

1 **Exploring the source of differences and similarities in L1 attrition and heritage**  
2 **speaker competence: evidence from pronominal resolution**

3

4 **1. Introduction**

5 Various studies of language processing and production in bilingual speakers have  
6 shown effects of crosslinguistic influence (CI), that is, effects of one language on  
7 the other (e.g. Cuza et al. 2013, Müller & Hulk 2001, Yip & Mathews in prep, 2007,  
8 Unsworth 2012 for child bilinguals; Author C & Iverson 2013; Francis 2005, for  
9 adult bilinguals). Crosslinguistic influence has been argued to be restricted to  
10 certain domains of language and with a specified direction for each phenomenon,  
11 i.e. from language X to language Y but not vice versa. Author B et al. (2004) for  
12 example argue that the overuse of Greek or Italian overt pronouns by attrited  
13 speakers is affected by English, a language with only one pronominal option for  
14 topic-continuity and topic-shift. This unidirectionality of CI has been attested for  
15 other syntactic phenomena too, such as word-order, overuse of null objects,  
16 complement ordering of pre- and postpositions and relative clauses (Döpke 1998,  
17 Müller & Hulk 2001, Yip & Matthews 2000, Cuza et al. 2013, Argyri & Sorace 2007).

18 In the present study we focus on an extensively studied interface  
19 phenomenon, namely pronominal resolution with the aim of addressing the  
20 question of whether two groups of bilingual speakers, an older and a younger group,  
21 reveal different interpretation preferences for null and overt pronouns. Specifically,  
22 we experimentally examine the interpretation of Greek null and overt subject

1 pronouns in terms of the selection of a subject, object or 'other' referent as the  
2 preferred antecedent of the pronoun. The two bilingual groups consist of adult  
3 Greek-Swedish speakers. The older group includes adults who developed  
4 knowledge of L2 Swedish in adulthood whereas the younger group includes  
5 younger adults who had bilingual exposure from preschool age. Potentially, the  
6 older group meets the characterization of non-pathological first language attrition  
7 in adulthood due to second language influence, in that these once monolingual  
8 Greek speakers might be affected by their late-developed bilingualism in L2  
9 Swedish<sup>1</sup>. The younger group includes early-sequential bilinguals of Greek and  
10 Swedish who acquired Greek naturalistically in early childhood as a "home"  
11 language in Sweden. This group is thus a typical heritage speakers' group (see  
12 e.g. Montrul 2008, Author C 2009a).

13 In non-pathological cases, first language (L1) attrition is viewed as a  
14 process during which a native speaker of a language who has grown up  
15 monolingual shows signs of changes in his native language use as a result of  
16 extensive contact with a second language (see e.g. Schmid 2011 for review). L1  
17 attriters typically preserve most core syntactic aspects of their native language  
18 such as basic word order, head directionality, syntactic licensing of empty

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<sup>1</sup> Whether this is actual influence of Swedish on the representation of the grammatical system of Greek, or a processing issue affecting processing the first language (Greek) or a combination of both are all empirical questions which cannot be addressed by the experimental task used here. We therefore have to leave this important issue aside for the purposes of the present paper.

1 categories and the like (see Cuza 1010, 2013; Domínguez 2009, 2013; Gürel 2002;  
2 Iverson 2012) but show effects of attrition in other domains. In particular, attrition  
3 effects have been found in lexical retrieval and access (Kohnert, Bates &  
4 Hernández 1999, Köpke 2002, among others), pragmatic transfer of L2 concepts  
5 (Pavlenko 2000) and discourse-related features of pronominal resolution relevant  
6 to the syntax-discourse interface (Gürel 2004, Author B et al. 2004, Author B 2007,  
7 Sorace 2005, 2011). The severity of the effects varies and depends on various  
8 factors such as the regularity of L1 use and the length of L2 exposure and use.

9 A different developmental situation with effects on L1 performance has  
10 been associated with heritage speakers (e.g. Montrul 2008, Polinsky 2011, Author  
11 C 2007, Pires & Author C 2009). Although it is hard to provide an exhaustive  
12 definition of heritage speakers to which all would subscribe (see for discussion  
13 Beaudrie & Fairclough 2012, Montrul 2008, Polinsky & Kagan 2007, Author C  
14 2009a), a typical case would be early bilinguals exposed to one language from  
15 birth, which happens to be different from the majority language and the main  
16 language of education in the society in which they grow up. Heritage speakers  
17 have been shown to differ from monolingual natives but also from second language  
18 learners in various interesting respects (Montrul 2004, 2008). Apart from lexical  
19 retrieval difficulties (see Ecke 2004 for heritage speakers; see Hulsen 2000,  
20 Montrul 2008, Schmid 2002, Schmid & Köpke 2008, Pavlenko 2003, 2004 for  
21 attriters), heritage speakers have been shown to exhibit difficulties in other areas  
22 of grammar (Montrul 2008, Polinsky 1997, 2007). A linguistic area most noticeably

1 affected is inflectional morphology. Heritage speakers of grammatical gender  
2 languages produce a significant number of gender errors compared to  
3 monolinguals. For example, although monolingual Russian and Spanish-speaking  
4 children control gender marking by age 4 with almost 100% accuracy (with the  
5 exception of irregular and less frequent forms), Polinsky (2008) and Montrul (2008)  
6 have shown that heritage speakers display high error rates ranging from 5% to  
7 25%. In the verbal domain, the tense system can also be affected. Heritage  
8 speakers of Spanish and Russian confuse aspectual distinctions between  
9 perfective and imperfective forms (Polinsky 2007, Silva-Corvalán 1994). Moreover,  
10 in reference to agreement and the distribution of null and overt subjects in null  
11 subject languages, it has been shown that this syntax-discourse interface  
12 phenomenon is also a vulnerable domain: Spanish and Russian heritage speakers  
13 have been found to overuse overt subjects in contexts where a null subject would  
14 be pragmatically more appropriate (Montrul 2004, Polinsky 2007, Author B et al.  
15 2004).

16 As mentioned, L1 attrition usually affects non-core properties of the  
17 language. We know that differences in heritage grammars are not solely confined  
18 to non-core areas per se although basic properties such as macro-parametric  
19 properties (e.g. basic word order, head-directionality and the like) seem unaffected.  
20 However, it is often the case that highly significant divergences are found in non-  
21 core areas of grammar, for example, Montrul (2004) found that the discourse  
22 regulated distribution of null and overt subjects in heritage speakers of Spanish

1 differs from monolingual norms in that null and overt subjects are used in contexts  
2 where they are pragmatically unexpected. Following Pires & Author C (2009), the  
3 question is whether this is a result of influence of bilingualism with English as the  
4 'other' language leading to morphosyntactic convergence (Montrul 2004) or  
5 whether it reflects, at least in part, higher use of overt subjects by the L1 attriters  
6 who provide heritage speakers their input. If a similar pattern is shown in L1  
7 attrition, then some differences in heritage grammars might simply be reflective of  
8 the input provided to them by bilingual L1 attriters (cf. Sorace 2004, Author C 2007;  
9 Pascual y Cabo & Author C 2012 for similar argumentation and, e.g., Montrul &  
10 Walker Sánchez 2013; Pascual y Cabo 2013 for empirical support).

11           Accordingly, an important theoretical question in the comparison between  
12 first language attriters and heritage speakers is whether the effects of  
13 crosslinguistic influence are similar in quality and in degree and whether the  
14 deviation from monolingual performance is persistent and permanent in both  
15 groups. In this respect, heritage speakers' L1 acquisition has been characterized  
16 as 'incomplete' in that there are grammatical aspects of the L1 that have not  
17 developed at the appropriate level compared to monolingual age-matched peers  
18 (Montrul forth.). Although we take issue with the term 'incomplete acquisition'<sup>2</sup> for

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<sup>2</sup> Our issue with the term incomplete acquisition to refer to heritage language differences is two-fold. First, it does not take into account possible input differences that heritage language speakers may be exposed to compared to monolingual children. In this case, the acquired grammar is complete insofar as the input properties are similar in quality and quantity for native grammatical development, since age of onset issues and age considerations with respect to cognitive development are similar. Secondly, we believe the

1 child bilingual language development in typical, non-pathological cases and the  
2 adult competence that arises from it, it should be noted that this notion of  
3 'incompleteness' can only be relevant to early bilingualism as in the case of  
4 heritage speakers; L1 attriters, in contrast, are expected to have reached a mature  
5 state of L1 development which, through attrition, may show signs of L1-divergent  
6 performance. If similarities are found in heritage speakers' and L1 attriters'  
7 performance in adulthood, we believe that these argue in support of vulnerability  
8 in certain domains of language, leaving the question of competence  
9 (representation of grammar) vs. performance (the use of grammar in a given  
10 context) open. Moreover, if similarities are found their underlying source is  
11 necessarily different. The L1 attrited grammar *becomes* different whereas the  
12 heritage speaker is different as a result of the environmental realities of their  
13 developmental path (see Putnam & Sánchez 2013). The common denominator in  
14 both cases is bilingualism and the differentiating factor is the age of onset of  
15 bilingualism. Thus, surface divergence from the monolingual grammar in the case  
16 of L1 attrition and heritage language can, in principle, reflect representational  
17 differences. For attriters, it might very well be the case that the emerging  
18 divergence is only surface deep a matter of performance as opposed to a change

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term to be descriptively inaccurate. A truly incomplete grammar would be one that is not systematic for the domain that is claimed to have been incompletely acquired. This is not the case of heritage grammars, as might be the case for some properties in L2 grammars, labelled as such under the origin of the term from Schachter's (1990) Incompleteness Hypothesis. If it were to be stable and 'incomplete' then it is, in principle, a different grammar.

1 in mental representation whereas for heritage speakers a representational one.  
2 This is to be expected since the former is the byproduct of reduced input after a  
3 mature state of grammar has been reached whereas the latter is the result of input  
4 differences and continuous language contact in the developing grammars of the  
5 bilingual child. Although this is a central question in research comparing HS and  
6 L1 attriters, our experimental study cannot address the relevant distinction (see  
7 also fn. 1).

8         Bringing together L1 attriters and the generation of speakers they provide  
9 input to, namely heritage speakers, as we do in the present study is especially  
10 interesting with respect to identifying sources of differences in development and  
11 ultimate attainment that characterize the mature state grammars of heritage  
12 speaker bilinguals (cf. Sorace 2004, Domínguez 2009, 2013, Pascual y Cabo 2013,  
13 Pascual y Cabo & Author C 2012, Pires & Author C 2009). In particular, the present  
14 study aims to examine the role of early vs. late bilingualism in HS and L1 attriters  
15 in a syntax-discourse phenomenon which has been shown to differentiate  
16 monolingual from bilingual speakers, namely pronominal resolution. In principle,  
17 two possibilities are envisaged with respect to the interaction between age of onset  
18 of bilingualism and pronominal resolution. According to the first, we expect stronger  
19 effects of the early bilingual experience of HS on pronominal resolution, giving rise  
20 to increased optionality in the interpretation of overt but also null subject pronouns.  
21 In this scenario, late bilinguals, namely L1 attriters, are expected to show  
22 bilingualism effects on overt pronouns only as a consequence of crosslinguistic

1 influence from the non-null subject L2. The second possibility is that bilingualism  
2 will affect both HS and L1 attriters similarly, without any cumulative effects of age  
3 of onset differences, and only on overt pronoun resolution as previous literature  
4 suggests (Author B et al 2004). This is based on the assumption that there are no  
5 qualitative differences in the effects of early vs. late bilingualism at least insofar as  
6 syntax-discourse phenomena are concerned. The second possibility is also  
7 compatible with the linguistically-driven distinction in the features of overt and null  
8 pronouns which assume overt pronouns to be marked, and thus more vulnerable  
9 than the null option, which constitutes the default in null subject languages.

10         The group of heritage speakers in our study consists of Greek-Swedish  
11 bilinguals with exposure to Greek in the home environment from birth and  
12 throughout childhood and adolescence. For some of them Greek literacy is also  
13 attained through language support classes. All participants in the heritage  
14 speakers' group grew up in Sweden and had early (preschool) exposure to  
15 Swedish as their second language. They attended Swedish schools and consider  
16 themselves dominant in Swedish. The group of L1 attriters in our study includes  
17 first generation Greek immigrants who moved to Sweden as young adults. Their  
18 Swedish developed after they immigrated through interaction with native speakers  
19 in the L2 society and, for some of the participants, through Swedish language  
20 courses.

21         The syntax-discourse phenomenon which is the focus of the present study  
22 is pronominal resolution in Greek in these two groups of Greek-Swedish bilinguals.



1 Greek and Swedish differ in the null subject property: Greek is a typical null-subject  
2 language with overt pronouns being a 'marked' option dictated by discourse-  
3 related features (see below) while Swedish requires subject pronouns to be overtly  
4 realized in finite clauses (e.g. Holmberg & Platzack 1995). Given the contrast in  
5 the value of the null subject option, the present study addresses two questions.  
6 First, we investigate the possibility of crosslinguistic influence (CI) from Swedish to  
7 Greek affecting the interpretation of overt subject pronouns. In particular, the  
8 expectation is that both L1 attriters and heritage speakers would show effects of  
9 Swedish subject properties onto Greek in the interpretation assigned to overt but  
10 not to null subjects, as previously reported for similar language combinations in  
11 Montrul 2004, Sorace & Filiaci 2009 and Author B et al. 2004. The underlying idea  
12 is that the syntactic availability of null and overt pronouns will not be affected by  
13 language contact in either group of bilinguals, but the interpretation assigned to  
14 overt pronouns, which is the overlapping option in Swedish and Greek, will become  
15 less sensitive to their Greek markedness feature of topic-shift. Accordingly, the  
16 interpretation of overt subject pronouns in the Greek of both bilingual groups will  
17 be open to topic-continuity and topic-shift options, as is the case in the 'other'  
18 language, Swedish. The second question our study seeks to address is a possible  
19 difference between heritage speakers and L1 attriters in the effects of CI in  
20 pronominal resolution. This difference is based on the early vs. late bilingualism of  
21 each group of Greek-Swedish participants. Specifically, the early acquired bilingual  
22 experience in the HS group in contrast with the late bilingual status of the attriters

1 may show stronger effects of crosslinguistic influence on pronominal resolution in  
2 the HS group, extending to attrition in the interpretation of null subject pronouns as  
3 well. More specifically, if the age-of-onset of exposure to bilingualism turns out to  
4 play an important role in the two groups heritage speakers will not be experiencing  
5 'attrition' affecting monolingual Greek but an early established bilingual Greek  
6 system with lower sensitivity to markedness features on overt pronouns from the  
7 start. Furthermore, we expect differences between HS and monolingual speakers  
8 of Greek to be greater than between L1 attriters and monolingual controls. We  
9 also expect that any link to differences in the heritage speakers possibly stemming  
10 from emerging attrition effects in the input would also favor the above-described  
11 predictions, again because the attriters had reached a mature state that is now  
12 being eroded whereas the heritage speakers might never have reached a state  
13 comparable to the monolinguals (cf. Shin and Cairns 2009)<sup>3</sup>. In other words, a  
14 change from what was once a monolingual grammar as is the case of L1 attrition,  
15 should show less divergence than a bilingual grammar with a mature state that has

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<sup>3</sup> Shin and Cairns' (2009) study of monolingual Mexican children shows that the switch reference properties of null and overt pronoun in Mexican Spanish are acquired very late, namely around the age of 15. As an anonymous reviewer points out, if this number of years of input is required for monolinguals to attain adult-like performance, HS are expected to systematically differ from monolingual and attriters whose input has been sustained during the relevant period of time. Although this may indeed be a matter of input, it is equally likely that it is a combination of input and age effects on cognitive development affecting language processing. In our study all participants are adult, so the input question for interface-related phenomena remains a possible explanation. Still, the lateness of the phenomenon indicates that it is not an instance of incomplete grammars (Author B 2014).

1 always been qualitatively different from monolinguals whether or not the heritage  
2 speaker performance correlates to input produced under L1 attrition.

3

#### 4 **2. Overt and null subject pronouns**

5 The distribution and interpretation of subject pronouns in null subject languages  
6 has received considerable attention in theoretical and experimental literature (see  
7 Sorace 2011 for a review). Carminati's (2002) analysis of the distribution of  
8 pronouns in null subject languages invokes a structural bias, the Position of  
9 Antecedent Strategy (PAS). Accordingly, the resolution of intra-sentential  
10 anaphora involves distinct biases for null and overt subject pronouns. The null  
11 pronoun prefers an antecedent which is in the canonical subject position i.e., in the  
12 Spec IP position, whereas the overt pronoun prefers an antecedent which is not in  
13 the Spec IP position. Her hypothesis was verified by a series of on line and off line  
14 experiments with monolingual adult Italian learners. Similar findings were also  
15 verified by Sorace & Filiaci (2006) for Italian and by Mayol (2012) for Spanish.

16         Meanwhile, other L1 studies report that overt subject pronouns do not  
17 necessarily exhibit a bias towards a less prominent antecedent such as the DP  
18 object (see Filiaci 2008 for Spanish), or even that no noticeable patterns are  
19 attested suggesting a more flexible nature of overt pronoun assignment (see Geber  
20 2006 for Romanian, Costa et al. 2004 for Brazilian Portuguese and Meridor 2006  
21 for Hebrew). Additionally, where ambiguity is not at stake, monolingual speakers  
22 are shown to disregard the typical antecedent assignment strategies (Ferreira &

1 Patson 2007) implying that the processing load of coordinating syntactic and  
2 pragmatic information could be relieved with the use of an overt pronoun (Sorace  
3 et al. 2009).

4         Pronominal resolution has been one of the most studied interface  
5 phenomena in monolingual and bilingual speakers. The motivation for this  
6 research stems from the idea that interfaces have been shown to be vulnerable  
7 domains in language development and language attrition (Platzack 2001, Müller &  
8 Hulk 2001, Sorace & Filiaci 2006, Author B et al. 2004) more so than purely  
9 grammatical aspects of language (Sorace 2004, Author B 2007, Schmid 2009).  
10 Interfaces require the coordination of different types of information rendering the  
11 interpretational demands more complex and subject to degrees of preference  
12 instead of categorical judgments in monolingual and bilingual speakers (Author B  
13 & Sorace 2006). Pronominal resolution and reference assignment, in general,  
14 presuppose the processing of grammatical and discourse information. Similarly,  
15 identifying the appropriate antecedent for a pronoun presupposes sensitivity to  
16 morphological and structural information (Carminati 2002) as well as developed  
17 pragmatics (Sperber & Wilson 2004). In null subject languages the availability of  
18 overt and null pronouns is a grammatical property. The appropriate choice for the  
19 subject pronoun, however, is regulated by discourse factors, such as topic-  
20 continuity, topic-shift and emphasis. In the context of first language attrition or  
21 bilingualism the overt pronoun appears to be overused in contexts of topic-  
22 continuity where the monolingual speaker would prefer to use a null subject (Author

1 B et al. 2004, Sorace 2011 and references therein). Interestingly, the overt pronoun  
2 is overused even when the two languages are both null subject languages, as  
3 shown in Spanish-Italian bilingual production (Filiaci et al. 2013, Serratrice et al.  
4 2011). Although this effect points to pronoun overuse as an effect of bilingualism  
5 rather than crosslinguistic influence, it is crucial to point out that the distribution of  
6 null vs. overt subject pronouns is not identical even among null subject languages  
7 (Iraola Azpiroz & Ezeizabarrena Seguro 2011, Mayol 2012). This raises the  
8 possibility that crosslinguistic influence may surface as the overuse of a more  
9 'marked' overt pronoun in one language to its relaxed markedness status in the  
10 other.

11         Pronominal resolution may also undergo attrition effects in non-null subject  
12 languages. Wilson (2009) examined anaphoric dependencies in German with  
13 personal and demonstrative pronouns in subject position. The division of labour  
14 between them is similar to that of null and overt subject pronouns in null subject  
15 languages. Wilson tested native, advanced L2 speakers, and potentially attrited  
16 German speakers who were resident in the UK. She found that anaphoric  
17 dependencies involving personal pronouns are stable, whereas those involving  
18 demonstratives are more indeterminate. Attrited German speakers' preferences for  
19 the antecedents of demonstratives show variability and divergence compared to  
20 monolingual Germans meaning either no clear preference, or a preference for a  
21 subject antecedent with strength of preference dependent on length of residence  
22 in the UK.

1

2 **3. Pronominal resolution in Greek: previous experimental studies**

3 Greek is a null subject language exhibiting similar, but not identical, interpretation  
4 properties for overt and null subject pronouns with other null subject languages  
5 such as Italian and Spanish. The preferences in the interpretation of overt and null  
6 subjects in Greek have been examined in a number of different populations such  
7 as L1 attrited speakers, monolingual children and monolingual adults. The  
8 theoretical accounts presented below converge on the attribution of different  
9 interpretations to null and overt subject pronouns for native Greek monolingual  
10 speakers. As this is essentially the background information we need to evaluate  
11 the results from our study with HS and L1 attriters, we will be brief in our  
12 presentation of the alternative theoretical approaches.

13 Dimitriadis's (1996) analysis argues for a Centering Theory account on the  
14 basis of corpus data on pronominal subjects. In his approach, the centering model  
15 establishes the anaphoric relationships and their effect on the interlocutors'  
16 attention. Specifically, the centers are the available antecedents for the  
17 subsequent utterance that formulate the forward looking centers list (Cf-list). The  
18 ranking within the Cf-list is argued to be language dependent; the null pronouns of  
19 Greek subjects tend to select as their antecedent the highest-ranked center that  
20 has compatible grammatical and agentivity features, while overt pronouns are  
21 incompatible with the preferred center (Cp), regardless of its features, instead  
22 antecedents lower in the list appear to be better candidates. In other words,

1 Dimitriadis (1996) suggests that the interpretation of pronouns is partly dependent  
2 on grammaticized properties of individual pronouns.

3         Miltsakaki (2007) examined the interpretation of null and overt subject  
4 pronouns in Greek in relation to argument ordering; SVO and OVS sentences with  
5 agent-patient combinations were included. Participants had to complete a second  
6 sentence whose first word was an overt pronoun. The data showed a strong  
7 preference for the overt pronoun to pick the patient-object antecedent irrespective  
8 of the word order. The participants were also given the option of introducing the  
9 subject (overt or null) on their own. The data showed that the patient-object  
10 reference was used in 52% of the responses, and the agent-subject reference in  
11 48% of the responses. Miltsakaki's study also provided evidence for a processing  
12 distinction between main and subordinate clauses finding that in the main clause  
13 continuations the null subjects preferred the subject referent and the overt  
14 pronouns the object referent. This pattern was not replicated with subordinate  
15 clause continuations where null subjects preferred the object rather than the  
16 subject referent.

17         In L1 attrition studies, the distribution of pronouns controlled by discourse  
18 features such as Focus and Topic Shift has been addressed on the hypothesis that  
19 attrition effects show up as optionality in the feature-specification on overt subject  
20 pronoun use. Author B et al. (2004), in particular, investigated forward and  
21 backward anaphora resolution in adult native speakers of Italian (with near-native  
22 L2 English) using an off-line sentence picture matching task. The findings showed

1 that in sentences with forward anaphora, when the subject of the subordinate  
2 clause was a null pronoun, participants preferred to interpret it as the subject of the  
3 main clause. In contrast, when the subject of the subordinate clause was an overt  
4 pronoun, participants strongly preferred to interpret it as referring to a new referent.  
5 In sentences with backward anaphora, when the subject of the subordinate clause  
6 was a null pronoun, participants allowed for either the subject or the object of the  
7 main clause as a possible referent. However, when the embedded subject was an  
8 overt pronoun, participants showed a strong preference for the matrix object to be  
9 the referent of the pronoun. Note that the Greek participants in Author B et al.  
10 (2004) did not differ significantly from non-attributed controls although their  
11 preferences for subject or object antecedents were weaker than those of the  
12 controls. The difference between Greek and Italian attriters was attributed to the  
13 difference in the status of the overt pronoun in each language; in Greek the overt  
14 subject pronoun is the demonstrative which can assume anaphoric function  
15 whereas in Italian this is not the case.

16 In a more recent study, Papadopoulou, Peristeri, Plemenou, Marinis &  
17 Author B (in press) tested the interpretation of null and overt subject pronouns in  
18 Greek speaking 10-11 year old children and adults using an on-line self-paced  
19 listening task as well as an off-line sentence-picture matching task. Since this task  
20 is the one used in the present study, presentation of the experimental conditions  
21 and materials is found in the following sections. The main findings with respect to  
22 the monolingual populations tested in Papadopoulou et al. (in press) is that the



1 interpretation of overt subject pronouns is similar in children and adults, i.e.  
2 showing a strong preference for the object antecedent. On the other hand, children  
3 differed from adults in the interpretation of null subject pronouns. In particular,  
4 children showed no strong preference for either the subject or the object  
5 antecedent while the adults showed a strong subject antecedent preference. The  
6 analysis proposed is based on the idea that while the overt pronoun is the marked  
7 option and as such its use implies topic-shift the null subject option is unmarked in  
8 the grammar and as such its interpretation is open to either antecedent. Adults  
9 regulate their interpretative options by assigning a subject antecedent preference  
10 to null subject pronouns as an economy strategy on pronominal resolution.  
11 Specifically, given that overt pronouns are the 'marked' option signaling a switch  
12 in topic, null subjects are preferred as the elsewhere condition which in this case  
13 is topic-continuity. The children's non-adult performance in the interpretation of null  
14 subject is thus viewed as a delay in the development of a strong parsing preference  
15 even at the age of 10-11, rather than a delay in the grammar or the relevant  
16 interface features of topic (shift/continuity) or focus.

17

#### 18 **4. The Study**

19 In the present study we compare two adult bilingual groups, first language attriters  
20 and heritage speakers of Greek in their ability to interpret subject pronouns in  
21 contexts where the matrix subject, the matrix object or a third referent is available  
22 in the picture presented. As discussed in Section 2 above, the null subject option

1 in Greek is the default option looking for an established topic in the preceding  
2 discourse as the preferred antecedent. The subject antecedent preference is  
3 theoretically and empirically grounded on the basis of monolingual adult native  
4 speaker data. On the other hand, the overt subject pronoun is discursively 'marked'  
5 (Cardinaletti & Starke 2001, Montalbetti 1984). As such non-subject antecedents  
6 are expected to be preferred in the case of overt subject pronoun use. Given  
7 previous evidence from Author B et al.'s (2004) study on L1 attrition we expect any  
8 differences between monolingual and bilingual groups to be more evident in the  
9 interpretation of overt pronouns. Although in the offline study in Author B et al  
10 (2004) Greek attriters did not show a significant difference from monolingual  
11 controls, the present study is methodologically different. Apart from being an online  
12 self-paced listening study, each sentence is matched (or not) with *one* picture at a  
13 time (Papadopoulou et al. 2014). In Author B et al. (2004), all three options (Subject,  
14 Object or Other) were presented simultaneously to the participant and more than  
15 one of the three could be selected as appropriate choices. This method  
16 encourages optionality and participants' preferences are weakened making any  
17 difference between controls and attriters less pronounced.

18 Furthermore, unlike the online data on monolingual children  
19 (Papadopoulou et al. 2008) which reveal a delay in showing a subject antecedent  
20 preference for null subject pronouns L1 attriters and heritage speakers are  
21 expected to show variability in the interpretation of the overt rather than the null  
22 pronoun since subject prominence as a processing strategy should already be in

1 place. On the other hand, if reduced input quantity in the early language  
2 development of heritage speakers compared to L1 attriters has qualitative effects  
3 on judgments, preferences and intuitions about pronominal reference it is possible  
4 that HS will show variability not only in the overt subject but in the null subject  
5 pronoun too allowing for more object antecedents than L1 attriters

6

#### 7 **4.1 Experiment 1: Self-paced listening task with overt pronouns**

##### 8 **4.1.1 Experimental Design: Materials & Procedure**

9 The self-paced listening experiment includes a sentence-picture matching task  
10 which aims to test pronoun resolution in Greek. The experiment consists of 10  
11 practice sentences, 10 experimental sentences, 30 experimental pictures, 30 filler  
12 sentences, and 30 filler pictures. The target sentences include a main clause, in  
13 which two referents are introduced, and an adverbial clause the subject of which  
14 was overt as in (1) below:

15

16 (1) I yiayia / xeretise / tin kopela / otan / afti / pernuse / to ðromo.

17 the-FEM old-lady-FEM / greeted-3S / the-FEM girl-FEM / when / she /

18 cross- PAST-3S / the street

19 'The old-lady greeted the girl when she crossed the street.'

20

1 In the example above the overt subject pronoun of the adverbial clause, *after*, could  
2 be construed as coreferential with the subject or the object of the main clause. In  
3 all the test items the noun phrases in subject and object position, were of the same  
4 gender so that the overt pronoun could in principle refer to either. The slashes  
5 indicate the way the sentence was divided into segments. The critical segment was  
6 the subject pronoun of the subordinate clause. The participants were shown a  
7 picture presented on the computer screen at the onset of the first auditory segment  
8 and started listening to the sentences in a segment-by-segment fashion. The  
9 participants controlled the onset of the listening of each segment by pressing a  
10 button on the keyboard. At the end of the sentence the picture was substituted with  
11 a question mark "?" on the computer screen. At this point the participant was asked  
12 to indicate whether the sentence they listened to matched the picture or not by  
13 pressing one of the two pre-specified buttons on the keyboard. The button press  
14 recorded the participants' answer choice and also their RT for this decision. The  
15 experiment lasted approximately 20-30 minutes (depending on the age of the  
16 participants). Each experimental sentence was matched to three different pictures.  
17 The pictures depicted the action presented in the adverbial clause and each picture

1 provided a different interpretation: in one picture the actor was the subject of the  
2 main clause, in the second the actor was the object of the main clause, and in the  
3 third picture the actor was a third referent. Three lists were created, each  
4 containing the 10 experimental and the 30 filler sentences. In each list, the  
5 experimental sentences were matched to one of the three pictures. In each list, the  
6 choice of antecedent depicted in the picture was rotated. Thus, each antecedent  
7 option was presented at least three times for each participant with one of the  
8 options (subject, object or third referent) presented four times in each list. Each  
9 participant encountered only one of the three lists (see example):

10

11 [Insert Picture Set]

12

#### 13 **4.1.2 Participants**

14 Ninety-one adult speakers of Greek were included in this study. There were two  
15 experimental groups and two control groups. There was an experimental group of  
16 HS and another including L1 attriters. The HS group consists of 30 adult Greek-  
17 Swedish bilinguals (sixteen female) of Greek origin and born in Sweden. They  
18 attended monolingual Swedish education along with Greek language-support  
19 classes (Saturday school) throughout their childhood and adolescence. They

1 reported that even though they speak predominantly Greek with family members,  
2 they use both languages on a daily basis. At the time of testing, the mean age was  
3 29 years (range: 19-34 years old). The majority of the participants (n=22) had  
4 university degrees from Swedish institutions. At the time of testing, twenty-five of  
5 the heritage speakers still lived in Sweden while five of them had recently moved  
6 to Greece to receive intensive language courses in Greek<sup>4</sup>.

7         The L1 attriters' group includes 25 adult native speakers of Greek (nine  
8 female) born and raised in Greece, who immigrated to Sweden during adulthood.  
9 They learnt Swedish through interaction with native speakers of the language and  
10 half of them attended Swedish language courses as well upon arrival in the L2  
11 community (the duration and frequency of the courses varied greatly among  
12 participants). They reported that they use Greek (L1) predominantly at home and  
13 Swedish (L2) when socializing in the L2-community. The attriters have been living  
14 in Sweden for 31 years in average (range: 25-44 years). At the time of testing, the  
15 mean age was 59 years (range: 55-65). It is noteworthy that these participants  
16 meet the external conditions for L1 attrition since their length of residence in the  
17 L2-community is well over the minimum of 6 years that has been assumed in other  
18 studies (e.g. Author B et al. 2004). They thus resemble attrition cases studied in  
19 Schmid (2002) with much lengthier stay in the L2-community. The majority of the  
20 participants (n=14) had completed secondary education, three participants had

---

<sup>4</sup> The period of residence in Greece was two to three months as they were all students in an Erasmus visit to a Greek university.

1 only finished primary school and the remaining eight participants had obtained a  
2 university degree before immigration.

3 Two groups of monolingual speakers of Greek were included for control  
4 purposes. The younger control group (n=18) matched the mean age of the heritage  
5 speakers' group (12 females) and the older control group (n=18) that of the attriters'  
6 group (9 females). While recruiting the monolingual participants we took into  
7 account their educational background in order to match them with the profiles of  
8 the participants in the experimental groups.

9

#### 10 **4.1.3 Predictions**

11 Our predictions are based on the following theoretical and empirical background  
12 assumptions. We assume that the syntax-discourse interface is a vulnerable  
13 domain in cases of language contact (Sorace & Filiaci 2006, Author B et al. 2004,  
14 Author B & Sorace 2006). The idea is that interface phenomena are not fully  
15 determined by syntactic computations nor do they trigger categorical judgments  
16 even in monolingual adult native speakers. Instead, these phenomena are subject  
17 to preferences affected by a) morphosyntactic options, e.g. null *vs.* overt subject  
18 pronouns, personal *vs.* demonstrative pronouns (Wilson 2009, Wilson et al. 2009),  
19 b) syntactic context e.g. intrasentential *vs.* intersentential anaphora (Peristeri 2010),  
20 adverbial *vs.* complement clauses (Miltakaki 2003), c) directionality of anaphora  
21 (forward or backward; Author B et al. 2004 and d) lexical and discourse properties  
22 such as plausibility and frequency factors. Successful integration of all the above

1 properties gives rise to preferences as these are found in monolingual adult native  
2 speaker data. The interface status of syntax-discourse phenomena opens up the  
3 possibility of differences from the monolingual adult grammar in their use by L1  
4 children, L2 adult speakers, bilingual children and L1 attrited adult speakers (Gürel  
5 2004, Papadopoulou et al. 2008, Sorace & Filiaci 2006, Sorace 2011 and  
6 references therein).

7         The current study concentrates on null and overt subject pronominal  
8 interpretation in adverbial clauses in forward anaphora contexts. The study seeks  
9 to address the comparison between heritage and L1 attrited speakers of Greek  
10 with Swedish as the other language. Swedish is a non-null subject language which  
11 uses the same form of personal pronoun to refer to subject and non-subject  
12 antecedents in the syntactic contexts included in the present study (e.g. (2)).  
13 However, a demonstrative pronoun can be used too although it is considered  
14 marked and of the written/high register mostly (e.g. (3)). In this case, the referent  
15 is necessarily that of the object antecedent<sup>5</sup>:

16

17 (2)   Den unge mannen hälsade på den äldre herren när **han** gick över gatan

18         The young man greeted the old man when he crossed the street

19         “The young man<sub>i</sub> greeted the old man<sub>j</sub> when he<sub>i/j</sub> crossed the street.”

20

---

<sup>5</sup> We are grateful to Prof. K. Boklund-Lagopoulou for providing us with the Swedish examples.



1 (3) Den unge mannen hälsade på den äldre herren när **denne** gick över gatan  
2 The young man greeted the old man when he-DEM crossed the  
3 street  
4 “The young man<sub>i</sub> greeted the old man<sub>j</sub> when he<sub>j</sub> crossed the street.”  
5

6 On the basis of the previous extensive literature in the domain of pronominal  
7 resolution in bilinguals, we predict that both groups will differ from monolingual  
8 adult native speakers of Greek in the interpretation of overt subject pronouns (Exp.  
9 1). Accordingly, both groups will allow more subject antecedents as possible  
10 referents of the overt subject pronoun compared to the control group. On the other  
11 hand, null subject pronouns are not expected to show differences between the  
12 experimental groups (Exp. 2) unless an effect of early vs. late bilingualism is  
13 relevant. Specifically, L1 attriters and heritage speakers should be similar to L1  
14 controls on the basis of previous relevant findings in adult L1 attrition (Author B et  
15 al. 2004). Our assumption is that null pronouns, being the default choice in the  
16 grammar, will not differ from monolingual controls in their interpretation as there is  
17 no overlap with the L2, Swedish, which is not a null subject language. If heritage  
18 speaker’s grammars, however, are different from L1 attriters’ due to the effect of  
19 early bilingualism it is possible that heritage speakers will differ from L1 attriters  
20 showing a weaker preference for subject antecedents for null subject pronouns as  
21 suggested by Montrul’s (2004) findings. If it turns out that the two bilingual groups  
22 differ in the interpretation of null pronouns, the result will be consistent with

1 accounts supporting age of onset effects in bilingual grammars. If the two groups  
2 do not differ, however, the effects of bilingualism on the interpretation of subject  
3 pronouns is shown to leave the non-overlapping pronominal option, namely the  
4 overt subject pronoun, unaffected in early and late bilinguals alike.

5         With respect to response times on the matching task in the overt pronoun  
6 experiment we predict that L1 controls should be faster than the other two groups  
7 as their decision to match an overt pronoun with a non-topic antecedent should be  
8 lexically driven as part of the feature specification of the overt subject pronoun  
9 while no difference is expected in the null pronoun condition. In the null pronoun  
10 experiment there could be a difference between the two bilingual groups only  
11 insofar as the younger age of heritage speakers may be associated with faster  
12 decision times compared to attriters. If age plays a role in response times, we  
13 expect differences between younger and older monolingual controls in response  
14 times too. Possible differences between the two control groups and the two  
15 bilingual groups in response times could be due to a delay that bilingualism may  
16 add to the age factor. We thus expect slowest decision times in L1 attriters and  
17 fastest in young monolingual controls. Heritage speakers should pattern with L1  
18 attriters in the overt pronoun condition with subject or object antecedents.

19

#### 20 **4.1.4 Results**

21 The variable examined was the type of the reference; subject, object and other.

22 The data obtained included (a) off-line sentence-picture matching preference (b)

1 response times on the data in (a) and (c) on-line listening times for the overt subject  
2 pronoun of the subordinate clause (5<sup>th</sup> segment). In each data set we performed  
3 MANOVAs testing the group factor and repeated measures ANOVAs with  
4 reference (Subject vs. Object vs. Other) as the within subjects variable. The  
5 MANOVA comparisons showed that the group factor (Heritage Speakers, Attriters,  
6 Young Monolinguals, Older Monolinguals) interacts with the reference type in the  
7 matching task ( $F(9, 664) = 4.018, p < .001$ ; Wilk's  $\Lambda = 0.879$ , partial  $\eta^2 = .042$ ). An  
8 interaction was also identified with regard to the answer RTs ( $F(9, 664) = 27.091,$   
9  $p < .001$ ; Wilk's  $\Lambda = 0.467$ , partial  $\eta^2 = .224$ ) and the listening times on the subject  
10 pronoun of the subordinate clause ( $F(9, 664) = 6.883, p < .001$ ; Wilk's  $\Lambda = 0.805,$   
11 partial  $\eta^2 = .070$ ). First we present the data from the sentence picture matching  
12 preferences for each group. A score of 100 was given when the participant replied  
13 that the picture matched the sentence and a score of 0 when the participant replied  
14 that the picture did not match the sentence. Figure 1 shows the participants' scores  
15 per group and condition.

16

17 [INSERT Figure 1]

18

19 All groups, both target and control show a significant effect of reference (Heritage:  
20  $F(2,178)=33.709, p < .001$ , Attriters:  $F(2,148)=24.399, p < .001$ , Young  
21 Monolinguals:  $F(2,58)=33.673, p < .001$  & Older Monolinguals:  $F(2,52)=12.419,$   
22  $p < .001$ ). To elaborate further on the preferences per referent for the matching task

1 in our data set we performed dependent-samples t-tests. The comparisons  
2 showed that the target groups differentiated all referents (HS: Subject vs. Object  
3  $t(89) = 4.545, p < .001$ , Subject vs. Other  $t(89) = 3.567, p = .001$ , Object vs. Other  
4  $t(89) = 8.499, p < .001$ ; Attriters: Subject vs. Object  $t(74) = 3.344, p = .001$ , Subject vs.  
5 Other  $t(74) = 3.709, p < .001$ , Object vs. Other  $t(74) = 6.772, p < .001$ ), while the  
6 monolingual control groups did not differentiate between the Subject and the Other  
7 referents (Young Monolinguals: Subject vs. Object  $t(59) = 7.303, p < .001$ , Object vs.  
8 Other  $t(59) = 7.303, p < .001$ ; Older Monolinguals: Subject vs. Object  $t(53) =$   
9  $4.176, p < .001$ , Object vs. Other  $t(53) = 4.558, p < .001$ ).

10 With regard to the between-group comparisons, we find that heritage  
11 speakers and attriters differ only in their preference for the Other referent with  
12 attriters showing a higher preference ( $F(1,99) = 4.021, p = .048$ ). Additionally, we  
13 performed repeated measures ANOVAs and independent-samples t-tests to  
14 compare the target and control groups' preferences. The comparisons showed that  
15 only in the Subject condition did the heritage speakers and attriters differ from their  
16 age-matched controls with both bilingual groups showing higher preference scores  
17 than controls (Heritage speakers vs. Young Monolinguals:  $F(1,59) = 16.917, p < .001$ ,  
18  $t(1,48) = 4.093, p < .001$ ; Attriters vs. Older Monolinguals:  $F(1,53) = 5.408, p = .024$ ,  
19  $t(1,27) = 3.143, p = .002$ ). This is due to the fact that both HS and attriters allow  
20 coreference between the overt pronoun and the subject antecedent significantly  
21 more than monolingual controls.

22 The RTs for the matching task are displayed in Figure 2.

1

2 [INSERT Figure 2]

3

4 All groups, both target and control ones show a significant effect of reference (HS:  
5  $F(2,178)=78.915$ ,  $p<.001$ , Attriters:  $F(2,148)=10.222$ ,  $p<.001$ , Young  
6 Monolinguals:  $F(2,58)=42.701$ ,  $p<.001$  & Older Monolinguals:  $F(2,52)=33.542$ ,  
7  $p<.001$ ). The dependent-samples t-test comparisons showed that all groups  
8 differentiated all referents with the exception of Subject vs. Other referent for  
9 attriters; for the bilingual groups the longer RTs are found in the subject and other  
10 referents while for monolinguals the longer RTs are found in the subject condition  
11 and the shorter in the other condition for the young group and the object condition  
12 for the older group (HS: Subject vs. Object  $t(89)= 10.590$ ,  $p<.001$ , Subject vs.  
13 Other  $t(89)= 8.319$ ,  $p<.001$ , Object vs. Other  $t(89)= 4.193$ ,  $p<.001$ ; Attriters:  
14 Subject vs. Object  $t(74)= 2.991$ ,  $p=.004$ , Object vs. Other  $t(74)= 4.557$ ,  $p<.001$ ;  
15 Young Monolinguals: Subject vs. Object  $t(59)= 7.794$ ,  $p<.001$ , Subject vs. Other  
16  $t(59)= 8.960$ ,  $p<.001$ , Object vs. Other  $t(59)= 2.405$ ,  $p=.019$ ; Older Monolinguals:  
17 Subject vs. Object  $t(53)= 8.258$ ,  $p<.001$ , Subject vs. Other  $t(53)= 4.788$ ,  $p<.001$ ,  
18 Object vs. Other  $t(53)= 2.190$ ,  $p=.033$ ).

19 With regard to the between target-group comparisons, we find that heritage  
20 speaker and attriters differ only in the Subject referent condition in which the HS  
21 group is slower to respond ( $F(1,74)=82.974$ ,  $p<.001$ ,  $t(163)= 7.423$ ,  $p<.001$ ).  
22 Younger and older monolinguals differ in the Other referent condition

1 ( $F(1,59)=12.506$ ,  $p=.001$ ). Additionally, the comparisons between heritage  
2 speakers and young monolinguals showed significant effects on Subject and Other  
3 referents and a marginal significance on the Object referent (Subject:  
4  $F(1,59)=129.778$ ,  $p<.001$ ,  $t(148)= 7.865$ ,  $p<.001$ ; Object:  $F(1,59)=3.332$ ,  $p=.073$ ,  
5  $t(148)= 2.535$ ,  $p=.012$ ; Other:  $F(1,59)=68.039$ ,  $p<.001$ ,  $t(178)= 9.313$ ,  $p<.001$ ).  
6 Meanwhile, the comparisons between attriters and older monolinguals showed  
7 significant effects on the Object and Other referents only (Object:  $F(1,53)=8.213$ ,  
8  $p=.006$ ,  $t(127)= 2.986$ ,  $p=.003$ ; Other:  $F(1,71)=43.093$ ,  $p<.001$ ,  $t(170)= 6.150$ ,  
9  $p<.001$ ).

10 The listening times on the subject pronoun of the subordinate clause are  
11 displayed in Figure 3:

12

13 [INSERT Figure 3]

14

15 Even though monolinguals do not show any variation in their listening times on the  
16 pronoun in the subordinate clause, heritage speakers and attriters show a  
17 significant effect of reference (HS:  $F(2,178)=5.115$ ,  $p=.007$ , Attriters:  
18  $F(2,148)=4.169$ ,  $p=.017$ ). Moreover, the dependent-samples t-test comparisons  
19 showed that heritage speakers and attriters differentiate marginally between  
20 Subject and Object referents (Heritage:  $t(89)= 1.811$ ,  $p=.073$ ; Attriters:  $t(74)= 1.804$ ,  
21  $p=.075$ ) being slower in the Object condition and significantly between Object and  
22 Other referents (Heritage:  $t(89)= 2.836$ ,  $p=.006$ ; Attriters:  $t(74)= 2.509$ ,  $p=.014$ ).

1           With regard to the between group comparisons, we find that heritage  
2 speakers and attriters do not differ in their listening times per referent. Additionally,  
3 the comparisons between heritage speakers and young monolinguals showed  
4 significant effects on all referents with heritage speakers showing shorter listening  
5 times on the critical segment (Subject:  $F(1,59)=9.297$ ,  $p=.003$ ,  $t(148)= 2.336$ ,  
6  $p<.001$ ; Object:  $F(1,59)=6.868$ ,  $p=.011$ ; Other:  $F(1,59)=20.411$ ,  $p<.001$ ,  $t(178)=$   
7  $3.463$ ,  $p=.001$ ). The same is true for the comparisons between attriters and older  
8 monolinguals (Subject:  $F(1,53)=24.346$ ,  $p<.001$ ,  $t(127)= 3.409$ ,  $p=.001$ ; Object:  
9  $F(1,53)=8.517$ ,  $p=.005$ ; Other:  $F(1,71)=28.672$ ,  $p<.001$ ,  $t(170)= 3.975$ ,  $p<.001$ ).  
10 Note, however, that in the independent-samples t-test comparisons for the Object  
11 referent we did not get a significance effect, which shows that the differences in  
12 listening times were not major in this condition.

13           To summarize the results from Experiment 1 testing overt subject  
14 pronominal resolution, the most relevant findings with respect to our predictions  
15 concern the tendency of both bilingual groups, namely heritage speakers and  
16 attriters, to accept a subject antecedent for the overt subject pronoun. These  
17 results confirm previous studies showing differences in overt pronoun  
18 interpretation between monolinguals and bilinguals. Notice that no significant  
19 differences were found in the listening times of the two target groups indicating that  
20 even at the online processing level the two bilingual groups appear quite similar  
21 and different from the two control groups.

22

1 **4.2 Experiment 2: Null Pronoun Anaphora Resolution**

2 **4.2.1 Experimental Design**

3 The participants, the materials and the procedure of Experiment 2 were exactly the  
4 same as those of Experiment 1. Experiment 2 examines the resolution of null  
5 subject pronouns. The target sentences consist of a main clause, in which two  
6 referents were introduced, and an adverbial clause the subject of which was null  
7 as in (4) below:

8

9 (4) O papus / milise / ðinata / ston egono tu / otan / *pro* ðiavaze / ena vivlio.

10 the-MASC old-man / spoke-3S / loudly / to his grand-child-MASC / when /

11 *pro* read-PAST-3S / a book

12 'The old-man spoke loudly to his grandchild when he read a book.'

13

14 In (4), the null subject of the adverbial clause is usually associated with topic-

15 continuity and is thus construed as coreferential with the matrix subject, *o papus*.

16

17 **4.2.2 Predictions**

18 As pointed out in 4.1.3, L1 attrition should not affect the interpretation of null subject

19 pronouns given previous findings (Author B et al 2004). On the other hand,

20 predictions about heritage speakers' matching decisions on null subject pronouns

21 may be contradictory. One possibility is that the interpretation of null subject

22 pronouns by heritage speakers should follow the pattern of L1 attriters which is not



1 different from monolingual native controls (Sorace 2011 and references therein).  
2 The other possibility, based on Montrul's (2004) study, suggests differences  
3 between heritage speakers and monolingual controls in the overuse of null  
4 subjects in contexts where they are considered illicit due to a change of referent in  
5 the discourse, i.e. in topic-shift contexts. According to Montrul's study, we can thus  
6 predict that heritage speakers will show a weaker preference for subject  
7 antecedents for null subject pronouns than monolingual controls and they will also  
8 differ from L1 attriters. The latter distinction could be argued to stem from the early  
9 bilingualism of the heritage speakers compared to the late bilingualism of L1  
10 attriters. Response times on the matching task are expected to be shorter for L1  
11 controls than for the other two groups due to the competition effects that we  
12 assume is caused by bilingualism. However, the age difference between heritage  
13 speakers and L1 attriters is predicted to have an effect on response times where  
14 the former group is expected to be faster than the attriters.

15

#### 16 **4.2.3 Results**

17 As in Experiment 1, the variable examined in Exp. 2 was type of reference; Subject,  
18 Object and Other. The data obtained included (a) off-line sentence-picture  
19 matching preference (b) response times on the data in (a) and (c) on-line listening  
20 times for the verb of the subordinate clause (5<sup>th</sup> segment). In each data set we  
21 performed Manovas testing the group factor and repeated measures ANOVAs with  
22 reference (Subject *vs.* Object *vs.* Other) as the within subjects variable. The

1 MANOVA comparisons showed that the group factor (Heritage Speakers, Attriters,  
2 Young Monolinguals, Older Monolinguals) interacts with reference type in the  
3 matching task ( $F(9, 664) = 3.222, p = .001$ ; Wilk's  $\Lambda = 0.901$ , partial  $\eta^2 = .034$ ). An  
4 interaction was also identified with regard to the answer RTs ( $F(9, 664) = 26.436,$   
5  $p < .001$ ; Wilk's  $\Lambda = 0.475$ , partial  $\eta^2 = .220$ ) and the listening times on the verb of  
6 the subordinate clause ( $F(9, 664) = 8.896, p < .001$ ; Wilk's  $\Lambda = 0.758$ , partial  $\eta^2 =$   
7  $.088$ ). First we present the data from the sentence picture matching preferences  
8 for each group.

9 Figure 4 shows the participants' scores per group and condition.

10

11 [INSERT Figure 4]

12

13 All groups, both target and control ones show a significant effect of reference  
14 (Heritage:  $F(2,178) = 27.774, p < .001$ , Attriters:  $F(2,148) = 13.475, p < .001$ , Young  
15 Monolinguals:  $F(2,58) = 76.690, p < .001$  & Older Monolinguals:  $F(2,52) = 14.267,$   
16  $p < .001$ ). Moreover, the dependent-samples t-test comparisons showed that all  
17 participants differentiate between referents showing a preference for the subject  
18 referent with the exception of Older monolinguals in the Subject *vs.* Object  
19 comparison (Heritage: Subject *vs.* Object  $t(89) = 2.096, p = .039$ , Subject *vs.* Other  
20  $t(89) = 6.895, p < .001$ , Object *vs.* Other  $t(89) = 5.262, p < .001$ ; Attriters: Subject *vs.*  
21 Object  $t(74) = 2.169, p = .033$ , Subject *vs.* Other  $t(74) = 5.117, p < .001$ , Object *vs.*  
22 Other  $t(74) = 2.933, p = .004$ ; Young Monolinguals: Subject *vs.* Object  $t(59) = 7.055,$

1  $p < .001$ , Subject vs. Other  $t(59) = 12.216$ ,  $p < .001$ , Object vs. Other  $t(59) = 2.688$ ,  
2  $p = .009$ ; Older Monolinguals: Subject vs. Other  $t(53) = 5.148$ ,  $p < .001$ , Object vs.  
3 Other  $t(53) = 3.802$ ,  $p < .001$ ).

4         With regard to the between group comparisons, both heritage speakers  
5 and attriters differ only in the Other referent condition with attriters showing a  
6 higher preference score ( $F(1,74) = 4.063$ ,  $p = .047$ ). The independent-samples t-  
7 tests also showed a marginal differentiation between the target groups in the  
8 Object ( $t(218) = 1.777$ ,  $p = .077$ ) and Other referents ( $t(163) = 1.772$ ,  $p = .048$ ).  
9 Additionally, the comparisons between heritage speakers and young monolinguals  
10 showed significant effects on the Subject and Object referents (Subject:  $t(148) =$   
11  $1.974$ ,  $p = .050$ ; Object:  $F(1,59) = 11.977$ ,  $p = .001$ ,  $t(178) = 3.042$ ,  $p = .003$ ) with young  
12 controls showing stronger preference for subject and weaker for object  
13 antecedents than the HS group. In contrast, attriters and older monolinguals  
14 showed no significant differences on any referent condition. It is important to note  
15 that young monolinguals differ significantly to older monolinguals in the Subject  
16 ( $F(1,53) = 8.079$ ,  $p = .006$ ) and Object conditions ( $F(1,59) = 8.119$ ,  $p = .006$ ) and only  
17 marginally in the Other referent condition ( $F(1,53) = 3.399$ ,  $p = .073$ ). In particular,  
18 the younger group of monolingual controls shows stronger preference for subject  
19 and weaker for object antecedent compared to the older monolingual group whose  
20 matching rates are less deterministic.

21         The RTs for the matching task are displayed in Figure 5.

22

1 [INSERT Figure 5]

2

3 All groups show a significant effect of reference although for heritage speakers the  
4 effect is marginally significant (Heritage:  $F(2,178)=2.867$ ,  $p=.060$ , Attriters:  
5  $F(2,148)=18.117$ ,  $p<.001$ , Young Monolinguals:  $F(2,58)=24.926$ ,  $p<.001$  & Older  
6 Monolinguals:  $F(2,52)=147.994$ ,  $p<.001$ ). Dependent-samples t-test comparisons  
7 showed that heritage speakers differentiate between the Object and Other  
8 referents when presented with a null pronoun, with longer RTs for object referents  
9 ( $t(89)= 3.375$ ,  $p=.001$ ), while attriters' RTs differed among all referents with longer  
10 RTs for subject ones (Subject vs. Object  $t(74)= 2.703$ ,  $p=.009$ , Subject vs. Other  
11  $t(74)= 5.990$ ,  $p<.001$ , Object vs. Other  $t(74)= 3.636$ ,  $p=.001$ ). Both control groups  
12 differentiate between Subject/Object and Other referents, with longer RTs on the  
13 latter condition (Young Monolinguals: Subject vs. Other  $t(59)= 4.794$ ,  $p<.001$ ,  
14 Object vs. Other  $t(59)= 7.109$ ,  $p<.001$ ; Older Monolinguals: Subject vs. Other  
15  $t(53)= 16.046$ ,  $p<.001$ , Object vs. Other  $t(53)= 14.981$ ,  $p<.001$ ). In all then, it was  
16 only the attriters' group which showed slower RTs in giving a response in the  
17 Subject condition compared to the Object condition.

18 With regard to the between group comparisons for the null pronoun  
19 resolution, we find that heritage speaker and attriters differ in the Subject  
20 ( $F(1,74)=20.507$ ,  $p<.001$ ) and Object referent conditions ( $F(1,99)=5.491$ ,  $p=.021$ )  
21 with attriters taking longer to respond in both conditions. The independent-samples  
22 t-tests also showed a significant effect between the target groups in the Subject

1 referent condition (HS: 1497ms vs. Attriters: 1927ms as shown in Figure 5,  
2  $t(163) = 3.454, p = .001$ ).

3         Additionally, the comparisons between heritage speakers and young  
4 monolinguals showed an effect on the Subject and Object referents with heritage  
5 speakers responding significantly slower (Subject:  $t(148) = 3.317, p = .001$ , Object:  
6  $F(1,59) = 69.054, p < .001, t(178) = 8.764, p < .001$ ). Meanwhile, the comparisons  
7 between attriters and older monolinguals showed attriters responded significantly  
8 slower on the Subject and Object referents but faster on the Other referent  
9 condition (Subject:  $F(1,53) = 124.250, p < .001, t(127) = 8.652, p < .001$ ; Object:  
10  $F(1,71) = 66.026, p < .001, t(170) = 8.048, p < .001$ ; Other:  $F(1,53) = 80.685, p < .001,$   
11  $t(127) = 8.112, p < .001$ ). Moreover, young monolinguals differ significantly to older  
12 monolinguals in the Other referent condition ( $F(1,53) = 32.701, p < .001$ ).

13         The listening times on the verb of the subordinate clause are displayed in  
14 Figure 6.

15

16 [INSERT Figure 6]

17

18         Neither heritage speakers nor attriters show a reference effect in their listening  
19 times contrary to monolinguals who differentiate among all referents (Young  
20 Monolinguals:  $F(2,58) = 20.427, p < .001$  & Older Monolinguals:  $F(2,52) = 13.063,$   
21  $p < .001$ ). Moreover, the dependent-samples t-test comparisons showed that young  
22 monolinguals differentiate only marginally between the Subject and Object

1 referents ( $t(59)= 1.889, p=.064$ ) and significantly for Subject vs. Other ( $F(59)= 6.271,$   
2  $p<.001$ ) and Object vs. Other comparisons ( $t(59)= 3.590, p=.001$ ) with the shorter  
3 RTs in subject condition. Older monolinguals' listening RTs differ significantly only  
4 for the Subject vs. Other with longer RTs in the other condition ( $t(53)= 4.335,$   
5  $p<.001$ ) and Object vs. Other comparisons ( $t(53)= 4.398, p<.001$ ).

6 With regard to the between group comparisons for the null pronoun  
7 resolution, we find that heritage speakers and attriters do not differ in any condition.  
8 Additionally, the comparisons between heritage speakers and young monolinguals  
9 showed an effect on the Object and Other referents with heritage speakers  
10 responding significantly faster (Object:  $F(1,59)=26.814, p<.001$ ; Other:  
11  $F(1,59)=34.776, p<.001, t(148)= 4.826, p<.001$ ). Meanwhile, the comparisons  
12 between attriters and older monolinguals showed attriters responded faster in all  
13 referent conditions (Subject:  $F(1,53)=27.780, p<.001, t(127)= 3.517, p=.001$ ;  
14 Object:  $F(1,71)=10.253, p=.002, t(170)= 1.816, p=.071$ ; Other:  $F(1,53)=50.915,$   
15  $p<.001, t(127)= 5.885, p<.001$ ). Lastly, young monolinguals differ significantly from  
16 older monolinguals in the Subject referent condition ( $F(1,53)=15.464, p<.001$ ).

17 To summarize, in the null subject pronoun experiment we find that both  
18 bilingual groups discriminate between Subject and Object antecedents in their  
19 matching preferences which is also the case for the younger control group.  
20 Nevertheless, heritage speakers' preference for Subject is significantly weaker  
21 than their controls while no difference is found between the attriters and the older  
22 monolingual group. Overall, bilinguals are faster in their listening times compared

1 to monolinguals. The fact that attriters and older monolinguals do not differ on the  
2 matching decisions possibly stems from the weakening of the Subject antecedent  
3 preference with age. On the basis of production data, Hendriks et al (to appear)  
4 suggest that aging may attenuate preferences in pronominal resolution in  
5 monolingual adults. In the following section, we attempt to address precisely this  
6 possibility.

7

#### 8 **4.3 Age Factor**

9 To further elaborate on our data set we examined the factor of age (at time of  
10 testing) by grouping our participants into two groups, a Young and an Old one. The  
11 motivation for this comparison comes from the differences we found between the  
12 young and the older controls in some of the experimental conditions but also  
13 between the two bilingual groups. Accordingly, the Young group consists of  
14 heritage speakers and young monolinguals and the Old group of attriters and older  
15 monolinguals. We then examined (a) the off-line sentence-picture matching  
16 preference and (b) the response times on the data both in the overt and null  
17 pronoun experiments.

18 Starting with the overt pronoun anaphora resolution data set, the MANOVA  
19 comparisons showed that the age factor (Young vs. Old) (marginally) interacts with  
20 the reference type in the matching task ( $F(3, 275) = 2.399, p=.068$ ; Wilk's  $\Lambda = 0.974$ ,  
21 partial  $\eta^2 = .026$ ). An interaction was also identified with regard to the answer RTs

1 ( $F(3, 275) = 19.323, p < .001$ ; Wilk's  $\Lambda = 0.826$ , partial  $\eta^2 = .174$ ). Figure 7 shows  
2 the participants' scores in the matching task per group and condition.

3

4 [INSERT Figure 7]

5

6 The between group comparisons show that young and old participants perform  
7 differently in the Subject condition only with the old participants displaying a higher  
8 preference for a match ( $F(1, 128) = 3.848, p = .052$ ).

9 The RTs for the matching task are displayed in Figure 8.

10

11 [INSERT Figure 8]

12

13 Response times in the Subject condition also differentiate between the two age  
14 groups with the younger requiring more time to respond to the possible coreference  
15 between overt pronouns and Subject referents ( $F(1, 178) = 46.484, p < .001$ ).

16 Turning to the null pronoun anaphora resolution data set, the MANOVA  
17 comparisons showed that the age factor (Young vs. Old) interacts with the  
18 reference type in the matching task ( $F(3, 275) = 2.714, p = .045$ ; Wilk's  $\Lambda = 0.971$ ,  
19 partial  $\eta^2 = .029$ ). An interaction was also identified with regard to the answer RTs  
20 ( $F(3, 275) = 9.622, p < .001$ ; Wilk's  $\Lambda = 0.905$ , partial  $\eta^2 = .095$ ). Figure 9 shows the  
21 participants' matching scores per group and condition.

22



1 [INSERT Figure 9]

2

3 The comparisons in the null pronoun task show that young and old participants  
4 exhibit different matching preferences for the Object and the Other reference  
5 conditions with the old ones displaying a higher preference for a match in both  
6 cases (Object:  $F(1,171)=6.927, p=.009$ ; Other:  $F(1,128)=4.909, p=.028$ ).

7 The RTs for the matching task are displayed in Figure 10.

8

9 [INSERT Figure 10]

10

11 The RT comparisons show that the old participants respond significantly slower in  
12 the subject and other conditions (Subject:  $F(1,128)=16.845, p<.001$ ; Other:  
13  $F(1,128)=11.933, p=.001$ ).

14 Overall, the results from both the overt and the null pronoun experiment  
15 reveal an 'age effect' in pronominal resolution. Older participants show weaker  
16 preferences for both overt and null pronouns allowing subject and object  
17 antecedents in both experiments significantly more than the younger participants.  
18 Overt pronouns seem to favour more subject antecedents in the older than the  
19 younger participants and null pronouns more matches for object in the older than  
20 the younger group. Although this 'age effect' in adults was not one of our original  
21 research questions, the attested differences indicate that interface vulnerability is  
22 open to factors other than attrition or bilingualism as such. Although further

1 investigations in this area are necessary it seems that age within adulthood plays  
2 a role in the tendency to discriminate between preferences in pronominal resolution  
3 overall.

4

#### 5 **4.4 Bilingualism Factor**

6 In order to address the effect of bilingualism on pronominal resolution we grouped  
7 our HS and L1 attriters into the Bilingual group and compared them with the  
8 Monolingual group which includes our two age groups of control participants. We  
9 then examined (a) the off-line sentence-picture matching preference and (b) the  
10 response times on the data in in the overt and null pronoun experiments.

11 Starting with the overt pronoun data set, the MANOVA comparisons  
12 showed that the bilingualism factor (Bilingual *vs.* Monolingual) interacts with  
13 reference type in the matching task ( $F(3, 275) = 9.103, p < .001$ ; Wilk's  $\Lambda = 0.910$ ,  
14 partial  $\eta^2 = .090$ ). An interaction was also identified with regard to the answer RTs  
15 ( $F(3, 275) = 54.376, p < .001$ ; Wilk's  $\Lambda = 0.628$ , partial  $\eta^2 = .372$ ). Figure 11 shows  
16 the participants' matching scores per group and condition.

17

18 [INSERT Figure 11]

19

20 Anaphora resolution in the Subject condition appears to be an area of  
21 differentiation for the bilingual and monolingual participants, with bilinguals

1 demonstrating a significantly higher preference for a match ( $F(1,113)=17.222$ ,  
2  $p<.001$ ).

3 The RTs for the matching task are displayed in Figure 12.

4

5 [INSERT Figure 12]

6

7 Furthermore, when comparing the two groups in the time they take to respond  
8 bilinguals require significantly more time to select the match or mismatch option in  
9 all reference conditions (Subject:  $F(1,113)=82.252$ ,  $p<.001$ ; Object:  
10  $F(1,113)=12.662$ ,  $p=.001$ ; Other:  $F(1,131)=135.790$ ,  $p<.001$ ).

11 Turning to the null pronoun data set, the MANOVA comparisons showed  
12 that the bilingualism factor (Bilingual vs. Monolingual) interacts with reference type  
13 in the matching task ( $F(3, 275) = 3.904$ ,  $p=.009$ ; Wilk's  $\Lambda = 0.959$ , partial  $\eta^2 = .041$ ).  
14 An interaction was also identified with regard to the answer RTs ( $F(3, 275) =$   
15  $69.138$ ,  $p<.001$ ; Wilk's  $\Lambda = 0.570$ , partial  $\eta^2 = .430$ ). Figure 13 shows the  
16 participants' matching scores per group and condition.

17

18 [INSERT Figure 13]

19

20 The between-group comparisons for the matching preferences are not significant,  
21 suggesting that both bilinguals and monolinguals interpret null pronouns similarly  
22 in all conditions. This indicates that the between-group differences found in the

1 interpretation of null pronouns in Section 4.2 above are not due to bilingualism as  
2 such but a combination of bilingualism and age effects at best. The RTs for the  
3 matching task are displayed in Figure 14.

4

5 [INSERT Figure 14]

6

7 Lastly, the RT comparisons show that bilinguals take significantly more time to  
8 select the match or mismatch option in Subject and Object reference conditions  
9 but less in the Other condition compared to monolinguals (Subject:  
10  $F(1,113)=35.446, p<.001$ ; Object:  $F(1,131)=125.769, p<.001$ ; Other:  
11  $F(1,113)=25.835, p<.001$ ).

12 Overall then, bilingualism seems to trigger differences in pronominal  
13 resolution of overt pronouns only, as reported in various previous studies with  
14 heritage speakers and late bilingual L1 attriters. However, the effect of bilingualism  
15 surfacing as a delay in the response time of HS compared to the younger  
16 monolingual control group is found with overt and null pronouns alike.

17

## 18 **5. Discussion**

19 The data obtained from both experiments overall group L1 attriters and heritage  
20 speakers together in the lack of a strong preference in pronoun resolution. While  
21 monolingual adult native controls clearly discriminate between overt and null  
22 subject pronouns with respect to object and subject preference respectively, the

1 other two groups do not show similarly robust preferences. In the overt pronoun  
2 condition, our results conform with the prediction that in L1 attrition or in bilingual  
3 grammars of Greek in general, the overt pronoun option is vulnerable in that it can  
4 be associated with either topic-continuity or topic-shift. Thus, an overt subject  
5 pronoun in the subordinate adverbial clause is open to coreferential readings with  
6 either the subject or the object antecedent. Whether this lack of preference is the  
7 effect of Swedish, i.e. the non-null subject language of these participants, an effect  
8 of processing resources (Sorace & Serratrice 2009) remains an open question. We  
9 would like to suggest however that the results of this study are consistent with an  
10 analysis which primarily builds on the *linguistic* (formal and discourse) properties  
11 of overt (and null) pronouns rather than on a purely processing account, for the  
12 following two reasons. First, because matching decisions on the overt pronoun are  
13 affected not only in the bilingual groups but also in the older monolingual controls,  
14 indicating that crosslinguistic influence is not the only cause which reveals the  
15 vulnerability of overt subject pronouns. Secondly, because the comparison  
16 between overt and null pronominal resolution indicate stable preferences  
17 (matching decisions) for null pronouns, suggesting that the problem is not with  
18 grammatical elements which are inherently underspecified for reference (i.e.  
19 pronouns in general) but with a specific member of this category in particular.

20         The matching decisions in the null subject condition show that both heritage  
21 speakers and L1 attriters prefer subject over object antecedents like the  
22 monolingual controls. This is consistent with the findings in Author B et al. (2004).

1 However, in terms of decision times L1 attriters take longer to respond to subject  
2 antecedents in the null pronoun experiment compared to heritage speakers who  
3 are faster to respond to subject than object antecedents in the same experiment.  
4 We interpret this finding as an indication of better resolution patterns in the young  
5 bilinguals who appear to be more certain about the subject orientation of null  
6 subject pronouns. In addition, our results indicate that differences between  
7 monolingual controls and attrited speakers are more evident in on-line  
8 investigations of syntax-discourse interface phenomena than in off-line tasks (cf.  
9 Author B et al. 2004).

10 The implication from these findings is that, in cases of extensive attrition or  
11 early bilingualism of heritage speakers the processing (but probably not the  
12 representation) of null subjects is affected causing more delay in choosing the  
13 appropriateness of a subject antecedent than in the monolingual grammar. Other  
14 variables may also be relevant to the difference between the two bilingual groups  
15 however. In particular, length of residence in the L2 country and level of education  
16 may skew the results. The educational background of the L1 attriters in this study  
17 was relatively low compared to the heritage speakers and to the L1 attriters in  
18 Author B et al. (2004). In the latter study, the attriters had a considerably shorter  
19 mean length of residence in the L2 community (Britain) and a higher educational  
20 background. The attrition or divergent acquisition effects found on the null subject  
21 pronoun are intriguing since they are evident primarily in the decision times while

1 in the matching decisions as such all groups show a preference for subject  
2 antecedents as better matches for a null subject pronoun.

3 All theoretical approaches to language acquisition accept that input is  
4 deterministic for grammatical development. It should thus be uncontroversial to  
5 expect that quantity, quality and low diversity of the input to which heritage  
6 speakers are exposed is at least partially responsible for what on the surface is  
7 characterized as divergent from monolinguals. Used neutrally, *divergence* is  
8 merely a descriptive term. Thus, it is true that both L1 attrited and heritage  
9 grammars that differ from monolinguals are comparatively divergent. However, the  
10 sources for divergence in attrition and heritage speaker grammars probably differ  
11 and their differences are important to identify. Terms that can be wrongly  
12 understood as evaluative, such as incomplete acquisition, are not always  
13 descriptively accurate precisely because incomplete and divergent are not  
14 synonymous. Although it might be true when speaking of grammatical competence  
15 that everything incomplete is divergent, the opposite is certainly not true. Not all  
16 divergence is accurately captured by the umbrella term incomplete. We submit  
17 that this argumentation is nicely shown in the data our study provides.

18 The L1 attriters and the heritage speakers diverge from monolinguals  
19 similarly despite the fact that only the former clearly reached a mature state  
20 grammar for Greek comparable to monolinguals. Despite the similarity in behavior  
21 on these tasks, it is possible, even likely, that the source of divergence for heritage  
22 speakers and L1 attriters our data show is different whereby only the former reflects

1 erosion. Our point is simply this: heritage speakers could only be expected to show  
2 difference from monolinguals for two converging reasons. First, there is an  
3 expected effect of bilingualism, as we saw in the case of emerging bilingualism for  
4 L1 attriters. Dealing with multiple grammars in a single mind has consequences for  
5 various domains of language, and so, when a property is affected by late  
6 bilingualism as in L1 attrition the default expectation is that this must also be true  
7 in heritage grammars as well. In fact, one might expect more pronounced  
8 differences for heritage grammars than L1 attrition precisely because bilingualism  
9 affects the course of development of the heritage language itself as opposed to the  
10 mature linguistic state that has been achieved in adult bilingualism. In addition,  
11 heritage speakers are provided with quantitatively less input than monolingual  
12 learners. It is also possible that the input is qualitatively different for heritage  
13 speakers' language development as it is likely to be provided by a generation of  
14 speakers who themselves exhibit surface effects of attrition (see Sorace 2004;  
15 Pascual y Cabo & Author c 2012) . This means that in addition to dealing with the  
16 complexities of maintaining multiple linguistic systems they are simultaneously  
17 presented with divergent input as compared to monolinguals. One could ask then,  
18 how could they possibly develop a monolingual-convergent grammar? So, while  
19 L1 attrition is clearly loss at some abstract level, heritage speaker divergence can  
20 be viewed as the outcome of a developmental path that is destined to be distinct  
21 from monolinguals as a result of a general byproduct of bilingualism, qualitative  
22 input differences among other factors.



1

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1                   **Appendix A: Statistically non-significant results**

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**Experiment 1: Overt Pronoun**

*Within group comparisons*

Listening RTs on Subject Pronoun ~ *Reference Effect (Subject vs. Object vs. Other): Young Monolinguals*  $F(2, 58) = .400, p = .672$ ;  
Older Monolinguals:  $F(2, 52) = 1.021, p = .367$

*Heritage Speakers vs. Attriters*

Matching ~ *Subject Referent*  $F(1, 74) = 1.261, p = .265$   
Matching ~ *Object Referent*  $F(1, 74) = .043, p = .836$   
Answer RTs ~ *Object Referent*  $F(1, 74) = 2.683, p = .106$   
Answer RTs ~ *Other Referent*  $F(1, 99) = 1.753, p = .189$   
Listening RTs on Subject Pronoun ~ *Subject Referent*  $F(1, 74) = .789, p = .378$   
Listening RTs on Subject Pronoun ~ *Object Referent*  $F(1, 74) = .758, p = .387$   
Listening RTs on Subject Pronoun ~ *Other Referent*  $F(1, 99) = 1.290, p = .259$

*Heritage Speakers vs. Young Monolinguals*

Matching ~ *Object Referent*  $F(1, 59) = .047, p = .829$   
Matching ~ *Other Referent*  $F(1, 59) = .000, p = 1.000$

*Attriters vs. Older Monolinguals*

Matching ~ *Object Referent*  $F(1, 53) = 2.988, p = .090$   
Matching ~ *Other Referent*  $F(1, 71) = .357, p = .552$   
Answer RTs ~ *Subject Referent*  $F(1, 53) = 1.748, p = .192$

**Experiment 2: Null Pronoun**

1 *Within group comparisons*  
2 Listening RTs on Verb ~ *Reference Effect (Subject vs. Object vs. Other):*  
3 *Attriters*  $F(2, 73) = .010, p = .990$   
4  
5 *Heritage Speakers vs. Attriters*  
6 Matching ~ *Subject Referent*  $F(1, 74) = .000, p = 1.000$   
7 Matching ~ *Object Referent*  $F(1, 99) = 1.260, p = .264$   
8 Answer RTs ~ *Other Referent*  $F(1, 74) = .817, p = .369$   
9 Listening RTs on Verb ~ *Subject Referent*  $F(1, 74) = 1.597, p = .210$   
10 Listening RTs on Verb ~ *Object Referent*  $F(1, 99) = .009, p = .926$   
11 Listening RTs on Verb ~ *Other Referent*  $F(1, 74) = .165, p = .686$   
12  
13 *Attriters vs. Older Monolinguals*  
14 Matching ~ *Subject Referent*  $F(1, 53) = .219, p = .642$   
15 Matching ~ *Object Referent*  $F(1, 71) = .330, p = .567$   
16 Matching ~ *Other Referent*  $F(1, 53) = 1.828, p = .182$   
17  
18 **Age Factor**  
19 *Matching*  
20 *Exp1. Overt Pronoun ~ Manova Reference Effect (Subject vs. Object vs.*  
21 *Other):*  
22  $F(3, 275) = 2.399, p = .068; \text{Wilk's } \Lambda = 0.974, \text{partial } \eta^2 = .026$   
23  
24 *Exp1. Overt Pronoun ~ Btw Group Comparison (Young vs. Old):*  
25 *Object Referent*  $F(1, 128) = .079, p = .779;$   
26 *Other Referent*  $F(1, 171) = 1.871, p = .173$   
27  
28 *Exp2. Null Pronoun ~ Btw Group Comparison (Young vs. Old):*  
29 *Subject Referent*  $F(1, 128) = 2.646, p = .106$   
30

1 *Answer RTs*

2 *Exp1. Overt Pronoun ~ Btw Group Comparison (Young vs. Old):*

3 *Object Referent*  $F(1, 128) = 2.399, p = .124;$

4 *Other Referent*  $F(1, 171) = 1.386, p = .241$

5

6 *Exp2. Null Pronoun ~ Btw Group Comparison (Young vs. Old):*

7 *Object Referent*  $F(1, 171) = .823, p = .366$

8

9 **Bilingualism Factor**

10 *Matching*

11 *Exp1. Overt Pronoun ~ Btw Group Comparison (Young vs. Old):*

12 *Object Referent*  $F(1, 113) = 2.097, p = .150;$

13 *Other Referent*  $F(1, 131) = .749, p = .389$

14

15 *Exp2. Null Pronoun ~ Btw Group Comparison (Young vs. Old):*

16 *Subject Referent*  $F(1, 113) = .358, p = .551;$

17 *Object Referent*  $F(1, 131) = 3.111, p = .080;$

18 *Other Referent*  $F(1, 113) = 1.939, p = .167$

19

20

1 Subject Reference



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3 Object Reference



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5 Other Reference



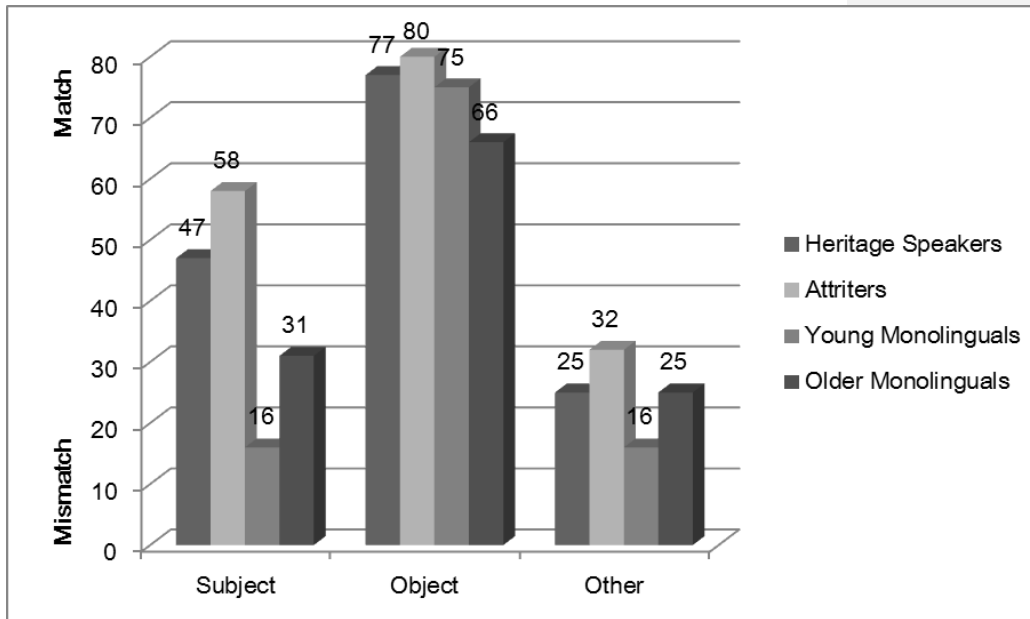
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1 **Experiment 1: Overt Pronoun Task**

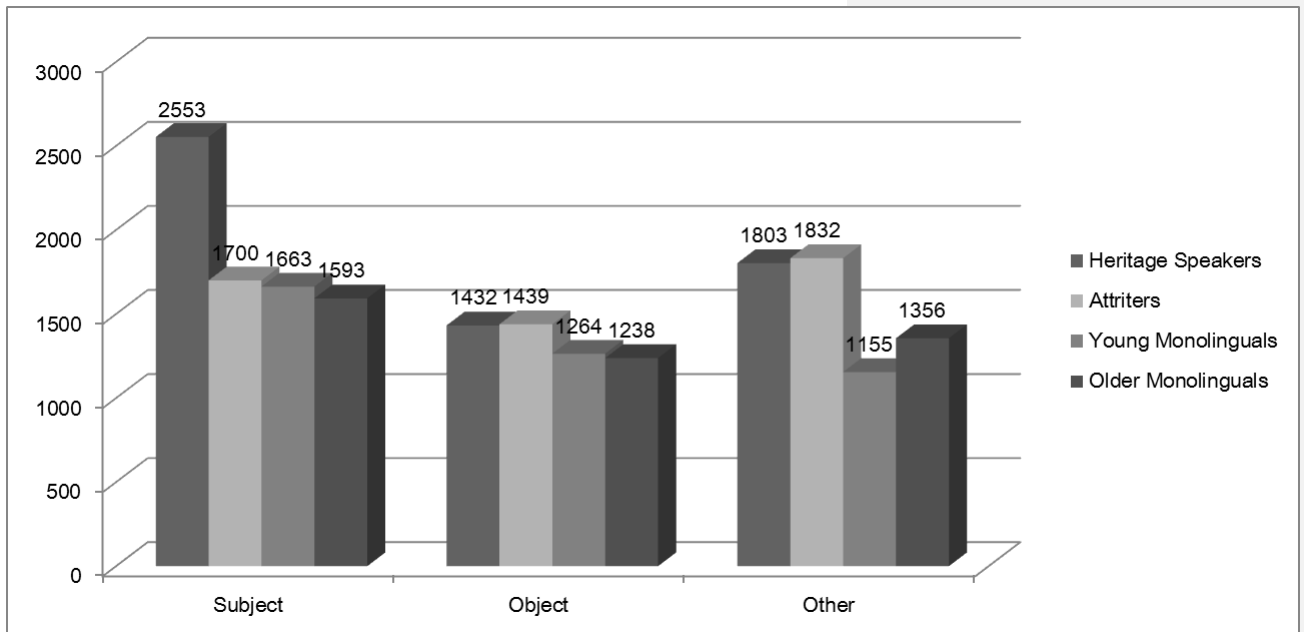
2 **Figure 1: Sentence Picture Matching Task**



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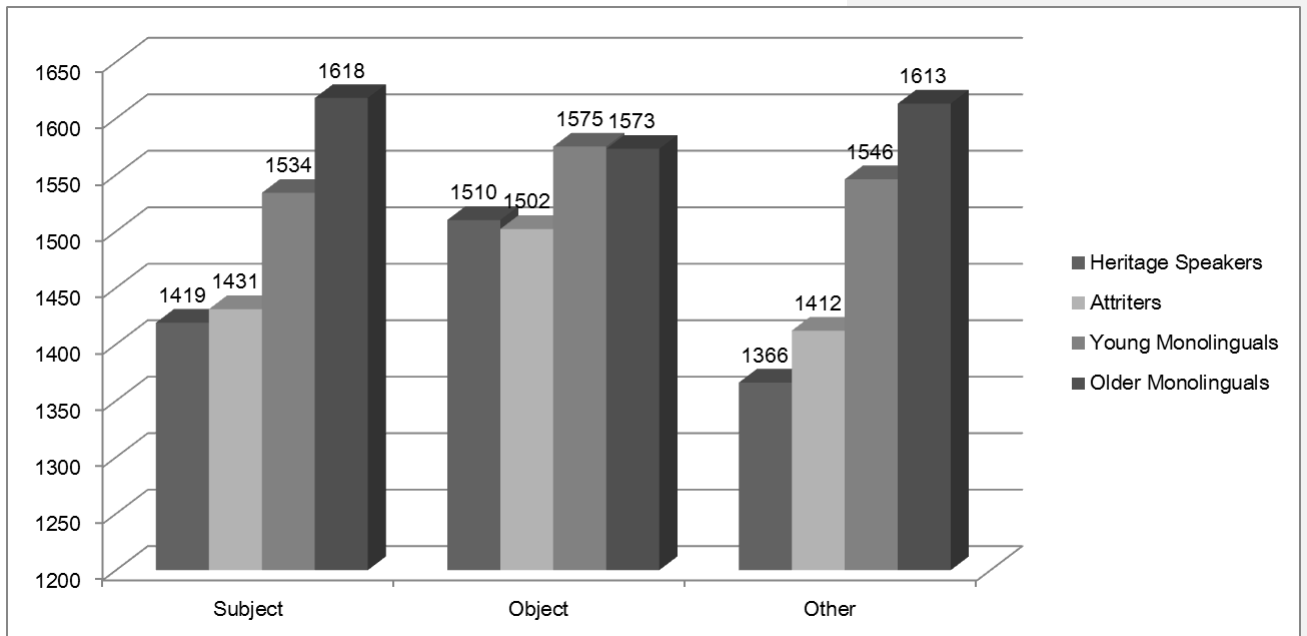
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5 **Figure 2: Answer RTs for the Matching Task**



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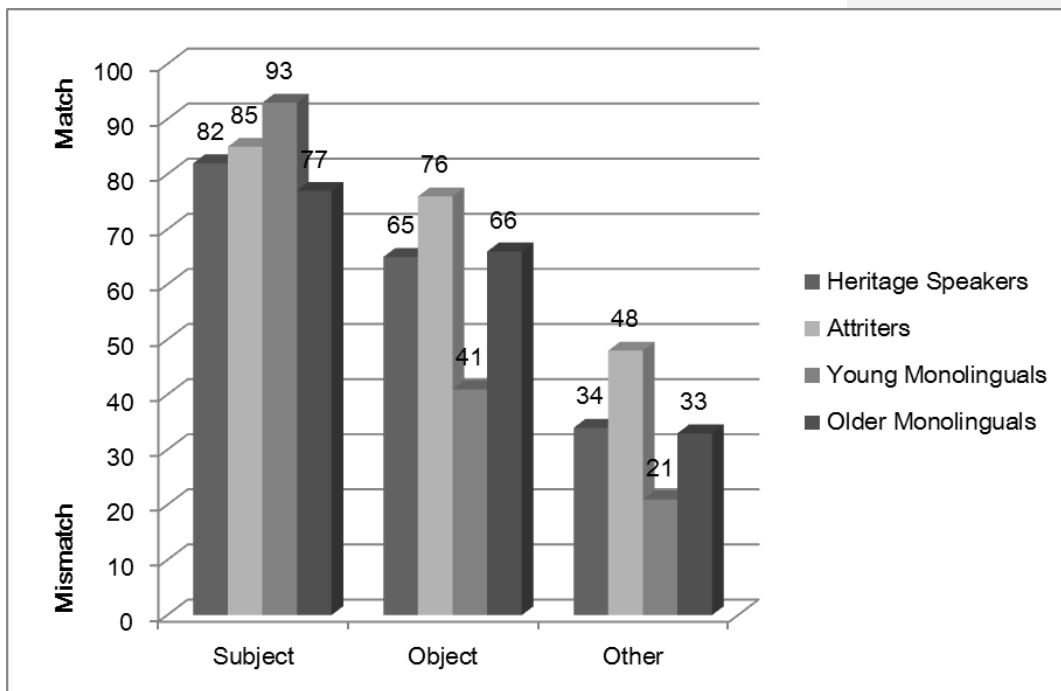
**Figure 3: Listening Times (RTs) on the Subject Pronoun of the Subordinate Clause**



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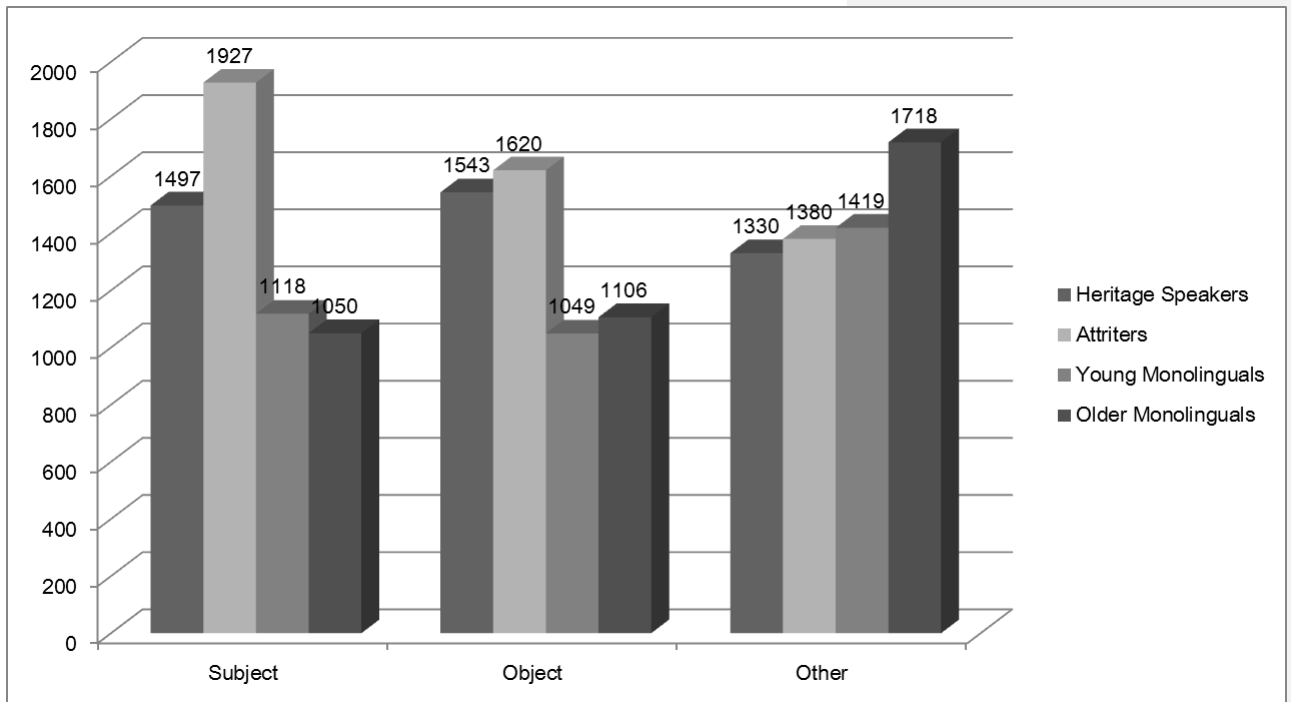
4 **Experiment 2: Null Pronoun Task**

5 **Figure 4: Sentence Picture Matching Task**



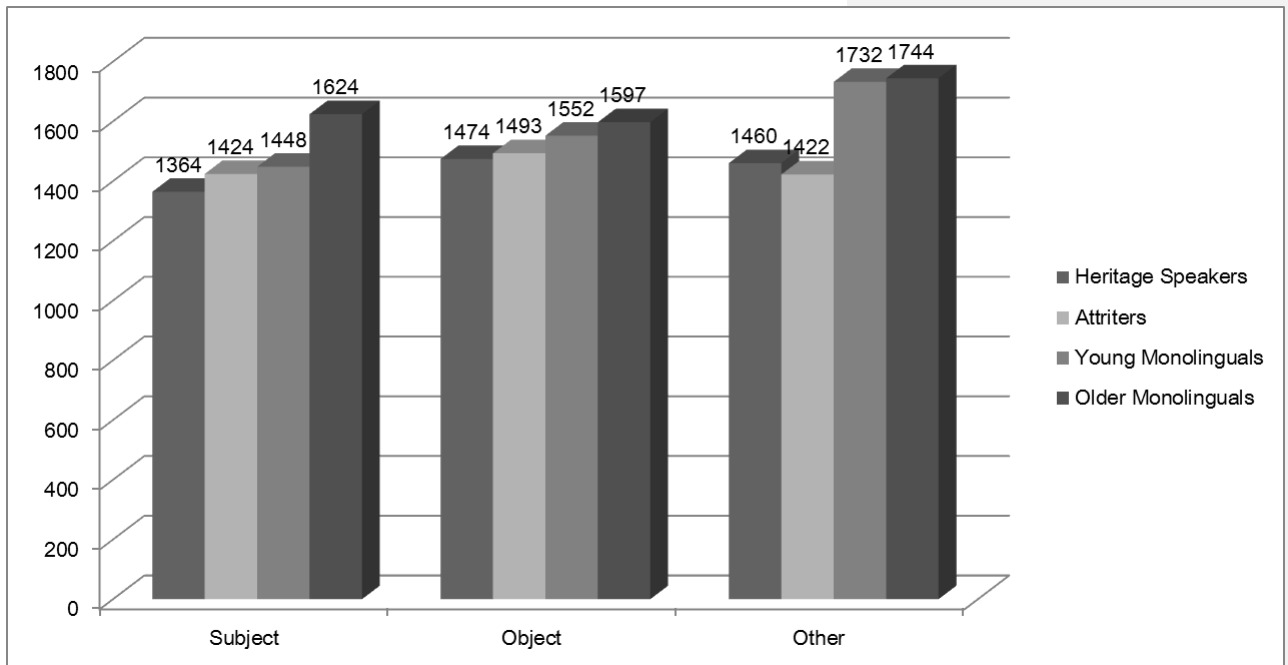
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2 **Figure 5: Answer RTs for the Matching Task**



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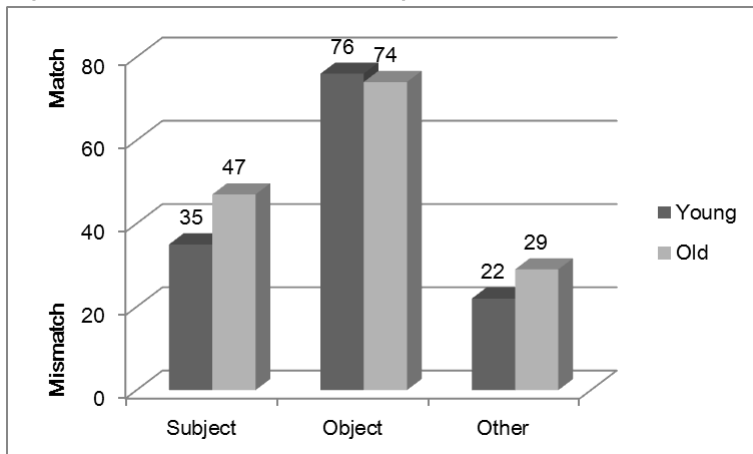
**Figure 6: Listening Times (RTs) on the Verb of the Subordinate Clause**



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**Overt Pronoun Task: Age Factor**

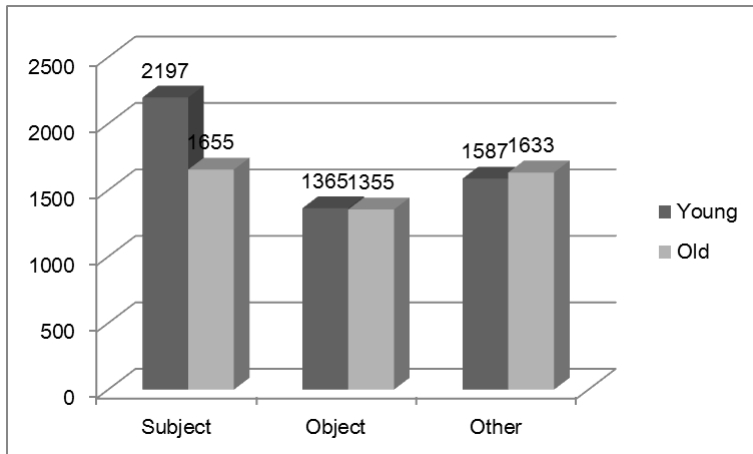
**Figure 7: Sentence Picture Matching Task**



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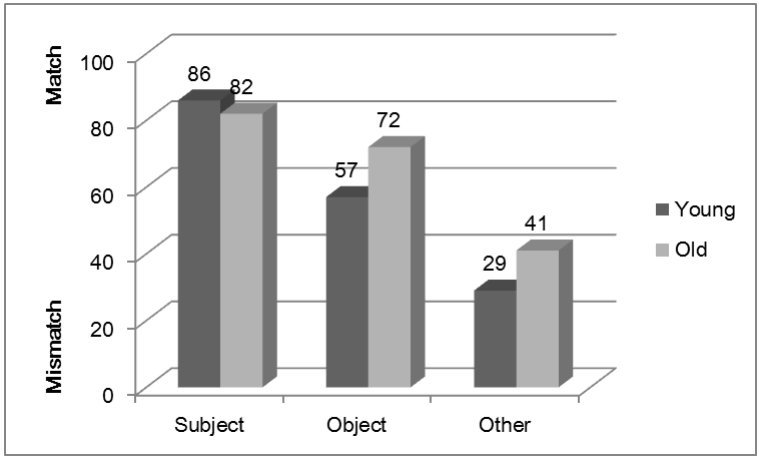
**Figure 8: Answer RTs for the Matching Task**



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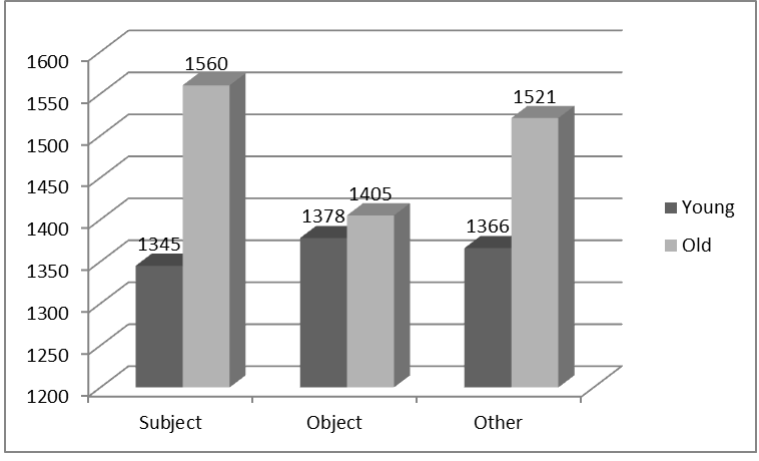
**Null Pronoun Task: Age Factor**

12 **Figure 9: Sentence Picture Matching Task**



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**Figure 10: Answer RTs for the Matching Task**



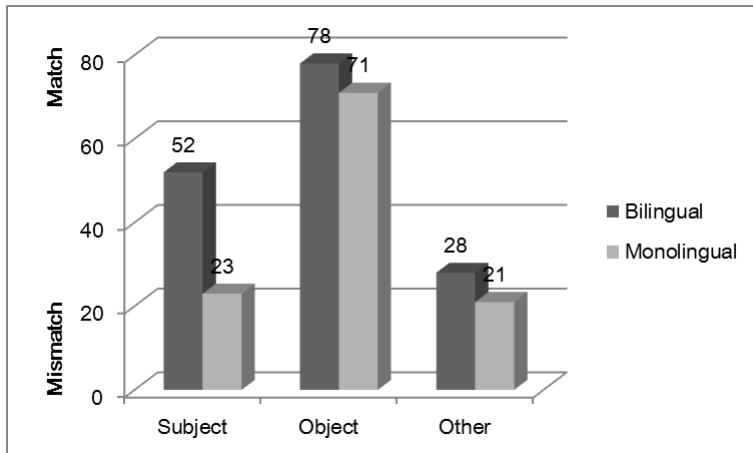
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2 **Overt Pronoun Task: Bilingualism Factor**

3 **Figure 11: Sentence Picture Matching Task**



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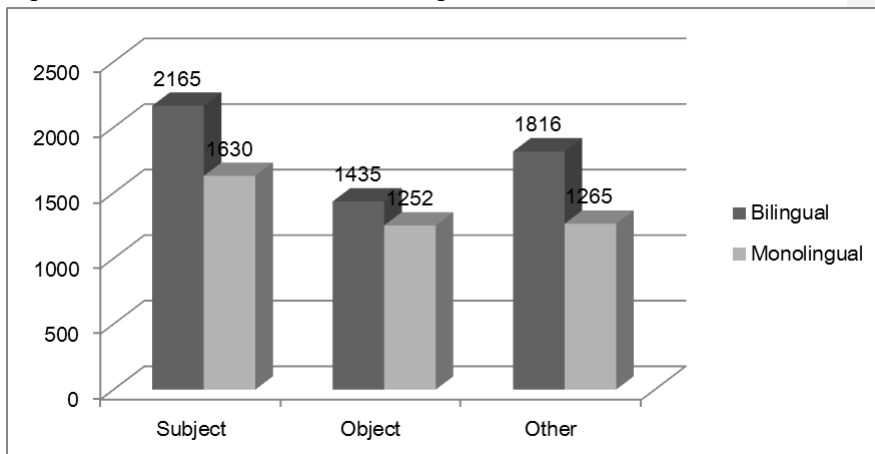
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9 **Figure 12: Answer RTs for the Matching Task**



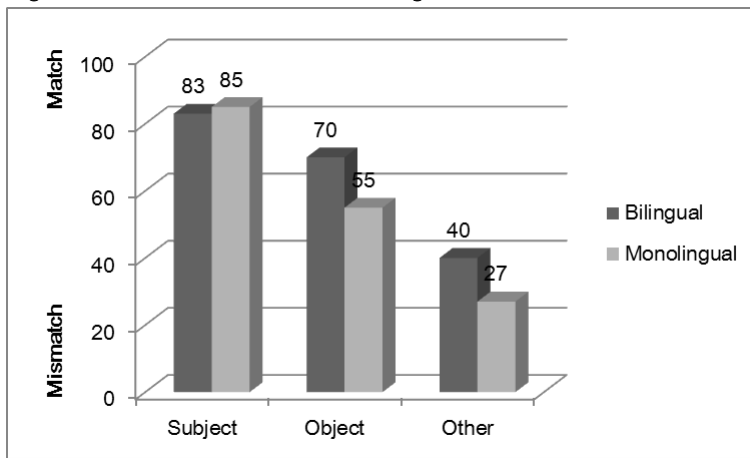
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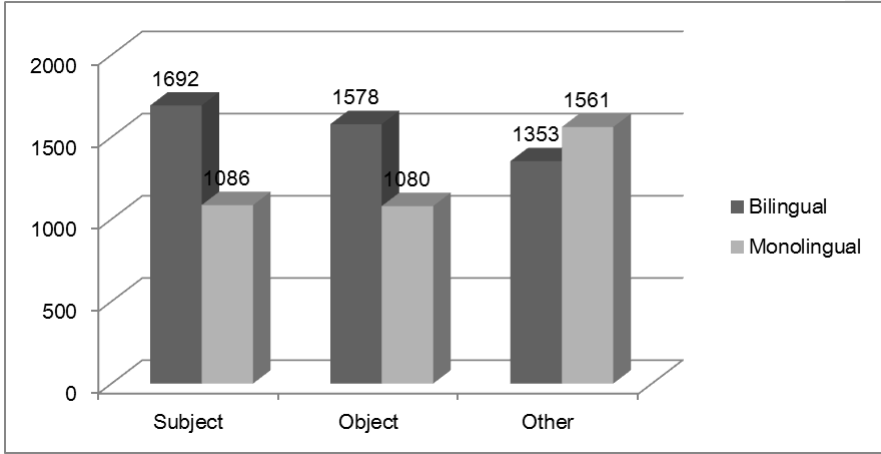
**Null Pronoun Task: Bilingualism Factor**

**Figure 13: Sentence Picture Matching Task**



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**Figure 14: Answer RTs for the Matching Task**



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