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

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

In the present study we focus on an extensively studied interface phenomenon, namely pronominal resolution with the aim of addressing the question of whether two groups of bilingual speakers, an older and a younger group, reveal different interpretation preferences for null and overt pronouns. Specifically, we experimentally examine the interpretation of Greek null and overt subject
pronouns in terms of the selection of a subject, object or ‘other’ referent as the preferred antecedent of the pronoun. The two bilingual groups consist of adult Greek-Swedish speakers. The older group includes adults who developed knowledge of L2 Swedish in adulthood whereas the younger group includes younger adults who had bilingual exposure from preschool age. Potentially, the older group meets the characterization of non-pathological first language attrition in adulthood due to second language influence, in that these once monolingual Greek speakers might be affected by their late-developed bilingualism in L2 Swedish. The younger group includes early-sequential bilinguals of Greek and Swedish who acquired Greek naturalistically in early childhood as a “home” language in Sweden. This group is thus a typical heritage speakers’ group (see e.g. Montrul 2008, Author C 2009a).

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

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

A different developmental situation with effects on L1 performance has been associated with heritage speakers (e.g. Montrul 2008, Polinsky 2011, Author C 2007, Pires & Author C 2009). Although it is hard to provide an exhaustive definition of heritage speakers to which all would subscribe (see for discussion Beaudrie & Fairclough 2012, Montrul 2008, Polinsky & Kagan 2007, Author C 2009a), a typical case would be early bilinguals exposed to one language from birth, which happens to be different from the majority language and the main language of education in the society in which they grow up. Heritage speakers have been shown to differ from monolingual natives but also from second language learners in various interesting respects (Montrul 2004, 2008). Apart from lexical retrieval difficulties (see Ecke 2004 for heritage speakers; see Hulsen 2000, Montrul 2008, Schmid 2002, Schmid & Köpke 2008, Pavlenko 2003, 2004 for attriters), heritage speakers have been shown to exhibit difficulties in other areas of grammar (Montrul 2008, Polinsky 1997, 2007). A linguistic area most noticeably
affected is inflectional morphology. Heritage speakers of grammatical gender
languages produce a significant number of gender errors compared to
monolinguals. For example, although monolingual Russian and Spanish-speaking
children control gender marking by age 4 with almost 100% accuracy (with the
exception of irregular and less frequent forms), Polinsky (2008) and Montrul (2008)
have shown that heritage speakers display high error rates ranging from 5% to
25%. In the verbal domain, the tense system can also be affected. Heritage
speakers of Spanish and Russian confuse aspectual distinctions between
perfective and imperfective forms (Polinsky 2007, Silva-Corvalán 1994). Moreover,
in reference to agreement and the distribution of null and overt subjects in null
subject languages, it has been shown that this syntax-discourse interface
phenomenon is also a vulnerable domain: Spanish and Russian heritage speakers
have been found to overuse overt subjects in contexts where a null subject would
be pragmatically more appropriate (Montrul 2004, Polinsky 2007, Author B et al.
2004).

As mentioned, L1 attrition usually affects non-core properties of the
language. We know that differences in heritage grammars are not solely confined
to non-core areas per se although basic properties such as macro-parametric
properties (e.g. basic word order, head-directionality and the like) seem unaffected.
However, it is often the case that highly significant divergences are found in non-
core areas of grammar, for example, Montrul (2004) found that the discourse
regulated distribution of null and overt subjects in heritage speakers of Spanish
differs from monolingual norms in that null and overt subjects are used in contexts where they are pragmatically unexpected. Following Pires & Author C (2009), the question is whether this is a result of influence of bilingualism with English as the ‘other’ language leading to morphosyntactic convergence (Montrul 2004) or whether it reflects, at least in part, higher use of overt subjects by the L1 attriters who provide heritage speakers their input. If a similar pattern is shown in L1 attrition, then some differences in heritage grammars might simply be reflective of the input provided to them by bilingual L1 attriters (cf. Sorace 2004, Author C 2007; Pascual y Cabo & Author C 2012 for similar argumentation and, e.g., Montrul & Walker Sánchez 2013; Pascual y Cabo 2013 for empirical support).

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

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

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

Bringing together L1 attriters and the generation of speakers they provide input to, namely heritage speakers, as we do in the present study is especially interesting with respect to identifying sources of differences in development and ultimate attainment that characterize the mature state grammars of heritage speaker bilinguals (cf. Sorace 2004, Domínguez 2009, 2013, Pascual y Cabo 2013, Pascual y Cabo & Author C 2012, Pires & Author C 2009). In particular, the present study aims to examine the role of early vs. late bilingualism in HS and L1 attriters in a syntax-discourse phenomenon which has been shown to differentiate monolingual from bilingual speakers, namely pronominal resolution. In principle, two possibilities are envisaged with respect to the interaction between age of onset of bilingualism and pronominal resolution. According to the first, we expect stronger effects of the early bilingual experience of HS on pronominal resolution, giving rise to increased optionality in the interpretation of overt but also null subject pronouns. In this scenario, late bilinguals, namely L1 attriters, are expected to show bilingualism effects on overt pronouns only as a consequence of crosslinguistic
influence from the non-null subject L2. The second possibility is that bilingualism will affect both HS and L1 attriters similarly, without any cumulative effects of age of onset differences, and only on overt pronoun resolution as previous literature suggests (Author B et al 2004). This is based on the assumption that there are no qualitative differences in the effects of early vs. late bilingualism at least insofar as syntax-discourse phenomena are concerned. The second possibility is also compatible with the linguistically-driven distinction in the features of overt and null pronouns which assume overt pronouns to be marked, and thus more vulnerable than the null option, which constitutes the default in null subject languages.

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

The syntax-discourse phenomenon which is the focus of the present study is pronominal resolution in Greek in these two groups of Greek-Swedish bilinguals.
Greek and Swedish differ in the null subject property: Greek is a typical null-subject language with overt pronouns being a ‘marked’ option dictated by discourse-related features (see below) while Swedish requires subject pronouns to be overtly realized in finite clauses (e.g. Holmberg & Plat Zack 1995). Given the contrast in the value of the null subject option, the present study addresses two questions. First, we investigate the possibility of crosslinguistic influence (CI) from Swedish to Greek affecting the interpretation of overt subject pronouns. In particular, the expectation is that both L1 attriter s and heritage speakers would show effects of Swedish subject properties onto Greek in the interpretation assigned to overt but not to null subjects, as previously reported for similar language combinations in Montrul 2004, Sorace & Filiaci 2009 and Author B et al. 2004. The underlying idea is that the syntactic availability of null and overt pronouns will not be affected by language contact in either group of bilinguals, but the interpretation assigned to overt pronouns, which is the overlapping option in Swedish and Greek, will become less sensitive to their Greek markedness feature of topic-shift. Accordingly, the interpretation of overt subject pronouns in the Greek of both bilingual groups will be open to topic-continuity and topic-shift options, as is the case in the ‘other’ language, Swedish. The second question our study seeks to address is a possible difference between heritage speakers and L1 attriter s in the effects of CI in pronominal resolution. This difference is based on the early vs. late bilingualism of each group of Greek-Swedish participants. Specifically, the early acquired bilingual experience in the HS group in contrast with the late bilingual status of the attriter s
may show stronger effects of crosslinguistic influence on pronominal resolution in
the HS group, extending to attrition in the interpretation of null subject pronouns as
well. More specifically, if the age-of-onset of exposure to bilingualism turns out to
play an important role in the two groups heritage speakers will not be experiencing
‘attrition’ affecting monolingual Greek but an early established bilingual Greek
system with lower sensitivity to markedness features on overt pronouns from the
start. Furthermore, we expect differences between HS and monolingual speakers
of Greek to be greater than between L1 attritors and monolingual controls. We
also expect that any link to differences in the heritage speakers possibly stemming
from emerging attrition effects in the input would also favor the above-described
predictions, again because the attritors had reached a mature state that is now
being eroded whereas the heritage speakers might never have reached a state
comparable to the monolinguals (cf. Shin and Cairns 2009). In other words, a
change from what was once a monolingual grammar as is the case of L1 attrition,
should show less divergence than a bilingual grammar with a mature state that has

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

2. Overt and null subject pronouns

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

Meanwhile, other L1 studies report that overt subject pronouns do not
necessarily exhibit a bias towards a less prominent antecedent such as the DP
object (see Filiaci 2008 for Spanish), or even that no noticeable patterns are
attested suggesting a more flexible nature of overt pronoun assignment (see Geber
2006 for Romanian, Costa et al. 2004 for Brazilian Portuguese and Meridor 2006
for Hebrew). Additionally, where ambiguity is not at stake, monolingual speakers
are shown to disregard the typical antecedent assignment strategies (Ferreira &
Patson 2007) implying that the processing load of coordinating syntactic and pragmatic information could be relieved with the use of an overt pronoun (Sorace et al. 2009).

Pronominal resolution has been one of the most studied interface phenomena in monolingual and bilingual speakers. The motivation for this research stems from the idea that interfaces have been shown to be vulnerable domains in language development and language attrition (Platzack 2001, Müller & Hulk 2001, Sorace & Filiaci 2006, Author B et al. 2004) more so than purely grammatical aspects of language (Sorace 2004, Author B 2007, Schmid 2009).

Interfaces require the coordination of different types of information rendering the interpretational demands more complex and subject to degrees of preference instead of categorical judgments in monolingual and bilingual speakers (Author B & Sorace 2006). Pronominal resolution and reference assignment, in general, presuppose the processing of grammatical and discourse information. Similarly, identifying the appropriate antecedent for a pronoun presupposes sensitivity to morphological and structural information (Carminati 2002) as well as developed pragmatics (Sperber & Wilson 2004). In null subject languages the availability of overt and null pronouns is a grammatical property. The appropriate choice for the subject pronoun, however, is regulated by discourse factors, such as topic-continuity, topic-shift and emphasis. In the context of first language attrition or bilingualism the overt pronoun appears to be overused in contexts of topic-continuity where the monolingual speaker would prefer to use a null subject (Author
Bet al. 2004, Sorace 2011 and references therein). Interestingly, the overt pronoun is overused even when the two languages are both null subject languages, as shown in Spanish-Italian bilingual production (Filiaci et al. 2013, Serratrice et al. 2011). Although this effect points to pronoun overuse as an effect of bilingualism rather than crosslinguistic influence, it is crucial to point out that the distribution of null vs. overt subject pronouns is not identical even among null subject languages (Iraola Azpiroz & Ezeizabarrena Segurola 2011, Mayol 2012). This raises the possibility that crosslinguistic influence may surface as the overuse of a more ‘marked’ overt pronoun in one language to its relaxed markedness status in the other.

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

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

Dimitriadis’s (1996) analysis argues for a Centering Theory account on the basis of corpus data on pronominal subjects. In his approach, the centering model establishes the anaphoric relationships and their effect on the interlocutors’ attention. Specifically, the centers are the available antecedents for the subsequent utterance that formulate the forward looking centers list (Cf-list). The ranking within the Cf-list is argued to be language dependent; the null pronouns of Greek subjects tend to select as their antecedent the highest-ranked center that has compatible grammatical and agentivity features, while overt pronouns are incompatible with the preferred center (Cp), regardless of its features, instead antecedents lower in the list appear to be better candidates. In other words,
Dimitriadis (1996) suggests that the interpretation of pronouns is partly dependent on grammaticized properties of individual pronouns. Miltsakaki (2007) examined the interpretation of null and overt subject pronouns in Greek in relation to argument ordering; SVO and OVS sentences with agent-patient combinations were included. Participants had to complete a second sentence whose first word was an overt pronoun. The data showed a strong preference for the overt pronoun to pick the patient-object antecedent irrespective of the word order. The participants were also given the option of introducing the subject (overt or null) on their own. The data showed that the patient-object reference was used in 52% of the responses, and the agent-subject reference in 48% of the responses. Miltsakaki's study also provided evidence for a processing distinction between main and subordinate clauses finding that in the main clause continuations the null subjects preferred the subject referent and the overt pronouns the object referent. This pattern was not replicated with subordinate clause continuations where null subjects preferred the object rather than the subject referent.

In L1 attrition studies, the distribution of pronouns controlled by discourse features such as Focus and Topic Shift has been addressed on the hypothesis that attrition effects show up as optionality in the feature-specification on overt subject pronoun use. Author B et al. (2004), in particular, investigated forward and backward anaphora resolution in adult native speakers of Italian (with near-native L2 English) using an off-line sentence picture matching task. The findings showed
that in sentences with forward anaphora, when the subject of the subordinate clause was a null pronoun, participants preferred to interpret it as the subject of the main clause. In contrast, when the subject of the subordinate clause was an overt pronoun, participants strongly preferred to interpret it as referring to a new referent. In sentences with backward anaphora, when the subject of the subordinate clause was a null pronoun, participants allowed for either the subject or the object of the main clause as a possible referent. However, when the embedded subject was an overt pronoun, participants showed a strong preference for the matrix object to be the referent of the pronoun. Note that the Greek participants in Author B et al. (2004) did not differ significantly from non-attributed controls although their preferences for subject or object antecedents were weaker than those of the controls. The difference between Greek and Italian attritors was attributed to the difference in the status of the overt pronoun in each language; in Greek the overt subject pronoun is the demonstrative which can assume anaphoric function whereas in Italian this is not the case.

In a more recent study, Papadopoulou, Peristeri, Plemenou, Marinis & Author B (in press) tested the interpretation of null and overt subject pronouns in Greek speaking 10-11 year old children and adults using an on-line self-paced listening task as well as an off-line sentence-picture matching task. Since this task is the one used in the present study, presentation of the experimental conditions and materials is found in the following sections. The main findings with respect to the monolingual populations tested in Papadopoulou et al. (in press) is that the
interpretation of overt subject pronouns is similar in children and adults, i.e. showing a strong preference for the object antecedent. On the other hand, children differed from adults in the interpretation of null subject pronouns. In particular, children showed no strong preference for either the subject or the object antecedent while the adults showed a strong subject antecedent preference. The analysis proposed is based on the idea that while the overt pronoun is the marked option and as such its use implies topic-shift the null subject option is unmarked in the grammar and as such its interpretation is open to either antecedent. Adults regulate their interpretative options by assigning a subject antecedent preference to null subject pronouns as an economy strategy on pronominal resolution. Specifically, given that overt pronouns are the ‘marked’ option signaling a switch in topic, null subjects are preferred as the elsewhere condition which in this case is topic-continuity. The children’s non-adult performance in the interpretation of null subject is thus viewed as a delay in the development of a strong parsing preference even at the age of 10-11, rather than a delay in the grammar or the relevant interface features of topic (shift/continuity) or focus.

4. The Study

In the present study we compare two adult bilingual groups, first language attritors and heritage speakers of Greek in their ability to interpret subject pronouns in contexts where the matrix subject, the matrix object or a third referent is available in the picture presented. As discussed in Section 2 above, the null subject option
in Greek is the default option looking for an established topic in the preceding
discourse as the preferred antecedent. The subject antecedent preference is
theoretically and empirically grounded on the basis of monolingual adult native
speaker data. On the other hand, the overt subject pronoun is discoursally 'marked'
(Cardinaletti & Starke 2001, Montalbetti 1984). As such non-subject antecedents
are expected to be preferred in the case of overt subject pronoun use. Given
previous evidence from Author B et al.’s (2004) study on L1 attrition we expect any
differences between monolingual and bilingual groups to be more evident in the
interpretation of overt pronouns. Although in the offline study in Author B et al
(2004) Greek attriters did not show a significant difference from monolingual
controls, the present study is methodologically different. Apart from being an online
self-paced listening study, each sentence is matched (or not) with one picture at a
time (Papadopoulou et al. 2014). In Author B et al. (2004), all three options (Subject,
Object or Other) were presented simultaneously to the participant and more than
one of the three could be selected as appropriate choices. This method
encourages optionality and participants’ preferences are weakened making any
difference between controls and attriters less pronounced.
Furthermore, unlike the online data on monolingual children
(Papadopoulou et al. 2008) which reveal a delay in showing a subject antecedent
preference for null subject pronouns L1 attriters and heritage speakers are
expected to show variability in the interpretation of the overt rather than the null
pronoun since subject prominence as a processing strategy should already be in
place. On the other hand, if reduced input quantity in the early language
development of heritage speakers compared to L1 attriters has qualitative effects
on judgments, preferences and intuitions about pronominal reference it is possible
that HS will show variability not only in the overt subject but in the null subject
pronoun too allowing for more object antecedents than L1 attriters

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

4.1.1 Experimental Design: Materials & Procedure

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

(1) I yiayia / xeretise / tin kopela / otan / affi / pernuse / to 
the-FEM old-lady-FEM / greeted-3S / the-FEM girl-FEM / when / she /
cross- PAST-3S / the street

'The old-lady greeted the girl when she crossed the street.'
In the example above the overt subject pronoun of the adverbial clause, *affi*, could be construed as coreferential with the subject or the object of the main clause. In all the test items the noun phrases in subject and object position, were of the same gender so that the overt pronoun could in principle refer to either. The slashes indicate the way the sentence was divided into segments. The critical segment was the subject pronoun of the subordinate clause. The participants were shown a picture presented on the computer screen at the onset of the first auditory segment and started listening to the sentences in a segment-by-segment fashion. The participants controlled the onset of the listening of each segment by pressing a button on the keyboard. At the end of the sentence the picture was substituted with a question mark “?” on the computer screen. At this point the participant was asked to indicate whether the sentence they listened to matched the picture or not by pressing one of the two pre-specified buttons on the keyboard. The button press recorded the participants’ answer choice and also their RT for this decision. The experiment lasted approximately 20-30 minutes (depending on the age of the participants). Each experimental sentence was matched to three different pictures. The pictures depicted the action presented in the adverbial clause and each picture
provided a different interpretation: in one picture the actor was the subject of the main clause, in the second the actor was the object of the main clause, and in the third picture the actor was a third referent. Three lists were created, each containing the 10 experimental and the 30 filler sentences. In each list, the experimental sentences were matched to one of the three pictures. In each list, the choice of antecedent depicted in the picture was rotated. Thus, each antecedent option was presented at least three times for each participant with one of the options (subject, object or third referent) presented four times in each list. Each participant encountered only one of the three lists (see example):

[Insert Picture Set]

4.1.2 Participants

Ninety-one adult speakers of Greek were included in this study. There were two experimental groups and two control groups. There was an experimental group of HS and another including L1 attriters. The HS group consists of 30 adult Greek-Swedish bilinguals (sixteen female) of Greek origin and born in Sweden. They attended monolingual Swedish education along with Greek language-support classes (Saturday school) throughout their childhood and adolescence. They
reported that even though they speak predominantly Greek with family members, they use both languages on a daily basis. At the time of testing, the mean age was 29 years (range: 19-34 years old). The majority of the participants (n=22) had university degrees from Swedish institutions. At the time of testing, twenty-five of the heritage speakers still lived in Sweden while five of them had recently moved to Greece to receive intensive language courses in Greek.

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

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*The period of residence in Greece was two to three months as they were all students in an Erasmus visit to a Greek university.*
only finished primary school and the remaining eight participants had obtained a university degree before immigration.

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

4.1.3 Predictions

Our predictions are based on the following theoretical and empirical background assumptions. We assume that the syntax-discourse interface is a vulnerable domain in cases of language contact (Sorace & Filiaci 2006, Author B et al. 2004, Author B & Sorace 2006). The idea is that interface phenomena are not fully determined by syntactic computations nor do they trigger categorical judgments even in monolingual adult native speakers. Instead, these phenomena are subject to preferences affected by a) morphosyntactic options, e.g. null vs. overt subject pronouns, personal vs. demonstrative pronouns (Wilson 2009, Wilson et al. 2009), b) syntactic context e.g. intrasentential vs. intersentential anaphora (Peristeri 2010), adverbial vs. complement clauses (Mitsakaki 2003), c) directionality of anaphora (forward or backward; Author B et al. 2004 and d) lexical and discourse properties such as plausibility and frequency factors. Successful integration of all the above
properties gives rise to preferences as these are found in monolingual adult native speaker data. The interface status of syntax-discourse phenomena opens up the possibility of differences from the monolingual adult grammar in their use by L1 children, L2 adult speakers, bilingual children and L1 attrited adult speakers (Gürel 2004, Papadopoulou et al. 2008, Sorace & Filiaci 2006, Sorace 2011 and references therein).

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

(2)  Den unge mannen hälsade på den äldre herren när han gick över gatan
The young man greeted the old man when he crossed the street
“The young man greeted the old man when he crossed the street.”

---

5 We are grateful to Prof. K. Boklund-Lagopoulou for providing us with the Swedish examples.
(3) Den unge mannen hälsade på den äldre herren när denne gick över gatan

The young man greeted the old man when he-DEM crossed the street

“The young man greeted the old man when he crossed the street.”

On the basis of the previous extensive literature in the domain of pronominal resolution in bilinguals, we predict that both groups will differ from monolingual adult native speakers of Greek in the interpretation of overt subject pronouns (Exp. 1). Accordingly, both groups will allow more subject antecedents as possible referents of the overt subject pronoun compared to the control group. On the other hand, null subject pronouns are not expected to show differences between the experimental groups (Exp. 2) unless an effect of early vs. late bilingualism is relevant. Specifically, L1 attriters and heritage speakers should be similar to L1 controls on the basis of previous relevant findings in adult L1 attrition (Author B et al. 2004). Our assumption is that null pronouns, being the default choice in the grammar, will not differ from monolingual controls in their interpretation as there is no overlap with the L2, Swedish, which is not a null subject language. If heritage speaker’s grammars, however, are different from L1 attriters’ due to the effect of early bilingualism it is possible that heritage speakers will differ from L1 attriters showing a weaker preference for subject antecedents for null subject pronouns as suggested by Montrul’s (2004) findings. If it turns out that the two bilingual groups differ in the interpretation of null pronouns, the result will be consistent with...
accounts supporting age of onset effects in bilingual grammars. If the two groups
do not differ, however, the effects of bilingualism on the interpretation of subject
pronouns is shown to leave the non-overlapping pronominal option, namely the
overt subject pronoun, unaffected in early and late bilinguals alike.

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

4.1.4 Results

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

[INSERT Figure 1]

All groups, both target and control show a significant effect of reference (Heritage: $F(2,178)=33.709$, $p<.001$, Attriters: $F(2,148)=24.399$, $p<.001$, Young Monolinguals: $F(2,58)=33.673$, $p<.001$, Older Monolinguals: $F(2,52)=12.419$, $p<.001$). To elaborate further on the preferences per referent for the matching task...
in our data set we performed dependent-samples t-tests. The comparisons showed that the target groups differentiated all referents (HS: Subject vs. Object t(89)= 4.545, p<.001, Subject vs. Other t(89)= 3.567, p=.001, Object vs. Other t(89)= 8.499, p<.001; Attriters: Subject vs. Object t(74)= 3.344, p=.001, Subject vs. Other t(74)= 3.709, p<.001, Object vs. Other t(74)= 8.499, p<.001; Attriters: Subject vs. Object t(74)= 3.344, p=.001, Subject vs. Other t(74)= 3.709, p<.001, Object vs. Other t(74)= 8.499, p<.001). While the monolingual control groups did not differentiate between the Subject and the Other referents (Young Monolinguals: Subject vs. Object t(59)= 7.303, p<.001, Object vs. Other t(59)= 7.303, p<.001; Older Monolinguals: Subject vs. Object t(53)= 4.176, p<.001, Object vs. Other t(53)= 4.558, p<.001).

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

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

With regard to the between target-group comparisons, we find that heritage speaker and attriters differ only in the Subject referent condition in which the HS group is slower to respond ($F(1,74)=82.974$, $p<.001$, $t(163)=7.423$, $p<.001$). Younger and older monolinguals differ in the Other referent condition.
Additionally, the comparisons between heritage speakers and young monolinguals showed significant effects on Subject and Other referents and a marginal significance on the Object referent (Subject: $F(1,59)=129.778$, $p<.001$, $t(148)=7.865$, $p<.001$; Object: $F(1,59)=3.332$, $p=.073$, $t(148)=2.535$, $p=.012$; Other: $F(1,59)=68.039$, $p<.001$, $t(178)=9.313$, $p<.001$).

Meanwhile, the comparisons between attriters and older monolinguals showed significant effects on the Object and Other referents only (Object: $F(1,53)=8.213$, $p=.006$, $t(127)=2.986$, $p=.003$; Other: $F(1,71)=43.093$, $p<.001$, $t(170)=6.150$, $p<.001$).

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

Even though monolinguals do not show any variation in their listening times on the pronoun in the subordinate clause, heritage speakers and attriters show a significant effect of reference (HS: $F(2,178)=5.115$, $p=.007$, Attriters: $F(2,148)=4.169$, $p=.017$). Moreover, the dependent-samples t-test comparisons showed that heritage speakers and attriters differentiate marginally between Subject and Object referents (Heritage: $t(89)=1.811$, $p=.073$; Attriters: $t(74)=1.804$, $p=.075$) being slower in the Object condition and significantly between Object and Other referents (Heritage: $t(89)=2.836$, $p=.006$; Attriters: $t(74)=2.509$, $p=.014$).
With regard to the between group comparisons, we find that heritage speakers and attritors do not differ in their listening times per referent. Additionally, the comparisons between heritage speakers and young monolinguals showed significant effects on all referents with heritage speakers showing shorter listening times on the critical segment (Subject: $F(1,59)=9.297$, $p=.003$, $t(148)=2.336$, $p<.001$; Object: $F(1,59)=6.868$, $p=.011$; Other: $F(1,59)=20.411$, $p<.001$, $t(178)=3.463$, $p=.001$). The same is true for the comparisons between attritors and older monolinguals (Subject: $F(1,53)=24.346$, $p<.001$, $t(127)=3.409$, $p=.001$; Object: $F(1,53)=8.517$, $p=.005$; Other: $F(1,71)=28.672$, $p<.001$, $t(170)=3.975$, $p<.001$).

Note, however, that in the independent-samples t-test comparisons for the Object referent we did not get a significance effect, which shows that the differences in listening times were not major in this condition.

To summarize the results from Experiment 1 testing overt subject pronominal resolution, the most relevant findings with respect to our predictions concern the tendency of both bilingual groups, namely heritage speakers and attritors, to accept a subject antecedent for the overt subject pronoun. These results confirm previous studies showing differences in overt pronoun interpretation between monolinguals and bilinguals. Notice that no significant differences were found in the listening times of the two target groups indicating that even at the online processing level the two bilingual groups appear quite similar and different from the two control groups.
4.2 Experiment 2: Null Pronoun Anaphora Resolution

4.2.1 Experimental Design

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

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

the-MASC old-man / spoke-3S / loudly / to his grand-child-MASC / when / pro read-PAST-3S / a book

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

In (4), the null subject of the adverbial clause is usually associated with topic-continuity and is thus construed as coreferential with the matrix subject, o papus.

4.2.2 Predictions

As pointed out in 4.1.3, L1 attrition should not affect the interpretation of null subject pronouns given previous findings (Author B et al 2004). On the other hand, predictions about heritage speakers’ matching decisions on null subject pronouns may be contradictory. One possibility is that the interpretation of null subject pronouns by heritage speakers should follow the pattern of L1 attriters which is not
different from monolingual native controls (Sorace 2011 and references therein).

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

4.2.3 Results

As in Experiment 1, the variable examined in Exp. 2 was type of reference; Subject,
Object and Other. The data obtained included (a) off-line sentence-picture
matching preference (b) response times on the data in (a) and (c) on-line listening
times for the verb of the subordinate clause (5th segment). In each data set we
performed Manovas testing the group factor and repeated measures ANOVAs with
reference (Subject vs. Object vs. Other) as the within subjects variable. The
MANOVA comparisons showed that the group factor (Heritage Speakers, Attriters, Young Monolinguals, Older Monolinguals) interacts with reference type in the matching task ($F(9, 664) = 3.222, p=.001$; Wilk’s $\Lambda = 0.901$, partial $\eta^2 = .034$). An interaction was also identified with regard to the answer RTs ($F(9, 664) = 26.436, p<.001$; Wilk’s $\Lambda = 0.475$, partial $\eta^2 = .220$) and the listening times on the verb of the subordinate clause ($F(9, 664) = 8.896, p<.001$; Wilk’s $\Lambda = 0.758$, partial $\eta^2 = .088$). First we present the data from the sentence picture matching preferences for each group.

Figure 4 shows the participants’ scores per group and condition.

All groups, both target and control ones show a significant effect of reference (Heritage: $F(2,178)=27.774, p<.001$, Attriters: $F(2,148)=13.475, p<.001$, Young Monolinguals: $F(2,58)=76.690, p<.001$ & Older Monolinguals: $F(2,52)=14.267, p<.001$). Moreover, the dependent-samples t-test comparisons showed that all participants differentiate between referents showing a preference for the subject referent with the exception of Older monolinguals in the Subject vs. Object comparison (Heritage: Subject vs. Object $t(89)= 2.096, p=.039$, Subject vs. Other $t(89)= 6.895, p<.001$, Object vs. Other $t(89)= 5.262, p<.001$; Attriters: Subject vs. Object $t(74)= 2.169, p=.033$, Subject vs. Other $t(74)= 5.117, p<.001$, Object vs. Other $t(74)= 2.933, p=.004$; Young Monolinguals: Subject vs. Object $t(59)= 7.055,$
With regard to the between group comparisons, both heritage speakers and attriters differ only in the Other referent condition with attriters showing a higher preference score ($F(1,74)=4.063, p=.047$). The independent-samples t-tests also showed a marginal differentiation between the target groups in the Object ($t(218)=1.777, p=.077$) and Other referents ($t(163)=1.772, p=.048$).

Additionally, the comparisons between heritage speakers and young monolinguals showed significant effects on the Subject and Object referents (Subject: $t(148)=1.974, p=.050$; Object: $F(1,59)=11.977, p=.001, t(178)=3.042, p=.003$) with young controls showing stronger preference for subject and weaker for object antecedents than the HS group. In contrast, attriters and older monolinguals showed no significant differences on any referent condition. It is important to note that young monolinguals differ significantly to older monolinguals in the Subject ($F(1,53)=8.079, p=.006$) and Object conditions ($F(1,59)=8.119, p=.006$) and only marginally in the Other referent condition ($F(1,53)=3.399, p=.073$). In particular, the younger group of monolingual controls shows stronger preference for subject and weaker for object antecedent compared to the older monolingual group whose matching rates are less deterministic.

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

With regard to the between group comparisons for the null pronoun resolution, we find that heritage speaker and attriters differ in the Subject condition ($F(1,74)=20.507, p<.001$) and Object referent conditions ($F(1,99)=5.491, p=.021$) with attriters taking longer to respond in both conditions. The independent-samples t-tests also showed a significant effect between the target groups in the Subject condition.
The listening times on the verb of the subordinate clause are displayed in Figure 6.

Neither heritage speakers nor attriters show a reference effect in their listening times contrary to monolinguals who differentiate among all referents (Young Monolinguals: $F(2,58)=20.427, p<.001$ & Older Monolinguals: $F(2,52)=13.063, p<.001$). Moreover, the dependent-samples t-test comparisons showed that young monolinguals differentiate only marginally between the Subject and Object referents with heritage speakers responding significantly slower (Subject: $t(148)=3.317, p=.001$, Object: $F(1,59)=69.054, p<.001$, $t(178)=8.764, p<.001$). Meanwhile, the comparisons between attriters and older monolinguals showed attriters responded significantly slower on the Subject and Object referents but faster on the Other referent condition (Subject: $F(1,53)=124.250, p<.001$, $t(127)=8.652, p<.001$; Object: $F(1,71)=66.026, p<.001$, $t(170)=8.048, p<.001$; Other: $F(1,53)=80.685, p<.001$, $t(127)=8.112, p<.001$). Moreover, young monolinguals differ significantly to older monolinguals in the Other referent condition ($F(1,53)=32.701, p<.001$).
referents ($t(59)= 1.889, p=.064$) and significantly for Subject vs. Other ($t(59)= 6.271, p<.001$) and Object vs. Other comparisons ($t(59)= 3.590, p=.001$) with the shorter RTs in subject condition. Older monolinguals’ listening RTs differ significantly only for the Subject vs. Other with longer RTs in the other condition ($t(53)= 4.335, p<.001$) and Object vs. Other comparisons ($t(53)= 4.398, p<.001$).

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

To summarize, in the null subject pronoun experiment we find that both bilingual groups discriminate between Subject and Object antecedents in their matching preferences which is also the case for the younger control group. Nevertheless, heritage speakers’ preference for Subject is significantly weaker than their controls while no difference is found between the attriters and the older monolingual group. Overall, bilinguals are faster in their listening times compared
The fact that attriters and older monolinguals do not differ on the matching decisions possibly stems from the weakening of the Subject antecedent preference with age. On the basis of production data, Hendriks et al (to appear) suggest that aging may attenuate preferences in pronominal resolution in monolingual adults. In the following section, we attempt to address precisely this possibility.

4.3 Age Factor

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

Starting with the overt pronoun anaphora resolution data set, the MANOVA comparisons showed that the age factor (Young vs. Old) (marginally) interacts with the reference type in the matching task ($F(3, 275) = 2.399, p = .068; \text{Wilk}'s \Lambda = 0.974$, partial $\eta^2 = .026$). An interaction was also identified with regard to the answer RTs.
(F(3, 275) = 19.323, p<.001; Wilk’s Λ = 0.826, partial η² = .174). Figure 7 shows the participants’ scores in the matching task per group and condition.

Figure 7 shows the participants’ scores in the matching task per group and condition.

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

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

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

Turning to the null pronoun anaphora resolution data set, the MANOVA comparisons showed that the age factor (Young vs. Old) interacts with the reference type in the matching task (F(3, 275) = 2.714, p=.045; Wilk’s Λ = 0.971, partial η² = .029). An interaction was also identified with regard to the answer RTs (F(3, 275) = 9.622, p<.001; Wilk’s Λ = 0.905, partial η² = .095). Figure 9 shows the participants' matching scores per group and condition.
The comparisons in the null pronoun task show that young and old participants exhibit different matching preferences for the Object and the Other reference conditions with the old ones displaying a higher preference for a match in both cases (Object: $F(1,171)=6.927, \ p=.009$; Other: $F(1,128)=4.909, \ p= .028$).

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

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

Overall, the results from both the overt and the null pronoun experiment reveal an ‘age effect’ in pronominal resolution. Older participants show weaker preferences for both overt and null pronouns allowing subject and object antecedents in both experiments significantly more than the younger participants. Overt pronouns seem to favour more subject antecedents in the older than the younger participants and null pronouns more matches for object in the older than the younger group. Although this ‘age effect’ in adults was not one of our original research questions, the attested differences indicate that interface vulnerability is open to factors other than attrition or bilingualism as such. Although further
investigations in this area are necessary it seems that age within adulthood plays
a role in the tendency to discriminate between preferences in pronominal resolution
overall.

4.4 Bilingualism Factor

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

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

[INSERT Figure 11]

Anaphora resolution in the Subject condition appears to be an area of
differentiation for the bilingual and monolingual participants, with bilinguals
demonstrating a significantly higher preference for a match ($F(1,113)=17.222, p<.001$).

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

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

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

The between-group comparisons for the matching preferences are not significant, suggesting that both bilinguals and monolinguals interpret null pronouns similarly in all conditions. This indicates that the between-group differences found in the
interpretation of null pronouns in Section 4.2 above are not due to bilingualism as such but a combination of bilingualism and age effects at best. The RTs for the matching task are displayed in Figure 14.

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

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

5. Discussion
The data obtained from both experiments overall group L1 attritors and heritage speakers together in the lack of a strong preference in pronoun resolution. While monolingual adult native controls clearly discriminate between overt and null subject pronouns with respect to object and subject preference respectively, the
other two groups do not show similarly robust preferences. In the overt pronoun condition, our results conform with the prediction that in L1 attrition or in bilingual grammars of Greek in general, the overt pronoun option is vulnerable in that it can be associated with either topic-continuity or topic-shift. Thus, an overt subject pronoun in the subordinate adverbial clause is open to coreferential readings with either the subject or the object antecedent. Whether this lack of preference is the effect of Swedish, i.e. the non-null subject language of these participants, an effect of processing resources (Sorace & Serratrice 2009) remains an open question. We would like to suggest however that the results of this study are consistent with an analysis which primarily builds on the linguistic (formal and discourse) properties of overt (and null) pronouns rather than on a purely processing account, for the following two reasons. First, because matching decisions on the overt pronoun are affected not only in the bilingual groups but also in the older monolingual controls, indicating that crosslinguistic influence is not the only cause which reveals the vulnerability of overt subject pronouns. Secondly, because the comparison between overt and null pronominal resolution indicate stable preferences (matching decisions) for null pronouns, suggesting that the problem is not with grammatical elements which are inherently underspecified for reference (i.e. pronouns in general) but with a specific member of this category in particular.

The matching decisions in the null subject condition show that both heritage speakers and L1 attriters prefer subject over object antecedents like the monolingual controls. This is consistent with the findings in Author B et al. (2004).
However, in terms of decision times L1 attriters take longer to respond to subject antecedents in the null pronoun experiment compared to heritage speakers who are faster to respond to subject than object antecedents in the same experiment. We interpret this finding as an indication of better resolution patterns in the young bilinguals who appear to be more certain about the subject orientation of null subject pronouns. In addition, our results indicate that differences between monolingual controls and attrited speakers are more evident in on-line investigations of syntax-discourse interface phenomena than in off-line tasks (cf. Author B et al. 2004).

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

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

The L1 attriters and the heritage speakers diverge from monolinguals similarly despite the fact that only the former clearly reached a mature state grammar for Greek comparable to monolinguals. Despite the similarity in behavior on these tasks, it is possible, even likely, that the source of divergence for heritage speakers and L1 attriters our data show is different whereby only the former reflects
erosion. Our point is simply this: heritage speakers could only be expected to show
difference from monolinguals for two converging reasons. First, there is an
expected effect of bilingualism, as we saw in the case of emerging bilingualism for
L1 attritors. Dealing with multiple grammars in a single mind has consequences for
various domains of language, and so, when a property is affected by late
bilingualism as in L1 attrition the default expectation is that this must also be true
in heritage grammars as well. In fact, one might expect more pronounced
differences for heritage grammars than L1 attrition precisely because bilingualism
affects the course of development of the heritage language itself as opposed to the
mature linguistic state that has been achieved in adult bilingualism. In addition,
heritage speakers are provided with quantitatively less input than monolingual
learners. It is also possible that the input is qualitatively different for heritage
speakers’ language development as it is likely to be provided by a generation of
speakers who themselves exhibit surface effects of attrition (see Sorace 2004;
Pascual y Cabo & Author c 2012). This means that in addition to dealing with the
complexities of maintaining multiple linguistic systems they are simultaneously
presented with divergent input as compared to monolinguals. One could ask then,
how could they possibly develop a monolingual-convergent grammar? So, while
L1 attrition is clearly loss at some abstract level, heritage speaker divergence can
be viewed as the outcome of a developmental path that is destined to be distinct
from monolinguals as a result of a general byproduct of bilingualism, qualitative
input differences among other factors.
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Appendix A: Statistically non-significant results

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
Within group comparisons

Listening RTs on Verb ~ Reference Effect (Subject vs. Object vs. Other):

Attriters F(2, 73) = .010, p = .990

Heritage Speakers vs. Attriters

Matching ~ Subject Referent F(1, 74) = .000, p = 1.000

Matching ~ Object Referent F(1, 99) = 1.260, p = .264

Answer RTs ~ Other Referent F(1, 74) = .817, p = .369

Listening RTs on Verb ~ Subject Referent F(1, 74) = 1.597, p = .210

Listening RTs on Verb ~ Object Referent F(1, 99) = .009, p = .926

Listening RTs on Verb ~ Other Referent F(1, 74) = .165, p = .686

Attriters vs. Older Monolinguals

Matching ~ Subject Referent F(1, 53) = .219, p = .642

Matching ~ Object Referent F(1, 71) = .330, p = .567

Matching ~ Other Referent F(1, 53) = 1.828, p = .182

Age Factor

Matching

Exp1. Overt Pronoun ~ Manova Reference Effect (Subject vs. Object vs. Other):

F(3, 275) = 2.399, p = .068; Wilk's Λ = 0.974, partial η² = .026

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

Object Referent F(1, 128) = .079, p = .779;

Other Referent F(1, 171) = 1.871, p = .173

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

Subject Referent F(1, 128) = 2.646, p = .106
Answer RTs

Exp1. Overt Pronoun ~ Btw Group Comparison (Young vs. Old):
Object Referent $F(1, 128) = 2.399, p = .124$;
Other Referent $F(1, 171) = 1.386, p = .241$

Exp2. Null Pronoun ~ Btw Group Comparison (Young vs. Old):
Object Referent $F(1, 171) = .823, p = .366$

Bilingualism Factor

Matching

Exp1. Overt Pronoun ~ Btw Group Comparison (Young vs. Old):
Object Referent $F(1, 113) = 2.097, p = .150$;
Other Referent $F(1, 131) = .749, p = .389$

Exp2. Null Pronoun ~ Btw Group Comparison (Young vs. Old):
Subject Referent $F(1, 113) = .358, p = .551$;
Object Referent $F(1, 131) = 3.111, p = .080$;
Other Referent $F(1, 113) = 1.939, p = .167$
1 Subject Reference

2 Object Reference

3 Other Reference

4

5

6
Experiment 1: Overt Pronoun Task

Figure 1: Sentence Picture Matching Task

Figure 2: Answer RTs for the Matching Task
Figure 3: Listening Times (RTs) on the Subject Pronoun of the Subordinate Clause
Experiment 2: Null Pronoun Task

Figure 4: Sentence Picture Matching Task
Figure 5: Answer RTs for the Matching Task
Figure 6: Listening Times (RTs) on the Verb of the Subordinate Clause
Overt Pronoun Task: Age Factor

Figure 7: Sentence Picture Matching Task
Null Pronoun Task: Age Factor

Figure 8: Answer RTs for the Matching Task

Figure 9: Sentence Picture Matching Task
Figure 10: Answer RTs for the Matching Task
Overt Pronoun Task: Bilingualism Factor

Figure 11: Sentence Picture Matching Task

Figure 12: Answer RTs for the Matching Task
Null Pronoun Task: Bilingualism Factor

Figure 13: Sentence Picture Matching Task

Figure 14: Answer RTs for the Matching Task