer DP1 attachment while processing RC ambiguities, yet since Persian is a scrambling language that syntactically accommodates focused elements, Persian readers may be more likely than English and French readers to integrate contextual information in their parsing preferences (Table 16).

Table 16

English, French, and Persian compared with respect to attachment preferences and possibility of scrambling

Language	Attachment	Scrambling
English	DP2	No
French	DP1	No
Persian	DP1	Yes

1.5. L2 Processing of RC ambiguities and context effects

RC ambiguities have been studied extensively in the L2 processing literature. Some previous studies have failed to find a strong attachment strategy in L2, even when the readers of both

L1 and L2 have been reported to have similar attachment preferences. These studies did not show a strong attachment preference and argued that L2 readers favour null attachment (Felser et al., 2003; Papadopoulou & Clahsen, 2003), which culminated in the Shallow Structure Hypothesis (SSH; Clahsen & Felser, 2006, 2018; Felser, 2019) that argues that L2 parsing is syntactically shallower than native parsing. In other words, what the SSH suggests is that L2 readers (over)rely on non-syntactic information such as contextual information to interpret RC ambiguities (Pan et al., 2015), and the observation that L2 readers do not show a strong attachment preference can be construed as evidence that unlike native readers, L2 readers fail to establish a syntactic agreement relationship in *(1)*, repeated below as *(2)*, between the RC antecedent (either DP1 or DP2) and the RC verb (*was*).

2) *Someone shot the servant* $_{DP1}$ *of the actress* $_{DP2}$ [$_{RC}$ *who* ***was*** *on the balcony*]

For example, Pan et al. (2015) investigated in a self-paced reading (SPR) task L2 English RC attachment preference in short paragraphs by intermediate-to-advanced L1-German (DP1 language) and L1-Chinese (DP2 language) readers of L2-English. Half of their experimental sentences had context conditions that involved more than one referent for DP1 (DP1-supporting context), and the other half had context conditions that introduced more than one referent for DP2 (DP2-supporting context). According to Pan et al., (2015), their results showed that contextual manipulations influenced RTs for the L2 group only, and unlike native readers, both L2 groups favoured DP1-attachment in a DP1-supporting context and DP2 attachment in a DP2-supporting context. Pan et al. (2015) concluded that L2 readers are more likely to recruit contextual information in RC disambiguation, in contrast to native readers, supporting the SSH. However, Pan et al.'s (2015) study design and interpretations are not without limitations. First, Pan et al. did not directly investigate attachment preferences in decontextualised RC ambiguities. Therefore, it is not all that clear how the addition of contextual information might

have influenced baseline attachment. Second, an argument can be made that the L2 participants were not advanced enough to display native-like parsing preferences. Some studies have suggested that only very highly advanced L2 participants might be capable of displaying native-like RC ambiguity resolution strategies due to the additional processing load in L2 (Frenck-Mestre, 2002; Hopp, 2006). Third, Pan et al. (2015) reported that the native English group had an overall null attachment preference, which is inconsistent with the SSH's claim that native readers have a robust attachment preference (either DP1 or DP2) regardless of context. Finally, it could be argued that the findings of Pan et al.' (2015) study are not easily generalisable to other L2 readers, since they did not investigate the way individual differences might affect L2 disambiguation (Kim & Christianson, 2017).

In contrast to the SSH, capacity approaches to L2 processing suggest that null attachment in RC disambiguation is not a generic feature of L2 parsing (Fernández, 1999; Frenck-Mestre, 2002) but is also observed in native parsing of RC ambiguities (Carreiras & Clifton, 1993; Swets et al., 2007). Capacity approaches argue that while L2 readers of low proficiency levels might fail to form a dependency relationship between the RC verb and the RC antecedent and therefore display null attachment, the lack of strong attachment at high proficiency levels does not necessarily indicate qualitatively different parsing in L2. Similar to native readers, highly proficient L2 readers might display variable attachment preferences, sometimes attaching the RC to DP1 and other times to DP2 (Cunnings, 2017), thus resulting in an overall null effect. In fact, there is evidence that with increased proficiency, L2 readers progress from null attachment to disambiguation preferences resembling the processing of similar structures in their L1 (Frenck-Mestre, 1997), and given even higher proficiency, L2 readers converge on native-like interpretations of RC ambiguities (Fernández, 1999; Frenck-Mestre, 2002; Hopp, 2006).

For example, Fernández (1999) administered a pencil-and-paper test to examine whether RC attachment in L2 processing is different from that in native processing. The participants

included two groups of L1-Spanish (DP1 language) L2-English (DP2 language) individuals: *(a)* those exposed to L2-English before the age of 10 (early learners), and *(b)* those exposed to L2-English after the age of 10 (late learners). According to Fernández (1999), late learners preferred attachment to DP1, mirroring attachment preferences in their L1. By contrast, early learners displayed variable parsing preferences, some favouring attachment to DP1 and others to DP2 (Fernández, 1999).

Similarly, Frenck-Mestre (1997) recorded eye-movements while native English (DP2 language) and L1-Spanish (DP1 language) learners of L2 French (DP1 language) read French RC ambiguities. According to Frenck-Mestre (1997), all participants were low-proficiency learners of L2 French (average self-ratings of overall proficiency at a level of 5 out of 10), and the results suggested that both Spanish and French readers preferred DP1 attachment, whereas English readers favoured DP2 attachment. According to Frenck-Mestre (1997), the readers transferred RC attachment preferences from their L1, Spanish readers favouring DP1 attachment and English readers DP2 attachment. In a later study, however, Frenck-Mestre (2002) examined RC disambiguation in L2-French by highly proficient native English readers (self-ratings of overall proficiency at a level of 7 or better out of 10) that enjoyed an average of 3 years immersion. According to Frenck-Mestre (2002), the results suggested a DP1 attachment preference, the same pattern found in the native French group. Frenck-Mestre (2002) concluded that L2 readers initially transfer their native processing preferences while reading RC ambiguities in L2, yet given sufficiently high proficiency, they converge on native-like parsing preferences.

Besides the influence of L1, capacity approaches to L2 processing argue that L2 readers are additionally subjected to capacity-based cognitive resource limitations in terms of the amount of information that WM can process in an L2 (Just & Carpenter, 1992). Working memory is a multi-component cognitive system responsible for the temporary storage and processing of

information (Baddeley et al., 2009). However, despite the agreement among capacity approaches to L2 processing that RC disambiguation in L2 is impacted by cognitive resource limitations, little consensus exists on the precise role of WMC in RC attachment preferences. Some studies suggest that only high WM L2 readers can match native readers in terms of RC attachment preferences (Dussias & Piñar, 2010), while others argue that high WMC is associated with null attachment (MacDonald et al., 1992). According to the Capacity Constrained Parsing Model (MacDonald et al., 1992), high WM individuals maintain multiple syntactic representations in their memory, and as such they are likely to entertain both DP1 and DP2 attachment interpretations. On the other hand, Traxler (2007) argues that high WMC is associated with DP1 attachment, since attachment to a linearly closer antecedent (i.e., DP2) is less costly and low WM readers attach to DP2 to minimise the chances of exceeding WM limits (see Swets et al, 2007, for a different view). Overall, there is little consensus on the way in which WMC restricts parsing preferences. Specifically, the potential role that WMC plays in L2 RC disambiguation is relatively unexplored (Hopp, 2014; Kim & Christianson, 2017).

To summarise, capacity models of L2 processing argue that the tendency to underuse syntactic information in L2 RC disambiguation is not a generic feature of L2 processing, and given high proficiency and WMC, L2 readers may display native-like RC parsing preferences. By contrast, the SSH predicts few L1 effects and argues that L2 readers are less sensitive to syntactic information, tending to rely on non-syntactic biases to interpret RC ambiguities.

4.3. The Present Study

The present study investigates the role of contextual information in online native and L2 RC attachment preferences and examines whether potential L1-L2 parsing differences can be attributable to L1 effects and individual differences in proficiency and WMC. This study has a similar design to Pan et al.'s (2015) to achieve a high degree of backward comparability.

However, a number of adjustments were made to the study design in order to address the research questions posed in this study.

First, we initially administered a grammaticality judgment task (GJT) and a proficiency c-test to discard data from those L2 participants who did not perform within the native reader range and to include L2 proficiency as an independent variable in the statistical analyses. Second, we tested two groups of advanced L2 readers of English with either French or Persian as their L1 to help explore the potential impact of L1 on L2 parsing. Finally, we administered a reading span task to investigate the impact of individual differences in WMC on RC disambiguation and employed two separate SPR tasks to investigate the same participants' parsing preferences in both isolated and contextualised RCs. Overall, the research questions motivating this study were:

(1) Do L1-French and L1-Persian readers display null attachment preferences in L2 English (neither DP1 nor DP2) in isolated RC ambiguities (as suggested by the SSH) or transfer a DP1-attachment preference from their L1 (as suggested by capacity approaches to L2 parsing)?

(2) Are there any differences among L1-English, L1-French, and L1-Persian readers in the way contextual manipulations impact English RC disambiguation preferences, and if so, can these differences be attributed to potential L1 effects?

(3) Do individual differences in L2 proficiency and WMC significantly impact RC disambiguation in isolated and contextualised ambiguous RCs in L2 English?

4.3.1. Method

4.3.1.1. Participants

Data for this study were collected online from two groups of L2 readers of English: 31 L1-French (mean age = 33, range = 19 - 39) and 36 L1-Persian readers (mean age = 33, range =

18 - 50). In addition, 32 native English readers served as the control group (mean age = 35, range = 20 - 51). All the L1-French, L1-English, and 11 L1-Persian participants were recruited through Prolific (www.prolific.co). The remaining L1-Persian readers were recruited through advertisements on social media. All the participants were paid for their participation, reported to have normal or corrected-to-normal vision, and were naive with respect to the purpose of the experiment. In addition, all participants reported to be living in an English-speaking country at the time of the experiment.

4.3.1.2. Pre-tasks

a. Background information: **Questionnaire.** All participants were required to complete a language history questionnaire to provide information about their experience in learning English. The questionnaire was composed of items on participants' native language, number of years living in an English-speaking country, and number of other languages known.

b. Proficiency: C-test. To examine the impact of L2 proficiency in English, all participants completed a c-test (Keijzer, 2007), where they were required to complete 5 mutilated passages (Cronbach's alpha = .91). All the L2 readers were at an advanced proficiency level, defined as those whose proficiency scores were within 2.5 standard deviations of the native readers' mean scores. Overall, there were significant differences in scores between groups ($F(2, 81) = 9.46$, $p < .001$). Both L2 groups scored lower than the English group (French mean = 7.49, SD = .63; Persian mean = 7.09, SD =.57; English mean = 7.75, SD = .59), although this difference was only significant in the Persian group ($\beta = .66$, $t(81) = 4.29$, $p < .001$, $d = 1.11$). No reliable difference was observed between native English and L1-French readers ($t(81) = 1.55$, $p = .13$). Additionally, the L1-French readers scored higher than the L1-Persian readers ($\beta = .40$, $t(81) = 2.53$, $p = .04$, $d = .68$).

c. Working memory capacity: Reading span task. Following the procedure described in Conway et al. (2005), the participants were required to complete a reading span task (Daneman

& Carpenter, 1980) to yield a measure of their WMC. Whereas all the L1-French and L1-English participants completed the reading span task, only 23 L1-Persian readers completed this task due to drop-out (Cronbach's alpha = .90). There was no reliable difference in WMC among the three L1 groups ($F(2, 81) = 1.56$, $p = .22$). Table 17 provides a summary of the participants' biographical data, proficiency, and WM scores.

Table 17

Participants' biographical information, c-test scores, and WMC

	AoA[a]		Immersion[b]		Proficiency[c]		WMC[d]	
Groups	*M*	*Range*	*M*	*Range*	*M*	*Range*	*M*	*Range*
L1-English N = 31	--	--	--	--	7.75	6.09 – 8.39	.84	.20 – 1.00
L1-French N = 32	22.90	16 – 29	88.40	19 - 221	7.49	5.96 - 8.44	.84	.47 – 1.00
L1-Persian N = 36	28.80	16 – 41	53.00	2 - 524	7.09	5.46 – 8.31	.76	.35 - .97

[a] age of arrival to an English-speaking country (in years)

[b] months lived in an English-speaking country

[c] possible range: 0 – 10

[d] possible range: 0 – 1

d. Knowledge of subject-verb agreement for disambiguation: grammaticality judgment task.

An untimed grammaticality judgment task (GJT) was administered to explore the grammatical acceptability of structures similar to those used in the SPR tasks for disambiguation. This was to ensure that the L2 readers in this study had sufficient knowledge of the syntactic feature used for RC disambiguation, i.e., subject-verb agreement. The experimental items included 12

sentences containing a complex DP (DP1-of-DP2), where either DP1 or DP2 agreed in number with the copula *was* or *were.* An example is provided below (for a full list, see Appendix B).

3) *The pupils of the teacher were unhappy with the test results.*

In addition to the critical items, 44 filler items were included. Half of the sentences were grammatical and the other half ungrammatical due to a subject-verb agreement error. The participants were required to judge the sentences as either grammatical or ungrammatical and make the necessary corrections if they judged a sentence to be ungrammatical. A reliable difference was observed among the three groups in judgments on subject-verb agreement ($F(2, 82) = 5.54$, $p = .004$), indicating that the L1-Persian readers were less sensitive to subject-verb agreement violations than the English controls ($\beta = .14$, $t(82) = 3.32$, $p = .04$, $d = .41$). No reliable difference was found between the English and French readers ($t(82) = 1.49$, $p = .30$), nor between French and Persian readers ($t(82) = 1.69$, $p = .22$). Data from those participants whose mean judgment scores were outside the range of 2.5 standard deviations of the native readers' judgment scores were excluded from further analysis.

4.3.1.3. Instruments

a. SPR 1: baseline attachment preferences

The first SPR task investigated baseline attachment preferences in decontextualised RC ambiguities. The materials appeared in 12 experimental items and 46 fillers. The experimental items, taken from Felser et al. (2003), were temporarily ambiguous at the relative pronoun *who*. DP number agreement was manipulated such that either DP1 or DP2 appeared in singular and the other one in plural, resulting in two experimental conditions (see examples 4 & 5 below), with attachment (DP1, DP2) as the within-subjects factor.

The experimental items and fillers were distributed across two lists in a Latin square design. Each list contained 6 sentences for each condition ($2 * 6 = 12$) and no list contained more than

one item from each condition. The items in each list were interspersed with the fillers and pseudorandomised. All the experimental items and 36 fillers were followed by a comprehension question to ensure that the participants were attentive to the task. The comprehension questions did not directly probe the RC antecedent so as not to draw attention to the structural ambiguity. Each sentence was segmented into 6 presentation regions in a non-cumulative moving window technique. If the participants preferred one attachment condition to another, it was expected that they should have relatively faster RTs in the disambiguating region 4 and the spill-over region 5. An example is provided below (subscripts indicate region numbers; for a full list, see Appendix C):

4) DP1-attachment

   /$_1$ *The customer spoke to* /$_2$ *the* <u>*assistants*</u> *of the pharmacist* /$_3$ *who* /$_4$ <u>*were*</u> /$_5$ *preparing the medicine* /$_6$ *and looking happy.*

5) DP2-attachment

   /$_1$ *The customer spoke to* /$_2$ *the assistants of the* <u>*pharmacist*</u> /$_3$ *who* /$_4$ <u>*was*</u> /$_5$ *preparing the medicine* /$_6$ *and looking happy.*

Did the customer speak to the assistants? **Yes** / No

b. SPR 2: attachment preferences in context

The second SPR task examined whether the addition of contextual bias would impact attachment preferences. A 2 x 2 design was adopted, with context (DP1-supporting, DP2-supporting) and attachment (DP1, DP2) as within-subjects factors, yielding 4 experimental conditions. The DP1-supporting contexts introduced more than one referent for DP1, whereas the DP2-supporting contexts had more than one referent for DP2, resulting in an additional focus on DP1 in DP1-supporting contexts and on DP2 in DP2-supporting contexts (Crain &

Steedman, 1985). The experimental items contained 6 sentences per condition (4 * 6 = 24) and were interspersed with 43 fillers. Twenty of the experimental items were taken from Pan et al. (2015) and 4 were adapted from Papadopoulou and Clahsen (2006). The context prior to the ambiguous sentence in the items from Papadopoulou and Clahsen (2006) were reduced in length to increase comparability with the other items from Pan et al. (2015). The items were distributed across 4 lists in a Latin square design and pseudorandomised. All of the experimental items and half of the fillers were followed by comprehension questions (for a full list of materials, see the OSF link[6]). If context impacts RC disambiguation preferences, it was expected that RTs in the critical and spill-over regions 8 and 9 should be facilitated on DP1-attached conditions that appear in a DP1-supporting context and on DP2-attached conditions that appear in a DP2-supporting context. The following examples illustrates the conditions (for a full list, see Appendix D):

6) DP1-supporting context

   /$_1$ *An economist was researching an article on a big national newspaper.* /$_2$ *Some journalists in the newspaper's head office were having an argument with their editor.* /$_3$ *Some journalists were very diligent,* /$_4$ *but others were a bit lazy.* /$_5$ *The economist liked* /$_6$ *the journalists of the editor* /$_7$ *who* /$_8$ *(was) were* /$_9$ *thinking about the report.*

7) DP2-supporting context

   /$_1$ *An economist was researching an article on a big national newspaper.* /$_2$ *Some journalists in the newspaper's head office were having an argument with their editor.* /$_3$ *One of the editors was very diligent,* /$_4$ *but the other one was a bit lazy.* /$_5$ *The*

[6] https://osf.io/r6bz7/?view_only=41f386a7773440648b3ad6022719649d

economist liked /6 the journalists of the editor /7 who /8 (was) were /9 thinking about the report.

Was the economist working on an article? **Yes** / No

4.3.2. Procedure

Data were collected online using Qualtrics, (v. 2020), and Ibex Farm (Zehr & Schwarz, 2018). The different tasks were administered in two separate sessions, with approximately 5 days in between. Initially, all the participants were required to complete a language history questionnaire on Qualtrics, a proficiency c-test on Ibex, and a GJT on Qualtrics. Subsequently, the participants were invited to complete the first SPR, the reading span (Daneman & Carpenter, 1980), and the second SPR tasks, all of which were performed on Ibex Farm.

4.4. Results

Since the data were collected online, extra measures were taken to ensure data quality. First, data from those participants who scored below 2.5 standard deviations of the control group's mean GJT scores or whose average comprehension scores were below 75% were excluded. Second, outlier RTs were identified by excluding RTs per subject in the critical and spill-over regions that were either below or above 2.5 standard deviations of the average RTs of the corresponding condition. In total, 16.42% of the data in SPR 1 and 17.43% in SPR 2 were discarded due to these criteria. Data analysis was restricted to items whose comprehension questions were answered correctly.

Nested linear mixed effects models were constructed using the *lmerTest* package (Bates et al., 2015) in R (R Core Team, 2020). All models were fitted with the maximum random effects structure that converged (Barr et al., 2013). Since none of the models with random slopes converged successfully, the random effects structure of the models included random intercepts

of subjects and items, only (Vasishth et al., 2020). After constructing each model, the *anova* function was run with Type 3 Sums of Squares to explore the presence of main and interaction effects. Treatment contrasts were set to allow comparisons across different levels of the categorical variables, with DP1 attachment, DP1-supporting context, and L1-English as the reference levels for attachment, context, and native language. All analyses were conducted on length-adjusted RTs to account for differences in region length, defined as raw RTs divided by the number of characters in each region. The c-test proficiency and reading span scores were standardised, and the RT data were log transformed to reduce skewness and minimise potential outlier effects. Effect size estimates of *Cohen's d* were calculated using R's *effectsize* package (Ben-Shachar et al., 2020; all data and analyses in R can be found here. Figure 3 illustrates the mean and confidence intervals of log transformed length-adjusted RTs per region and condition for the first and second SPR tasks, respectively.

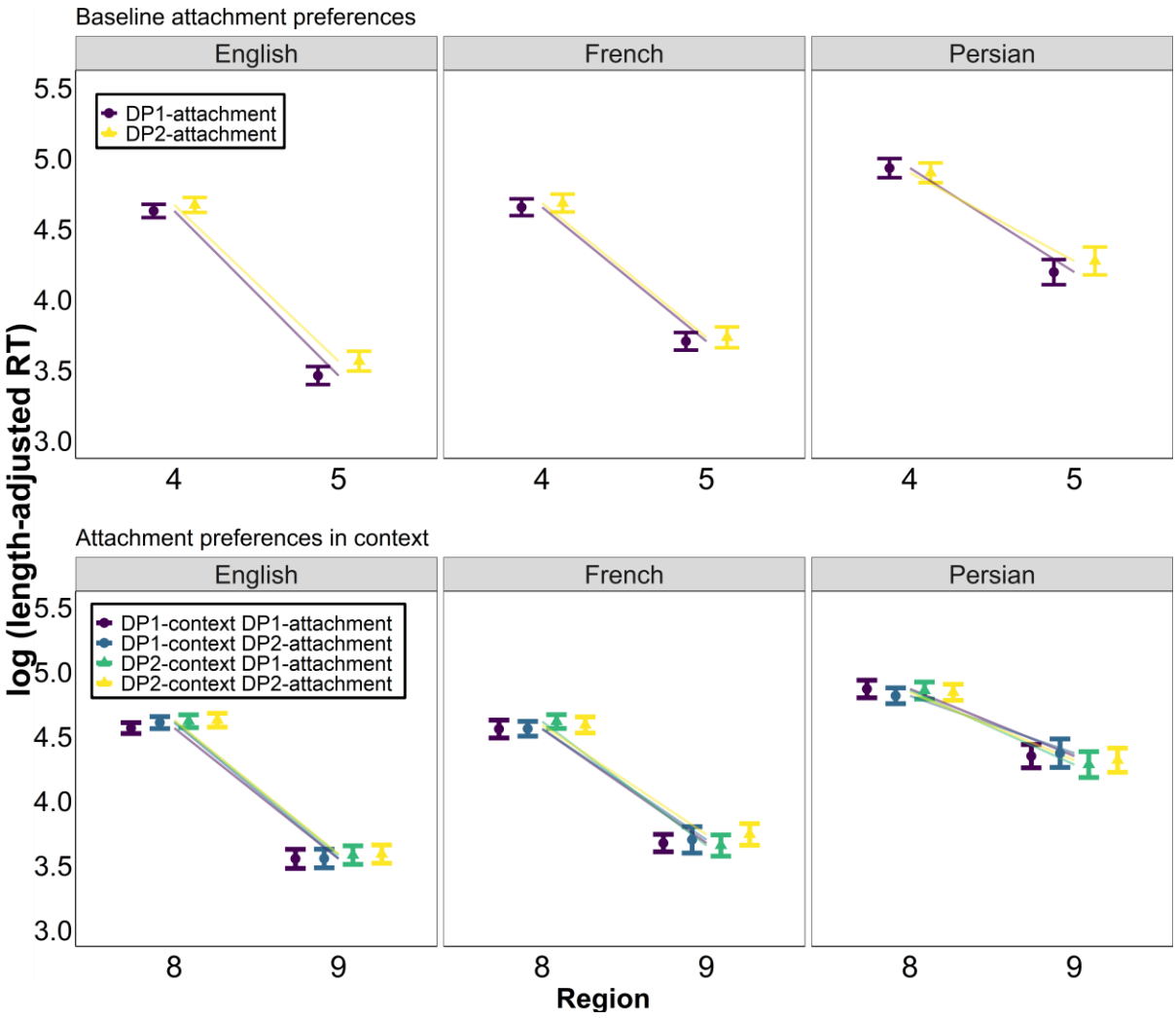

Figure 3. Log transformed length-adjusted RTs and confidence intervals in SPR 1 (top) and SPR 2 (bottom) based on region number and condition.

4.4.1. Baseline attachment preferences

A sequence of between-groups comparisons was made to assess the hypothesis that a reliable difference exists among the three groups in terms of baseline attachment preferences. Two models were constructed on the disambiguation regions 4 and its spill-over region 5, respectively. The fixed effects were L1 (English, French, Persian), attachment (DP1, DP2) and their interaction. The results showed a main effect of L1 in regions 4 ($F(2, 82) = 11.05$, $p < .001$), and 5 ($F(2, 82) = 32.17$, $p < .001$): Persian readers had longer RTs than the English (region 4: $\beta = .27$, $SE = .06$, $t(82) = 4.30$, $p < .001$, $d = .81$; region 5: $\beta = .73$, $SE = .08$, $t(82) =$

7.84, p < .001, d = 2.00) and French readers (region 4: β = .25, SE = .07, t(82) = 3.72, p < .001, d = .76; region 5: β = .52, SE = .10, t(82) = 5.23, p < .001, d = 1.43). No significant RT difference was found between the English and French readers in region 4 (t(82) =.30, p = .95) and 5 (t(82) =2.11, p = .09).

There was no significant main effect of attachment in the disambiguation region 4 (F(1, 924) = .45, p = .50), yet this was significant in the spill-over region 5 (F(1, 916) = 12.49, p < .001), and DP1-attached structures were read faster than DP2-attached structures (β = .08, SE = .02, t(916) = 3.53, p < .001, d = .23). Importantly, no significant interactions were observed between L1 and attachment (region 4: F(2, 920) = 1.43, p = .24; region 5: F(2, 915) =.57, p = .57), thus supporting the conclusion that the three groups did not have a different parsing preference and all favoured DP1 over DP2 attachment.

4.4.2. Ambiguity resolution in context

Following a similar procedure, two models were constructed on the disambiguation regions 8 and the spill-over region 9 to assess the hypothesis that the three groups patterned differently with respect to the effect of context. The fixed effects were L1 (English, French, Persian), attachment (DP1, DP2), context (DP1-supporting, DP2-supporting), and their interactions. The results showed a main effect of L1 (region 8: F(2, 81) = 14.30; region 9: F(2, 81) = 32.11, both ps < .001): Persian readers had significantly longer RTs than English (region 8: β = .24, SE = .05, t(81) = 4.39, p < .001, d =.72; region 9: β = .76, SE = .10, t(81) = 7.41, p < .001, d =1.77) and French readers (region 8: β = .27, SE = .06, t(81) = 4.66, p < .001, d =.79; region 9: β = .64, SE = .11, t(81) = 5.98, p < .001, d =1.48). No significant RT difference was found between English and French readers (region 8: t(81) =.40, p = .91; region 9: t(81) = 1.13, p = .50).

The main effect of context was marginally significant in the disambiguation region 8 (F(1, 1922) = 3.61, p = .06) and items with a DP1-supporting context were read faster than those with a DP2-supporting context (β = .03, SE = .015, t(1922) = 1.898, p = .058, d =.09), though

this was not significant in the spill-over region 9 (F(1, 1901) = .22, p = .64). Furthermore, the readers did not show an RT difference between DP1 and DP2 attachment conditions (region 8: F(1, 1900) = .22, p = .64; region 9: F(1, 1893) = 2.16, p = .14), which was the same in all groups (region 8: F(2, 1914) = 1.30, p = .27, region 9: F(2, 1897) = .46, p = .63). Similarly, no significant interactions were found between L1 and context (region 8: F(2, 1906) = .57, p = .56; region 9: F(2, 1895) = 2.20, p = .11) or between attachment and context (region 8: F(1, 1922) = .09, p = .76; region 9: F(1, 1900) = .23, p = .63). Crucially, there was no 3-way interaction among L1, attachment, and context (region 8: F(2, 1906) = .18, p = .64; region 9: F(2, 1895) = .26, p = .77), suggesting that context had a similar effect on all groups.

Therefore, it can be concluded that context had a similar effect on all three groups, namely that it lessened the overall bias towards DP1 attachment when RCs were presented in paragraphs (as opposed to isolated sentences). This might potentially reflect the additional processing burden associated with the parsing of extended paragraphs, standing in contrast with the results obtained in isolated ambiguities, where all groups showed a preference for DP1 attachment.

4.4.3. Individual differences

To explore the potential impact of individual differences in proficiency and WMC, separate models were constructed on each group's data in the critical regions 4 (the copula *was/were*) and the spill-over 5 for the first SPR and 8 (the copula *was/were*) and 9 (spill-over) for the second SPR task. The analyses for the native English controls included the main effects of attachment, context, WMC, and their interactions, while the L2 analyses involved additional main effects of WMC, proficiency, immersion, and their interactions with attachment and context.

1.5.2.1. Native control group

a. Baseline attachment. As shown in the omnibus analysis, the native English group read the disambiguating auxiliary in the spill-over region 5 significantly faster when it agreed with DP1 (35 ms) than when it agreed with DP2 (39 ms; β = .11, SE = .03, t(325) = 3.23, p = .001, d =.23). No other effects were observed (ps > .15).

b. Attachment in context. As indicated under the omnibus model, the main effect of attachment was not significant in the copula regions 8 (103 ms. vs. 108 ms.; t(615) = 1.33, p = .18) and 9 (39.9 ms. vs. 40.1 ms.; t(591) = .04, p = .97), despite individual differences in WMC (region 8: t(615) = .27, p = .79; region 9: t(597) = .40, p = .69). However, a tendency was found in the copula region 8 among the native readers to read the disambiguating auxiliary faster when it was preceded by a DP1-supporting context (102 ms.) than when it was preceded by a DP2-supporting context (109 ms.; β = .05, SE = .03, t(615) = 1.69, p = .09, d =.17), which was not affected by WMC (t(615) = .75, p = .45). No 3-way interactions were found among attachment, context, and WMC (region 8: t(615) = .59, p = .56; region 9: t(592) = .16, p = .87).

1.5.2.2. L1-French

a. Baseline attachment. Although the omnibus model showed no between-group differences in baseline attachment and all groups seemed to favour DP1 over DP2 attachment in the spill-over region 5, the impact of attachment was not significant for the French group after considering the effects of individual differences (t(256) = 1.09, p = .28). The French readers did not have different RTs in DP1- (44 ms.) and DP2-attached structures (46 ms.). No other effects were observed (ps > .16)

b. Attachment in context. The French group did not show a main effect of attachment in the copula regions 8 (103 ms. vs. 108 ms.; t(615) = 1.33, p = .18) and its spill-over region 9 (108 ms. vs. 105 ms.; t(540) = .05, p = .96), despite individual differences in WMC (region 8: t(540)

= .84, p = .40; region 9: t(518) = 1.60, p = .11), proficiency (region 8: t(540) = .42, p = .68; region 9: t(524) = .68, p = 50), and immersion (region 8: t(540) = .27, p = .79; region 9: t (520) = .13, p = .90). However, a marginally significant interaction was observed in the critical region 8 between context and WMC, such that high WMC was associated with faster RTs on the copula region of items preceded by a DP1-suuporting context (β = .07, SE = .039, t(540) = 1.72, p = .086, d =.18), although this interaction was not significant in the spill-over region 9 (t(519 = .54, p = .59)). Furthermore, no 3-way interactions were observed with WMC (region 8: t(540) = 1.02, p = .31; region 9: t(519) = 1.35, p = .18), proficiency (region 8: t(540) = .29, p = .77; region 9: t(530) = 1.21, p = .23), and immersion (region 8: t(540) = .02, p = .99; region 9: t(516) = .56, p = .58).

Overall, there was limited evidence that the French group had a strong attachment preference in contextualised RC ambiguities despite contextual biases and individual differences in proficiency, immersion, and WMC.

1.5.2.3. L1-Persian

a. Baseline attachment. The Persian participants read the disambiguating auxiliary faster in the spill-over region 5 when it agreed with DP1 (77 ms) than when it agreed with DP2 (87 ms), even though this was only marginally significant (β = .08, SE = .04, t(307) = 1.80, p = .07, d =.13). In addition, high WMC was associated with longer RTs in region 5 (β = .20, SE = .10, t(28) = 2.09, p = .046, d =.31).

b. Attachment in context

Unlike with the other two groups, the results of the Persian group showed that in the copula region 8 proficiency interacted marginally significantly with attachment and significantly with context: high proficiency was associated with faster RTs on DP1-attached structures (β = .08, SE = .04, t(715) = 1.84, p = .066, d =.16) and on items preceded by a DP1-supporting context

(β = .09, SE = .04, t(722) = 2.16, p = .03, d =.19). There was also a significant 3-way interaction among attachment, context, and proficiency (region 8: F(1, 722) = 11.44, p < .001; region 9: F(1, 715) = 5.40, p =.02). To explore the nature of this interaction, separate models were constructed on items with DP1- and DP2-supporting contexts. The fixed effects were attachment, WMC, proficiency, immersion, and their interactions. The results, illustrated in Figure 4, showed that in a DP1-supporting context, high proficiency tended to lead to faster RTs on DP1-attached structures in region 8 (β = .07, SE = .04, t(342) = 1.699, p = .09, d =.16), although this was not observed in the spill-over region 9 (t(709) = 1.10, p = .27). By contrast, in a DP2-supporting context, high proficiency was associated with faster RTs on DP2-attached structures in both regions (region 8: β = .12, SE = .04, t(348) = 2.96, p = .003, d =.26; region 9: β = .12, SE = .05, t(345) = 2.41, p = .02, d =.18). The impact of context did not seem to moderate with immersion (region 8: t(719) = .60, p = .55; region 9: t(721) = 1.03, p = .30) or WMC (region 8: t(720) = .46, p = .65; region 9: t(712) = .12, p = .91) and no other statistically significant effects were found (ps > .10).

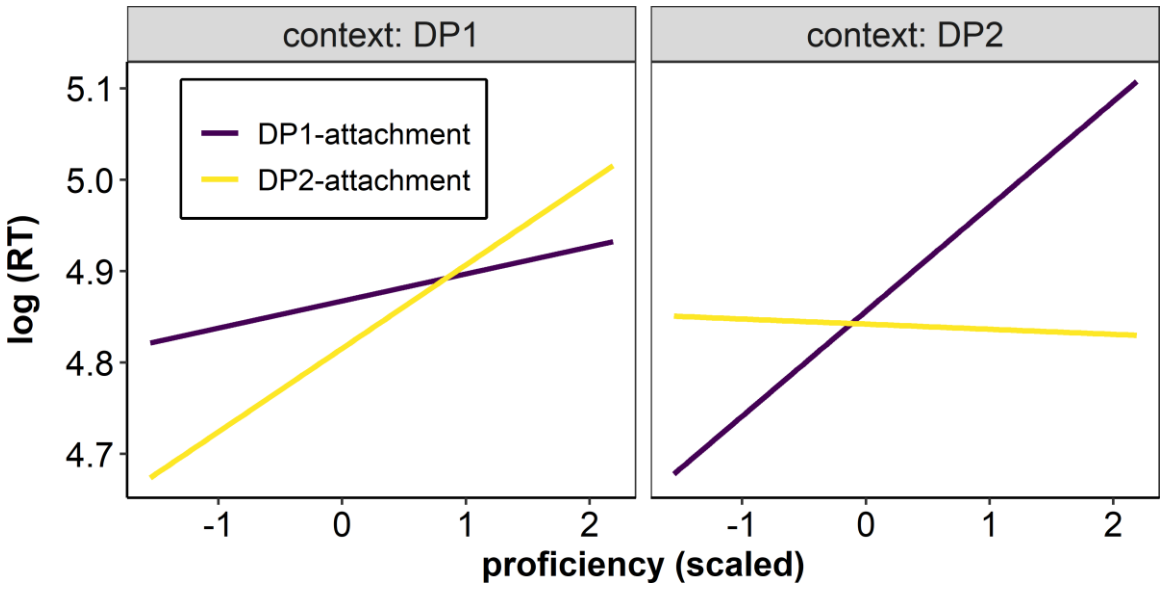

Figure 4. impact of context on attachment preferences by L1-Persian readers (region 8)

In summary, both L1 and L2 groups displayed a DP1 attachment bias. As for the impact of context, the L1-French participants patterned like the native controls in that neither group showed a strong attachment preference despite the presence of biasing contextual information. However, parsing preferences by proficient L1-Persian readers were affected by context.

4.5. Discussion

This study investigated L2-English attachment preferences in isolated and contextualised RC ambiguities by readers of L1 French and Persian. The results can be summarised as follows: *(a)* there were no reliable between-group differences in baseline attachment preferences and all three groups preferred DP1 over DP2 attachment; *(b)* similarly, little difference was observed among the three groups in disambiguating contextualised RCs and none of the three groups showed context effects on attachment preferences; *(c)* however, after considering the impact of individual differences, the evidence for DP1 attachment in isolated ambiguities by the French readers was found to be weaker than that by the English and Persian readers, and the

more advanced Persian readers displayed an attachment strategy that was impacted by the preceding discourse context.

4.5.1. Disambiguation in decontextualised RCs

The results showed that the native English readers preferred a DP1 attachment strategy in the copula region 4 of SPR 1, which is not compatible with previous studies reporting a DP2 attachment strategy in native English (Frazier, 1978). To explain the results, we note that the materials in this study were adapted from Felser et al. (2003) who also reported DP1 attachment in English. Therefore, it is possible that the materials in this study might have biased the readers towards a DP1-attachment strategy (Carreiras & Clifton; Grillo et al., 2015). Additionally, this study assessed attachment preferences in an SPR task by using a moving-window technique, in which the participants were presented with only one window at a time. According to the Chunking Hypothesis (Swets et al., 2007), the integration of the complex DP and the RC in one region might lead the readers to chunk more information and therefore select the more economically efficient disambiguation strategy, i.e., to attach the ambiguous RC to a linearly closer antecedent, DP2. By contrast, the separation of the complex DP and the RC into two separate chunks could be interpreted as marking a syntactic discontinuity, where the RC is interpreted as modifying the entire complex DP, rather than just DP2. The fact that the complex DP and the ambiguous RC were presented in two separate regions in this study might therefore have created a bias towards a DP1-attachment strategy (Swets et al., 2007).

As for the L2 readers, there was limited evidence that the French and Persian readers favoured an attachment strategy that was different from the native English readers' attachment preference, since few between-group differences were found. The results do not support the SSH's claim that L2 readers necessarily have null attachment preferences, as both L2 groups favoured DP1 attachment. Since the native readers also showed a DP1 attachment preference, we remain ambivalent as to the source of DP1 attachment by the L2 readers, i.e., it is unclear

whether the L2 readers were processing the RC ambiguities in a native-like manner or operating on an L1-based attachment strategy in French and Persian. Upon closer inspection, however, it seems that an L1-based transfer account might better account for the behaviour of the Persian readers than for the French readers. Recall that the Persian readers had lower proficiency and enjoyed less immersion experience than the French readers. Assuming that the transfer of L1-based parsing strategies is moderated by L2 proficiency (Dussias & Sagarra, 2007), we expected stronger L1 effects in the Persian readers compared to the French readers. This seems to be supported by the results, since even though both the French and Persian readers preferred DP1 attachment, the effect of attachment was marginally significant for the Persian (and not the French) group after factoring out the variance due to individual differences in proficiency and WMC. This suggests that despite individual differences in proficiency and WMC, the Persian readers had a tendency towards DP1 attachment, whereas the French readers had a weak DP1 attachment preference that no longer reached statistical significance after considering the impact of proficiency and WMC.

Overall, the results are consistent with capacity approaches to L2 parsing, since similar RC disambiguation preferences were observed by native and L2 readers, yet Persian readers who were less advanced in L2 English were more likely to display L1 effects.

4.5.2. Disambiguation in contextualised RCs

The results of the second SPR task showed that the readers were unlikely to integrate contextual biases into their disambiguation preferences, as evidenced by the null interaction observed between attachment and context at a group-level analysis. No reliable between-group differences were observed in terms of the interaction between attachment and context. This is not compatible with constraint satisfaction theories such as the Referential Hypothesis (Crain & Steedman, 1985) that predict online effects of non-syntactic information, rather suggesting that non-syntactic information does not impact initial parsing preferences (Frazier, 1978;

Gibson et al., 1996). In fact, even though no reliable interaction was observed between context and attachment, the native English readers showed a marginally significant main effect of context towards items preceded by a DP1-supporting context in the copula region 8. This tendency among the English readers might indicate an expectation of DP1 rather than DP2 modification, which is compatible with their baseline attachment preferences in the first SPR task.

It should be noted that the lack of reliable attachment preferences in contextualised RCs as opposed to a strong DP1 preference in isolated RCs does not suggest context effects on attachment preferences. Discourse context was systematically manipulated in the second SPR task, and if context had an effect on parsing preferences, we should have observed RT facilitations in DP1-attached structures that were preceded by a DP1-supporting context and in DP2-attached structures that were preceded by a DP2-supporting context. However, the results did not show a strong attachment preference regardless of context.

A similar pattern was observed among the L1-French readers, and we found little evidence that they took account of contextual information while reading contextualised RC ambiguities in L2-English. The French readers displayed no reliable interaction between context and attachment in SPR 2. Additionally, the main effect of attachment was not significant either, thus indicating a lack of strong attachment preferences. This is not consistent with the results obtained from SPR 1, where all groups showed a preference for DP1 attachment. The lack of convergence between the results of the first SPR and the second SPR task might well reflect the additional cognitive load in SPR 2. The readers were required to disambiguate RCs in isolated ambiguities in SPR 1, whereas they read extended paragraphs in SPR 2. The interaction between context and WMC in the spill-over region 9 by the French readers suggests that individuals with a high WMC showed a speed disadvantage when the preceding context supported a DP2-attached interpretation (Just & Carpenter, 1992). The high WM French

readers were more likely to show an expectation of native-like attachment (i.e., DP1) but might have failed to show a reliable RT difference between the two attachment conditions due to the higher processing load in L2 (Dussias & Piñar, 2010).

Finally, the L1-Persian readers were more likely than the other two groups to integrate contextual biases while disambiguating English RCs. The three-way interaction among attachment, context, and proficiency indicates that the Persian readers who were more proficient took account of contextual information in their disambiguation preferences. The more proficient L1-Persian readers displayed a strong effect of context on attachment preferences in the copula region 8, which was also present in the spill-over region 9. Recall that Persian is a scrambling language where syntactic constituency is strongly influenced by contextual factors such as focus (Karimi, 2005). Given that the L1-Persian readers were less advanced in English and enjoyed less immersion experience than the L1-French readers, the impact of context on attachment preferences likely reflects the transfer of L1 processing from Persian, since reading comprehension in Persian is more likely to be driven by discourse-level factors such as focus. In fact, compared to the other two groups, the Persian readers had considerably longer RTs while processing context sentences that preceded the critical RC ambiguity, reflecting the additional significance of context for the Persian readers as opposed to that for the French and English readers. This effect is visible in Figure 5 as longer relative reading times in regions 1 and 2 compared to the French and English groups.

The results show that with increased proficiency, L2 readers progress from null attachment to reliance on non-syntactic information and then to disambiguation preferences that are unaffected by contextual information (as evidenced by the results of the French group). The Persian readers resorted to L1-Persian preferences by relying on contextual information, whereas the more proficient L2ers (the L1-French readers) did not show a context effect, similar to the native English controls. Some previous studies have reported that L2 readers have

null attachment preferences (Clahsen & Felser, 2006), suggesting that readers fail to form a dependency relationship between the RC antecedent and the RC verb, and as such display no reliable RT difference between DP1-attached and DP2-attached structures. To account for the possible lack of sufficient knowledge of subject-verb agreement, this study employed an additional GJT to include RT data from only those participants who had advanced enough knowledge of the syntactic structure used for RC disambiguation. However, given the offline nature of the GJT, it is conceivable that some of the RT data that were ultimately entered into the statistical analysis came from those L1-Persian readers that were not as advanced as the other two groups in performing RC disambiguation in the online SPR task. Unlike in the first SPR task that involved RC ambiguities in isolation, the less proficient Persian readers might have failed to successfully establish a dependency relationship between the RC antecedent and the RC verb in the second SPR task, hence the lack of strong attachment preferences in the second SPR task. On the other hand, the more proficient Persian readers likely resorted to L1-Persian parsing preferences and relied on discourse-level cues to disambiguate RCs in context, i.e., favouring DP1 attachment in a DP1-supporting context and DP2 attachment in a DP2-supporting context.

It should be noted that the interaction between attachment and context by the Persian readers does not suggest qualitatively different parsing. In fact, upon closer look, there is (tentative) evidence that the Persian readers who were as highly proficient as French readers performed similarly to the other two groups and showed no context effects. Among the Persian readers, there was a single individual who scored in the same range as the French readers both in terms of proficiency (> 7.50) and immersion experience (> 90), with a c-test score of 7.89 and immersion experience of 277 months living in an English-speaking country. Their RT data showed that in a DP1-supporting context, DP1-attached structures were not read faster in region 8 (mean = 161.67 ms., SD = 24.80 ms.) than DP2-attached structures (mean = 159.43,

SD = 37.53). Similarly, RTs for this individual were not more strongly facilitated in a DP2-supporting context when the RC was disambiguated towards DP2 (mean = 158.76, SD = 46.24) than when it was disambiguated towards DP1 (mean = 163.28 ms., SD = 30.65 ms.). Although this is data from a single subject only, it does suggest that with even greater proficiency, L2 readers match native readers in interpreting ambiguous RCs.

4.5.3. Individual differences in RC disambiguation

As far as individual differences are concerned, this study found that it was only among the L1-Persian readers that proficiency played a significant role in RC disambiguation. The L1-Persian readers were overall less proficient than the L1-French readers and had longer RTs in both the critical copula and the spill-over regions. There was little difference in proficiency between French and English readers. It was therefore not surprising to find no evidence of an interaction between proficiency and attachment preferences among the L1-French readers of L2 English.

As for the impact of WMC, we did not observe a reliable interaction between attachment and WMC for any of the groups. We note that since the reading span task used to assess WMC in this study was administered online, there was little control over the task procedure to stop the rehearsal of the to-be-remembered information. In fact, 38% of the native English readers, 39% of the L1-French readers, and 28% of the L1-Persian readers scored above 90% accuracy in retaining the to-be-remembered information, suggesting possible ceiling effects. It might well be the case that the WMC measure obtained from the reading span task in this study was not powerful enough to show a reliable contingency with attachment preferences.

We also did not observe a significant impact of immersion on attachment preferences in any of the two SPR tasks. While this might seem at odds with previous studies reporting reliable effects of linguistic exposure on parsing preferences, we note that the average immersion experience in this study was quite low (7 years among L1-French and 4 years among L1-Persian readers). This stands in contrast with the average immersion experience in previous

studies that reported an interaction between immersion and parsing decisions (e.g., Pliatsikas, & Marinis, 2013, reported minimum of 13 years immersion). The participants in this study might have had too little immersion experience for it to impact RC disambiguation preferences. Overall, the results provided little evidence that L1 and L2 disambiguation of English RCs are qualitatively different at the end state of L2 acquisition, suggesting that L2 readers are not necessarily less sensitive to the syntactic agreement information on the RC verb while parsing RC ambiguities. Instead, evidence suggested that the L2 readers are more likely to resort to L1 to overcome the difficulty found in parsing RC ambiguities in a non-native language. The more proficient Persian readers showed evidence of relying on an L1-based strategy to disambiguate RCs in L2-English and relied on contextual information while interpreting RC ambiguities. Even though we adapted the materials in the second SPR task from Pan et al. (2015), our results do not support their conclusion that L2 readers are overall more sensitive to non-syntactic information. This might be due to the fact that while their participants were only intermediate-to-advanced L2 readers with little or no immersion experience, the participants in this study were all highly advanced L2 readers of English and were living in an English-speaking country at the time of the experiment. Unlike lower levels of proficiency which are associated with null attachment and reliance on non-syntactic information, highly proficient L2 readers are more likely to display parsing behaviour that matches native parsing in parsing preferences.

4.6. Conclusion

This study employed two separate SPR tasks to examine L2 English disambiguation preferences in both isolated and contextualised RC ambiguities. The results showed that L1 and L2 disambiguation preferences in isolated ambiguous RCs in English are not necessarily different and all groups showed a DP1-attachment preference. There was limited evidence to suggest the underuse of syntactic information in L2 parsing although the results highlighted the significant impact of L1 transfer and L2 proficiency. The Persian readers scored lower on

the proficiency c-test and showed a reliable interaction between context and attachment preferences, suggesting that while low proficiency individuals might favour null attachment as in some previous studies (Clahsen & Felser, 2006), more proficient L2 readers integrate contextual information in their disambiguation preferences. However, as L2 readers become even more proficient, they are likely to match native readers in parsing preferences. No reliable between-group differences were observed between the French and native English control group who scored equally high on the proficiency c-test. Overall, the results do not lend support to the hypothesis that L1 and L2 parsing of ambiguous RCs are qualitatively different, rather providing support to capacity approaches to L2 processing that L1-L2 parsing differences can disappear at high levels of L2 proficiency.

Chapter 5: L1 and L2 processing of long-distance wh-dependencies: is syntactic parsing involved?

Abstract

The level of syntactic detail that second language readers postulate while processing wh-dependencies in L2 is the subject of ongoing debate. Specifically, no agreement exists on the psychological reality of syntactic copies derived during wh-movement processes. The present study contributes to this debate by investigating L2 parsing of long-distance wh-dependencies, examining the potential impact of L1, working memory limitations in capacity and linguistic interference, and individual differences in proficiency and immersion. Seventy-five advanced L2 readers of English with either French [+wh] or Persian [-wh] as their L1 and 33 native English controls [+wh] participated in a self-paced reading task involving long-distance wh-dependencies. The results cast doubt on the hypothesis that L2 processing involves a less detailed syntactic representation, since both L2 groups patterned like native controls and relied on lexical subcategorisation information to form the dependencies. There was limited evidence for the impact of L1, working memory, and individual differences.

5.1. Introduction

Increased interest in second language (L2) processing has brought attention to L1-L2 processing differences, especially the way in which parsing complex syntactic structures such as long-distance wh-movement structures is different between native (L1) and L2 readers. In fact, many studies have investigated L2 processing of wh-structures, yet no agreement has been reached on the source of L1-L2 parsing differences (Dussias & Piñar, 2010; Juffs, 2005; Juffs & Harrington, 1995; Marinis et al., 2005). The present study contributes to this debate by comparing and contrasting native English and L2 parsing of long distance wh-movement dependencies such as *(1)* by L2 readers of English [+wh] with either French [+wh] or Persian [-wh] as their L1 (Marinis et al., 2005, p. 61).

1) *The nurse who the doctor argued* <who> *that the rude patient had angered* <who> *is refusing to work late*.

The Minimalist Program (Chomsky, 1995) mandates that after moving to the clause initial position, a copy of the wh-morpheme *what* is left at its base -- following *had angered*. According to the Trace Reactivation Hypothesis (TRH; Nicol & Swinney, 1989), processing a wh-dependency that crosses a verb such as *argued* in *(1)* above involves reactivating the extracted wh-morpheme at the interclausal boundary prior to *that*. However, there is no agreement on the psychological reality of syntactic copies denoted by <*who*> at the clausal boundary in *(1)* (Pickering & Barry, 1991), and more broadly, it is not clear how L2 parsing of wh-dependencies might be impacted by proficiency (Pliatsikas & Marinis, 2013) and cognitive resource limitations, particularly constraints on working memory (WM; Cunnings, 2022). This study investigates whether readers reactivate the extracted wh-morpheme at inter-clausal boundaries in sentences such as *(1)* as a signature of access to syntactic copies of extracted wh-

morphemes (Marinis et al., 2005, p. 61), and explores the way in which this might be affected by WM limitations and proficiency.

5.2. Background

Whether L2 readers are able to parse complex syntactic structures in a native-like fashion is the subject of ongoing debate. L2 processing theories provide different explanations as to the source of L1-L2 differences in parsing wh-movement dependencies. Some attribute L1-L2 parsing differences in forming wh-dependencies to proficiency and working memory (WM) effects (Cunnings, 2022; Dussias & Piñar, 2010), and suggest that L1-L2 parsing differences disappear at high levels of proficiency and working memory capacity (WMC). On the other hand, others suggest that unlike native parsing, L2 parsing of wh-dependencies involves constructing a less detailed syntactic representation, and L1-L2 parsing differences persist at high levels of proficiency and WMC (Marinis et al., 2005).

5.2.1. Working memory limitations in L2 parsing of wh-dependencies

Previous research suggests that L2 processing of non-local dependencies is moderated by the limitations of the underlying cognitive system, particularly constraints on WM (Hopp, 2014; Kim & Christianson, 2017). In fact, there is evidence that differences in WM measures engender different parsing patterns (Cunnings, 2022; Hopp, 2014; Kim & Christianson, 2017). According to the capacity-based view of WM (Just & Carpenter, 1992), readers are limited in the number of words and phrases that can be maintained in WM at one time, or alternatively in how many information sources (e.g., syntax only vs. syntax plus semantic subcategorisation information) are utilised during parsing. This view characterises L1-L2 processing differences in terms of differences in WMC and argues that only L2 readers of high enough WMC, as measured in reading span tasks, for example, can match native readers in processing complex syntactic structures (Dussias & Piñar, 2010). According to computational approaches to L2

processing, L2 readers draw on a non-native and unroutinised language (Hopp, 2014; McDonald, 2006), and lowering the load on WM leads to increasing L2 proficiency (Miyake & Friedman, 1998) and native-like processing of wh-dependencies (Dussias & Piñar, 2010). For example, Dussias and Piñar (2010) examined the role of plausibility information and WMC in L2 parsing of subject- and object-extraction structures as in *(2)* and *(3)* (Dussias & Piñar, 2010, p. 452). The participants were proficient native Chinese readers of L2 English and a group of English native controls, who were required to complete an SPR task involving subject- and object-extractions.

2) Implausible

   a. Who did the police declare <who> *killed the pedestrian?* Subject-extraction

   b. Who did the police declare the pedestrian killed <who>*?* object-extraction

3) Plausible

   a. Who did the police know <who> *killed the pedestrian?* Subject-extraction

   b. Who did the police know the pedestrian killed <*who*>*?* object-extraction

In half of the conditions, the extracted wh-morpheme was an implausible object of the subcategorising verb (*who did the police declare*), while in the other half it was a plausible object (*who did the police know*). Dussias and Piñar (2010) reported longer RTs for both groups following the matrix verb in subject-extraction structures, suggesting that both native English and L2 readers found subject-extractions more difficult to process than object-extractions. They further showed that native English readers displayed longer RTs in subject-extraction structures when the wh-morpheme was a plausible direct object of the verb *know* in *(2b)* compared to when it was an implausible direct object of the verb *declare* in *(2a)*, suggesting that the readers recovered faster from an implausible parse *(2a)* than a plausible one *(2b)*. By contrast, according to Dussias and Piñar, it was only L2 readers of high WMC (as opposed to

low WM L2 readers) that resembled English native readers in their ability to utilise plausibility information in this manner. Dussias and Piñar concluded that WMC is an important individual differences measure in L2 processing of wh-movement dependencies.

However, the capacity-based view of WM has not been unchallenged, and a growing body of research conceptualises the role of WM in language processing in terms of the quality (as opposed to quantity) of operations performed in forming syntactic dependencies (Cunnings, 2027, 2022; Lewis et al., 2006; Van Dyke & Johns, 2012). Cunnings (2017) argued that L2 readers of lower WMC do not necessarily face persistent difficulty in attempting wh-movement operations, but rather the primary source of L1-L2 processing differences is due to the ability to successfully retrieve information that has been constructed during processing from memory. L2 readers are argued to be more likely than native readers to display non-target-like processing behaviour when retrieval becomes exceedingly difficult as a result of similarity of linguistic representations in WM. Psycholinguistic evidence suggests that successful sentence comprehension requires skilled memory retrieval (Lewis et al., 2006; Van Dyke & McElree, 2006), whereby a set of *(*extra)linguistic cues are compared against the features of all items in memory and the item that provides the best match wins the competition and is highly activated. However, according to the interference-based models of WM (e.g., Lewis et al., 2006), those items that partially match the retrieval cues may also be retrieved, hence causing similarity-based interference.

For example, in an eye-tracking task, Cunnings and Fujita (2021), following Gorden et al.'s (2001, 2004, 2006) work on L1 processing of RC structures, manipulated whether the local subject and object were proper names or definite descriptions, as below (ibid, p. 8). The participants were native English readers and intermediate-to-advanced L2 English readers of various L1 backgrounds, including Chinese, Japanese, Korean, French, Greek, Bulgarian, Romanian, and German.

4) Subject-extraction

a. *The boy that* <who> *saw the girl/Rebecca the other day walked through the park*

Object-extraction.

b. *The boy that the girl/Rebecca saw* <who> *the other day, walked through the park.*

Cunnings and Fujita (2021) reported that while reading times were not affected in subject-extraction structures due to the similarity of nouns, longer reading times were observed at the relative clause region (*that the girl/Rebecca saw the other day*, *that saw the girl/Rebecca the other day*) in object-extractions with matched NPs (two description NPs) compared to object-extractions with unmatched NPs (one description, one proper NP). No significant RT difference was reported between the L1 and L2 readers. Cunnings and Fujita (2021) concluded that retrieval operations are facilitated in both native and L2 parsing of wh-dependencies when memory traces are sufficiently distinguishable.

However, the results by Cunnings and Fujita (2021) should be interpreted with caution. First, according to Troyer et al. (2016), there is a positive relationship between the amount of information denoted by an NP and the ease of its retrieval for establishing wh-dependencies, and since description NPs are more informative than proper names, sentences with proper names are not necessarily easier to process than sentences with description names (Cohen, 1990). In fact, some studies have even suggested that the presence of dissimilar nouns within a wh-dependency leads to additional L2 parsing difficult (Xia et al., 2022). A second point is that Cunnings and Fujita (2021) did not systematically investigate the impact of L1 due to sample size issues, and thus the reported results do not provide a nuanced picture of the impact of L1 on L2 processing of RCs. For instance, Chinese L2 readers may behave differently compared to the other L2 groups, given that previous studies have suggested a reliable object RC advantage in Chinese (for review, see Lau & Tanaka, 2021).

It is also worth noting that in both studies by Cunnings and Fujita (2021) and Dussias and Piñar (2010) the copy of the extracted morpheme <*who*> was adjacent to the subcategorising verb, and as such, the observed processing difficulty could be because the readers postulated a copy of the extracted wh-morpheme or because they attempted to integrate it as a verbal argument by relying on subcategorisation information. Therefore, those studies do not provide unequivocal evidence as to whether parsing wh-dependencies is mediated by syntactic copies or is a function of the verb's lexical subcategorisation information.

5.2.2. Shallow parsing of wh-dependencies

According to the Shallow Structure Hypothesis (SSH; Clahsen & Felser, 2006, 2018), whereas native readers utilise abstract syntactic information such as the phonologically null copy of extracted wh-morphemes, L2 readers prioritise other information types such as the verb's argument structure while forming wh-dependencies. The SSH argues that L1-L2 parsing differences in establishing wh-dependencies lie in the ability to utilise different information sources. For illustration, consider *(5)*, repeated from *(1)* (Marinis et al., 2005, p. 61).

5) *a. The nurse who the doctor argued* <who> *that the rude patient had angered* <who> *is refusing to work late*. VP-extraction

b. *The nurse who the doctor's argument about the rude patient had angered* <who> *is refusing to work late*. NP-extraction

According to the TRH (Nicol & Swinney, 1989), readers reactivate the extracted wh-morpheme <*who*> at the interclausal boundary prior to *that* in *(5a)*. By contrast, since the sentence in *(5b)* illustrates a case of extraction across an NP (*argument*), no reactivation of the wh-morpheme is assumed to take place prior to *about*. Theories of syntactic complexity that take distance between the fronted wh-morpheme and its thematic position as the primary metric

for processing difficulty predict faster RTs for VP-extraction than for NP-extraction sentences (Gibson, 2000), since the dependency distance is minimised by the intermediate copy of *who.*

Marinis et al. (2005) investigated L2 processing of long-distance wh-dependencies by L2 readers of L1-Greek, German, Chinese, and Japanese. The participants were required to complete a self-paced reading (SPR) task involving long distance wh-dependencies such as *(5a)* and *(5b).* Their results showed that reaction times (RTs) were facilitated for the L1-English participants when the intermediate copy was present (*5a*) compared to when it was not (*5b*). By contrast, they reported no such effect for any of the L2 groups, thus suggesting that regardless of the native language, L2 parsing of complex wh-structures involves a less detailed syntactic representation that does not take into account abstract syntactic categories such as intermediate copies of the extracted wh-morpheme. Marinis et al. (2005) argued that L1-L2 parsing differences in forming wh-dependencies reflect an increased tendency by L2ers to compute a shallow syntactic analysis of the L2 input that does not take into account syntactic copies of extracted wh-morphemes.

However, Marinis et al.'s (2005) results are open to interpretation. First, the assumption that intermediate copies have a psychological reality is questionable (Sag & Fodor, 1995), and according to the Direct Association Hypothesis (DAH; Pickering & Barry, 1991), all readers integrate fronted wh-morphemes directly with their lexical subcategoriser by using the verb's argument structure (Branigan & Pickering, 2017; Pickering & Barry, 1991). Second, Marinis et al. (2005) reported that their participants were at an upper intermediate proficiency level, raising the possibility that they might not have been sufficiently advanced to display native-like processing. In fact, Pliatsikas and Marinis (2013) replicated Marinis et al.'s (2005) study on two groups of L1-Greek L2-English readers: one with only classroom exposure to L2 English and another with a mean of 9 years of naturalistic exposure. They reported that the group with limited exposure to English showed similar parsing behaviour as Marinis et al.'s

participants (2005). However, the group with more naturalistic exposure behaved like English native readers, such that their processing of long-distance RCs was facilitated by the presence of the intermediate copy *who*. Third, the argument that L2 parsing of wh-dependencies is universally characterised by a lack of sensitivity to abstract syntactic information does not adequately account for the complexity of L2 processing. There is a wealth of research that suggests L2 parsing of wh-dependencies is affected by the presence/absence of wh-movement in L1 (e.g., Juffs, 2005; Juffs & Harrington, 1995). The SSH does not adequately explain how the possibility of wh-movement in L1 impacts the parsing of wh-dependencies in L2. Furthermore, the assumption that native readers always access the copy of the extracted wh-morpheme is questionable. Ferreira, Christianson, and colleagues have shown that linguistic representations constructed during native processing can also lack syntactic accuracy, precision, and detail. According to the theory of good-enough (GE) language processing (Christianson et al., 2001; Ferreira & Patson, 2007), linguistic representations in native processing are only good enough for the task at hand and become syntactically elaborated only if motivated by the task requirements (H. Karimi & Ferreira, 2016).

Overall, there is no agreement on the nature of L1-L2 parsing differences in establishing wh-dependencies, and while some suggest that L2 parsing involves a less detailed syntactic analysis of wh-dependencies, others argue that L1-L2 parsing differences disappear at high levels of L2 proficiency and WMC.

5.3. The Present Study

Against this background, the present study aimed to investigate the L2 processing of English long-distance wh-movement dependencies by seeking answers to the following research questions (RQs):

RQ1) Is there any difference between native English and L2 readers in whether they access the intermediate copy of the extracted wh-morpheme when parsing long-distance wh-dependencies?

RQ2) How is access to intermediate copy of the extracted wh-morpheme affected by factors such as L1 [+/-wh], L2 proficiency and WM limitations?

5.3.1. Method

5.3.1.1. Participants

Two groups of L2-English readers participated in this study: 34 L1-French (mean age = 33, range = 19 - 42) and 41 L1-Persian readers (mean age = 33.2, range = 17 - 50). In addition, 33 L1-English readers were included as the control group (mean age = 35.3, range = 20 - 51). All the L1-French, L1-English, and 5 of L1-Persian participants were recruited through Prolific (www.prolific.co). The remaining L1-Persian readers were recruited through social media advertisements. All the participants reported to have normal or corrected-to-normal vision and were naive with respect to the purpose of the experiment. The participants were also required to complete a grammaticality judgment task, reported elsewhere. The native English control group reported that they were fluent only in their L1, and the L2 participants reported that they were not fluent in any additional language other than their L1s (French or Persian) and L2-English.

1.5.2.4. Pre-tasks

a. Background information: **Questionnaire**

All participants were required to complete a language history questionnaire to provide information about their experience learning English. The questionnaire was composed of items on participants' native language, number of years living in an English-speaking country, and other languages known.

b. Proficiency: C-test

To assess the participants' general level of proficiency in English, all completed a c-test (Keijzer, 2007), where they were required to complete 5 mutilated passages (Cronbach's alpha: .91). There was a significant difference in proficiency among the three groups ($F(2, 94) = 9.41$, $p < .001$): L1-English readers scored higher (mean = 7.69, SD = .56) than L1-French (mean = 7.40, SD = .66) and L1-Persian (mean = 7.03, SD = .63) readers, even though this difference was statistically significant only for the Persian group ($\beta = .66$, SE = .15, $t(94) = 4.32$, $p < .001$, $d = 1.06$). The difference in proficiency between the English and French readers was not significant ($t(94) = 1.82$, $p = .17$), and the French readers also scored significantly higher than the Persian readers ($\beta = .37$, SE = .15, $t(94) = 2.44$, $p = .04$, $d = .61$).

c. Working memory capacity: Reading span task

Following the procedure described in Conway et al. (2005), the participants were required to complete a reading span task (Daneman & Carpenter, 1980) to yield a measure of their WMC. Whereas all the L1 French and L1 English participants attempted the reading span task, only 23 L1 Persian readers completed this task due to drop-out. No reliable difference was found in WMC between the groups (Cronbach's alpha = .90; $F(2, 90) = 2.56$, $p = .08$). Table 18 summarises participants' biographical information along with their proficiency and WM scores.

Table 18

Participants' biographical information, c-test scores, and WMC

L2 groups	AoA[a]		Immersion[b]		Proficiency[c]		WMC[d]	
	M	*Range*	*M*	*Range*	*M*	*Range*	*M*	*Range*
L1-French (n = 34)	22.9	16 – 29	88.40	19 - 221	7.40	5.96 – 8.44	.84	.47 - 1
L1-Persian (n = 41)	28.8	16 – 41	53.00	2 - 277	7.03	5.46 – 8.31	.76	.31 - .97
L1-English (n = 33)	--	--	--	--	7.69	6.09 – 8.39	.84	.20 - 1

[a] age of arrival to an English-speaking country (in years)

[b] months lived in an English-speaking country

[c] possible range: 0 – 10

[d] possible range: 0 – 1

1.5.2.5. Materials

This study used an SPR task to explore the processing of long-distance wh-dependencies. The participants read a total of 60 sentences, of which 2 were practice items, 36 experimental items, and 22 filler items. Of the total of experimental items, 24 had definite description NPs (matched), taken from Marinis et al. (2005), and 12 had a mixture of proper names and definite descriptions (unmatched). A 2 x 2 design was adopted with sentences containing matched NPs, with Extraction Type (Extraction, Non-extraction) and Phrase Type (VP, NP) as the within-subjects factors, resulting in 4 experimental conditions:

6) *a. The nurse who the doctor argued that the rude patient had angered is refusing to work late.* Extraction (VP), matched

b. The nurse who the doctor's argument about the rude patient had angered is refusing to work late. Extraction (NP), matched

c. The nurse thought the doctor argued that the rude patient had angered the staff at the hospital. Non-Extraction (VP), matched

d. The nurse thought the doctor's argument about the rude patient had angered the staff at the hospital. Non-Extraction (NP), matched

In the extraction conditions *(6a)* and *(6b)*, the initial NP (*the nurse*) was followed by a relative clause, introduced by the wh-morpheme *who*, which functioned as the direct object of the embedded clause verb (*had angered*). In the extraction-VP condition *(6a)*, the extraction of *who* crosses a verb (*argued*) and creates an intermediate copy prior to *that*, whereas the extraction-NP condition *(6b)* involves a wh-movement crossing a noun (*argument*) with no intermediate copy present. By contrast, the non-extraction conditions *(6c)* and *(6d)* do not involve a similar movement of the wh-morpheme, even though they have the same number of words as in the extraction conditions up to the embedded clause.

We also included two additional unmatched conditions *(7a)* and *(7b)* to explore the impact of similarity-based interference. These conditions had similar NPs and verbs as the extraction-VP and extraction-NP structures *(6a)* and *(6b)* above, with the added difference that the embedded clause subject was a proper name, whereas the other NPs remained definite descriptions (for a full list of materials, see the OSF link[7] & also Appendix E).

7) *a. The politician who the journalist stated that **John** had fascinated is calling a press conference.* Extraction (VP), unmatched

*b. The politician who **John's** statement about the journalist had fascinated is calling a press conference.* Extraction (NP), unmatched

[7] https://osf.io/uejyb/?view_only=71f414a3994442aa8f4c68131e911543

The experimental items and fillers were distributed across six lists in a Latin square design. Each list contained 6 sentences for each condition (6 * 6 = 36) and no list contained more than one item from each condition. The items in each list were interspersed with the fillers and pseudorandomised. All the experimental items and fillers were followed by a comprehension question with either *yes* or *no* as answers to ensure that the participants were attentive to the task. Each sentence was segmented into 6 presentation regions in a non-cumulative technique (subscripts indicate region numbers):

8) /$_1$ *The nurse who* /$_2$ *the doctor argued* /$_3$ *that* /$_4$ *the rude patient* /$_5$ *had angered* /$_6$ *is refusing to work late.*

Did the doctor's argument anger the nurse? Yes/ **No**

1.5.2.6. Procedure

All the data were collected online using Qualtrics, version (2020), and Ibex Farm (Zehr & Schwarz, 2018). The different tasks were administered in two separate sessions, with approximately 5 days in between. Initially, all participants were required to complete a language history questionnaire on Qualtrics and a proficiency c-test on Ibex. Subsequently, the participants were invited to complete the reading span (Daneman & Carpenter, 1980) and the SPR tasks, respectively, both of which were performed on Ibex.

1.5.2.7. Predictions

The critical regions of interest in this experiment were 3 and 5, as region 3 contained the intermediate copy and region 5 was where the moved wh-morpheme *who* is integrated with its lexical subcategoriser. We also investigated RTs at regions 4 and 6 as potential spill-overs of 3 and 5, respectively. According to the TRH, there should be an interaction between extraction and phrase type in region 3, assuming that readers reconstitute the extracted wh-morpheme at

inter-clausal boundaries: while no RT difference should be observed between the two non-extraction conditions, extraction-VP structures should be read slower than extraction-NP structures due to the presence of the intermediate copy. Similarly, the reactivation of *who* should affect RTs of extraction-VP structures in region 5 and lead to an interaction between extraction and phrase type: whereas no RT difference should be observed between the two non-extraction conditions, antecedent reactivation should facilitate RTs in extraction-VP structures as the dependency distance is minimised. Furthermore, if the presence of unmatched NPs helps readers make a more syntactically detailed parse that contains the intermediate copy of *who*, a more pronounced RT difference is expected between extraction-VP and extraction-NP structures in the case of unmatched conditions.

By contrast, if readers process long-distance wh-dependencies according to DAH, no interaction is expected due to antecedent reactivation. Rather, there should be a main effect of phrase in region 3, as well as a main effect of extraction in region 5, assuming that the readers successfully encode the extracted element in region 3 and integrate it into the sentence structure in region 5. Readers should have slower RTs on VP structures in region 3, reflecting the additional effort associated with processing the verb's argument structure in VP conditions. Similarly, extraction conditions should take longer than non-extraction conditions in region 5 due to the additional processing difficulty associated with the integration of the dislocated wh-morpheme with its lexical subcategoriser, i.e., the embedded clause verb. Furthermore, if readers do not assume intermediate copies, the above pattern should obtain regardless of the reduction of interference, i.e., no reliable RT difference should be observed between extraction-NP and extraction-VP conditions in the two interference conditions.

5.4. Results

Following standard procedure in previous SPR studies on long-distance dependencies, data from participants with substandard performance were excluded (e.g., Marinis et al., 2005;

Pliatsikas & Marinis, 2013). The analyses were carried out only on those participants whose mean accuracy to the follow-up comprehension questions were above 75%. Additionally, outliers were identified per subject and item as those RTs that were not within 3 standard deviations of the mean RT of the corresponding condition. Finally, it was found that one of the items with unmatched NPs had a coding mistake and was therefore deleted before further analysis. The analysis was performed only on those items whose comprehension questions were answered correctly.

Nested linear mixed effects models were constructed using the lme4 package in R (Bates et al., 2015; R Core Team, 2020), with extraction (extraction, non-extraction), phrase (VP, NP), native language (English, French, Persian), proficiency, immersion, and WMC as fixed effects. The models were fitted with the maximum random effects structure that converged (Barr et al., 2013). Since none of the models with random slopes converged, the random effects structure of the models included random intercepts of subject and item, only (Vasishth et al., 2020). The models were evaluated with the same random effects structure to allow for model comparison. Treatment contrasts were used to allow comparisons between different levels of the categorical variables, with non-extraction, NP, and L1-English as the reference levels for extraction type, phrase type, and native language. All analyses were conducted on RTs adjusted for length to account for differences in region length, defined as raw RTs divided by the length of the region (number of characters). Figure 5 illustrates length-adjusted RTs per condition for each group.

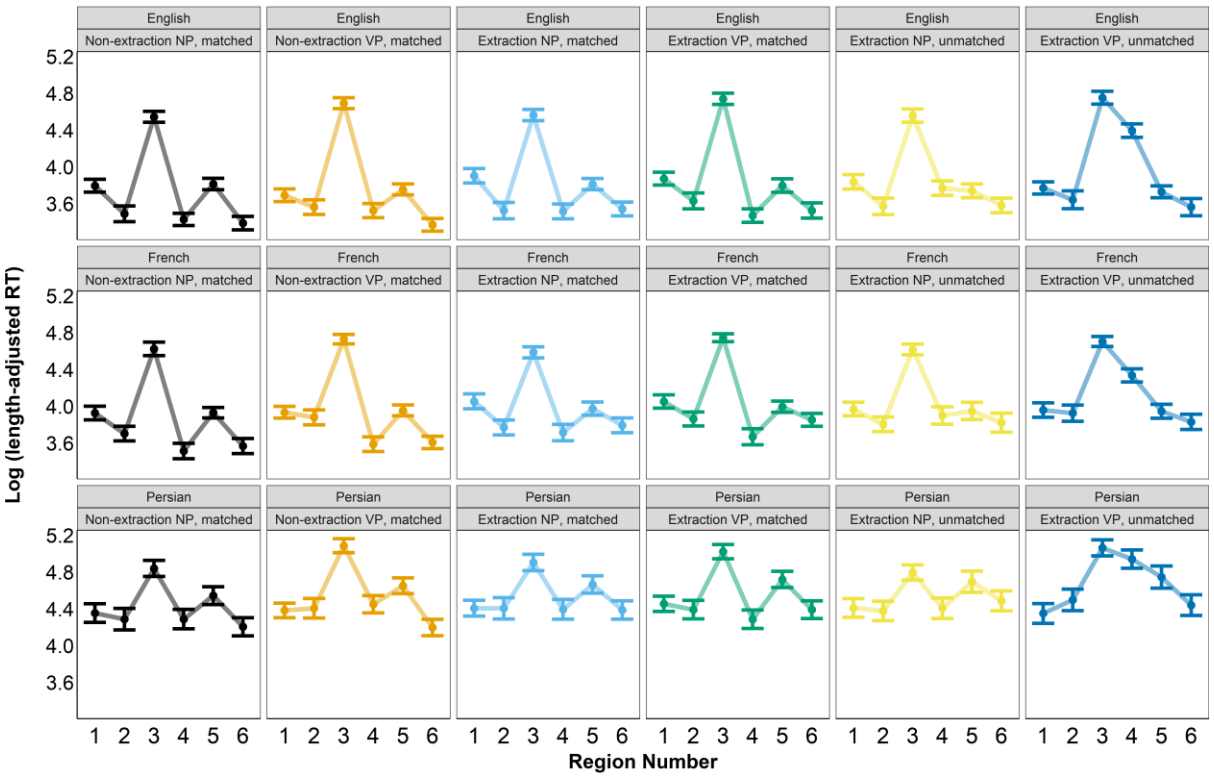

Figure 5. Log-transformed length-adjusted RTs per group and condition in each region

Furthermore, the c-test proficiency and reading span scores were standardised, and the RT data were log transformed to reduce skewness and minimise potential outlier effects (analysis code can be found on the OSF link[8].

First, a between-group analysis was performed to compare the three groups in their ability to access the intermediate copy. No measures of individual differences was included in this analysis. However, following the initial between-groups analysis, we conducted separate models on each group's data to investigate the impact of individual differences in proficiency, WMC, and immersion experience.

[8] https://osf.io/uejyb/?view_only=71f414a3994442aa8f4c68131e911543

5.4.1. Between-groups comparisons

To address the first research question (RQ1), we conducted between-group comparisons in regions 3, 4, 5, and 6 and constructed models with fixed effects of extraction, phrase type, and native language. The main effect of L1 was significant in all regions, with the Persian group displaying the longest RTs, while no RT difference was observed between the French and English readers.

Region 3 *(that/about)***.** The main effect of phrase type was significant in this region, and VP structures had longer RTs (β = .14, SE = .04, t(1746) = 3.52, p < .001, d =.31). The interaction between phrase and native language was not significant, however, suggesting that the VP disadvantage was not different between the English and French readers (t(1734) =.49, p = .62), nor between the English and Persian readers (t(1733) =1.47, p = .14). The English readers did not display a significant RT difference between the extraction and non-extraction conditions (t(1743) = .21, p = .83), similar to the French (t(1734) = .72, p = .47) and Persian readers (t(1735) = 1.14, p = .25). Finally, while the interaction between extraction and phrase type was not significant (t(1747) = 1.11, p = .27), a 3-way interaction was found between extraction, phrase type, and native language. Specifically, the above-mentioned VP disadvantage was smaller for the Persian readers in the extraction conditions (β = .19, SE = .08, t(1737) = 2.45, p = .02, d = .43), whereas the VP disadvantage was the same in the two extraction conditions for the English and French readers (t(1734) = .30, p = .76).

Region 4 *(the rude patient)*. No main effects of extraction or phrase type was observed in this region (extraction: t(1733) = 1.60, p =.11; phrase: t(1736) = 1.68, p =.09). However, there was a significant interaction between extraction and native language; while there was no significant difference between English and Persian readers in the RTs of the two extraction conditions (t(1729) = 1.02, p = .31), the French readers had longer RTs on extraction structures (t(1728) = 2.00, p = .046). Furthermore, similar to the previous region, the English readers did not

display a significant interaction between extraction and phrase type (t(1738) = 1.34, p = .18), which was the same for the French (t(1730) = .60, p = .55) and Persian readers (t(1730) = 1.90, p = .06).

Region 5 *(had angered).* No main effects of extraction or phrase type were found in this region (extraction: t(1740) = .39, p = .70; phrase : t(1743) = 1.83, p = .068). However, both extraction and phrase type interacted significantly with native language, and unlike the English group, the Persian readers had longer RTs on extraction compared to non-extraction conditions (β = .12, SE = .06, t(1738) = 2.21, p = .027, d = .21) and on VP compared to NP conditions (β = .13, SE = .05, t(1738) = 2.41, p = .016, d = .22). By contrast, there was not a significant difference between the English and French readers in the RTs of the extraction (t(1738) = .90, p =.37) and phrase conditions (t(1738) = 1.47, p =.14). Moreover, there was no significant 3-way interaction between extraction, phrase type, and native language, i.e., the absence of a significant interaction between extraction and phrase type was not significantly different between English and French (t(1738) = .75, p = .45) nor between English and Persian readers (t(1739) = 1.03, p = .31).

Region 6. The only significant effect was that of extraction in this region, and extraction structures were read significantly slower than non-extraction conditions by the English readers (β = .13, SE = .04, t(1755) = 3.09, p < .005, d = .21), which was the same for the French (t(1751) = 1.35, p = .18) and Persian readers (t(1752) = 1.71, p = .09). Importantly, no significant interaction was found between extraction and phrase type in this region for the English readers (t(1761) = .90, p = .37), which was the same for the French (t(1752) = .39, p = .69) and Persian groups (t(1752) = .91, p = .37).

Overall, despite some between-group differences, all three groups had longer RTs in region 3 on VP structures and experienced more processing difficulty in the final region 6 of extraction conditions. In addition, none of the three groups showed a significant interaction between

extraction and phrase type, thus suggesting a lack of sensitivity to the intermediate copy of the extracted morpheme *who.*

5.4.2. Individual differences

In order to answer RQ2, each group's data were examined separately by constructing models with the main effects of extraction, phrase type, and the interaction between the two, as well as the main and interaction effects of the individual differences measures WMC, proficiency, and immersion. The models for the English natives contained WMC, while the models for the L2 groups had additional effects of proficiency and immersion. Assuming that access to intermediate copies is moderated by individual differences, a 3-way interaction was expected in regions 3 and 5 between extraction, phrase type, and individual differences. Below we report only the results that reached statistical significance, as well as the results of the three-way interactions.

Working memory capacity. All three groups showed a significant interaction between phrase type and WMC, with high WMC associated with longer RTs on VP structures in all groups: for the English controls in region 4 ($\beta = .09$, SE = .05, $t(553) = 2.02$, $p = .044$, $d = .18$), for the French readers in region 3 ($\beta = .09$, SE = .05, $t(562) = 1.99$, $p = .047$, $d = .22$), and for the Persian readers in region 6 ($\beta = .10$, SE = .04, $t(541) = 2.42$, $p = .016$, $d = .19$). No other effects were observed and no 3-way interactions were found between phrase type, extraction, and WMC (all ps > .12).

Proficiency. The French readers did not display a main or interaction effect of proficiency (all ps > .07). By contrast, the Persian readers showed a main effect of proficiency in region 3, more proficient Persian readers had longer RTs ($\beta = .17$, SE = .08, $t(39) = 2.07$, $p = .045$, $d = .29$). Furthermore, there was a significant interaction between proficiency and extraction in region 5, and more proficient readers had longer RTs in extraction compared to non-extraction conditions ($\beta = .13$, SE = .05, $t(529) = 2.44$, $p = .02$, $d = .20$). No other effects were observed

and crucially, the 3-way interactions between extraction, phrase type, and proficiency, were not significant in any of the regions (all ps > .14).

Immersion. The French readers showed a significant interaction between immersion and phrase type in the final region 6 (β = .12, SE = .06, t(549) = 2.10, p = .037, d = .20). By contrast, the Persian readers did not display a significant effect of immersion (all ps > .13). Similar to the other individual differences measures, no 3-way interactions were observed between extraction, phrase type, and immersion (all ps > .13).

In summary, there was little evidence that access to the intermediate copy of the extracted wh-morpheme is a function of individual differences, as per the lack of 3-way interactions observed.

5.4.3. Similarity-based interference

In order to answer the third research question (RQ3), we constructed four models on regions 3, 4, 5, and 6, respectively. The fixed effects were phrase type, interference, native language, and their interactions. Assuming that the presence of unmatched NPs facilitates access to the intermediate copy, we expected to observe an interaction between phrase type and interference.

Region 3. No main or interaction effects of interference were observed in this region (all ps > .07).

Region 4. A significant main effect of interference was found in this region, and unmatched conditions were read significantly slower than matched conditions (β = .12, SE = .06, t(549) = 2.10, p = .037, d = .20). In addition, the interaction between interference and native language was significant, and the Persian readers showed a significantly less pronounced RT difference between the matched and unmatched conditions (β = .25, SE = .06, t(2438) = 4.18, p < .001, d = .37). Furthermore, there was a significant interaction between interference and phrase type, and the unmatched conditions were read significantly slower in VP structures (β = .58, SE =

.06, t(2463) = 9.40, p < .001, d = .84). The 3-way interaction between phrase type, interference, and native language was not significant (t(2436) = .53, p = .60).

Region 5. There was a significant interaction between native language and interference in this region, and compared to the English and French readers, the Persian group read the unmatched conditions significantly slower than the matched conditions. No other significant interference effects were observed in this region (all ps > .08).

Region 6. No significant main or interaction effects of interference were observed in this region (all ps > .48).

Overall, there was no evidence that unmatched conditions contributed to a more detailed syntactic analysis of wh-dependencies, since the subcategorising verb in VP structures was not read faster in unmatched conditions compared to matched conditions. In fact, unmatched conditions were found to lead to longer RTs in region 4, suggesting that the presence of proper names leads to more processing difficulty, even though this was observed in region 5 for the less proficient group, i.e., the Persian readers.

5.5. Discussion

The purpose of this study was to explore L2 processing of long-distance wh-movement dependencies and assess the potential impact of L1, proficiency and WM limitations in capacity and representations of NPs (matched/unmatched). We investigated the encoding of *who* in regions 3 and 4 and its integration in regions 5 and 6. Assuming that readers reactivate the extracted wh-morpheme at inter-clausal boundaries, we expected to observe an interaction between extraction and phrase type in both encoding and integration regions, and while no RT difference was expected between the two non-extraction conditions, longer RTs were expected on extraction-VP structures in regions 3 and 4. By contrast, due to the hypothesised antecedent reactivation, we predicted that in regions 5 and 6, extraction-VP structures should have faster

RTs than extraction-NP structures, as the dependency distance was minimised by the intermediate copy.

The results can be summarised as follows: *(a)* all groups showed protracted RTs in region 3 on VP structures, reflecting the encoding of the extracted wh-morpheme; *(b)* all groups had longer RTs in region 6 on extraction conditions, suggesting the integration of the wh-morpheme with its subcategorising verb; *(c)* no reliable interactions were found in any of the regions between extraction and phrase type regardless of L1 and proficiency, thus suggesting that the presence of the intermediate copy did not significantly facilitate access to the intermediate copy; *(d)* similarly, limited evidence was found that WM limitations in terms of either capacity or NP representations impacted the processing of the intermediate copy.

5.5.1. Access to the intermediate copy

If parsing is influenced by the presence of the intermediate copy, we expected an interaction between extraction and phrase type. No RT difference should have been observed in the non-extraction conditions between VP and NP structures, yet it was expected that readers should have longer RTs on extraction-VP structures than extraction-NP structures in region 3 and 4. Additionally, extraction-VP structures were expected to have faster RTs in region 5 and 6, reflecting the hypothesised antecedent re-activation (Marinis et al., 2005). However, these predictions were not borne out, and we observed longer RTs in region 3 on VP structures of both extraction and non-extraction conditions. In addition, there was no reliable RT difference in region 5 and 6 between extraction-VP and extraction-NP structures. Therefore, no evidence was found that readers access the intermediate copy of the extracted wh-morpheme while parsing long-distance dependencies, but rather the results suggested that the main source of processing difficulty lied in accessing the verb's argument structure. Longer RTs for VP structures in region 3 reflect the additional cost associated with the subcategorisation information of the verb in VP structures prior to *that/about*, while longer RTs for extraction

structures in region 6 reflect the cost associated with the integration of the extracted morpheme *who* with its subcategorising verb (Gibson, 2000). The results do not support the TRH that assumes access to intermediate copies, while they are consistent with DAH that locates the source of processing difficulty to accessing the verb's subcategorisation information.

The observation that neither L1 nor L2 parsing seemed to benefit from the presence of intermediate copies is not compatible with previous research that suggested that extracted morphemes are reactivated at inter-clausal boundaries (Gibson & Warren, 2004; Marinis et al., 2005; Pliatsikas & Marinis, 2013). To explain the results, we note that the data for this study was collected online, unlike previous studies which used lab-based experiments. According to good-enough processing, readers rely on non-syntactic information while parsing complex sentences and engage in a "small set of fast and frugal heuristics" to accomplish the information processing task, especially if they are not specifically motivated to devote attentional resources (Ferreira & Patson, 2007, p. 72). The online data in this study might have biased the results in such a way that readers would not be as invested as they would have been in a controlled lab-based experiment, thus reliance on lexical subcategorisation rather than abstract syntactic information. Consistent with previous research, we found that native parsing of wh-dependencies involves reliance on the lexical subcategorisation information of the verb and does not include phonologically null syntactic copies of movement dependencies (Christianson, 2016; Ferreira & Patson, 2007; H. Karimi & Ferreira, 2016). Importantly for the purposes of this study, since the above pattern was observed for both the native and L2 groups, the results call into question the SSH's claim that L1 and L2 parsing of wh-dependencies are qualitatively different (Clahsen & Felser, 2006).

5.5.2. L1 effects?

We collected data from two groups of L2 English readers, *(a)* L1-French [+wh], and *(b)* L1-Persian [-wh]. Under the hypothesis that L2 readers of [-wh] backgrounds face additional

difficulty when processing wh-movement dependencies in L2, we expected to observe a discrepancy between L1-French and L1-Persian readers in terms of their processing behaviour. Specifically, the L1-French readers should have been more likely to match native English readers in successfully parsing long-distance wh-dependencies. We note that compared to the other two groups, the Persian readers did not display as large a VP disadvantage effect in region 3 of extraction conditions. A similar pattern was observed in region 5, but importantly with an opposite direction, i.e., the Persian readers read VP structures significantly slower in both extraction and non-extraction conditions.

We argue that the above between-group differences are unlikely to reflect a qualitatively different parsing mechanism by L1-Persian readers. The Persian readers scored lower on the c-test proficiency task and had longer RTs in all regions, and as such, it is possible that they showed a delayed effect of extraction in region 5 (Hopp, 2014). The more proficient Persian readers showed a larger RT difference between the two extraction conditions in region 5, suggesting that the above pattern likely reflects a quantitative rather than a qualitative difference. In fact, similar to the other two groups, the Persian readers slowed down in region 3 of VP conditions, reflecting the additional cost associated with the parsing of the verb's argument structure. Additionally, the Persian readers showed a similar processing pattern in region 6 as the other two groups and displayed protracted RTs on extraction conditions, reflecting the integration of the extracted *who* with its subcategorising verb. Overall, there was limited evidence for an L1 [-wh/+wh] effect. The L2 participants were all at a highly advanced proficiency level and were residing in an English-speaking country at the time of experiment, and as such were unlikely to display L1 [-wh] effects (Hopp, 2006; Pliatsikas & Marinis, 2013), consistent with previous research that L1-L2 parsing differences disappear at highly advanced proficiency (Çele & Gürel, 2011).

5.5.3. Impact of L2 proficiency and immersion experience

As for the impact of proficiency and immersion on access to the intermediate copy, we expected that more proficient readers would show sensitivity to the presence of the intermediate copy in extraction-VP structures. However, the L2 readers did not suggest access to the intermediate copy regardless of proficiency and immersion experience, as evidenced by the lack of a reliable interaction among extraction, phrase type, and proficiency. While this might seem at odds with previous studies reporting reliable effects of proficiency and linguistic exposure, we note that neither the native nor the L2 readers showed evidence of reconstituting the intermediate copy while parsing the extraction-VP structures. Previous research that reported a significant impact of proficiency/immersion suggested a positive correlation with the parsing of the intermediate copy (Pliatsikas, & Marinis, 2013). In our data, all groups relied on verb's subcategorisation to parse the wh-dependencies, and thus the lack of proficiency/immersion effects on access to intermediate copy is not inconsistent with previous research. Additionally, the average immersion experience in this study was quite low (7 years among L1-French and 4 years among L1-Persian readers). This stands in contrast with the average immersion experience on previous studies that reported a reliable interaction between immersion and parsing decisions (e.g., Pliatsikas, & Marinis, 2013, reported a minimum of 13 years immersion).

5.5.4. Working memory limitations

We examined WMC by administering a reading span task and explored the role of similarity-based interference by manipulating the match between the nouns prior to the subcategorising verb. The results showed that readers with higher WMC had longer RTs on VP structures, suggesting that readers with high WMC are more sensitive to the lexical subcategorisation information. The VP structures involved an additional verb compared to NP structures, and high WMC readers slowed down more on VP conditions due to their higher sensitivity to the verb's argument structure. This is in line with the capacity-based view of WM (Just &

Carpenter, 1992), according to which readers with a higher WMC are more likely to integrate different information sources than readers with lower WMC (Dussias & Piñar, 2010). It should be noted that we did not observe a significant interaction between WMC and the parsing of the intermediate copy in extraction-VP structures, as there was no significant 3-way interaction between extraction, phrase type, and WMC. This suggests that regardless of WMC, readers did not have access to the syntactic information afforded by the intermediate copy. Importantly, the above pattern was obtained for all groups, thus suggesting that the underlying parsing mechanism in L1 and L2 were qualitatively the same.

As for the role of interference, we included two additional extraction conditions with unmatched NPs (description & proper nouns) to compare processing patterns with wh-dependencies containing matched NPs (description NPs only). It was expected that if the reduction of interference facilitates access to the intermediate copy, i.e., VP structures should be read slower than NP structures in region 3 and 4 and faster in region 5 and 6 (integration of the extracted *who*) of unmatched conditions (encoding of the extracted *who*). However, these predictions were not borne out. While no interaction was observed between phrase type and interference in regions 3 and 5, all groups read the VP structures slower in unmatched conditions in regions 4 and 6, which is the opposite of what an interference-based view would predict. There are two possible explanations for this.

As the first explanation, it might be argued that the readers managed to successfully encode the intermediate copy prior to *that* in extraction-VP structures with unmatched VPs, as evidenced by the longer RTs of VP structures in unmatched conditions in region 4. If this is the case, the lack of a significant interaction between phrase type and interference in region 6 might be interpreted as spill-over effects of region 4. That is, the VP structures were read slower in region 4 of unmatched conditions, and this might have masked faster RTs of unmatched conditions in region 6. However, we note that no RT difference was observed between matched

and unmatched conditions in region 5, and therefore any spill-over effects of region 4 should have been neutralised in region 5. Thus, this is an unlikely explanation, and the observation that no RT difference was found between the matched and unmatched conditions of region 6 suggests that intermediate copies were not utilised regardless of the amount of interference induced.

A second possibility is that readers slowed down more at VP structures in region 4 due to the additional difficulty associated with the processing of proper names in this region (Cohen, 1990). We observed a less pronounced RT difference between the matched and unmatched conditions among the Persian readers (compared to the other two groups) in both regions 4 and 5, suggesting that they were less sensitive to proper/description name distinction. This is in line with previous research that suggests L2ers of lower proficiency have a less distinct lexical representation of description and proper names (Hopp, 2018).

Overall, the results do not support the hypothesis that L2 readers are more susceptible than native readers to similarity-based interference, since we found no RT facilitation effects in unmatched conditions for any of the groups due to antecedent reactivation by the intermediate copy. Thus, it seems reasonable to argue that the implicit bias to parse long-distance wh-dependencies based on good-enough heuristics (i.e., reliance on subcategorisation information rather than the intermediate copy) is not significantly affected by the reduction of interference due to the similarity of nouns.

However, it should be noted that the above argument remains speculative, since the two interference conditions were not fully matched; therefore, the interaction observed in region 4 between interference and phrase type might related to the different lexical materials in the two conditions. Further research is required to examine the relationship between similarity-based interference and depth of syntactic processing in parsing long-distance wh-structures.

5.6. Conclusion

The results of this study show that neither L1 nor L2 readers necessarily access abstract syntactic categories such as the intermediate copies of extracted wh-morpheme while processing long-distance wh-dependencies. In fact, the results suggest that given the online nature of the task, readers integrate fronted wh-morphemes directly with their lexical subcategoriser. This challenges the SSH's claim that L1 and L2 parsing are qualitatively different (Clahsen & Felser, 2006). Additionally, the results are not compatible with the hypothesis that L2 readers of [-wh] L1s face persistent difficulty while parsing complex wh-movement structures in a [+wh] L2. Rather, we found evidence of both encoding and integration of the fronted wh-morpheme by both L1-French [+wh] and L1-Persian [-wh] readers of L2 English [+wh]. We also found little RT facilitation for any of the groups due to the reduction of similarity-based interference. More research is required to investigate L2 processing of long-distance wh-dependencies, especially the factors that lead to good-enough processing and reliance on subcategorisation information.

Chapter 6: Discussion and Conclusion

6.1. Introduction

This project investigated the processing of English relative clauses (RCs) by L1-French, L1-Persian, and native English readers. The main focus of Study 1 was on the acceptability of resumptive pronouns, whereas Studies 2 and 3 explored the parsing of ambiguous and long-distance RCs, respectively. Before discussing the theoretical implications of this project, the following section summarises the findings.

6.2. Summary of the findings

6.2.1. Study one

The first Study investigated the acceptability of different RC types in L2 English by L1-French and L1-Persian readers. Unlike English and French, Persian grammaticalises resumption in direct object (DO) and object-of-preposition (OP) RCs and the only grammatical relativiser in Persian takes the form of an invariant complementiser. By contrast, (standard) English and French disallow resumptive pronouns and both wh-pronouns and complementisers can function as potential relativisers.

The results suggested that Persian readers were more likely to accept resumptive pronouns in L2 English, particularly in DO and OP RCs which allow resumption in Persian. However, as discussed in Chapter 3, this is unlikely to reflect a representational deficit in the underlying syntactic knowledge of the Persian readers, since all groups patterned similarly with respect to the acceptability of the form of relativiser. All favoured gapped RCs (without resumption) preceded by the relative pronoun *who*, while the choice of relativiser (complementiser vs. relative pronoun) did not significantly impact the acceptability of resumptive RCs for any of the three groups. That is, even though Persian only allows resumptives with an invariant complementiser, the Persian readers did not show a significant difference in acceptability between resumptive RCs preceded by *who* and resumptive RCs preceded by *that*. Therefore, it was concluded in Study 1 that advanced L2 readers of different L1s do not necessarily have a

fundamentally different syntactic knowledge of L2 English RCs, at least as far as resumption is concerned, yet the Persian readers may sometimes resort to an L1 resumption strategy to ease processing limitations. Relativisation of DO and OP positions is more difficult (compared to the subject position; Gibson, 2000), and it is possible that L2 readers of [+resumption] L1s prefer a resumptive pronoun in these positions to ease the processing of L2 English RCs (Gass, 1979; Hofmeister & Norcliffe, 2013; Tezel, 1999).

6.2.2. Study Two

Building on Study 1, Studies 2 and 3 investigated the nature of L2 processing limitations. Study 2 administered two self-paced reading (SPR) tasks to investigate attachment preferences in temporarily ambiguous English RCs by L1-French and L1-Persian readers. The critical structures were presented in isolation in the first SPR task and were embedded in context in the second SPR task to examine the potential impact of discourse-level cues that biased attachment to either DP1 (i.e., DP1-supporting context) or DP2 (i.e., DP2-supporting context). As Persian is a scrambling and topic-dominent language (Karimi, 2005; Karimi & Taleghani, 2007), unlike English and French, it was expected that attachment preferences by Persian readers would be affected by contextual biases, i.e., they would prefer DP1-attachment in a DP1-supporting context and DP2-attachment in a DP2-supporting context.

This was consistent with the results, and highly proficient Persian readers showed a significant interaction between attachment and context. However, both the native English and L1-French readers had a null attachment preference (neither DP1 nor DP2), regardless of contextual manipulations.

It was argued in Chapter 4 that the different processing behaviour observed by the Persian readers does not suggest qualitatively different parsing, since all groups had a similar DP1 attachment preference when the RCs were presented in isolation. The results were interpreted as supporting the capacity-based models of L2 processing, according to which L2 readers draw

on their L1 phrase structure rules to disambiguate RCs in an L2 in order to conserve processing resources.

6.2.3. Study Three

Study 3 investigated the processing of unambiguous long-distance wh-dependencies in English RCs by L1-French and L1-Persian readers. Following previous research on the processing of long-distance dependencies, it was predicted that dependency formation between the extracted wh-morpheme and its subcategorising verb would be facilitated by the presence of abstract syntactic information such as copies of extracted wh-morphemes (Marinis et al., 2005; Pliatsikas & Marinis, 2013).

However, this prediction was not borne out for any of the native and L2 groups. Rather, it was found that syntactic copies did not contribute to the formation of long-distance dependencies and both native and L2 readers relied on the verb's argument structure to parse the dependencies. The above pattern was observed regardless of working memory (WM) effects, which were operationalised in Study 3 in terms of WMC and similarity-based interference, thus suggesting that the processing of English RCs does not necessarily involve a detailed syntactic analysis, by neither native nor L2 groups. Similarly to the other two Studies, it was concluded in Study 3 that L1 and L2 processing of RCs are qualitatively similar.

Overall, the findings of this project suggest that L2 readers draw on the same inventory of syntactic knowledge available in the native processing of RCs, contrary to the predictions of representational deficit accounts (Bley-Vroman, 2009; Clahsen & Felser, 2006, 2018; Felser, 2019; Hawkins &Chan, 1997; Hawkins & Hattori, 2006; Marinis et al., 2005; Tsimpli & Dimitrakopoulou, 2007), and L1-L2 processing differences at a highly advanced proficiency reflect the lack of sufficient cognitive resources in L2 and occasional reliance on L1 processing routines. The following sections discuss the theoretical implications of this project in detail.

6.3. Influence of native language

By definition, adult L2 readers have already mastered their native language, and therefore, it is possible that they are influenced by the grammatical properties of their L1 while processing an L2. In fact, there is a wealth of research that suggests L2 readers display residual L1 effects while processing an L2 even at a highly advanced proficiency (Juffs & Harrington, 1995; Lardiere, 2008; Tsimpli & Dimitrakopoulou, 2007).

6.3.1. L1 Uninterpretable features

According to the Interpretability Hypothesis (IH), uninterpretable syntactic features that have not been selected during native language acquisition will not be available for L2 grammar construction. This is because uninterpretable features do not appear at the LF interface (i.e., they do not have any semantic import), and therefore, they are less likely to be noticed in the L2 input (Tsimpli & Dimitrakopoulou, 2007). In order to test the IH, the participants completed a grammaticality judgment task (GJT) in Study 1 and rated the acceptability of different English RC types, particularly focusing on the uninterpretable CP [EPP, wh] features which drive wh-movement and relativiser choice, respectively, and uninterpretable TP [agreement] features which drive resumptive pronouns.

As discussed in Chapter 3, the particular settings of the above-mentioned features are different in Persian compared to English and French in such a way that unlike English and French, *(a)* resumption is grammatical in Persian DO- and OP RCs, *(b)* Persian does not have a CP [EPP] feature, hence being a wh-in-situ language, and *(c)* the only grammatical relativiser form in Persian is an invariant complementiser. Therefore, the IH predicts that L1-Persian readers learning English develop some form of grammatical knowledge of English RCs which systematically diverges from that of L1-French and native English readers.

The results, however, were not compatible with the predictions of the IH. It was found that even though the Persian readers accepted resumptive RCs in DO and OP RCs more frequently

compared to the other two groups, there were striking commonalities among the three groups. All overwhelmingly preferred gaps over resumptives and displayed an identical pattern with respect to the interaction between the relativisation strategy and the potential form of relativiser. Even though the only form of relativiser in Persian is an invariant complementiser, resumption acceptability in L1-Persian L2-English did not seem to be influenced by the form of relativiser used. Thus, it was concluded in Chapter 3 that the L1 Persian readers resorted to a resumptive strategy to counter processing limitations in DO and OP RCs. Similar explanations have been proposed with respect to the acceptability of resumptive pronouns in L1-English grammars (Hofmeister & Norcliffe, 2013), and given the hypothesis that L2 readers are more susceptible to cognitive resource limitations than native readers (Hopp, 2014), L2 readers are equally, if not more, likely to adopt a resumption strategy in DO and OP RCs. This argument is bolstered by the observation that the acceptability of resumption RCs in L2 English was negatively associated with proficiency and immersion experience, i.e., those L2 English readers that were highly proficient and lived for relatively long periods in an L2 environment were less likely to accept resumptives in L2 English RCs.

Thus, it can be concluded that inserting a resumptive pronoun in RCs potentially reflects an L2 developmental stage in the acquisition of RCs regardless of L1, which may persist longer in L2ers whose L1 grammaticalises resumption (Hitz, 2012). No evidence was found in support of the IH's claim that uninterpretable features are inaccessible at an advanced proficiency level.

6.3.2. L1 parsing routines

Given the findings of Study 1 that the underlying RC representations at an advanced proficiency in L2 English are not restricted by the particular settings of L1 uninterpretable features, it seems logical to ask whether the parsing of L2 English RCs is also unaffected by L1. Even though the grammar and the parser in some sense have a similar task – that of assigning a syntactic analysis to a string of words (Dussias, 2003; Papadopoulou, 2006) -- the

principles that guide them are not necessarily identical. This is because a string of words may be perceived as grammatically acceptable and still cause processing breakdown (e.g., see Frazier & Clifton, 1996). Therefore, it is possible that L2 readers demonstrate native-like grammatical knowledge at an advanced proficiency yet still use non-native-like parsing routines.

To examine this possibility, Studies 2 and 3 included data on only those L2 readers with native-like proficiency levels who performed within the range of native controls on the GJT, investigating whether L2 readers use the same set of constraints, rules, and principles in the L2 as native readers when parsing RCs in their native language.

6.3.2.1. Disambiguation strategies in L1

Many parsing theories have assumed the existence of universal parsing principles that strive to minimise burden on the underlying processing mechanism and improve computational efficiency (Frazier, 1978; Frazier & Clifton, 1996; Gilboy et al., 1995). For instance, some studies have suggested that when confronted with an ambiguous RC in English that has two potential antecedent host sites (DP1, DP2), the parser prefers an adjacent antecedent (i.e., DP2) over a non-adjacent antecedent (i.e., DP1) to ensure immediate integration of new constituents with prior materials (Frazier & Clifton, 1996; Papadopoulou, 2006). However, previous studies have shown that, unlike English readers, French (Dekydtspotter et al., 2008) and Persian (Marefat et al., 2015) readers prefer to attach RC ambiguities to a distant DP (i.e., DP1), and therefore, it is possible that L1-French and L1-Persian readers rely on their L1 and prefer DP1 attachment over DP2 attachment to conserve processing resources, especially when processing the L2 becomes difficult. This was investigated in Study 2, where three groups of L1-French, L1-Persian, and native English readers completed two SPR tasks involving temporarily ambiguous RCs that could be attached to either DP1 or DP2.

Consistent with an L1-based transfer account, the results of the first SPR task showed that the French and Persian readers favoured DP1 attachment when the RCs were presented in isolation. However, since the native English readers also favoured DP1 attachment, it is not completely clear if the observed L2 disambiguation strategy reflects the transfer of L1-based RC attachment preferences or indicates convergence on native-like parsing at a high proficiency. In fact, when considering the impact of individual differences in proficiency and WMC, the statistical analysis revealed that the French group did not have a robust attachment preference in isolated ambiguities, i.e., they sometimes attached the ambiguous RC to DP1 and other times to DP2, hence a null effect of attachment. In addition, neither the French nor the Persian readers displayed the same DP1 attachment strategy when the RCs were embedded in context in the second SPR task, suggesting that DP1 attachment was not strongly favoured by the two L2 groups. The French readers displayed a null attachment preference (neither DP1 nor DP2) in the second SPR task, and the Persian readers favoured attachment to DP1 in a DP1-supporting context and DP2 in a DP2-supporting context in the second SPR task, further questioning the hypothesis that RC disambiguation preferences in L2 are a function of RC disambiguation preferences in L1. Overall, despite the observation that both L2 groups tended towards a DP1 attachment preference in the first SPR task, the results of Study 2 question the transfer of L1 disambiguation strategies in L2 at an advanced proficiency.

6.3.2.2. Wh-movement in L1

Some studies have suggested that L2 readers of [-wh] L1s face persistent parsing difficulty when processing RCs in a [+wh] L2, since they are not used to performing wh-movement operations in real-time (Juffs & Harrington, 1995). This was investigated in Study 3, where three groups of L1-French [+wh], L1-Persian [-wh], and native English [+wh] controls completed an SPR task involving long-distance wh-dependencies, examining whether readers access syntactic copies while forming wh-dependencies. The results showed that compared to

the other two groups, the Persian readers slowed down less strongly at the region containing the intermediate copy. This might be interpreted as qualitatively different parsing at the region containing the intermediate copy by the L1-Persian readers; however, since this region occurred immediately after the first RC verb, it is not clear if this is due to the lesser sensitivity of the Persian readers to syntactic copies or slower processing of the verb's subcategorisation information. In fact, none of the three groups showed longer RTs at the subcategorising verb in conditions with the intermediate copy, thus suggesting that intermediate copies were not accessed at all by any of the groups. In addition, the analysis of the regions following the first RC verb showed that the Persian readers slowed down significantly more than the other two groups, suggesting that the above pattern reflects a quantitative rather than a qualitative difference. The Persian readers scored lower on the c-test proficiency task and had longer RTs in all regions, and therefore, it is possible that they showed a delayed effect of accessing the first RC verb's subcategorisation information (Hopp, 2014). In addition, the Persian readers showed a similar processing pattern in the final region as the other two groups and displayed protracted RTs on conditions with the extracted wh-morpheme, reflecting the integration of the extracted *who* with its subcategorising verb. Thus, the results suggest no evidence that an L1 [-wh] effect leads to qualitatively different parsing of L2 English RCs.

6.3.3. L1 typological organisation

This project also investigated the role of L1 typological properties in the processing of L2 English RCs. Unlike English and French, Persian is a scrambling language with a flexible word order, where constituency relations are heavily influenced by discourse-level information such as focus. As such, using the phrase structure rules of their native language, Persian readers might perceive discourse-level information as less marked or more universal and, therefore, display higher levels of sensitivity to discourse-based biases compared to French readers. This was investigated in Study 2, where the participants completed two SPR tasks involving

temporarily ambiguous RCs in isolation (SPR 1) or in context (SPR 2). Compatible with an L1-based transfer account, the results of SPR 2 showed that ambiguity resolution by more proficient Persian readers was affected by the contextual information preceding the critical RC ambiguity, such that they preferred a DP1 attachment strategy in a DP1-supporting context and a DP2 attachment strategy in a DP2-supporting context. By contrast, the French readers and the lower proficiency Persian readers displayed null attachment in contextualised RC ambiguities, suggesting that their disambiguation preferences were not affected by context. Given that the Persian readers were overall less proficient in English than the French readers, it is not immediately clear if the observed interaction between attachment and context reflects qualitatively different parsing by the Persian readers or is a signature of parsing at a lower proficiency.

Given their lower proficiency in L2 English, it is conceivable that the Persian readers had more difficulty than the French readers in computing RC disambiguation in real-time. Unlike in the first SPR task that involved RC ambiguities in isolation, the less proficient Persian readers might have failed to successfully establish a dependency relationship between the RC antecedent and the RC verb in the second SPR task, hence the lack of strong attachment preferences in the second SPR task. On the other hand, the more proficient Persian readers might have resorted to L1-Persian parsing preferences and relied on discourse-level cues to disambiguate RCs in context, i.e., favouring DP1 attachment in a DP1-supporting context and DP2 attachment in a DP2-supporting context.

Overall, the three Studies in this project suggest that L2 readers may sometimes resort to L1 to facilitate processing constraints in L2, but no evidence was found that this leads to qualitatively different processing of English RCs at an advanced proficiency.

6.4. Working memory constraints

Most (if not all) processing models attest to the significance of a capacity-limited processor, namely WM, which can only maintain limited amounts of information (Lewis et al., 2006; Van Dyke & Johns, 2012). According to serial processing theories, incremental processing becomes necessary because the parser cannot leave the incoming information unanalysed due to WM limitations (Frazier, 1978). Similarly, parallel parsing models suggest that the parser tends to compute only one analysis at a time since computing multiple analyses overtaxes WM resources (Crain & Steedman, 1985). However, despite the wealth of research on the role of WM in syntactic processing, the precise nature of WM limitations imposed on the sentence processing mechanism remains unclear, especially as far as processing an L2 is concerned (Cunnings, 2022). The findings of this project contribute to the debate by offering several implications on the role of WM in processing English RCs, both in L1 and L2.

6.4.1. Amount of information in working memory

Previous research suggests that language users are limited in the number of words and phrases that can be maintained in WM at one time (Ferreira & Henderson, 1990), or alternatively in how many information sources (e.g., syntax only vs. syntax plus discourse-level information) are utilised during language processing (Just & Carpenter, 1992). The following sections discuss the implications of the results for the hypothesis that WM can only process limited amounts of information.

6.4.1.1. Dependency length

Many studies have indicated that the cost of integrating a wh-morpheme with its subcategorising verb depends on the distance between the two, as the strength of memory representations fades with the passage of time and retrieval becomes increasingly difficult (e.g., see Gibson, 2000; Van Dyke & Johns, 2012). That is, increasing the distance between an

unattached constituent and its dependent head leads to increased processing difficulty (Gibson, 2000; Lewis et al., 2006; Van Dyke & Johns, 2012). This is compatible with the results of Study 1, since despite the lack of syntactic deficits (see above for details), the Persian readers accepted resumptive RCs in DO and OP RCs more than in subject (SU) RCs. Unlike in SU RCs, an additional NP subject always intervenes in DO and OP RCs between the extracted wh-morpheme and the subcategorising verb, leading to a non-adjacent syntactic relationship and thus causing increased processing difficulty. By inserting a resumptive pronoun in DO and OP RCs, the Persian readers enhance the availability of the extracted morpheme in WM by highlighting its morphosyntactic features (Lewis et al., 2006).

However, dependency length does not offer a satisfactory explanation regarding the processing pattern observed in Studies 2 and 3. The focus of Study 2 was on disambiguation strategies by the three groups of L1-French, L1-Persian, and native reader controls. If parsing strategies were (primarily) motivated by the need to minimise dependency length, all groups should have favoured DP2 over DP1 attachment as it offers a linearly closer antecedent site for the ambiguous RC. However, the results showed that all groups favoured DP1 attachment in isolated RC ambiguities, which seems especially surprising for the native controls given that previous studies suggest DP2 is the preferred attachment strategy in English (Frazier & Clifton, 1996; Gilboy et al., 1995). To explain the results, it should be noted that Study 2 assessed attachment preferences in an SPR task by using a moving-window technique, in which the participants were presented with only one window at a time. According to the Chunking Hypothesis (Swets et al., 2007), the integration of the complex DP and the RC in one region might lead the readers to chunk more information and therefore select the more economically efficient disambiguation strategy, i.e., to attach the ambiguous RC to a linearly closer antecedent, DP2. By contrast, the separation of the complex DP and the RC into two separate chunks could be interpreted as marking a syntactic discontinuity, where the RC is interpreted

as modifying the entire complex DP, rather than just DP2. The fact that the complex DP and the ambiguous RC were presented in two separate regions in this study might therefore have created a bias towards a DP1-attachment strategy (Swets et al., 2007).

Similarly, in Study 3, no lexical material intervened in VP conditions between the subject and its subcategorising verb (i.e., adjacent subject-verb relations), whereas the subject was always followed by a prepositional phrase (PP) in NP conditions. Therefore, a dependency length hypothesis would predict more processing difficulty at the embedded clause verb in NP conditions compared to VP conditions. However, the results showed that the critical source of processing difficulty at the embedded clause verb was not due to the phrasal manipulation (NP, VP) but was due to the additional parsing effort associated with the fronting of the wh-morpheme. It was the extraction conditions that were read slower at the embedded clause verb and not the NP conditions, suggesting that the readers integrated the extracted wh-morpheme at the subcategorising verb by relying on the verb's argument structure. This was the pattern observed for all groups, suggesting that dependency length is not the primary cause of processing difficulty in long-distance dependencies in L1 and L2.

Overall, the findings of this project are mixed regarding the impact of dependency length. While the results of Study 1 suggest that L2 readers of [+resumption] L1 backgrounds may resort to resumptive pronouns in RCs with non-adjacent subject-verb relationships (i.e., DO & OP RCs), The results of Studies 2 and 3 indicate the dependency length is not the primary predictor of processing difficulty. To explain this observed discrepancy, it should be noted that Study 1 administered an untimed GJT and the critical structures were unambiguous RCs that were not structurally nested, i.e., the extracted wh-morpheme and the subcategorising verb occurred within the same clause. By contrast, the readers in Study 2 were required to read RC ambiguities in real-time and thus might have been additionally impaired by the requirement to disambiguate these structures. Similarly, the materials in Study 3 involved nested

dependencies, where one RC was embedded into another, which must have added to the level of syntactic complexity involved. Overall, the results suggest that processing limitations in the form of efforts to minimise dependency length interacts with other sources of processing difficulty, including confusion over syntactic ambiguities and the added level of structural complexity due to nested dependencies.

6.4.1.2. Information sources in working memory

According to Just and Carpenter (1992), each word, phrase and proposition has a representational element in WM, and the number of available WM resources determines how many information types are recruited while processing RCs. Since processing an L2 is inherently more taxing for memory resources than native processing, L2 readers should consult fewer information sources when parsing English RCs, especially at lower proficiency levels. The results of Study 2 might be interpreted as being compatible with this hypothesis, since the Persian readers, who scored lower on the proficiency test, were more likely to be impacted by discourse-level information. However, this might also be taken as evidence of transfer of L1 Persian phrase structure rules. Since Persian involves constituency relations that are heavily impacted by discourse-level constraints such as topic dominance and focus, it may well be the case that the Persian readers were operating on their L1 whilst parsing RC ambiguities in L2 English (see above for a discussion). In addition, unlike the Persian readers, the French group did not show a significant interaction between attachment and context, thus questioning the argument that L2 readers are across the board less likely to consult non-syntactic information sources while parsing an L2. Similarly, the results of Study 3 indicated that the processing of long-distance RCs was not impacted due to the syntactic copy of the extracted *who* by any of the three groups. Rather, all groups showed sensitivity to the embedded clause verb's argument structure and displayed longer RTs in extraction conditions with a fronted wh-morpheme. Since the above pattern was observed for all groups, the results of Study 3 also undermine the

hypothesis that L2 readers consult fewer information types to satisfy processing constraints. Overall, no evidence was found in this project that the number of information types recruited is limited in L2 processing compared to native processing.

6.4.2. Individual differences in working memory capacity

This project also administered an online reading span task (Daneman & Carpenter, 1980) to explore the way individual differences in WMC impact the processing of English RCs. The critical hypothesis was that L2 readers of high WMC should be more likely to match native readers in the syntactic representations and parsing of English RCs (Dussias & Piñar, 2010). Compatible with this hypothesis, Study 1 found that native English readers with higher WMC did not accept resumptive RCs as much as the lower-span individuals, suggesting that resorting to a resumptive strategy mitigates WM limitations (Gass, 1979; Hofmeister & Norcliffe, 2013; Tezel, 1999). The same pattern of results was observed with the two L2 groups, i.e., WMC was negatively correlated with the acceptability of resumptive RCs, even though the trend did not reach statistical significance for the L2 groups. Furthermore, the L1-French readers with a higher WMC displayed a more pronounced DP1 preference in Study 2, and given that the native controls showed a DP1-attachment preference in isolated ambiguities, this suggests that high WMC is associated with more native-like disambiguation strategies. Moreover, in Study 3, high WM individuals in all groups had longer RTs on VP compared to NP structures, reflecting the processing of the additional verb in VP conditions. Furthermore, no significant interaction was observed between WMC and the parsing of the intermediate copy in extraction-VP structures in Study 3, suggesting that regardless of WMC, readers did not have access to the syntactic information afforded by the intermediate copy. Importantly, the above pattern was obtained for all groups, thus further suggesting that the underlying parsing mechanism in L1 and L2 were qualitatively similar.

However, it should also be noted that since the reading span task used to assess WMC in this study was administered online, there was little control over the task procedure to stop the rehearsal of the to-be-remembered information. In fact, 38% of the native English readers, 39% of the L1-French readers, and 28% of the L1-Persian readers scored above 90% accuracy in retaining the to-be-remembered information, suggesting possible ceiling effects. It might well be the case that the WMC measure obtained from the reading span task in this study was not powerful enough to show a reliable contingency with some of the critical manipulations in this project.

6.4.3. Similarity-based interference

In contrast to the capacity-based view of WM (Just & Carpenter, 1992), interference-based accounts suggest that it is the quality (as opposed to the quantity) of information in WM that determines successful language processing (Cunnings, 2022; Van Dyke & Johns, 2012). According to cue-based theories of sentence comprehension (Gordon et al., 2006; Lewis et al., 2006), the success of WM operations is dependent on the similarity of different items in memory, i.e., to the extent that memory representations of linguistic elements are similar, language processing will be disrupted in both L1 and L2, hence causing similarity-based interference (Cunnings, 2022). This project investigated similarity-based interference in Study 3 by including two matched and unmatched conditions, where the subject of the embedded clause in the long-distance dependencies was either a descriptive noun (as the previous nouns; matched conditions) or a proper name (unlike the previous nouns; unmatched conditions). If the presence of unmatched NPs helps readers make a more syntactically detailed parse that contains the intermediate copy of the extracted wh-morpheme, an interference-based view of WM predicts a larger RT advantage on the extraction-VP compared to extraction-NP structures in the case of unmatched conditions.

However, contrary to this prediction, it was found that all groups read the VP structures slower in unmatched conditions, which is the opposite of what an interference-based view would predict. There are two possible explanations for this. It might be argued that the readers managed to successfully encode the intermediate copy prior to *that* in extraction-VP structures with unmatched VPs, as evidenced by the longer RTs of VP structures in unmatched conditions following the complementiser *that*. If this is the case, the lack of a significant interaction between phrase type and interference at the embedded clause verb might be interpreted as spill-over effects of the previous regions. That is, the VP structures were read slower in the region immediately following the complementiser *that* in unmatched conditions, and this might have masked faster RTs of unmatched conditions in the region including the embedded clause verb. However, no RT difference was observed between matched and unmatched conditions in the region prior to the embedded clause verb, suggesting that any spill-over effects were neutralised by then. Thus, this is an unlikely explanation, and the observation that no RT difference was found between the matched and unmatched conditions at the embedded clause verb suggests that intermediate copies were not utilised regardless of the amount of interference induced.

A second possibility is that readers slowed down more at VP structures in the region following the complementiser *that* due to the additional difficulty associated with the processing of proper names (Cohen, 1990). A less pronounced RT difference was observed between the matched and unmatched conditions among the Persian readers (compared to the other two groups), suggesting that they were less sensitive to proper/description name distinction. This is in line with previous research that suggests L2ers of lower proficiency have a less distinct lexical representation of description and proper names (Hopp, 2018). Overall, the results of Study 3 do not support the hypothesis that L2 readers are more susceptible than native readers to

similarity-based interference, since no RT facilitation effects were found in unmatched conditions for any of the groups due to antecedent reactivation by the intermediate copy.

However, it should be noted that the above argument remains speculative, since the two interference conditions were not fully matched; therefore, the interaction observed in region 4 between interference and phrase type might related to the different lexical materials in the two conditions. For instance, it might well be the case that the impact of interference is more local and appears in the most embedded RC, not in the left-most RC, as in *(2)* rather than *(1)*:

(1) The politician who (the journalist stated that John / John's statement about the journal) had fascinated…

(2) The politician (who the journalist stated that John / who the journalist's statement about John) had fascinated…

Clearly, further research is required to examine the relationship between similarity-based interference and depth of syntactic processing in parsing long-distance wh-structures.

6.5. Sensitivity to different information types in L1 and L2

There is no agreement on the use of different information types in L2 processing (Cunnings, 2017; Hopp, 2014; Papadopoulou, & Clahsen, 2003). While some L2 processing theories argue that (at an advanced proficiency) L2 readers access syntactic information to the same extent as native readers (e.g., Hopp, 2014; Pliatsikas & Marinis, 2013), others suggest that building syntactic representations in an L2 is more strongly guided by non-syntactic information sources such as lexical subcategorisation (Papadopoulou, & Clahsen, 2003) and discourse-level information (Pan et al., 2015). This project sheds light on the use of syntactic and non-syntactic information.

6.5.1. Syntactic information

Study 1 investigated the CP [EPP, wh] and TP [agreement] syntactic features that underlie relativisation strategies in English, French, and Persian. The critical hypothesis tested was whether L2 English readers of L1-French and L1-Persian display a similar acceptability behaviour with respect to resumption, motivated by TP [agreement] features, and relativiser choice, motivated by [EPP, wh] features. If L2 readers underuse syntactic information compared to native readers, there should be a different acceptability pattern between the L2 groups and the native reader controls.

The results suggested that both L2 groups had acquired the above-mentioned syntactic features, despite the difference in the particular settings of these features in their native languages French and Persian. Specifically, the L1-French readers seemed to face little difficulty pre-empting the increased syntactic complexity of French RCs which restricts the distribution of relativisers. They seemed to have acquired the [+wh] feature in SU and DO RCs, which allows English SU and DO RCs to begin with an overt wh-operator, unlike the case of relativisers in L1 French which allows only an invariant complementiser in SU and DO RCs. No difference was observed in acceptability of English RC types between the French and the English readers. As for Persian readers, the results suggested that they too have acquired both the wh-operator movement and the syntactic ban on resumptive pronouns in L2 English RCs. If it were the case that they were operating on L1-Persian uninterpretable features, they should have displayed higher acceptability rates for *that* RCs than for *who* RCs, since Persian does not allow wh-morphemes to function as relativisers. However, the results showed that not only did the L1-Persian readers predominantly favour a gap over a resumptive strategy, they also showed a differential pattern of preference in grammatical RCs for the form of relativiser, displaying significantly higher acceptability rates for *who ... gap* RCs than *that ... gap* RCs, similar to native readers.

Similarly, Study 2 investigated disambiguation strategies in L2 English RCs by L1-French and L1-Persian. Some previous studies did not find a strong attachment preference and argued that L2 readers favour null attachment (Felser et al., 2003; Papadopoulou & Clahsen, 2003), which culminated in the Shallow Structure Hypothesis (SSH; Clahsen & Felser, 2006, 2018; Felser, 2019) that argues that L2 parsing is syntactically shallower than native parsing. According to the SSH, the observation that L2 readers do not show a strong attachment preference can be construed as evidence that unlike native readers, L2 readers fail to establish a syntactic agreement relationship in RC ambiguities between the antecedent (either DP1 or DP2) and the RC verb. However, it is possible that the participants in those studies were not advanced enough to display native-like disambiguation in L2 English or that they might not have enjoyed native-like syntactic knowledge of the disambiguation cues used. In Study 2, an untimed GJT was administered to ensure that the L2 readers in this study had sufficient knowledge of the syntactic feature used for RC disambiguation, i.e., subject-verb agreement. The results showed that all groups displayed a similar DP1 attachment when RC ambiguities were presented in isolation, i.e., not only did the L2 readers have a robust attachment strategy, but they also showed similar sensitivity to the agreement disambiguation cue of the RC verb. This is not compatible with previous research showing null attachment in L2, potentially reflecting the advanced proficiency state of the participants in this study. While the participants in the previous studies were intermediate-to-advanced L2 learners (Clahsen & Felser, 2006), the participants in this study were highly advanced and had native-like knowledge of the syntactic cue used for RC disambiguation. Therefore, it is not surprising that the L2 readers showed a robust native-like disambiguation strategy in isolated ambiguities. Overall, the results of Study 2 undermine the hypothesis that L2 readers are less sensitive to syntactic information compared to native readers, at least at a highly advanced proficiency.

Furthermore, Study 3 investigated L2 processing of English long-distance wh-dependencies by L1-French and L1-Persian readers and examined if L2 parsing is facilitated by the presence of abstract syntactic information such as the intermediate copy of the extracted wh-morpheme. Assuming that unlike native readers, L2 readers do not access the syntactic copies of wh-morphemes (Marinis et al., 2005), a different processing pattern was expected between the L2 groups and the native English readers. However, the results showed that none of the groups – neither the two L2 groups nor the English native controls – utilised intermediate syntactic copies in forming wh-dependencies. According to the Trace Reactivation Hypothesis (TRH), the intermediate copy occurs following the complementiser *that* in extraction-VP conditions of Study 3. Therefore, if readers accessed the intermediate copy, as suggested by the TRH, they should have displayed longer RTs at *that* in extraction-VP conditions. In addition, according to the TRH, the presence of the intermediate copy minimises the dependency distance between the wh-morpheme and the subcategorising verb, and if syntactic copies are accessed, readers should have displayed faster RTs at the embedded clause verb in extraction-VP conditions. However, the results showed no significant difference at either the complementiser/relative pronoun or the embedded clause verb between extraction-VP (with intermediate copy) and extraction-NP conditions (without intermediate copy), suggesting that syntactic copies of extracted wh-morphemes are not accessed while processing long-distance wh-dependencies.

The results of Study 3 are compatible with the Good-enough (GE) Theory of language processing (Christianson et al., 2001; Ferreira & Patson, 2007), according to which linguistic representations in native processing are only good enough for the task at hand and become syntactically elaborated only if motivated by the task requirements (H. Karimi & Ferreira, 2016). The GE theory suggests that readers engage in a "small set of fast and frugal heuristics" to accomplish the information processing task, especially if they are not specifically motivated to devote attentional resources (Ferreira & Patson, 2007, p. 72). The online data in this study

might have biased the results in such a way that readers would not be as invested as they would have been in a controlled lab-based experiment, thus (under)relying on abstract syntactic information. Since the above pattern was observed for all groups, the results of Study 3 also question the argument that L2 readers are less sensitive to syntactic information compared to native readers. Overall, no evidence was found in this project that L2 readers are less sensitive to syntactic information than native readers while processing English RCs.

6.5.2. Discourse-level information

The second SPR task in Study 2 presented RC ambiguities in short paragraphs, where the sentences prior to the critical RC ambiguity biased attachment preferences to either DP1 or DP2. Under the hypothesis that L2 readers are more sensitive to non-syntactic information such as discourse-level cues (Clahsen & Felser, 2006, 2017), it was expected that unlike the native English controls, both French and Persian readers would display sensitivity to the contextual manipulations, i.e., they should favour DP1 attachment in a DP1-supporting context and DP2 attachment in a DP2-supoting context. However, the results indicated that the above pattern was observed only for the more proficient Persian readers.

This might be interpreted as less sensitivity to syntactic disambiguation information (subject-verb agreement) by the proficient Persian readers. However, this is not a valid interpretation. Given the offline nature of the GJT, it is conceivable that some of the RT data that were ultimately entered into the statistical analysis came from those L1-Persian readers that were not as advanced as the other two groups in performing RC disambiguation. Unlike in the first SPR task that involved RC ambiguities in isolation, the less proficient Persian readers might have failed to successfully establish a dependency relationship between the RC antecedent and the RC verb in the second SPR task, hence the lack of strong attachment preferences in contextualised RC ambiguities. On the other hand, the more proficient Persian readers may have resorted to L1-Persian parsing preferences and relied on discourse-level cues to

disambiguate RCs in context, i.e., favouring DP1 attachment in a DP1-supporting context and DP2 attachment in a DP2-supporting context.

6.5.3. Lexical subcategorisation information

Study 3 investigated the role of lexical subcategorisation information by requiring the three groups of L1-French, L1-Persian, and native English controls to form long-distance wh-dependencies by drawing on the verb's argument structure. Under the hypothesis that L2 readers over-rely on non-syntactic information while parsing an L2, a difference was expected in the processing pattern of the native control readers and the two L2 groups. However, the results indicated that all groups relied on lexical subcategorisation information to establish the dependencies. All groups showed protracted RTs at the complementiser/wh-pronoun on VP structures, reflecting the encoding of the extracted wh-morpheme. In addition, all groups had longer RTs at the embedded clause verb of extraction conditions, suggesting the integration of the wh-morpheme with its subcategorising verb. Longer RTs for VP structures at the complementiser/relative pronoun reflect the additional cost associated with the subcategorisation information of the verb in VP structures prior to *that/about*, while longer RTs on extraction structures at the embedded clause verb reflect the cost associated with the integration of the extracted morpheme *who* with its subcategorising verb (Gibson, 2000). The results of Study 3 are consistent with the Direct Association Hypothesis (DAH; Pickering & Barry, 1991) that locates the source of processing difficulty in accessing the verb's subcategorisation information. Since the above pattern was observed for both the native and L2 groups, the results of Study 3 also call into question the SSH's claim that L1 and L2 parsing of wh-dependencies are qualitatively different due to reliance on different information sources (Clahsen & Felser, 2006).

Overall, the results of the three Studies in this project do not support the representational deficit accounts that suggest L2 readers are across the board less sensitive to syntactic information

while processing wh-dependencies. No evidence was found in this project that L2 readers prioritise non-syntactic over syntactic information while processing English RCs. In addition, when L2 processing shows sensitivity to non-syntactic information, this is probably due to the influence of L1 or a lack of sufficient cognitive resources to process complex structures in L2, rather than an indication of syntactic deficits in L2.

6.6. Limitations and suggestions for future research

The studies in this project have a number of important and potentially worthwhile theoretical implications in the field of L2 processing as well as suggesting multiple avenues and several recommendations for further research. However, a number of limitations need to be addressed regarding the findings.

As discussed in Chapter 1, different RC types modify nouns in slightly different ways (Cinque, 2020; Poletto & Sanfelici, 2017), and therefore, it is possible that they involve different acquisitional and processing patterns (Hawkins, 1989; Keenan & Comrie, 1977; Luzi, 2012; Myles, 1995). For instance, consider Study 1 which examined the role of uninterpretable features of [EPP, wh, agreement] in the acceptability of different English RCs. While the results suggested that the syntactic representations of RCs were not qualitatively different in L1 and L2, Study 1 did not investigate the role of interpretable features in the acceptability of different English RCs. According to the IH (Tsimpli & Dimitrakopoulou, 2007), L2 readers over-rely on interpretable features to constrain the use of ungrammatical L2 phenomena due to the inaccessibility of uninterpretable features. While the results of Study 1 question the claim by the IH that uninterpretable features are not accessible in adult L2 grammars, they do not shed light on the use of interpretable features in L2. More specifically, an argument can be made that all of the GJT materials in Study 1 involved RCs with human referents (an interpretable feature), which might confound the results of Study 1, particularly the observed native-like acceptability of the L2 readers. It could be argued that the L1 Persian readers, for example,

received positive evidence in the L2 environment that *who*-relatives are more frequent than *that*-relatives for human referents, and thus managed to achieve native-likeness by resorting to the interpretable feature of [+/- human], not necessarily acquiring the uninterpretable [EPP, wh] features. As discussed in Chapter 3, while this proposal can successfully explain the higher acceptability rates of *who* than *that* in grammatical gapped RCs, it falls short of adequately explaining the pattern of results observed in ungrammatical resumptive RCs. Resumption in Persian always appears with an invariant complementiser and if L1 Persian readers were operating based on their L1 uninterpretable features, *that* resumption RCs should have been favoured compared to *who* resumption RCs. Nevertheless, Study 1 did not specifically investigate the role of interpretable features such as [+/- human] in the acceptability of different RC types, and thus, the above explanation remains speculative and is in need of further research.

A similar issue arises with the interpretation of the results of Study 2. Previous studies have suggested that RC disambiguation strategies are generally very mild (Gilboy et al., 1995), and even English natives display variable attachment preferences, i.e., sometimes DP1 and other times DP2, depending on a variety of factors such as the RC length (Carreiras & Clifton, 1993; Swets et al., 2007) or individual differences in the size of cognitive resources (e.g., as measured by WMC; Kim & Christianson, 2017). In fact, according to Frazier and Clifton (1996), RCs are processed in non-deterministic ways, and ambiguous RCs are never strongly attached to either DP1 or DP2. Since parsing RC ambiguities does not involve committing to a robust attachment strategy, the findings of Study 2 might not be generalisable to other syntactic phenomena. More research is required to investigate the L2 parsing of ambiguities in syntactic structures for which native readers have been shown to display a robust disambiguation strategy. For instance, consider the example of *(*noun + verb-PAST) sequences in English, which are frequently ambiguous because the same verb form, usually verb + “ed”, is used for

both the past tense and participle forms of many verbs. A fragment starting with a noun followed by a verb (e.g., *the patient presented …*) is ambiguous between a main clause (e.g., *the patient presented the documents*) and a reduced RC interpretation (e.g., *the patient presented by the doctor*). Many studies have reported that native readers face processing difficulty as soon as they encounter the preposition *by* (as in *the patient presented by the doctor*) that disambiguates these structures towards a reduced RC interpretation (e.g., Spivey et al., 1993, p. 307). However, to the best of the researcher's knowledge, no studies to date have been carried out to compare L1 and L2 processing of main clause and reduced relatives in English sequences of *(*noun + verb-PAST).

Furthermore, the findings of the three Studies in this project suggested that L2 parsing of English RCs is more likely to be affected at an advanced proficiency by cognitive resource limitations, particularly constraints in WM, rather than by potential syntactic deficits in the underlying grammatical knowledge. However, none of the three Studies systematically investigated the underlying operations involved in WM when processing L2 English RCs. In fact, contrary to the predictions of the interference-based view of WM, the results of Study 3 suggested that L2 parsing of English RCs is not facilitated by the representational distinctiveness between common and proper names, but that proper names increase the processing difficulty of long-distance RCs in both L1 and L2. This is not compatible with cue-based parsing models that attest to the significance of representational distinctiveness in processing wh-dependencies. Given previous studies that suggest WM representations are a function of, among other things, factors such as the degree of noun specificity (Hofmeister, 2011), number of semantic attributes (Hofmeister, 2011) and the presence of elaborative information in the preceding context (Troyer et al., 2016), a more thorough and fruitful investigation of L2 processing can utilise these factors to examine the nature of WM operations in L1 and L2, at three levels of analysis: one at the word level (examining the role of noun-

specificity), one at the phrase level (examining the role of number of semantic attributes), and one at the discourse level (examining the role of elaborative information).

Another limitation of the findings of this project pertains to the way nativelikeness was operationalised in Chapters 3, 4, and 5. It was assumed in this project that L2ers have native-like performance when they do not differ significantly from the native readers. However, this definition is limited, in that it does not adequately address the wide range of previously reported studies on L1 performance. A more fruitful investigation of L1-L2 processing differences should examine not only potential performance differences between the L2 readers and a group of native reader controls but also explain any potential discrepancies between the observed results for the L2 readers and the previously reported findings on L1 performance. This is especially an issue in Chapter 4, which reported that L1 disambiguation preferences were not affected by contextual manipulations. Even though it was argued in Chapter 4 that the results are compatible with syntax-first models of parsing such as the Garden Path and Predicate Proximity Models, the observed lack of sensitivity to contextual information by native readers is not compatible with a bulk of previous studies suggesting the significance of non-syntactic information in L1 parsing preferences (Crain & Steedman, 1985; MacDonald & Christiansen, 2002; Papadopoulou & Clahsen, 2006). There are other ways to operationalise native-like performance in L2 processing research, and as such, more research is required to investigate native-like processing preferences, especially as far as RC disambiguation preferences are concerned.

This project was also subject to methodological limitations. As discussed in Study 3, the results suggested that readers do not access the intermediate copy of the extracted wh-morpheme when forming wh-dependencies, since no significant interactions were observed at the complementiser *that* and the subcategorising verb between phrase type and extraction. This is not compatible with previous research suggesting that the processing of English RCs is

facilitated by syntactic copies of extracted wh-morphemes, which is especially surprising for the native English readers (Gibson & Warren, 2004; Marinis et al., 2005; Pliatsikas & Marinis, 2013). It was argued in Study 3 that even native readers sometimes engage in shallow processing and that the syntactic representations constructed in real-time native processing may also lack sufficient accuracy and syntactic detail (Christianson et al., 2001; Ferreira & Patson, 2007). This is rather speculative, however; it is also possible that the above pattern reflects the Internet-based nature of the data (due to Covid-19 restrictions) and the fact that the participants were not adequately attentive to the task, even though additional measures were taken in this project to ensure data quality. Therefore, a lab-based replication of Study 3 would help confirm the unexpected processing pattern observed with respect to the lack of significant effect of intermediate copies.

6.7. Conclusion

This project investigated the syntactic representations and processing of English RCs by L1-French, L1-Persian, and native English readers. The three studies discovered an absence of representational deficits in the L2 syntactic knowledge and processing of English RCs. Specifically, it was found that *(a)* the syntactic representations of resumptive pronouns and relativiser choice in English RCs are essentially similar in L1 and L2 (Study 1); *(b)* processing ambiguous RCs in English is subserved by a qualitatively similar parser in L1 and L2 (Study 2); and *(c)* establishing long-distance wh-dependencies in English is achieved by reliance on the verb's subcategorisation information in both L1 and L2, and not by accessing intermediate syntactic copies (Study 3). Overall, the findings of this project suggest that highly advanced L2 readers match native readers in both syntactic representations and underlying processing mechanism. Where L1-L2 differences arise at an advanced proficiency, this is more likely to reflect real-time processing limitations rather than syntactic deficits. More research is required

to investigate the potential interrelationship between L2 processing and cognitive resource limitations, particularly constraints on WM.

References

Abdollahnejad, E., & Marefat, H. (2017). Relative clauses in Persian: A small-scale corpus study. *Lingvisticæ Investigationes*, *40*(2), 135-149. https://doi.org/10.1075/li.00001.abd

Adger, D. (2003). *Core Syntax: A Minimalist Approach*. Oxford: Oxford University Press.

Aghaei, B. (2006). *The syntax of ke-clause and clausal extraposition in Modern Persian*. (MA thesis, University of Texas at Austin).

Alexiadou, A., Law, P., Meinunger, A., & Wilder, C. (2000). *Introduction.* In Alexiadou, A., Law, P., Meinunger, A., & Wilder, C. (Eds.). (2000). The syntax of relative clauses. Amsterdam: John Benjamins.

Alexopoulou, T., & Keller, F. (2007). Locality, cyclicity, and resumption: At the interface between the grammar and the human sentence processor. *Language*, 110-160.

Baddeley, A. D., Eysenck, M. W., & Anderson, M. C. (2009). *Memory*. Hove: Psychology Press.

Bader, M., & Häussler, J. (2010). Toward a model of grammaticality judgments1. *Journal of Linguistics*, *46*(2), 273-330.

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, *67*(1), 1–48. https://doi.org/10.18637/jss.v067.i01

Belikova, A., & White, L. (2009). Evidence for the fundamental difference hypothesis or not?: Island constraints revisited. *Studies in Second Language Acquisition*, *31*(2), 199-223. https://doi.org/10.1017/s0272263109090287

Ben-Shachar, M., Lüdecke, D., & Makowski, D. (2020). effectsize: Estimation of effect size indices and standardized parameters. *Journal of Open Source Software* 5: 2815.

Biber, D., Johansson, S., Leech, G., Conrad, S., Finegan, E., & Quirk, R. (1999). *Longman grammar of spoken and written English* (Vol. 2). London: Longman.

Bley-Vroman, R. (2009). The evolving context of the fundamental difference hypothesis. *Studies in Second Language Acquisition*, *31*(2), 175-198.

Bley-Vroman, R., & Masterson, D. (1989). Reaction time as a supplement to grammaticality judgements in the investigation of second language learners' competence. *University of Hawai'i Working Papers in ESL*, *8*(2), 207-237.

Branigan, H. P., & Pickering, M. J. (2017). An experimental approach to linguistic representation. *Behavioral and Brain Sciences, 40*, e282.

Carnie, A. (2013). *Syntax: A Generative Introduction*, Oxford: Blackwell.

Carreiras, M., & Clifton, C. (1993). Relative clause interpretation preferences in Spanish and English. *Language and Speech*, *36*(4), 353-372.

Çele, F., & Gürel, A. (2011). L2 acquisition of wh-extractions via a [-wh-movement] L1. In *Proceedings of the 11th Generative Approaches to Second Language Acquisition Conference (GASLA 2011)* (pp. 30-44).

Chomsky, N. (1995). *The Minimalist Program*. Cambridge, MA: MIT Press. https://doi.org/10.7551/mitpress/9780262527347.001.0001

Chomsky, N. (2000). *New Horizons in the Study of Language and Mind*, Cambridge, Cambridge University Press. https://doi.org/10.1017/cbo9780511811937

Christianson, K. (2016). When language comprehension goes wrong for the right reasons: Good-enough, underspecified, or shallow language processing. *Quarterly Journal of Experimental Psychology*, *69*(5), 817-828.

Christianson, K., Hollingworth, A., Halliwell, J. F., & Ferreira, F. (2001). Thematic roles assigned along the garden path linger. *Cognitive Psychology*, *42*(4), 368-407.

Cinque, G. (2020). *The syntax of relative clauses: A unified analysis*. Cambridge: Cambridge University Press.

Clahsen, H., & Felser, C. (2006). Grammatical processing in language learners. *Applied Psycholinguistics*, *27*, 3-42.

Clahsen, H., & Felser, C. (2018). Some notes on the shallow structure hypothesis. *Studies in Second Language Acquisition*, *40*(3), 693-706.

Cohen, G. (1990). Why is it difficult to put names to faces?. *British Journal of Psychology*, *81*(3), 287-297.

Colonna, S., & Pynte, J. (2002). La levée des ambiguïtés syntaxiques: apport des recherches inter-langues. *L'Année Psychologique*, *102*, 151-187.

Conway, A. R., Kane, M. J., Bunting, M. F., Hambrick, D. Z., Wilhelm, O., & Engle, R. W. (2005). Working memory span tasks: A methodological review and user's guide. Psychonomic Bulletin & Review, 12 (5), 769 –786. https://doi.org/10.3758/bf03196772

Couro, T., & Langdon, M. (1975). *Let's Talk 'Iipay Aa: An Introduction to the Mesa Grande Diegueño Language*. Ramona, California: Ballena Press.

Crain, S., & Steedman, M. (1985). On not being led up the garden path: The use of context by the psychological syntax processor. In D. R. Dowty, L. Karttunen, & A. M. Zwicky (Eds.), *Natural language parsing: Psychological, computational and theoretical perspectives* (pp. 320–358). Cambridge: Cambridge University Press.

Cuetos, F., & Mitchell, D. (1988). Cross-linguistic differences in parsing: Restrictions on the use of the late closure strategy in Spanish. *Cognition* 3. 73–105.

Cunnings, I. (2017). Parsing and working memory in bilingual sentence processing. *Bilingualism: Language and Cognition*, *20*(4), 659-678.

Cunnings, I. (2022). *Working memory and L2 sentence processing*. In Schwieter, J. W. & Wen, Z. (Eds.), The Cambridge Handbook of Working Memory and Language. Cambridge University Press, pp. 593-612.

Cunnings, I., & Fujita, H. (2021). Similarity-based interference and relative clauses in second language processing. *Second Language Research*, Advance online publication.

Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior*, *19*(4), 450-466. https://doi.org/10.1016/s0022-5371(80)90312-6

Dekydtspotter, L., Donaldson, B., Edmonds, A. C., Fultz, A. L., & Petrush, R. A. (2008). Syntactic and prosodic computations in the resolution of relative clause attachment ambiguity by English-French learners. *Studies in Second Language Acquisition*, *30*(4), 453-48.

Dekydtspotter, L., Schwartz, B. D., & Sprouse, R. A. (2006). The comparative fallacy in L2 processing research. In *Proceedings of the 8th generative approaches to second language acquisition conference (GASLA 2006)* (Vol. 3340). Somerville, MA: Cascadilla Proceedings Project.

Del Gobbo, F. (2005). Chinese relative clauses: restrictive, descriptive or appositive?. In *Brugè, Laura et al.(eds.), Contributions to the thirtieth Incontro di Grammatica Generativa, Venezia: Libreria Editrice Cafoscarina, 2005, pp. 207-305.*. Venezia, Libreria Editrice Cafoscarina.

Dickens, K. R. (2018). *The acquisition of relative clause structures in L2 French*. (MA thesis, University of Delaware).

Dietrich, H. (2007). *Relative Clauses with Relative Pronouns*. GRIN Verlag, Munich, Germany.

Dörnyei, Z., & Katona, L. (1992). Validation of the C-test amongst Hungarian EFL learners. *Language Testing*, *9*(2), 187-206.

Dryer, M. (2005). *Order of relative clauses and nouns*. In M. Haspelmath, M. S. Dryer, D. Gil, and B. Comrie (Eds.), The world atlas of language structures, 366-370. Oxford: Oxford University Press.

Dussias, P. E. (2003). Syntactic ambiguity resolution in L2 learners: Some effects of bilinguality on L1 and L2 processing strategies. *Studies in Second Language Acquisition*, *25*(4), 529-557.

Dussias, P. E. (2010). Uses of eye-tracking data in second language sentence processing research. *Annual Review of Applied Linguistics*, *30*, 149-166.

Dussias, P. E., & Piñar, P. (2010). Effects of reading span and plausibility in the reanalysis of wh-gaps by Chinese-English second language readers. *Second Language Research*, *26*(4), 443-472.

Dussias, P. E., & Sagarra, N. (2007). The effect of exposure on syntactic parsing in Spanish–English bilinguals. *Bilingualism: Language and Cognition*, *10*(1), 101-116.

Ellis, R. (2005). Measuring implicit and explicit knowledge of a second language: A psychometric study. *Studies in Second Language Acquisition*, *27*(2), 141-172.

Felser, C. (2019). Structure-sensitive constraints in non-native sentence processing. *Journal of the European Second Language Association*, *3*(1).

Felser, C., Marinis, T., & Clahsen, H. (2003). Children's processing of ambiguous sentences: A study of relative clause attachment. *Language Acquisition*, *11*(3), 127-163.

Fernández, E. (1999). *Processing strategies in second language acquisition: Some preliminary results*. In E. Klein & G. Martohardjono (Eds.), The development of second language grammars: A generative approach (pp. 217–240). Amsterdam: John Benjamins.

Ferreira, F., & Henderson, J. M. (1990). Use of verb information in syntactic parsing: evidence from eye movements and word-by-word self-paced reading. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *16*(4), 555.

Ferreira, F., & Patson, N. D. (2007). The 'good enough' approach to language comprehension. *Language and Linguistics Compass*, *1*(1-2), 71-83.

Frazier, L. (1978). *On comprehending sentences: Syntactic parsing strategies*. Storrs, CT: University of Connecticut, Storrs, dissertation.

Frazier, L., & Clifton, C. (1996). *Construal*. Cambridge, MA: MIT Press.

Frazier, L., & Fodor, J. D. (1978). The sausage machine: A new two-stage parsing model. *Cognition*, *6*(4), 291-325.

Frenck-Mestre, C. (1997). Examining second language reading: An on-line look. In A. Sorace, C. Heycock & R. Shillcock (eds.), *Proceedings of the GALA '97 Conference on Language Acquisition*, pp. 444‑449. Edinburgh: University of Edinburgh Press.

Frenck-Mestre, C. (2002). *An on-line look at sentence processing in the second language*. In R. R. Heredia & J. Altarriba (Eds.), Bilingual sentence processing (pp. 217–236). Amsterdam: Elsevier.

García Mayo, M. P. (2003). Age, length of exposure and grammaticality judgments in the acquisition of English as a foreign language". In M.P. García Mayo and M. L. García Lecumberri (eds.) *The Acquisition of English as a Foreign Language* (94- 114). Clevedon: Multilingual Matters.

Gass, S. (1979). Language transfer and universal grammatical relations. *Language Learning*, *29*(2), 327-344. https://doi.org/10.1111/j.1467-1770.1979.tb01073.x

Gass, S. (1983). The development of L2 intuitions. *Tesol Quarterly*, *17*(2), 273-291.

Gibson, E. (1998). Linguistic complexity: Locality of syntactic dependencies. *Cognition*, *68*(1), 1-76.

Gibson, E. (2000). The dependency locality theory: A distance-based theory of linguistic complexity. *Image, Language, Brain, 2000*, 95-126.

Gibson, E., Desmet, T., Grodner, D., Watson, D., & Ko, K. (2005). Reading relative clauses in English. *Cognitive Linguistics, 16*(2), 313–353.

Gibson, E., Pearlmutter, E., Canseco-González, E., & Hickok, G. (1996). Cross-linguistic attachment preferences: Evidence from English and Spanish. *Cognition* 59. 23–59.

Gibson, E., & Warren, T. (2004). Reading-time evidence for intermediate linguistic structure in long-distance dependencies. *Syntax*, *7*(1), 55-78.

Gilboy, E., Sopena, J. M., Clifton, C., & Frazier, L. (1995). Argument structure and association preferences in Spanish and English complex NPs. *Cognition*, *54*(2), 131-167.

Goad, H., Guzzo, N. B., & White, L. (2021). Parsing ambiguous relative clauses in L2 English: Learner sensitivity to prosodic cues. *Studies in Second Language Acquisition*, *43*(1), 83-108.

Gordon P.C., Hendrick R, and Johnson M (2001) Memory interference during language processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *27*(6), 1411–23.

Gordon P.C., Hendrick R, and Johnson M (2004) Effects of noun phrase type on sentence complexity. *Journal of Memory and Language*, *51*(1): 97–114.

Gordon, P. C., Hendrick, R., Johnson, M., & Lee, Y. (2006). Similarity-based interference during language comprehension: Evidence from eye tracking during reading. *Journal of experimental psychology: Learning, Memory, and Cognition*, *32*(6), 1304-1321.

Grillo, N., Costa, J., Fernandes, B., & Santi, A. (2015). Highs and lows in English attachment. *Cognition*, *144*, 116-122.

Gutiérrez, X. (2013). The construct validity of grammaticality judgment tests as measures of implicit and explicit knowledge. *Studies in Second Language Acquisition*, *35*(3), 423-449.

Hawkins, J. A. (2007). Acquisition of relative clauses in relation to language universals. *Studies in Second Language Acquisition*, *29*(2), 337-344.

Hawkins, J. A. (2009). *Language universals and the performance-grammar correspondence hypothesis*. In M. H. Christiansen, C. Collins & S. Edelman (Eds.), Language universals, pp. 54–78. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195305432.003.0004

Hawkins, R. (1989). Do Second Language Learners Acquire Restrictive Relative Clauses on the Basis of Relational or Configurational Information? The Acquisition of French Subject, Direct Object and Genitive Restrictive Relative Clauses by Second Language Learners. *Second Language Research*, *5*(2), 156-88. https://doi.org/10.1177/026765838900500204

Hawkins, R. (2005). Revisiting wh-movement: The availability of an uninterpretable [wh] feature in interlanguage grammars. In Dekydtspotter, L., Sprouse, D.R. and Liljestrand, A., editors, *Proceedings of the 7th Generative Approaches to Second Language Acquisition Conference (GASLA 2004)*. Somerville, MA: Cascadilla Proceedings Project 124–37.

Hawkins, R., & Chan, C. Y. H. (1997). The partial availability of Universal Grammar in second language acquisition: The 'failed functional features hypotheses. *Second Language Research*, *13*(3), 187-226. https://doi.org/10.1191/026765897671476153

Hawkins, R., & Hattori, H. (2006). Interpretation of English multiple wh-questions by Japanese speakers: A missing uninterpretable feature account. *Second Language Research*, *22*(3), 269-301.

Hemforth, B., Konieczny, L., & Scheepers, C. (2000). Syntactic attachment and anaphora resolution: Two sides of relative clause attachment. In M. Crocker, M. Pickering, & C. Clifton (Eds), Architectures and mechanisms for language processing (pp. 259-28). New York: Cambridge University Press.

Hermas, A. (2014). Restrictive relatives in L3 English: L1 transfer and ultimate attainment convergence. *Australian Journal of Linguistics*, *34*(3), 361-387. https://doi.org/10.1080/07268602.2014.898227

Hilbig, B.E. (2016). Reaction time effects in lab- versus Web-based research: Experimental evidence. *Behavioral Research*, *48*, 1718–1724.

Hitz, J. (2012). *A study on the constraints affecting resumption in Turkish and Mandarin Chinese relative clauses, and the transfer of these constraints to English as a second language* (Doctoral Dissertation, Indiana Purduce University).

Hofmeister, P. (2011). Representational complexity and memory retrieval in language comprehension. *Language and Cognitive Processes*, *26*(3), 376-405.

Hofmeister, P., & Norcliffe, E. (2013). Does resumption facilitate sentence comprehension? In *The core and the periphery: Data-driven perspectives on syntax inspired by Ivan A. Sag* (pp. 225-246). CSLI Publications.

Hopp, H. (2006). Syntactic features and reanalysis in near-native processing. *Second Language Research*, *22*, 369– 397. https://doi.org/10.1191/0267658306sr272oa

Hopp, H. (2014). Working memory effects in the L2 processing of ambiguous relative clauses. *Language Acquisition*, *21*, 250–278. https://doi.org/10.1080/10489223.2014.892943

Hopp, H. (2018). The bilingual mental lexicon in L2 sentence processing. *Second Language*, *17*, 5-27.

Hornstein, N., Jairo, N., & Grohmann, K. (2005). *Understanding Minimalism*, Cambridge University Press, Cambridge. https://doi.org/10.1017/cbo9780511840678

Huddleston, R., & Pullum, G. (2006). Coordination and subordination. *A handbook of English linguistics*, 198-219.

Johnson, J. S. (1992). Critical period effects in second language acquisition: The effect of written versus auditory materials on the assessment of grammatical competence. *Language Learning*, *42*(2), 217-248.

Juffs, A. (2005). The influence of first language on the processing of wh-movement in English as a second language. *Second Language Research*, *21*(2), 121-151.

Juffs, A., & Harrington, M. (1995). Processing effects in second language sentence processing: Subject and object asymmetries in wh-extraction. *Studies in Second Language Acquisition*, *17*(4), 483-516.

Just, M. A., & Carpenter, P. A. (1992). A capacity theory of comprehension: individual differences in working memory. *Psychological Review*, *99*(1), 122-149.

Karimi, H., & Ferreira, F. (2016). Good-enough linguistic representations and online cognitive equilibrium in language processing. *Quarterly Journal of Experimental Psychology*, *69*(5), 1013-1040.

Karimi, S. (2005). *A Minimalist Approach to Scrambling: Evidence from Persian*. Berlin: Walter de Gruyter. https://doi.org/10.1515/9783110199796

Karimi, S., & Taleghani, A. (2007). Wh-movement interpretation and optionality in Persian. In: Karimi, S., Samiian, V., Wilkins, W.K. (Eds.), *Clausal and Phrasal Architecture: Syntactic*

Derivation and Interpretation. Amsterdam: John Benjamins, 166–187. https://doi.org/10.1075/la.101.09kar

Keenan, E. L., & Comrie, B. (1977). Noun phrase accessibility and universal grammar. *Linguistic Inquiry*, *8*(1), 63-99. https://doi.org/10.2307/413321

Keffala, B., & Goodall, G. (2011, March). *Do resumptive pronouns ever rescue illicit gaps in English* [Poster presentation]. City University of New York Athletic Conference, New York.

Keijzer, M. (2007). Last in first out?: an investigation of the regression hypothesis in Dutch emigrants in Anglophone Canada. *Toegepaste Taalwetenschap in Artikelen*, *78*(1), 131-139.

Kidd, E. (Ed.). (2011). *The acquisition of relative clauses: Processing, typology and function* (Vol. 8). Amsterdam: John Benjamins.

Kim, J. H., & Christianson, K. (2017). Working memory effects on L1 and L2 processing of ambiguous relative clauses by Korean L2 learners of English. *Second Language Research*, *33*(3), 365-388.

Klein, E. C. (2001). (Mis)construing null prepositions in L2 intergrammars: a commentary and proposal. *Second Language Research* 17, 37-7. https://doi.org/10.1177/026765830101700102

Klein-Braley, C., & Raatz, U. (1984). A survey of research on the C-Test1. *Language Testing*, *1*(2), 134-146.

Kunzetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest package: tests in linear mixed effect models. *Journal of Statistical Software*, *82*(13), 1-26. https://doi.org/10.18637/jss.v082.i13

Labelle, M. (1990). Predication, wh-movement, and the development of relative clauses. *Language acquisition*, *1*(1), 95-119.

Lapole, A. L. (2014). Effect of Relativizer Type in the Processing of Non-restrictive Relative Clauses in L2 French. In *2012 Second Language Research Forum* (pp. 110-119). Cascadilla Proceedings Project.

Lardiere, D. (2008). Feature assembly in second language acquisition. In Liceras, J.M., Zobl, H. and Goodluck, H., editors, *The role of formal features in second language acquisition*. New York: Lawrence Erlbaum Associates, 106–140. https://doi.org/10.4324/9781315085340-5

Lau, E., & Tanaka, N. (2021). The subject advantage in relative clauses: A review. *Glossa: A Journal of General Linguistics, 6*(1), 1–34.

Leal-Méndez, T., & Slabakova, R. (2014). The Interpretability Hypothesis again: A partial replication of Tsimpli and Dimitrakopoulou (2007). *International Journal of Bilingualism*, *18*(6), 537-557. https://doi.org/10.1177/1367006912448125

Lewis, R. L., Vasishth, S., & Van Dyke, J. A. (2006). Computational principles of working memory in sentence comprehension. *Trends in Cognitive Sciences*, *10*(10), 447-454. https://doi.org/10.1016/j.tics.2006.08.007

Loewen, S. (2009). Grammaticality judgment tests and the measurement of implicit and explicit L2 knowledge. In: Ellis R, Loewen S, Elder C et al. (eds) *Implicit and explicit knowledge in second language learning, testing and teaching*. Bristol: Multilingual Matters, pp. 94–112.

Luzi, E. (2012). Relativization strategies in SLA. *Second Language Research, 28*(4), 443-476.

MacDonald, M., & Christiansen, M. (2002). Reassessing working memory: A comment on Just & Carpenter (1992) and Waters & Caplan (1996). *Psychological Review* 109. 35–54.

MacDonald, M., Just, M. A., & Carpenter, P. A. (1992). Working memory constraints on the processing of syntactic ambiguity. *Cognitive Psychology, 24*, 56–98.

Mackey, A., & Gass, S. (2016). *Second Language Research: Methodology and Design*. 2nd ed. London: Routledge. doi:10.4324/9781315750606

Marefat, H., & Abdollahnejad, A. (2014). Acquisition of English relative clauses by adult Persian learners: Focus on resumptive pronouns. *Journal of Teaching Language Skills*, *32*(4), 19-4.

Marefat, H., Samadi, E., & Yaseri, M. (2015). Semantic priming effect on relative clause attachment ambiguity resolution in L2. *Applied Research on English Language, 4*(2), 78-95.

Marinis, T., Roberts, L., Felser, C., & Clahsen, H. (2005). Gaps in second language sentence processing. *Studies in Second Language Acquisition*, *27*(1), 53-78.

McDonald, J. L. (2006). Beyond the critical period: Processing-based explanations for poor grammaticality judgment performance by late second language learners. *Journal of Memory and Language*, *55*(3), 381-401. https://doi.org/10.1016/j.jml.2006.06.006

McKay, T. (2019). *More on the validity and reliability of C-test scores: a meta-analysis of C-test studies*. (Master's thesis, Georgetown University).

Miyake, A., & Friedman, N. (1998). Individual differences in second language proficiency: Working memory as language aptitude. In A. F. Healy & L. E. Bourne (eds.), *Foreign language learning: Psycholinguistic studies on training and retention*, 339–364. Mahwah, NJ: Lawrence Erlbaum.

Myles, F. (1995). Interaction between linguistic theory and language processing in SLA. *Second Language Research*, *11*(3), 235-266.

Nicol, J., & Swinney, D. (1989). The role of structure in coreference assignment during sentence comprehension. *Journal of Psycholinguistic Research*, *18*(1), 5-19.

Pan, H. Y., Schimke, S., & Felser, C. (2015). Referential context effects in non-native relative clause ambiguity resolution. *International Journal of Bilingualism*, *19*(3), 298-313.

Papadopoulou, D. (2006). C*ross-linguistic variation in sentence processing: Evidence from RC attachment preferences in Greek (Vol. 36)*. Springer: The Netherlands.

Papadopoulou, D., & Clahsen, H. (2003). Parsing strategies in L1 and L2 sentence processing: A study of relative clause attachment in Greek. *Studies in Second Language Acquisition*, *25*(4), 501-528.

Papadopoulou, D., & Clahsen, H. (2006). Ambiguity resolution in sentence processing: The role of lexical and contextual information. *Journal of Linguistics*, *42*(1), 109-138.

Park, J. (1998). *The C-test: usefulness for measuring written language ability of non-native speakers of English in high school* (Doctoral Dissertation, Iowa State University).

Pérez-Leroux, A. T. (1995). Resumptives in the acquisition of relative clauses. *Language Acquisition*, *4*(1-2), 105-138. https://doi.org/10.1080/10489223.1995.9671661

Pickering, M., & Barry, G. (1991). Sentence processing without empty categories. *Language and Cognitive Processes*, *6*(3), 229-259.

Pliatsikas, C., & Marinis, T. (2013). Processing empty categories in a second language: When naturalistic exposure fills the (intermediate) gap. *Bilingualism: Language and Cognition*, *16*(1), 167-182. Bilingualism: Language and Cognition, 16(1), 167-182. https://doi.org/10.1017/s136672891200017x

Poletto, C., & Sanfelici, E. (2017). 22. Relative clauses. In *Manual of Romance morphosyntax and syntax*, 804-836. De Gruyter. https://doi.org/10.1515/9783110377088-022

Prentza, A. I. (2012). Second Language Acquisition of Complex Structures: The Case of English Restrictive Relative Clauses. *Theory & Practice in Language Studies*, *2*(7), 1330-1340.

Pynte, J., & Colonna, S. (2000). Decoupling syntactic parsing from visual inspection: The case of relative clause attachment in French. In A. Kennedy, R. Radach, D. Heller, & J. Pynte (Eds.), *Reading as a perceptual process*. Oxford: Elsevier.

Radford, A. (2009). *Analysing English sentences: A Minimalist approach*. Cambridge: Cambridge University Press. https://doi.org/10.1017/cbo9780511801617

Raghibdoust, S. (1993). *Interrogative constructions in Persian*. (MA thesis, University of Ottawa).

Rahmany, R., Marefat, H., & Kidd, E. (2014). Resumptive elements aid comprehension of object relative clauses: Evidence from Persian. *Journal of Child Language*, *41*(4), 937-948.

Rowlett, P. (2007). *The Syntax of French* [Cambridge Syntax Guides]. Cambridge: Cambridge University Press.

Safir, K. (1986). Relative clauses in a theory of binding and levels. *Linguistic Inquiry*, 17(4), 663-689.

Sag, I. A., & Fodor, J. D. (1995). Extraction without traces. In R. Aranovich, W. Byrne, S. Preuss, & M. Senturia (Eds.), *Proceedings of the 13th annual meeting of the West Coast Conference on Formal Linguistics* (365–384). Stanford, CA: CSLI Publications.

Schachter, J., & Yip, V. (1990). Grammaticality judgments. *Studies in Second Language Acquisition*, *12*(4), 379-392.

Schwartz, B. D., & Sprouse, R. A. (2017). The role of Universal Grammar in nonnative language acquisition. In I.G. Roberts (Ed.), *The Oxford handbook of Universal Grammar* (pp. 289–304). New York: Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199573776.013.13

Shiu L-J, Yalçın Ş, & Spada, N. (2018). Exploring second language learners' grammaticality judgment performance in relation to task design features. *System 72*: 215–25.

Spivey-Knowlton, M. J., Trueswell, J. C., & Tanenhaus, M. K. (1993). Context effects in syntactic ambiguity resolution: Discourse and semantic influences in parsing reduced relative clauses. *Canadian Journal of Experimental Psychology*, 47(2), 276–309. doi:10.1037/h0078826

Sportiche, D. (1981). Bounding nodes in French. *Linguistic Review (1)*, 219–46. https://doi.org/10.1515/tlir.1981.1.2.219

Swets, B., Desmet, T., Hambrick, D. Z., & Ferreira, F. (2007). The role of working memory in syntactic ambiguity resolution: a psychometric approach. *Journal of Experimental Psychology: General*, *136*(1), 64–81.

Taghvaipour, M. A. (2005). *Persian relative clauses in head-driven phrase structure grammar* (Doctoral Dissertation, University of Essex).

Tezel, Z. (1999). *The acquisition of restrictive relative clause configurations in English as a second language* (Doctoral Dissertation, Indiana University of Pennsylvania).

Trace, J. (2020). Clozing the gap: How far do cloze items measure?. *Language Testing*, *37*(2), 235-253.

Traxler, M. J. (2007). Working memory contributions to relative clause attachment processing: A hierarchical linear modeling analysis. *Memory & Cognition*, *35*(5), 1107-1121.

Traxler, M. J., Morris, R. K., & Seely, R. E. (2002). Processing subject and object relative clauses: Evidence from eye movements. *Journal of Memory and Language*, *47*(1), 69-90.

Troyer, M., Hofmeister, P., & Kutas, M. (2016). Elaboration over a discourse facilitates retrieval in sentence processing. *Frontiers in Psychology*, 7(MAR), 1–9.

Tsimpli, I. M., & Dimitrakopoulou, M. (2007). The Interpretability Hypothesis: Evidence from wh-interrogatives in second language acquisition. *Second Language Research*, *23*(2), 215-242. https://doi.org/10.1177/0267658307076546

Vafaee, P., Suzuki, Y., & Kachisnke, I. (2017). Validating grammaticality judgment tests: Evidence from two new psycholinguistic measures. *Studies in Second Language Acquisition*, *39*(1), 59-95.

Van Dyke, J. A., & Johns, C. L. (2012). Memory interference as a determinant of language comprehension. *Language and Linguistics Compass*, *6*(4), 193-211.

Van Dyke, J. A., & McElree, B. (2006). Retrieval interference in sentence comprehension. *Journal of Memory and Language*,*55*(2), 157-166.

Van Gompel, R. P., Pickering, M. J., Pearson, J., & Liversedge, S. P. (2005). Evidence against competition during syntactic ambiguity resolution. *Journal of Memory and Language*, 52, 284–307.

Vasishth, S., Schad, D., Bürki, A., & Kliegl, R. (2020). *Linear Mixed Models in Linguistics and Psychology: A Comprehensive Introduction*. URL https://vasishth.github.io/Freq_CogSci/.

White, L. (2003). *Second language acquisition and Universal Grammar*. New York: Cambridge University Press.

Wolter, B. (2002). Assessing proficiency through word associations: is there still hope?. *System*, *30*(3), 315-329.

Wong, W. (2001). Modality and attention to meaning and form in the input. *Studies in Second Language Acquisition*, *23*(3), 345-368.

Xia, V. Y., White, L., & Guzzo, N. B. (2022). Intervention in relative clauses: Effects of relativized minimality on L2 representation and processing. *Second Language Research*, 38(2), 347-372.

Zagar, D., Pynte, J., & Rativeau, S. (1997). Evidence for early closure attachment on first pass reading times in French. *The Quarterly Journal of Experimental Psychology Section A*, *50*(2), 421-438.

Zahedi, K., Khalighi, M., Abolhasani Chimeh, Z., & Golfam, A. (2012). Resumptive pronouns in Persian. *Language Related Research*, *3*(3), 201-121.

Zehr, J., & Schwarz, F. (2018). Penncontroller for internet-based experiments (ibex). *https://doi. org/10*, *17605*

Zhang, R. (2015). Measuring university-level L2 learners' implicit and explicit knowledge. *Studies in Second Language Acquisition*, 37, 457–486.

Appendices

Appendix A: Grammaticality Judgment Task Sentences (Resumption Acceptability)

Table 19 *Materials for the Grammaticality Judgment Task (Study 1: resumption acceptability)*

	Grammaticality	Gap/resumption	RC.type	Relativiser	Sentence
1	Grammatical	gap	DO	that	The consultant that the doctor met was at the hospital.
2	Grammatical	gap	DO	that	The paediatrician that the psychologist warned is from New York.
3	Grammatical	gap	DO	who	The athlete who the referee warned lost her control.
4	Grammatical	gap	DO	who	The guy who Mary met is originally from Wales.
5	Grammatical	gap	DO	who	The patient who the doctor advised took the warnings seriously.
6	Grammatical	gap	DO	who	The person who Susan married is an amazing man.
7	Grammatical	gap	DO	who	The reporter who the journalist called refused to comment on the subject.
8	Grammatical	gap	OP	that	The little boy that the athelete gave the ball to was extremely happy.
9	Grammatical	gap	OP	that	The photographer that the director sent the letter to was hired for a new job.
10	Grammatical	gap	OP	who	The assistant who Jane showed the medals to was depressed.
11	Grammatical	gap	OP	who	The doctor who Jane referred you to is really brave.

To be continued

Table 19. Continued

	Grammaticality	Gap/resumption	RC type	Relativiser	Sentence
12	Grammatical	gap	OP	who	The friend who she confides in is unreliable.
13	Grammatical	gap	OP	who	The little girl who Jason gave the candy to was crying.
14	Grammatical	gap	OP	who	The publisher who Rachel made a request to refused to answer the question.
15	Grammatical	gap	SU	that	The bodybuilder that was running the other day did not attend the meeting.
16	Grammatical	gap	SU	that	The worker that pleased the employer was promised a pay raise.
17	Grammatical	gap	SU	who	The athlete who won the Olympics was very famous.
18	Grammatical	gap	SU	who	The committee members who changed their position were extremely concerned.
19	Grammatical	gap	SU	who	The employees who criticised the manager are worried.
20	Grammatical	gap	SU	who	The man who kissed Natalie the other day is here again.
21	Grammatical	gap	SU	who	The politician who supported the Communist party had a heart attack.
22	Ungrammatical	resumption	DO	that	The handyman that the government official married him was very unwell.
23	Ungrammatical	resumption	DO	that	The journalist that the woman criticised her was becoming really angry.

To be continued

Table 19. Continued

	Grammaticality	Gap/resumption	RC type	Relativiser	Sentence
24	Ungrammatical	resumption	DO	who	The camerawoman who Mark adored her was really angry.
25	Ungrammatical	resumption	DO	who	The criminal who Saba met her was giving a talk in room 32.
26	Ungrammatical	resumption	DO	who	The secretary who James loves her called in sick today.
27	Ungrammatical	resumption	DO	who	The student who Jane likes him did his homework this morning.
28	Ungrammatical	resumption	DO	who	The woman who Katerina met her studied Accounting at Essex.
29	Ungrammatical	resumption	OP	that	The employee that the cameraman argued with her was clearly anxious.
30	Ungrammatical	resumption	OP	that	The student that the teacher counted on her was absent today.
31	Ungrammatical	resumption	OP	who	The employer who you talked to him was getting very angry.
32	Ungrammatical	resumption	OP	who	The journalist who the security team shouted at her works for ITV.
33	Ungrammatical	resumption	OP	who	The person who you sent the letter to her did not answer my call yesterday.
34	Ungrammatical	resumption	OP	who	The postman who Layla gave the book to him is hospitalised.
35	Ungrammatical	resumption	OP	who	The professor who you submitted the assignments to him gave me a very low score.
36	Ungrammatical	resumption	SU	that	The editor that she worked hard decided to have a party next week.

To be continued

Table 19. Continued

	Grammaticality	Gap/resumption	RC type	Relativiser	Sentence
37	Ungrammatical	resumption	SU	that	The secretary that she answered the phone was worried about her job.
38	Ungrammatical	resumption	SU	who	The guy who he kissed Carla was later dismissed from work.
39	Ungrammatical	resumption	SU	who	The handyman who he repaired the radiator attended the evening party.
40	Ungrammatical	resumption	SU	who	The politician who she performed poorly apologised to her supporters.
41	Ungrammatical	resumption	SU	who	The salesperson who he resigned always comes to work on time.
42	Ungrammatical	resumption	SU	who	The thief who he robbed the old woman was sentenced to 3 years in prison.

Appendix B: Grammaticality Judgment Task Sentences (Subject-verb Agreement)

Table 20. *Materials for the Grammaticality Judgment Task (Study 2: subject-verb agreement)*

	Grammaticality	Sentence
1	Grammatical	The nurse of the patients was not planning to attend the training that was going to be held.
2	Grammatical	The consultants of the economist were reading the report which was published years ago.
3	Grammatical	The pupils of the teacher were unhappy with the test results which were carelessly corrected.
4	Grammatical	The assistant of the officers was making a personal call in her room which was recently decorated.
5	Grammatical	The apprentices of the builder were wearing blue gloves which they had bought from Primark.
6	Ungrammatical	The client of the lawyers have decided to immigrate to the UK where there are more jobs.
7	Ungrammatical	The assistants of the manager was planning to throw a surprise party that could make him happy.

To be continued

Table 20. Continued

	Grammaticality	Sentence
8	Ungrammatical	The designer of the photographers are working on a new report which should be submitted to the manager within 2 weeks.
9	Ungrammatical	The guitarists of the singer is planning to ask for a pay raise that could help with the financial crisis.
10	Ungrammatical	The consultant of the clients are filing a new lawsuit which could implicate the mayor as well.

Appendix C: Self-paced Reading Task 1 Materials (Disambiguation in Isolated RC Ambiguities)

Table 21. *SPR 1 materials (Study 2: disambiguation in isolated RC ambiguities)*

Item	Attachment	Sentence
1	DP1	I watched the fans of the singer who were dancing funny and looking happy."
1	DP2	I watched the fans of the singer who was dancing funny and looking happy."
2	DP1	The customer spoke to the assistants of the pharmacist who were preparing the medicine very cautiously."
2	DP2	The customer spoke to the assistants of the pharmacist who was preparing the medicine very cautiously."
3	DP1	The director noticed the hairdresser of the players who was wearing a green dress and a yellow hat."
3	DP2	The director noticed the hairdresser of the players who were wearing a green dress and a yellow hat."
4	DP1	The reporter watched the lawyer of the criminals who was speaking to the judge very loudly."
4	DP2	The reporter watched the lawyer of the criminals who were speaking to the judge very loudly."
5	DP1	A strange woman called to the guide of the travellers who was crossing the street looking excited."
5	DP2	A strange woman called to the guide of the travellers who were crossing the street looking excited."
6	DP1	The man smiled at the supervisors of the clerk who were reading a paper and taking notes."
6	DP2	The man smiled at the supervisors of the clerk who was reading a paper and taking notes."
7	DP1	The publisher smiled at the illustrators of the poet who were getting angry without reason."

To be continued

Table 21. Continued

Item	Attachment	Sentence
7	DP2	The publisher smiled at the illustrators of the poet who was getting angry without reason."
8	DP1	A fan looked at the guitarists of the singer who were reading the music and looked confident."
8	DP2	A fan looked at the guitarists of the singer who was reading the music and looked confident."
9	DP1	A man observed the barrister of the criminals who was waiting for the decision looking nervous."
9	DP2	A man observed the barrister of the criminals who were waiting for the decision looking nervous."
10	DP1	The coach watched the physiotherapist of the football players who was wearing jeans and looked excited."
10	DP2	The coach watched the physiotherapist of the football players who were wearing jeans and looked excited."
11	DP1	The headmaster looked at the teacher of the pupils who was interested in card games."
11	DP2	The headmaster looked at the teacher of the pupils who were interested in card games."
12	DP1	The supervisor was looking at the trainers of the athlete who were thinking about the next tournament."
12	DP2	The supervisor was looking at the trainers of the athlete who was thinking about the next tournament."

Appendix D: Self-paced Reading Task 2 Materials

Table 22. *SPR 2 Materials (Study 1: disambiguation in contextualised RC ambiguities)*

Item	Context	Attachment	Sentences
1	DP1	DP1	An economist was researching an article on a big national newspaper. Some journalists in the newspaper's head office were having an argument with their editor. Some journalists were very diligent but others were a bit lazy. The economist liked the journalists of the editor who were thinking about the report.
1	DP1	DP2	An economist was researching an article on a big national newspaper. Some journalists in the newspaper's head office were having an argument with their editor. Some journalists were very diligent but others were a bit lazy.The economist liked the journalists of the editor who was thinking about the report.
1	DP2	DP1	An economist was researching an article on a big national newspaper. Some journalists in the newspaper's head office were having an argument with their two editors. One of the editors was very diligent but the other one was a bit lazy. \nThe economist liked the journalists of the editor who were thinking about the report.
1	DP2	DP2	1 "An economist was researching an article on a big national newspaper. Some journalists in the newspaper's head office were having an argument with their two editors. One of the editors was very diligent but the other one was a bit lazy. \nThe economist liked the journalists of the editor who was thinking about the report.
2	DP1	DP1	The young girl needed someone to drive her to school every day.Only two drivers were invited for an interview. They had worked for some football players.One driver was very friendly and charming, \n whereas the other one seemed quiet. \nThe young girl favoured the driver of the players who was talking to an old woman.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
2	DP1	DP2	The young girl needed someone to drive her to school every day. Only two drivers were invited for an interview. They had worked for some football players.One driver was very friendly and charming, \n whereas the other one seemed quiet. \nThe young girl favoured the driver of the players who were talking to an old woman.
2	DP2	DP1	The young girl needed someone to drive her to school every day.Only one driver was invited for an interview. He had worked for some football players.Some players were very friendly and charming, \n whereas others seemed quiet. \nThe young girl favoured the driver of the players who was talking to an old woman.
2	DP2	DP2	The young girl needed someone to drive her to school every day.Only one driver was invited for an interview. He had worked for some football players.Some players were very friendly and charming, \n whereas others seemed quiet. \nThe young girl favoured the driver of the players who were talking to an old woman.
3	DP1	DP1	A thief sneaked into a dental practice, intending to steal what he could.A group of technicians witnessed the crime whilst fixing an x-ray machine for the dentist.Some technicians did not know what to do,but the others immediately phoned the police.The thief hit the technicians of the dentist who were looking frightened.
3	DP1	DP2	A thief sneaked into a dental practice, intending to steal what he could.A group of technicians witnessed the crime whilst fixing an x-ray machine for the dentist. Some technicians did not know what to do,but the others immediately phoned the police.The thief hit the technicians of the dentist who was looking frightened.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
3	DP2	DP1	A thief sneaked into a dental practice, intending to steal what he could.A group of technicians witnessed the crime whilst fixing an x-ray machine for the two dentists. One dentist did not know what to do,but the other one immediately phoned the police.The thief hit the technicians of the dentist who were looking frightened.
3	DP2	DP2	A thief sneaked into a dental practice, intending to steal what he could.A group of technicians witnessed the crime whilst fixing an x-ray machine for the two dentists. One dentist did not know what to do,but the other one immediately phoned the police.The thief hit the technicians of the dentist who was looking frightened.
4	DP1	DP1	A woman was looking for someone to take pictures at her wedding.Two photographers currently working for some famous singers caught her interest.One photographer seemed gentle and polite, \n while the other one looked rather cold.The woman knew the photographer of the singers who was reading a book.
4	DP1	DP2	A woman was looking for someone to take pictures at her wedding.Two photographers currently working for some famous singers caught her interest.One photographer seemed gentle and polite, \n while the other one looked rather cold.The woman knew the photographer of the singers who were reading a book.
4	DP2	DP1	A woman was looking for someone to take pictures at her wedding.One photographer currently working for some famous singers caught her interest.Some singers seemed gentle and polite, \n while the other ones looked rather cold.The woman knew the photographer of the singers who was reading a book.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
4	DP2	DP2	A woman was looking for someone to take pictures at her wedding.One photographer currently working for some famous singers caught her interest.Some singers seemed gentle and polite, \n while the other ones looked rather cold.The woman knew the photographer of the singers who were reading a book.
5	DP1	DP1	The little girl needed someone to look after her.Some maids previously employed at the palace to look after a princess were interviewed.Some of the maids were very easy-going, \n whilst the other ones were a bit eccentric.The little girl envied the maids of the princess who were eating chocolate.
5	DP1	DP2	The little girl needed someone to look after her.Some maids previously employed at the palace to look after a princess were interviewed.Some of the maids were very easy-going, \n whilst the other ones were a bit eccentric.The little girl envied the maids of the princess who was eating chocolate.
5	DP2	DP1	The little girl needed someone to look after her.Some maids previously employed at the palace to look after two princesses were interviewed.One of the princesses was very easy-going, \n whilst the other one was a bit eccentric.The little girl envied the maids of the princess who were eating chocolate.
5	DP2	DP2	The little girl needed someone to look after her.Some maids previously employed at the palace to look after two princesses were interviewed.One of the princesses was very easy-going, \n whilst the other one was a bit eccentric.The little girl envied the maids of the princess who was eating chocolate.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
6	DP1	DP1	The dean was in charge of all faculty personnel.There were two secretaries recruited from abroad, working for several professors.One secretary specialized in accounting, \n while the other one specialized in computing. \nThe dean liked the secretary of the professors who was reading a letter.
6	DP1	DP2	The dean was in charge of all faculty personnel.There were two secretaries recruited from abroad, working for several professors.One secretary specialized in accounting, \n while the other one specialized in computing. \nThe dean liked the secretary of the professors who were reading a letter.
6	DP2	DP1	The dean was in charge of all faculty personnel.There was one secretary recruited from abroad, working for several professors.Some professors specialized in accounting, \n while the other ones specialized in computing. \nThe dean iked the secretary of the professors who was reading a letter.
6	DP2	DP2	The dean was in charge of all faculty personnel.There was one secretary recruited from abroad, working for several professors.Some professors specialized in accounting, \n while the other ones specialized in computing. \nThe dean iked the secretary of the professors who were reading a letter.
7	DP1	DP1	A student was sitting in the audience of a popular TV show.Some fans had stood in the lobby for hours waiting for the arrival of an actress.Some of the fans looked calm and cheerfulbut the other ones seemed rather impatient.The student photographed the fans of the actress who were looking happy.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
7	DP1	DP2	A student was sitting in the audience of a popular TV show.Some fans had stood in the lobby for hours waiting for the arrival of an actress.Some of the fans looked calm and cheerfulbut the other ones seemed rather impatient.The student photographed the fans of the actress who was looking happy.
7	DP2	DP1	A student was sitting in the audience of a popular TV show.Some fans had stood in the lobby for hours waiting for the arrival of two actresses.One actress looked calm and cheerfulbut the other one seemed rather impatient.The student photographed the fans of the-actress who were looking happy.
7	DP2	DP2	A student was sitting in the audience of a popular TV show.Some fans had stood in the lobby for hours waiting for the arrival of two actresses.One actress looked calm and cheerfulbut the other one seemed rather impatient.The student photographed the fans of the-actress who was looking happy.
8	DP1	DP1	A new nurse was recruited during a recent flu outbreak at a local school.There were two doctors attending specifically to the teachers that had been weak from the flu.One doctor was very kind and friendly, \n while the other one seemed introverted.The nurse trusted the doctor of the teachers who was preparing to go home.
8	DP1	DP2	A new nurse was recruited during a recent flu outbreak at a local school.There were two doctors attending specifically to the teachers that had been weak from the flu.One doctor was very kind and friendly, \n while the other one seemed introverted.The nurse trusted the doctor of the teachers who were preparing to go home.
8	DP2	DP1	A new nurse was recruited during a recent flu outbreak at a local school.There was one doctor attending specifically to the teachers that had been weak from the flu.Some of the teachers were very kind and friendly, \n while the other ones seemed introverted.The nurse trusted the doctor of the teachers who was preparing to go home.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
8	DP2	DP2	A new nurse was recruited during a recent flu outbreak at a local school.There was one doctor attending specifically to the teachers that had been weak from the flu.Some of the teachers were very kind and friendly, \n while the other ones seemed introverted.The nurse trusted the doctor of the teachers who were preparing to go home.
9	DP1	DP1	A woman was very unhappy with her new haircut.A group of apprentices recently recruited by the hairdresser must have misunderstood her instructions.Some apprentices were deeply embarrassed, \n whereas the others did not say anything.The woman blamed the apprentices of the hairdresser who were smiling all the time.
9	DP1	DP2	A woman was very unhappy with her new haircut.A group of apprentices recently recruited by the hairdresser must have misunderstood her instructions.Some apprentices were deeply embarrassed, \n whereas the others did not say anything.The woman blamed the apprentices of the hairdresser who was smiling all the time.
9	DP2	DP1	A woman was very unhappy with her new haircut.A group of apprentices recently recruited by the two hairdressers must have misunderstood her instructions.One hairdresser was deeply embarrassed, \n whereas the other one did not say anything.The woman blamed the apprentices of the hairdresser who were smiling all the time.
9	DP2	DP2	A woman was very unhappy with her new haircut.A group of apprentices recently recruited by the two hairdressers must have misunderstood her instructions.One hairdresser was deeply embarrassed, \n whereas the other one did not say anything.The woman blamed the apprentices of the hairdresser who was smiling all the time.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
10	DP1	DP1	The professor was attending a formal dinner party.Two attorneys were having a serious discussion with the consultants they worked for.One attorney seemed really upset,but the other one managed to stay calm. \nThe professor observed the attorney of the consultants who was reading the newspaper.
10	DP1	DP2	The professor was attending a formal dinner party.Two attorneys were having a serious discussion with the consultants they worked for.One attorney seemed really upset,but the other one managed to stay calm. \nThe professor observed the attorney of the consultants who were reading the newspaper.
10	DP2	DP1	The professor was attending a formal dinner party.An attorney was having a serious discussion with the consultants he worked for.Some of the consultants seemed really upset,but the others managed to stay calm. \nThe professor observed the attorney of the consultants who was reading the newspaper.
10	DP2	DP2	The professor was attending a formal dinner party.An attorney was having a serious discussion with the consultants he worked for.Some of the consultants seemed really upset,but the others managed to stay calm. \nThe professor observed the attorney of the consultants who were reading the newspaper.
11	DP1	DP1	A journalist was writing a report on an engineering project.Two assistants were happy to be interviewed, fully supervised by the inspectors.One assistant had been involved at the planning stage, \n whilst the other one was monitoring the building work.The journalist interviewed the assistant of the inspectors who was looking very serious.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
11	DP1	DP2	A journalist was writing a report on an engineering project.Two assistants were happy to be interviewed, fully supervised by the inspectors.One assistant had been involved at the planning stage, \n whilst the other one was monitoring the building work.The journalist interviewed the assistant of the inspectors who were looking very serious.
11	DP2	DP1	A journalist was writing a report on an engineering project.An assistant was happy to be interviewed, fully supervised by the inspectors.Some of the inspectors had been involved at the planning stage, \n whilst the other ones were monitoring the building work.The journalist interviewed the assistant of the inspectors who was looking very serious.
11	DP2	DP2	A journalist was writing a report on an engineering project.An assistant was happy to be interviewed, fully supervised by the inspectors.Some of the inspectors had been involved at the planning stage, \n whilst the other ones were monitoring the building work.The journalist interviewed the assistant of the inspectors who were looking very serious.
12	DP1	DP1	The doctor needed someone to assist him in his clinic.A group of nurses, currently working for a lawyer, were interviewed.Some nurses had years of work experience, \n whilst the other ones had just obtained their diplomas.The doctor contacted the nurses of the lawyer who were talking on the phone.
12	DP1	DP2	The doctor needed someone to assist him in his clinic.A group of nurses, currently working for a lawyer, were interviewed.Some nurses had years of work experience, \n whilst the other ones had just obtained their diplomas.The doctor contacted the nurses of the lawyer who was talking on the phone.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
12	DP2	DP1	The doctor needed someone to assist him in his clinic.A group of nurses, currently working for two lawyers, were interviewed.One lawyer had years of work experience, \n whilst the other one had just obtained their diplomas.The doctor contacted the nurses of the lawyer who were talking on the phone.
12	DP2	DP2	The doctor needed someone to assist him in his clinic.A group of nurses, currently working for two lawyers, were interviewed.One lawyer had years of work experience, \n whilst the other one had just obtained their diplomas.The doctor contacted the nurses of the lawyer who was talking on the phone.
13	DP1	DP1	The publisher wanted to issue a book on the state of the economy.A team of executives, accompanied by the economist they worked for, were invited.Some executives were extremely arrogant, \n while the other ones were easy to talk to.The publisher hated the executives of the economist who were wearing round glasses.
13	DP1	DP2	The publisher wanted to issue a book on the state of the economy.A team of executives, accompanied by the economist they worked for, were invited.Some executives were extremely arrogant, \n while the other ones were easy to talk to.The publisher hated the executives of the economist who was wearing round glasses.
13	DP2	DP1	The publisher wanted to issue a book on the state of the economy.A team of executives, accompanied by two economists they worked for, were invited.One economist was extremely arrogant, \n while the other one was easy to talk to.The publisher hated the executives of the economist who were wearing round glasses.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
13	DP2	DP2	The publisher wanted to issue a book on the state of the economy.A team of executives, accompanied by two economists they worked for, were invited.One economist was extremely arrogant, \n while the other one was easy to talk to.The publisher hated the executives of the economist who was wearing round glasses.
14	DP1	DP1	The secretary was looking for someone to drive her boss home every day.Two drivers, previously employed by some managers, were waiting in the corridor.One driver had quit his job, \n whilst the other one had been fired.The secretary frowned at the driver of the managers who was going on holiday soon.
14	DP1	DP2	The secretary was looking for someone to drive her boss home every day.Two drivers, previously employed by some managers, were waiting in the corridor.One driver had quit his job, \n whilst the other one had been fired.The secretary frowned at the driver of the managers who were going on holiday soon.
14	DP2	DP1	The secretary was looking for someone to drive her boss home every day.A driver, previously employed by some managers, was waiting in the corridor.Some of the managers had quit their jobs, \n whilst the other ones had been fired.The secretary frowned at the driver of the managers who was going on holiday soon.
14	DP2	DP2	The secretary was looking for someone to drive her boss home every day.A driver, previously employed by some managers, was waiting in the corridor.Some of the managers had quit their jobs, \n whilst the other ones had been fired.The secretary frowned at the driver of the managers who were going on holiday soon.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
15	DP1	DP1	A photographer was taking pictures at a political conference.Some ministers nominated as representatives by the president were invited to take part.Some ministers were very popular with the public,but the other ones had a bad reputation.The photographer ignored the ministers of the president who were waving at the crowd.
15	DP1	DP2	A photographer was taking pictures at a political conference.Some ministers nominated as representatives by the president were invited to take part.Some ministers were very popular with the public,but the other ones had a bad reputation.The photographer ignored the ministers of the president who was waving at the crowd.
15	DP2	DP1	A photographer was taking pictures at a political conference.Some ministers nominated as representatives by the two presidents were invited to take part.One president was very popular with the public,but the other one had a bad reputation.The photographer ignored the ministers of the president who were waving at the crowd.
15	DP2	DP2	A photographer was taking pictures at a political conference.Some ministers nominated as representatives by the two presidents were invited to take part.One president was very popular with the public,but the other one had a bad reputation.The photographer ignored the ministers of the president who was waving at the crowd.
16	DP1	DP1	The judge was relieved when the murder trial was over.Two solicitors had been working very hard trying to defend the suspected criminals.One of the solicitors was disappointed by the outcome,but the other one did not show any emotions.The judge recognized the solicitor of the criminals who was suffering from insomnia.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
16	DP1	DP2	The judge was relieved when the murder trial was over.Two solicitors had been working very hard trying to defend the suspected criminals.One of the solicitors was disappointed by the outcome,but the other one did not show any emotions.The judge recognized the solicitor of the criminals who were suffering from insomnia.
16	DP2	DP1	The judge was relieved when the murder trial was over.A solicitor had been working very hard trying to defend the suspected criminals.Some of the criminals were disappointed by the outcome,but others did not show any emotions.The judge recognized the solicitor of the criminals who was suffering from insomnia.
16	DP2	DP2	The judge was relieved when the murder trial was over.A solicitor had been working very hard trying to defend the suspected criminals.Some of the criminals were disappointed by the outcome,but others did not show any emotions.The judge recognized the solicitor of the criminals who were suffering from insomnia.
17	DP1	DP1	A journalist was visiting an army training camp.Two soldiers had just returned from an exercise supervised by the army colonels.One soldier looked incredibly tired, \n whilst the other one was still full of energy.The journalist hated the soldier of the colonels who was sitting down.
17	DP1	DP2	A journalist was visiting an army training camp.Two soldiers had just returned from an exercise supervised by the army colonels.One soldier looked incredibly tired, \n whilst the other one was still full of energy.The journalist hated the soldier of the colonels who were sitting down.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
17	DP2	DP1	A journalist was visiting an army training camp.A soldier had just returned from an exercise supervised by many army colonels.Some of the colonels looked incredibly tired, \n whilst the other ones were still full of energy.The journalist hated the soldier of the colonels who was sitting down.
17	DP2	DP2	A journalist was visiting an army training camp.A soldier had just returned from an exercise supervised by many army colonels.Some of the colonels looked incredibly tired, \n whilst the other ones were still full of energy.The journalist hated the soldier of the colonels who were sitting down.
18	DP1	DP1	A journalist was writing a special column about budget airlines.Many pilots, regularly flying a frequent traveller to Spain, were involved in an official investigation.Some of the pilots were rather upset by this, \n whereas the other ones pretended not to be concerned. \nThe journalist criticized the pilots of the traveller who were drinking too much.
18	DP1	DP2	A journalist was writing a special column about budget airlines.Many pilots, regularly flying a frequent traveller to Spain, were involved in an official investigation.Some of the pilots were rather upset by this, \n whereas the other ones pretended not to be concerned. \nThe journalist criticized the pilots of the traveller who was drinking too much.
18	DP2	DP1	A journalist was writing a special column about budget airlines.The pilots, regularly flying two frequent travellers to Spain, were involved in an official investigation.One traveller was rather upset by this, \n whereas the other one pretended not to be concerned. \nThe journalist criticized the pilots of the traveller who were drinking too much.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
18	DP2	DP2	A journalist was writing a special column about budget airlines.The pilots, regularly flying two frequent travellers to Spain, were involved in an official investigation.One traveller was rather upset by this, \n whereas the other one pretended not to be concerned. \nThe journalist criticized the pilots of the traveller who was drinking too much.
19	DP1	DP1	A doctor visited a school for a volunteer clinic.Two nurses were there to assist him, giving a pupil injections.One nurse seemed very nervous, \n while the other one kept laughing and making jokes.The doctor examined the nurse of the pupils who was feeling very tired.
19	DP1	DP2	A doctor visited a school for a volunteer clinic.Two nurses were there to assist him, giving a pupil injections.One nurse seemed very nervous, \n while the other one kept laughing and making jokes.The doctor examined the nurse of the pupils who were feeling very tired.
19	DP2	DP1	A doctor visited a school for a volunteer clinic.One nurse was there to assist him, giving the pupils injections.Some of the pupils seemed very nervous, \n whilst the other ones kept laughing and making jokes.The doctor examined the nurse of the pupils who was feeling very tired.
19	DP2	DP2	A doctor visited a school for a volunteer clinic.One nurse was there to assist him, giving the pupils injections.Some of the pupils seemed very nervous, \n whilst the other ones kept laughing and making jokes.The doctor examined the nurse of the pupils who were feeling very tired.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
20	DP1	DP1	The cameraman was attending a European film festival.Many directors had flown in from the United States, currently talking to an actor.Some of the directors were young and handsome, \n whilst the other ones looked exhausted. The cameraman adored the directors of the actor who were wearing cowboy boots.
20	DP1	DP2	The cameraman was attending a European film festival.Many directors had flown in from the United States, currently talking to an actor.Some of the directors were young and handsome, \n whilst the other ones looked exhausted.The cameraman adored the directors of the actor who was wearing cowboy boots.
20	DP2	DP1	The cameraman was attending a European film festival.Many directors had flown in from the United States, currently talking to two actors.One actor was young and handsome, \n whilst the other one looked exhausted.The cameraman adored the directors of the actor who were wearing cowboy boots.
20	DP2	DP2	The cameraman was attending a European film festival.Many directors had flown in from the United States, currently talking to two actors.One actor was young and handsome, \n whilst the other one looked exhausted.The cameraman adored the directors of the actor who was wearing cowboy boots.
21	DP1	DP1	The cleaning lady was angry about the mess in the baseball team’s common room. Two captains had been in charge of the after game party and were checking on a notorious player.One captain took this matter very seriously,but the other one was not bothered at all.The cleaning lady noticed the captain of the players who was working very late.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
21	DP1	DP2	The cleaning lady was angry about the mess in the baseball team's common room. Two captains had been in charge of the after game party and were checking on a notorious player.One captain took this matter very seriously,but the other one was not bothered at all.The cleaning lady noticed the captain of the players who were working very late.
21	DP2	DP1	The cleaning lady was angry about the mess in the baseball team's common room. The captain had been in charge of the after game party and was checking on a notorious player.Some of the players took this matter very seriously,but the other ones were not bothered at all.The cleaning lady noticed the captain of the players who was working very late.
21	DP2	DP2	The cleaning lady was angry about the mess in the baseball team's common room. The captain had been in charge of the after game party and was checking on a notorious player.Some of the players took this matter very seriously,but the other ones were not bothered at all.The cleaning lady noticed the captain of the players who were working very late.
22	DP1	DP1	A man sought advice on adventure holidays from a travel agency.A group of guides were recommended to him that had been praised by another tourist.Some of the guides were experienced mountaineers, \n whereas the other ones mostly went on boat trips.The man questioned the guides of the tourist who were feeling rather exhausted.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
22	DP1	DP2	A man sought advice on adventure holidays from a travel agency.A group of guides were recommended to him that had been praised by another tourist.Some of the guides were experienced mountaineers, \n whereas the other ones mostly went on boat trips.The man questioned the guides of the tourist who was feeling rather exhausted.
22	DP2	DP1	A man sought advice on adventure holidays from a travel agency.A group of guides were recommended to him that had been praised by two tourists.One touris twas an experienced mountaineer, \n whereas the other one mostly went on boat trips.The man questioned the guides of the tourist who were feeling rather exhausted.
22	DP2	DP2	A man sought advice on adventure holidays from a travel agency.A group of guides were recommended to him that had been praised by two tourists.One tourist was an experienced mountaineer, \n whereas the other one mostly went on boat trips.The man questioned the guides of the tourist who was feeling rather exhausted.
23	DP1	DP1	The director was pleased about the results of the annual school inspection.Two instructors specializing in working with an ill-behaved schoolboy had received special praise.One instructor was tough indeed, \n whereas the other one was quite easy-going.The director congratulated the instructor of the schoolboys who was writing the reports.
23	DP1	DP2	The director was pleased about the results of the annual school inspection.Two instructors specializing in working with an ill-behaved schoolboy had received special praise.One instructor was tough indeed, \n whereas the other one was quite easy-going.The director congratulated the instructor of the schoolboys who were writing the reports.

To be continued

Table 22. Continued

Item	Context	Attachment	Sentences
23	DP2	DP1	The director was pleased about the results of the annual school inspection.The instructor specializing in working with two ill-behaved schoolboys had received special praise.Some of the schoolboys were tough indeed, \n whereas the other ones were quite easy-going.The director congratulated the instructor of the schoolboys who was writing the reports.
23	DP2	DP2	The director was pleased about the results of the annual school inspection.The instructor specializing in working with two ill-behaved schoolboys had received special praise.Some of the schoolboys were tough indeed, \n whereas the other ones were quite easy-going.The director congratulated the instructor of the schoolboys who were writing the reports.
24	DP1	DP1	The policeman was investigating a brutal murder.A group of supervisors currently training a bodyguard were questioned as witnesses.Some of the supervisors were terribly frightenedbut the other ones looked as if nothing had happened.The policeman arrested the supervisors of the bodyguard who were wearing a black suit.
24	DP1	DP2	The policeman was investigating a brutal murder.A group of supervisors-currently training a bodyguard were questioned as witnesses.Some of the supervisors were terribly frightenedbut the other ones looked as if nothing had happened.The policeman arrested the supervisors of the bodyguard who was wearing a black suit.
24	DP2	DP1	The policeman was investigating a brutal murder.A supervisor currently training two bodyguards was questioned as a witness.One bodyguard was terribly frightenedbut the other one looked as if nothing had happened.The policeman arrested the supervisors of the bodyguard who were wearing a black suit.
24	DP2	DP2	The policeman was investigating a brutal murder.A supervisor currently training two bodyguards was questioned as a witness.One bodyguard was terribly frightenedbut the other one looked as if nothing had happened.The policeman arrested the supervisors of the bodyguard who was wearing a black suit.

Appendix E: Self-paced Reading Task 1 Materials (Long-distance Wh-dependencies)

Table 23. *SPR 1 materials (Study 3: long-distance dependencies)*

Item	Type	Phrase	Sentence
1	Extraction	VP	The manager who the secretary claimed that the new salesman had pleased will raise company salaries.
1	Extraction	NP	The manager who the secretary's claim about the new salesman had pleased will raise company salaries.
1	Non-extraction	VP	The manager thought the secretary claimed that the new salesman had pleased the boss in the meeting.
1	Non-extraction	NP	The manager thought the secretary's claim about the new salesman had pleased the boss in the meeting.
2	Extraction	VP	The student who the headmaster thought that the clever teacher had surprised does not like doing homework.
2	Extraction	NP	The student who the headmaster's thoughts about the clever teacher had surprised does not like doing homework.
2	Non-extraction	VP	The student believed the headmaster thought that the clever teacher had surprised everybody at school last week.
2	Non-extraction	NP	The student believed the headmaster's thoughts about the clever teacher had surprised everybody at school last week.

To be continued

Table 23. Continued

Item	Type	Phrase	Sentence
3	Extraction	VP	The nurse who the doctor argued that the rude patient had angered is refusing to work late.
3	Extraction	NP	The nurse who the doctor's argument about the rude patient had angered is refusing to work late.
3	Non-extraction	VP	The nurse thought the doctor argued that the rude patient had angered the staff at the hospital.
3	Non-extraction	NP	The nurse thought the doctor's argument about the rude patient had angered the staff at the hospital.
4	Extraction	VP	The witness who the lawyer proved that the evil criminal had confused does not want to testify.
4	Extraction	NP	The witness who the lawyer's proof about the evil criminal had confused does not want to testify.
4	Non-extraction	VP	The witness said the lawyer proved that the evil criminal had confused the judge during the trial.
4	Non-extraction	NP	The witness said the lawyer's proof about the evil criminal had confused the judge during the trial.
5	Extraction	VP	The actress who the journalist suggested that the talented writer had inspired will go on stage tonight.
5	Extraction	NP	The actress who the journalist's suggestion about the talented writer had inspired will go on stage tonight.

To be continued

Table 23. Continued

Item	Type	Phrase	Sentence
5	Non-extraction	VP	The actress thought the journalist suggested that the talented writer had inspired everybody with the new play.
5	Non-extraction	NP	The actress thought the journalist's suggestion about the talented writer had inspired everybody with the new play.
6	Extraction	VP	The customer who the receptionist stated that the lazy cleaner had annoyed will not pay his bill.
6	Extraction	NP	The customer who the receptionist's statement about the lazy cleaner had annoyed will not pay his bill.
6	Non-extraction	VP	The customer thought the receptionist stated that the lazy cleaner had annoyed the manager of the hotel.
6	Non-extraction	NP	The customer thought the receptionist's statement about the lazy cleaner had annoyed the manager of the hotel.
7	Extraction	VP	The farmer who the builder thought that the dedicated worker had amazed will give everybody extra money.
7	Extraction	NP	The farmer who the builder's thoughts about the dedicated worker had amazed will give everybody extra money.
7	Non-extraction	VP	The farmer said the builder thought that the dedicated worker had amazed the new boss last week.
7	Non-extraction	NP	The farmer said the builder's thoughts about the dedicated worker had amazed the new boss last week.

To be continued

Table 23. Continued

Item	Type	Phrase	Sentence
8	Extraction	VP	The singer who the musician stated that the drunken guitarist had offended will not perform this evening.
8	Extraction	NP	The singer who the musician's statement about the drunken guitarist had offended will not perform this evening.
8	Non-extraction	VP	The singer thought the musician stated that the drunken guitarist had offended the drummer after the performance.
8	Non-extraction	NP	The singer thought the musician's statement about the drunken guitarist had offended the drummer after the performance.
9	Extraction	VP	The schoolboy who the teacher proved that the aggressive child had distressed will complain at the meeting.
9	Extraction	NP	The schoolboy who the teacher's proof about the aggressive child had distressed will complain at the meeting.
9	Non-extraction	VP	The schoolboy said the teacher proved that the aggressive child had distressed the class at school yesterday.
9	Non-extraction	NP	The schoolboy said the teacher's proof about the aggressive child had distressed the class at school yesterday.
10	Extraction	VP	The girl who the policeman concluded that the nasty boy had frightened has stopped going to school.
10	Extraction	NP	The girl who the policeman's conclusion about the nasty boy had frightened has stopped going to school.

To be continued

Table 23. Continued

Item	Type	Phrase	Sentence
10	Non-extraction	VP	The girl said the policeman concluded that the nasty boy had frightened the children at the school.
10	Non-extraction	NP	The girl said the policeman's conclusion about the nasty boy had frightened the children at the school.
11	Extraction	VP	The coach who the manager decided that the violent footballer had annoyed will cancel the match today.
11	Extraction	NP	The coach who the manager's decision about the violent footballer had annoyed will cancel the match today.
11	Non-extraction	VP	The coach said the manager decided that the violent footballer had annoyed his fans at the match.
11	Non-extraction	NP	The coach said the manager's decision about the violent footballer had annoyed his fans at the match.
12	Extraction	VP	The politician who the minister stated that the TV journalist had upset will not give an interview.
12	Extraction	NP	The politician who the minister's statement about the TV journalist had upset will not give an interview.
12	Non-extraction	VP	The politician thought the minister stated that the TV journalist had upset the president on the program.
12	Non-extraction	NP	The politician thought the minister's statement about the TV journalist had upset the president on the program.

To be continued

Table 23. Continued

Item	Type	Phrase	Sentence
13	Extraction	VP	The chef who the cook argued that the head waitress had bothered wants to find another job.
13	Extraction	NP	The chef who the cook's argument about the head waitress had bothered wants to find another job.
13	Non-extraction	VP	The chef said the cook argued that the head waitress had bothered the manager of the restaurant.
13	Non-extraction	NP	The chef said the cook's argument about the head waitress had bothered the manager of the restaurant.
14	Extraction	VP	The director who the agent suggested that the unpleasant dancer had disappointed will cancel the performance tonight.
14	Extraction	NP	The director who the agent's suggestion about the unpleasant dancer had disappointed will cancel the performance tonight.
14	Non-extraction	VP	The director said the agent suggested that the unpleasant dancer had disappointed the people in the ballet.
14	Non-extraction	NP	The director said the agent's suggestion about the unpleasant dancer had disappointed the peopole in the ballet.
15	Extraction	VP	The film star who the interviewer suggested that the horrible photographer had embarrassed will not answer any questions.

To be continued

Table 23. Continued

Item	Type	Phrase	Sentence
15	Extraction	NP	The film star who the interviewer's suggestion about the horrible photographer had embarrassed will not answer any questions.
15	Non-extraction	VP	The film star said the interviewer suggested that the horrible photographer had embarrassed the editor of the newspaper.
15	Non-extraction	NP	The film star said the interviewer's suggestion about the horrible photographer had embarrassed the editor of the newspaper.
16	Extraction	VP	The man who the customer thought that the shop assistant had amused was trying not to laugh.
16	Extraction	NP	The man who the customer's thoughts about the shop assistant had amused was trying not to laugh.
16	Non-extraction	VP	The man believed the customer thought that the shop assistant had amused everybody in the store yesterday.
16	Non-extraction	NP	The man believed the customer's thoughts about the shop assistant had amused everybody in the store yesterday.
17	Extraction	VP	The therapist who the patient dreamed that the strange woman had fascinated is writing a new book.
17	Extraction	NP	The therapist who the patient's dream about the strange woman had fascinated is writing a new book.
17	Non-extraction	VP	The therapist said the patient dreamed that the strange woman had fascinated the members of the group.

To be continued

Table 23. Continued

Item	Type	Phrase	Sentence
17	Non-extraction	NP	The therapist said the patient's dream about the strange woman had fascinated the members of the group.
18	Extraction	VP	The man who the detective concluded that the dangerous thief had distressed will buy a new alarm.
18	Extraction	NP	The man who the detective's conclusion about the dangerous thief had distressed will buy a new alarm.
18	Non-extraction	VP	The man thought the detective concluded that the dangerous thief had distressed the people in the neighbourhood.
18	Non-extraction	NP	The man thought the detective's conclusion about the dangerous thief had distressed the people in the neighbourhood.
19	Extraction	VP	The captain who the officer decided that the young soldier had displeased will write a formal report.
19	Extraction	NP	The captain who the officer's decision about the young soldier had displeased will write a formal report.
19	Non-extraction	VP	The captain said the officer decided that the young soldier had displeased the colonel at training today.
19	Non-extraction	NP	The captain said the officer's decision about the young soldier had displeased the colonel at training today.
20	Extraction	VP	The tourist who the guide claimed that the hotel manager had angered wants to return home now.

To be continued

Table 23. Continued

Item	Type	Phrase	Sentence
20	Extraction	NP	The tourist who the guide's claim about the hotel manager had angered wants to return home now.
20	Non-extraction	VP	The tourist believed the guide claimed that the hotel manager had angered everybody in the holiday party.
20	Non-extraction	NP	The tourist believed the guide's claim about the hotel manager had angered everybody in the holiday party.
21	Extraction	VP	The translator who the consultant claimed that the secretary had impressed will buy everyone chocolate tomorrow.
21	Extraction	NP	The translator who the consultant’s claim about the secretary had impressed will buy everyone chocolate tomorrow.
21	Non-extraction	VP	The translator stated the consultant claimed that the secretary had impressed the president in the office.
21	Non-extraction	NP	The translator stated the consultant’s claim about the secretary had impressed the president in the office.
22	Extraction	VP	The woman who the psychologist claimed that the engineer had bothered decided to petition for a divorce.
22	Extraction	NP	The woman who the psychologist’s claim about the engineer had bothered decided to petition for a divorce.

To be continued

Table 23. Continued

Item	Type	Phrase	Sentence
22	Non-extraction	VP	The woman suggested the psychologist claimed that the engineer had bothered the zookeeper at the party.
22	Non-extraction	NP	The woman suggested the psychologist's claim about the engineer had bothered the zookeeper at the party.
23	Extraction	VP	The student who the advisor thought that the doorman had surprised was new to the partying scene.
23	Extraction	NP	The student who the advisor's thoughts about the doorman had surprised was new to the partying scene.
23	Non-extraction	VP	The student argued the advisor thought that the doorman had surprised the dean in the hallway.
23	Non-extraction	NP	The student argued the advisor's thoughts about the doorman had surprised the dean in the hallway.
24	Extraction	VP	The mailman who the manager stated that the journalist had hurt was upset about the problem.
24	Extraction	NP	The mailman who the manager's statement about the journalist had hurt was upset about the problem.
24	Non-extraction	VP	The mailman suggested the manager stated that the journalist had hurt the secretary in the conference.
24	Non-extraction	NP	The mailman suggested the manager's statement about the journalist had hurt the secretary in the conference.

To be continued

Table 23. Continued

Item	Type	Phrase	Sentence
25	Unmatched	VP	The politician who the journalist stated that John had fascinated is calling a press conference.
25	Unmatched	NP	The politician who John's statement about the minister had fascinated is calling a press conference.
26	Unmatched	VP	The manager who the consultant claimed that Andrew had pleased will hire five workers tomorrow.
26	Unmatched	NP	The manager who Andrew's claim about the secretary had pleased will hire five workers tomorrow.
27	Unmatched	VP	The general who the advisor thought that Mary had angered was attempting to appear calm.
27	Unmatched	NP	The general who the advisor's thoughts about Mary had angered was attempting to appear calm.
28	Unmatched	VP	The student who the teacher thought that Lauren had inspired is studying artificial intelligence.
28	Unmatched	NP	The student who Lauren's thoughts about the teacher had inspired is studying artificial intelligence.
29	Unmatched	VP	The actress who the agent suggested that Steve had distressed lobbied to play in the film.
29	Unmatched	NP	The actress who Steve's suggestion about the agent had distressed lobbied to play in the film.
30	Unmatched	VP	The mayor who the counsellor concluded that Nancy had annoyed registered with a new GP.
30	Unmatched	NP	The mayor who Nancy's conclusion about the counsellor had annoyed registered with a new GP.
31	Unmatched	VP	The patient who the doctor stated that Trudy had bothered was afraid she had cancer.
31	Unmatched	NP	The patient who Trudy's statement about the doctor had bothered was afraid she had cancer.

To be continued

Item	Type	Phrase	Sentence
32	Unmatched	VP	The employee who the reporter argued that Adam had embarrassed decided to sue the paper.
32	Unmatched	NP	The employee who Adam's argument about the reporter had embarrassed decided to sue the paper.
33	Unmatched	VP	The defendant who the witness suggested that Mandy had distressed looked nervous in court.
33	Unmatched	NP	The defendant who Mandy's suggestion about the witness had distressed looked nervous in court.
34	Unmatched	VP	The client who the lawyer claimed that Robert had hurt was fired from his job.
34	Unmatched	NP	The client who Robert's claim about the lawyer had hurt was fired from his job.
35	Unmatched	VP	The journalist who the editor stated that Kamal had implicated responded to the allegations very quickly.
35	Unmatched	NP	The journalist who Kamal's statement about the editor had implicated responded to the allegations very quickly.
36	Unmatched	VP	The boy who the schoolteacher thought that Mia had irritated finally decided to leave home.
36	Unmatched	NP	The boy who Mia's thoughts about the schoolteacher had irritated finally decided to leave home.