88. Processing Wh-dependencies in L2 English by L1 Turkish and Spanish Speakers: Island Constraints and *that-trace* Effect

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Abstract

This study investigates whether advanced L2 speakers exhibit comparable sensitivity to island constraints and the that-trace effect as L1 speakers during real-time processing of long distance grammatical and ungrammatical wh-extractions in English. L1 Spanish, Turkish, and English speakers participated in an online grammaticality judgment task (GJT) featuring five types of wh-extractions with island and that-trace violations, presented in full-sentence and self-paced reading conditions. Findings reveal distinctions between L2 learners and native speakers in accuracy and response times, particularly in subject extractions from non-finite clauses and that-trace violations. However, subject-object asymmetry was consistent across groups, suggesting shared processing patterns. L2 learners showed sensitivity to island constraints, paralleling native speakers. L1 influence varied, with no significant discrepancy between Spanish and Turkish groups. Turkish learners' success in grammatical wh-extractions may stem from overt movement via scrambling and universal grammar availability, whereas Spanish participants displayed nuanced L1 influence on ungrammatical wh-extractions with that-trace violations.

Keywords: Island constraint, *that*-trace effect, *wh*-dependencies, L1 Turkish, L1 Spanish, L2 English

Wh bağımlılığının L2 İngilizcede D1 Türkçe ve İspanyolca Konuşanlar Tarafından İşlenmesi: Ada Kısıtlamaları ve o-iz Etkisi

Bu çalışma, ileri düzeydeki D2 konuşmacılarının, İngilizce'deki uzun mesafeli dilbilgisel ve dilbilgisel olmayan wh çıkarımlarının gerçek zamanlı işlenmesi sırasında, ada kısıtlamalarına karşı karşılaştırılabilir bir duyarlılık sergileyip sergilemediğini ve D1 konuşmacıları ile iz etkisi gösterip göstermediğini araştırmaktadır. L1 İspanyolca, Türkçe ve İngilizce konuşanlar, tam cümle ve kendi hızında okuma koşullarında sunulan, ada ve bu iz ihlalleriyle birlikte beş tür Wh-çıkartımı içeren çevrimiçi bir gramer değerlendirme görevine (GJT) katılmıştır. Bulgular, özellikle sonlu olmayan cümlelerden konu çıkarımları ve iz ihlallerinde olmak üzere, ikinci dil öğrenenler ile anadili İngilizce olanlar arasında doğruluk ve tepki süreleri açısından farklılıklar olduğunu ortaya koyuyor. Bununla birlikte, özne-nesne asimetrisinin gruplar arasında tutarlı olması, ortak işlem modellerini akla getiriyor. İkinci dil öğrenenler de anadili İngilizce olanlarla paralel olarak ada kısıtlamalarına karşı duyarlılık gösterdiler. L1 etkisi çeşitlilik gösteriyordu; İspanyol ve Türk grupları arasında anlamlı bir farklılık yoktu. Türk öğrencilerin dilbilgisel wh çıkarımlarındaki başarısı, karıştırma yoluyla açık hareketlerden ve evrensel dilbilgisi kullanılabilirliğinden kaynaklanabilirken, İspanyol katılımcılar that-trace ihlalleri ile dilbilgisi dışı Wh çıkarımları üzerinde incelikli L1 etkisi sergilediler.

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Anahtar kelimeler: Ada kısıtı, iz etkisi, wh bağımlılıkları, L1 Türkçe, L1 İspanyolca, L2 İngilizce

I. Introduction

In the field of second language (L2) processing, wh-dependencies have attracted a considerable number of researchers who have been interested in differences between L1 and L2 speakers in real-time sentence processing Wh-dependencies, despite being syntactically unambiguous, provide for languages processing due to involving empty categories (ECs). These ECs pose two key features their inferred existence as research they are absent in the s-structure, and distant association with antecedents, disrupting local sentence representation (Fodor, 1989). Within the framework of the generative grammar, L1 researchers focused on ECs in the real time processing of wh-dependencies. The basic assumption of the gap-based accounts is that the parser uses gaps (i.e. traces) left behind by the moved wh-phrase (also known as filler) to form filler-gap dependencies. One of the well-known filler-driven strategies is the Active Filler Strategy (AFS) of Frazier & Clifton (1989) which suggests that as soon a wh-filler has been identified, the parser ranks the option of assigning it to a gap above all other options.

However, L2 researchers focused on wh-dependencies for both whether ECs are used by L2 speakers in the same way as L1 speakers (e.g., Marinis, Roberts, Felser & Clahsen, 2005; Felser & Roberts, 2007) and if L2 speakers are as sensitive as L1 speakers to island constraints on wh-dependencies such as Subjacency Principle or Empty Category Principle (ECP) (e.g., Schachter, 1989; Schachter & Yip, 1990; Johnson & Newport, 1991; White & Juffs, 1998, Juffs & Harrington, 1995; 1996). Nevertheless, the results are not conclusive yet. For instance, in two studies, Juffs and Harrington (1995; 1996) examined whether L2 speakers are as sensitive as L1 speakers to island constraints, and ECP during real-time processing of wh-extractions in English testing L1 Chinese learners on an online grammaticality judgment task involving (un)grammatical wh-extractions. They reported that L2 learners were less accurate and slower than L1 speakers in online interpretation of wh-extractions. Moreover, they observed a subject -object asymmetry in the processing of grammatical wh-extractions form finite and nonfinite clauses. In a follow-up study, Juffs (2005) tried to establish clearly the role of L1 by looking at L2 English data of learners with L1 Japanese, Korean, Chinese and Spanish in online processing of wh-questions. However, the results of these studies revealed neither a clear L1 influence nor a strong subject-object asymmetry in processing finite and nonfinite clauses. Similarly, Marinis, Roberts, Felser & Clahsen (2005) and Felser & Roberts (2007) reported that unlike native speakers, adult L2 learners did not use gaps in the formation of filler-gap dependencies in real-time processing. This suggests that L2 learners do not process wh-dependencies in the same way as native speakers.

The present study aims to contribute to L2 sentence processing literature by examining Turkish and Spanish end-state L2 speakers' online processing of wh-dependencies in English. Spanish is similar to English with respect to overt movement and island constraints on wh-extractions whereas Turkish, unlike Spanish and English, is a wh-in-situ language and exhibits wh-movement and island constraints via scrambling. Thus, this pair of languages provides a good testing ground to verify the role of L1 in the L2 processing of wh-constraints in an overt wh-movement language like English. Within this background, this study explores whether adult L2 English learners with different L1 backgrounds—one with overt wh-movement like English (i.e., Spanish) and the other one with wh-movement via scrambling, which is subject to island constraints (i.e., Turkish) can achieve native-like success in processing long distance wh-constructions in English in terms of accuracy and response latency. Moreover, the study aims to examine whether the L1 (i.e. Turkish and Spanish) still plays a role in end-state L2 processing. Furthermore, it attempts to find out if the subject-object asymmetry previously

reported in processing wh-extractions from finite and nonfinite clauses is also observed in this investigation.

We used an online grammatical judgment task (GJT) adapted from Juffs and Harrington's (1995; 1996) studies in English to compare the accuracy of the two L2 groups and native English speakers in online comprehension of sentences with both grammatical and ungrammatical *wh*-extractions. The grammatical sentences involved object extractions from finite and non-finite clauses with/without the complementizer *that*. The ungrammatical sentences consisted of *wh*-extractions with island constraints such as adjunct island, complex noun phrase (NP) island, relative clause (RC) island, subject island and *wh*-extractions involving *that*-trace violation. The GJT was presented in two conditions: the full sentence condition and the self-paced word by word reading condition. The structure of the article is as follows: Section 2 presents linguistic background of the study followed by Section 3 which involves previous research on the processing of wh-dependencies in the L1 and L2. Section 4 provides the study with research questions, materials and instruments followed by the results in Section 5 and discussion of the findings in Section 6. We present concluding remarks in Section 7.

2. Linguistic Background of the Study

2.1. Wh-movement and Island Constraints in English

Within the framework of generative grammar, languages like English and Spanish exhibit overt wh-movement to form wh-questions. Chomsky (1995) introduced a feature-based checking process in the Minimalist Program (MP) to account for linguistic derivations involved in operations related to movement. One particular instance of this is wh-movement, a phenomenon in which a wh-phrase undergoes a transition from its original position to a new position known as Spec-CP leaving a copy in its initial position. The underlying assumption is that within an interrogative CP, the question affix (Q) occupies the head C position. This Q carries a specific interrogative specifier-feature. In cases involving wh-operations such as 'who', they possess an interrogative head-feature. This prompts their movement to the Spec-CP position to check/verify the interrogative specifier-head feature on the head C by Q-agreement. In other words, the head C has an uninterpretable Q feature. The uninterpretable [Q] will be checked and deleted in the syntax by Q agreement during wh-movement operation as in (1a,b).

1. "a. Becky bought the syntax book.

b. What did Becky buy?

[$_{CP}$ *What*$_i$ did [$_{TP}$ Becky] [$_{VP}$ buy t$_i$]]]?" (Carnie, 2007, p. 318)

However, in the context of embedded wh-questions, the dynamics of wh-movement are subject to certain constraints put forth by Bounding Theory, a concept rooted in the works of Chomsky (1964) and Ross (1967). Ross identified specific linguistic constructions known as "islands," within which wh-phrases face limitations in their extraction. These islands encompass relative clauses, clausal adjuncts, wh-clauses, coordinate structures, and sentential subjects. Movement out of these structures results in ungrammatical expressions, termed as island effects. To address this phenomenon, Chomsky (1973) introduced the Subjacency Principle, a unified explanation for the island constraint. This principle delineates movement boundaries, thereby determining the extent to which a wh-phrase can be displaced from its original position. The core claim of Subjacency is that movement is restricted from crossing

more than one bounding node simultaneously. In English, these bounding nodes are identified as IPs and NPs.

Complex NP Island (CNPI)

The complex NP/DP constraint states that a CP which is dominated by a NP is an island for movement. In other words, no element can be extracted out of a complex NP/DP (i.e., an NP/DP[1] consisting of an N, and a complement clause as in (2).

2. Bill make the claim that he read in the syntax book?

[$_{CP1}$ What$_i$ did [$_{TP1}$ Bill make [$_{DP}$ the claim [$_{CP2}$ t_i that [$_{TP2}$ he read t_i in the syntax book]]]]]?" (Carnie, 2007, p. 334).

Relative Clause Island (RCI)

Like complex DPs, relative causes are islands for movements. Wh-phrases cannot move out of relative clause islands as in (3).

3. *How many cities does Bill have brothers who live in?

*[$_{CP1}$ How many cities does [$_{TP1}$ [$_{DP1}$ Bill have [$_{DP2}$ brothers [$_{CP2}$ t_i who [$_{TP2}$ live in t_i]]]]]?

Adjunct Island (AI)

Adjuncts are another kind of Islands, out of which wh-phrases cannot be extracted as in (4)

4. *Who did he leave because he met?

*[$_{CP1}$ Who did [$_{TP1}$ he leave [$_{CP2}$ t_i because [$_{TP2}$ he met t_i]]]]? (Cook & Newson, 2007, p. 143)

Subject Island (SI)

According to the Subject Island Constraint, a wh-phrase cannot be extracted out of a subject island in the subject position as in (5). The movement crosses a DP and a TP simultaneously, violating subjacency.

5. *Who did a picture of fall off the wall?

* [$_{CP1}$ Who$_i$ did [$_{TP1}$ [$_{DP}$ a picture [$_{PP}$ of $_{ti}$] fall off the wall]]?

2.2 That–trace effect

In English, wh-movement encounters a constraint known as the "that-trace effect." This constraint involves the long-distance movement of subjects preceded by an overt complementizer. Initially identified by Chomsky and Lasnik (1977) and termed the that-trace effect, it reveals that traces in object positions are permissible, while those in subject positions require no accompanying complementizer for licensing. This constraint aligns with the Empty Category Principle (ECP), which mandates proper governance for traces. A trace is deemed "licensed" when governed by a lexical head or antecedent.

Traces in object positions consistently satisfy this, serving as objects of lexical heads. Conversely, subject traces lack head governance, necessitating antecedent governance. The presence of an overt complementizer obstructs antecedent governance, giving rise to the that-trace effect (Cook & Newson, 2007: 177). For instance, the question in (6) violates the ECP as the subject trace lacks theta-governance. The verb, which assigns the theta role, is too low in the structure to govern it. Moreover, the intermediate trace, functioning as the antecedent, is prevented from governing its subject trace by the intervening complementizer "that".

6. "*Who did he say that wanted a beer?

*[$_{CP}$ Who$_i$ did [$_{TP}$ he say [$_{CP}$ that [$_{TP}$ t_i wanted a beer]]]]?" (Cook & Newson, 2007, p. 175)

2.3 Wh-movement and island constraints in Spanish

Similar to English, Spanish employs overt wh-movement in wh-questions. This entails moving a wh-phrase from its original location to the beginning of the sentence (i.e., Spec-CP). However, the positioning of the verb is subject to specific limitations. The sentence-initial placement of wh-phrases is exemplified in (7a-b)

7. "Juan leyò ese libro. (Declarative sentencie)

Juan read-PAST that book

[$_{CP}$ Juan [$_{TP}$ leyò ese libro]]

" ¿Què libro leyò Juan? (Direct Question)

Which book read-PAST Juan

'Which book did Juan read?"

"Marī̄a no sabe [qué libro leyó Juan]. (Indirect Question)

Marī̄a not know-PRES [which book read-PAST Juan].

"Maria doesn't know which book Juan read." (Zagona, 2002, p. 242)

To have an interrogative reading the wh-phrase *qué libro* "which book" moves from canonical object position to sentence initial position in the direct question (7a) and the indirect question (7b).Regarding island constraints, Spanish is assumed to exhibit the same island constraints as those observed on wh-movement in English. In Spanish, extracting a wh-phrase out of a NP island, relative clause island, adjunct island, or subject island results in ungrammatical expressions (see Cebreiros, 1996 for more information).

2.4 That-trace effect in Spanish

In contrast to English, Spanish requires the obligatory use of the complementizer "that" in both object and subject extractions, as shown in (46 a-b). Additionally, subject extraction from embedded clauses following the complementizer "that" does not lead to an Empty Category Principle (ECP) violation

(Torrego, 1984). Torrego's explanation for the Spanish that-trace effect involves verb-preposing in questions. According to Torrego, when the verb is preposed, it no longer governs a trace within the VP. Instead, it accurately governs the subject position immediately to its right, as exemplified in (8b).

"a. ¿Con Quièn piensa-s que Sue reunió?

whom think-PRES-2SG that Sue meet-PAST

"Who do you think that Sue met __?"

b. ¿Quièn piensa Marī̄a que t_i es de Argentina?

Who think-PRES Maria that is from Argentina

*Who$_i$ does Maria think that t_i is from Argentina?" (Montrul et al, 2008, p. 95)

To summarize, this section establishes that, like in English, wh-phrases overtly shift to the Spec-CP position in both direct and indirect questions in Spanish. They encounter identical island constraints on overt movement as observed in English. Unlike English, subject extraction from embedded clauses with the complementizer "that" avoids the that-trace effect in Spanish. The subsequent section discusses wh-movement, island constraints and that-trace effect in Turkish.

2.5 Wh-movement, island constraints and that-trace effect in Turkish

Turkish, characterized by a fundamental SOV word order, functions as a wh-in-situ language. This signifies that wh-phrases, including terms like "kim" (who), "nereye" (where), "neden" (why), and "hangisi" (which) remain in their original positions within both main and embedded questions. Notably, these wh-phrases do not undergo overt raising to the Spec-CP position. Furthermore, these wh-phrases are marked with case markers to align with their grammatical role in the structure (Arslan, 1999). Illustrations of declarative and interrogative forms in Turkish are provided in (9a-b).

a. "Zeynep Ali-yi gör-dü.

Zeynep-NOM Ali-ACC see-PAST

Zeynep saw Ali.

b. Zeynep kim-i gör-dü?

Zeynep-NOM who-ACC see-PAST

Who did Zeynep see?" (Arslan, 1999, p., 3).

In (9b) wh-phrase *kim-i* stays in-situ at the preverbal syntactic position as the internal argument of the verb *see* and is marked with accusative case.

However, in-situ wh-phrases in Turkish move to Spec-CP position in two ways: (1) they undergo movement at LF (covert movement), and (2) can overtly move via scrambling. Following Huang's (1982) LF-raising analysis of the in-situ wh-phrases in Chinese, it has been assumed that in-situ wh-phrases in

Turkish as in (10b) move to Spec-CP at LF to derive interrogative interpretation (10a), but the movement is not phonetically observable (e.g., Özsoy, 1996; 2009).

10. a. Zeynep kim-i gör-dü?

Zeynep-NOM who-ACC see-PAST

b. [$_{CP}$ Kim-i$_i$ [$_{IP}$ Zeynep [$_{vP}$ t$_i$ [$_{VP}$ t$_i$ gör-dü]]]] ? (LF)

who-ACC Zeynep-NOM see-PAST

'Who did Zeynep see?'" (Arslan, 1999, p. 3).

Scrambling in Turkish derives from the movement of constituents leftward into various specifier positions. (11) and (11b) illustrate local and long-distance scrambling of wh-words in Turkish, respectively.

11. "a. Ayşe kim-i gör-müş?

Ayşe who-ACC see-HS-3SG

'Who has Ayşe seen?'

b. Kim-i$_i$ Ayşe t$_i$ gör-müş?

Who-ACC Ayşe see-HS-3SG

'Who has Ayşe seen?" (Özsoy, 2009, p.223).

Leftward movements via scrambling are subject to regular syntactic constraints such as locality constraints on movement, the WCO effect, reconstruction effects, and binding properties associated with overt movement (e.g., Kural, 1993; Aygen, 2000; Öztürk, 2005). Long-distance movement through scrambling in Turkish exhibits island constraints (i.e., complex NP island, relative clause island, adjunct island, and sentential subject island). This is in line with Boeckx (2008), who states that island effects exist in all languages. Still, there is some variation in the patterns of extractions that may be difficult to explain within a purely configurational view of locality (For further information, see Ikizoglu, 2007).

2.6 That-trace effect in Turkish

The that-trace effect seems irrelevant for Turkish, because unlike English and Spanish, Turkish does not have an overt complementizer *that* in complement clauses. Therefore, it does not exhibit *that*-trace effect at the trace site, where embedded subject is extracted. The examples (12a-b) illustrate *that*-trace effect in English and Turkish, respectively.

12. a. *Who did he say that wanted a beer?

*[$_{CP}$ Who$_i$ did [$_{TP}$ he say [$_{CP}$ that [$_{TP}$ t$_i$ wanted a beer]]]]?

b. Kim-in$_i$ [*t*$_i$ bir bira iste-diğ-i-ni] söyle-di?

Who-GEN a bear want-NOM-3SG.POSS-ACC say-PAST

*Who did he say that wanted a beer?

(12b) shows that subject extraction from the embedded clauses does not result in ungrammaticality in Turkish because there is not an intervening complementizer *that*, which prevents the subject trace to be properly governed.

In sum, examples for covert movement of in-situ wh-phrases at LF and for overt-movement in scrambling indicate that although Turkish is a wh-in-situ language, it has covert movement at LF but allows overt movement via scrambling. This movement is similar to that of overt movement in languages such as English with respect to island constraints. In the next section, I will discuss previous research on the theories of L1 and L2 sentence processing.

3. L1 and L2 processing of wh-dependencies

3.1 L1 processing of wh-dependencies and island constraints

Within the framework of generative grammar, research in L1 sentence processing proposed a"gap-based" account constructing gaps at canonical argument positions (e.g., Crain & Fodor, 1985; Stowe, 1986). Gap-based stems from generative grammar, moving verb arguments to sentence start, leaving a trace (Chomsky, 1981). Studies indicate parsers predict gap sites during processing (filler-driven parsing) (Fodor et al., 1987; Frazier, 1987). For example, Stowe, (1986) reported a filled gap effect at the direct object gap position of the embedded verb in (13b) with a fronted wh-phrase, and this is reflected in slower reading times for the pronoun us. However no such effect was found in the control condition that did not involve a fronted wh-phrase (13a). This slowdown is expected if the parser actively posits a direct object gap in (3b) as soon as it encounters the transitive verb bring, and hence experiences difficulty when it finds an overt pronoun in the direct object position. The slowdown is unexpected if the parser waits to identify an empty argument position before positing a gap.

13. "a. My brother wanted to know if Ruth will bring us home to Mom at Christmas.

b. My brother wanted to know who Ruth will bring us home to _at Christmas." (Stowe, 1986, p. 234)

In this study, Stowe found readers slow down post "bring," a potential gap position, suggesting forced reanalysis of the object gap strategy, supporting native English speakers' adoption of filler-driven approach.

Similar evidence emerged in Dutch, Russian, Hungarian, Italian, German, and Japanese. L1 priming studies affirmed gaps' psychological reality, reactivating fillers at gap positions, aligning with Active Filler Strategy (AFS) (Frazier & Clifton, 1989). Research on island constraints also found parser's sensitivity to islands during initial parsing (Stowe, 1986; Bourdages, 1992; Pickering et al., 1994; McElree & Griffith, 1998; Yoshida et al., 2004). To conclude, consensus exists among gap-driven accounts that mental representation of wh-dependencies involves filler-gap formation.

3.2 L2 Processing of Wh-Dependencies: Examining Cross-Linguistic Differences

Wh-dependencies in second language (L2) processing have garnered significant attention, paralleling studies on ambiguity resolution. These investigations stem from earlier work on wh-movement acquisition. For instance, Schachter & Yip (1990) contrasted native and non-native judgments on long-distance wh-dependencies through offline tasks, uncovering difficulties in subject extractions from nonfinite clauses.

A pivotal study by Juffs and Harrington (1995; 1996) initiated online investigations into L2 wh-processing. They utilized self-paced reading to analyze Chinese L2 learners' handling of grammatical subject- and object- extractions. The findings, aligned with Pritchett's Generalized Theta Attachment Theory, highlighted L2 speakers' struggles in subject extraction from finite and nonfinite clauses. Native English speakers faced challenges with subject extraction from nonfinite clauses. Accuracy results substantiated these trends, showing L2 learners' weaker performance in accepting grammatical extractions. Notably, difficulties persisted in subject extraction from finite clauses. Meanwhile, Juffs (2005) replicated these findings with various L2 groups and L1s. It appeared that L1 background influenced accuracy in grammatical wh-extractions but not in ungrammatical cases.

Further studies, including those by Williams et al. (2001) and Felser and Roberts (2007), probed filler integration in L2 processing. The evidence suggested a lexically-driven strategy among L2 learners, regardless of L1 background. Gibson and Warren (2004) and Marinis et al. (2005) supported the notion of intermediate landing sites in L1 processing of long-distance dependencies, yet this was not evident among L2 speakers. In light of evolving theoretical frameworks for island constraints, changes have occurred in the understanding of L2 acquisition.

To contribute to existing literature, this study examines online processing of wh-dependencies in L2 English using two adult groups with distinct L1s—Turkish with wh-in-situ properties and Spanish with overt wh-movement. The aim is to determine whether the discrepancy between native and nonnative speakers in ultimate attainment is a result of processing challenges or L2 grammar deficits.

4. The present study

4.1. Research questions

This study addresses the following research questions:

1. Are L1 Spanish and Turkish speakers of L2 English as accurate and swift as native English speakers in processing grammatical and ungrammatical long-distance wh-extractions with island constraints and that-trace violations in English sentences under the full sentence condition?

2. Is there a significant difference in the accurate processing of grammatical and ungrammatical wh-extractions with island constraints and that-trace violations in English between L1 Spanish speakers and L1 Turkish speakers due to their native language background under the full sentence condition?

Our hypotheses for the first question assume that L2 speakers can apply universal principles such as subjacency and the Empty Category Principle. Therefore, their performance in assessing the grammaticality of long-distance wh-extractions in English will match that of L1 English speakers, irrespective of their native language.

Regarding the second question, the study explores the influence of L1 background on L2 judgments of (un)grammatical wh-extractions. It hypothesizes that L1 Spanish speakers will excel in evaluating subjacency-governed wh-extractions due to the shared overt wh-movement feature between Spanish and English. Conversely, L1 Turkish speakers might exhibit lower proficiency, given Turkish's deviation from this linguistic pattern. Concerning that-trace effects, the assumption is that L1 Spanish speakers will show less accuracy compared to L1 Turkish speakers in evaluating the grammaticality of ungrammatical wh-extractions with that-trace violations in L2 English. This stems from the linguistic structure of Spanish, which permits subject extractions over an overt complementizer like "that."

Drawing on Pritchett's Generalized Theta Attachment Theory (GTA), the research predicts an asymmetry in accuracy and response times (RTs) among all groups, particularly the L2 groups. This pertains to subject and object extraction from finite and nonfinite clauses. The SPRT is expected to reveal extended RTs for subject extractions due to complex theta role changes and case assignments. This complexity is higher for nonfinite clauses with embedded NPs. Similar difficulties are predicted for subject extraction from finite clauses, stemming from changes in theta roles and case assignments.

4.2. Participants

Two groups of adult L2 speakers participated in this study: (1) 30 near-native Turkish-speakers of English; and (2) 30 near-native Spanish speakers of English. Similar to English, Spanish has overt *wh*-movement with a SVO word order. However, Turkish is a wh-in-situ language and *wh*-words can overtly move through scrambling. It has a SOV word order as its canonical word order. Therefore, including these syntactically different languages as the L1 of L2 learners is believed to contribute to the identification of L1 influence in processing grammatical *wh*-extractions as well as Subjacency violations in L2 English. In addition, 31 adult native speakers of English were tested as the control group in the study.

Table 1. L2 speakers' background information

Groups	Sex		Age			Length of stay in the USA or UK
	Male	Female	Mean age of first exposure to L2 English	Mean age at time of testing	Age range	
Turkish	21	9	11	36	30-54 (SD:5)	8.6
Spanish	12	13	11	33	20-69 (SD:9)	5.9

As can be seen on Table 1, Turkish and Spanish speakers were similar in terms of age, age of first exposure to L2 English, and length of stay in an English-speaking country. All Turkish participants received a Ph.D. degree at a university in the USA or UK. 88% of the Spanish participants either obtained a Ph.D. degree or were pursing to get it at the University of Essex in the UK or working at that university as faculty members.

The mean age in the English native speakers was 37 with a range of 19-58 (SD: 11). All of them were exposed to English as home language and took their primary, secondary, and high school as well as university education in English. They were all either graduate students or faculty members at the University of Essex in the UK or graduates of various universities in the UK or the USA.

All participants had normal hearing, and normal vision, and were not informed of the ultimate purpose of the experiment.

4.3. Materials

Grammaticality judgement task

The experimental stimuli utilized in this study encompassed long-distance grammatical wh-extractions and ungrammatical counterparts, which involved island constraints and that-trace violations. The experimental items were adapted from the study of White and Juffs (1996), as well as Juffs (2005). Below are provided examples of grammatical wh-extractions across five distinct types:

Grammatical wh-sentences:

(1) "a. What does the woman think the plumber stole from the garage? (Object extractio/finite clause)

b. What does the inspector think that the boy stole from home? (Object extraction/finite clause with *that*)

c. Who does the manager expect to meet at work this morning? (Object extraction/ nonfinite clause)

d. Who does the woman think stole the bicycle in the garage? (Subject extraction/finite clause)

e. Who does the manager expect to meet the job applicants today? (Subject extraction/nonfinite)" (White & Juffs, 1998, p. 129)

In contrast, the ungrammatical stimuli comprised five distinct types of wh-extractions that violate island constraints and the that-trace effect (f-k). These ungrammatical instances served as a valuable testing ground to explore the extent to which L2 speakers—regardless of whether their L1 features overt wh-movement—demonstrated sensitivity to island constraints and the that-trace effect in L2 English. Below are provided examples of ungrammatical wh-extractions across five distinct types:

Ungrammatical wh-extractions:

(2) "f. *Who did Alison go to work after she took to school? (Adjunct Island)

g. *Who does James believe the fact that Alison saw at work? (Complex Noun Phrase Island)

h. *What does Jane visit the architect who designed for her friend? (Relative Clause Island)

i. *Who does the teacher believe a story by amuses the children? (Subject Island)

k. *Who do the police believe that attacked the man last night? (That-trace)" (White & Juffs, 1998, p. 129)

The Grammaticality Judgment Test (GJT) involved a total of 100 sentences—50 grammatical wh-extractions and 50 ungrammatical counterparts—in English. Moreover, we constructed an additional

set of 80 filler sentences, encompassing various interrogative structures such as relative clauses and noun clauses. Notably, all experimental sentences and filler sentences were meticulously composed to consist of precisely 11 words each. *Instrument* The GJT task was presented in two conditions; (1) the full- sentence condition to get an idea about RTs spent on each sentence (White & Juffs, 1998; Juffs & Harrington, 1995); and (2) the self-paced word-by-word reading with a moving window display (Just et al., 1992) to identify specific loci of processing difficulty.

(1*) Full- sentence condition*: in the first part of the experiment, participants read and judged a set of the sentences in the full-sentence presentation condition, in which the entire sentence appeared on the screen of a computer. The sentences were displayed one at a time. The participants were asked to read the sentence and press a (green) YES key if they find the sentence to be a grammatically correct in English or to press a (red) NO key on the keyboard if they find it to be grammatically incorrect. The letter q and p on the keyboard were covered in green and read respectively. They were asked to do this as quickly as possible. The amount of time that participants spent reading each sentence and making grammatical judgment was recorded as the time between key-presses. After an incorrect response, the word 'INCORRECT' flashed briefly on the screen as a feedback to the participant. A similar feedback was also given for a correct response. The presentation of items is randomized for each participant. There was a practice session involving 10 samples of grammatical and ungrammatical wh-extractions before the real trial to familiarize the participants with the experiment.

(2) *The Self-paced moving window reading technique* provided the collection of word-level readings to identify specific loci of processing difficulties. The participants first read and judged the sentences in the self-paced moving condition (Just *et al.*, 1982). In this technique, each sentence was presented on a computer screen one word at a time. The words appeared in a linear position in the sentence moving across the screen from left to right. Participants pressed the spacebar to reveal each word of the sentence. As each new word in the sentence appeared, the preceding word disappeared. The amount of time the participant spent reading each word was recorded as the time between key-presses. After the last word the wh-sentence in the experimental stimuli a question appeared which asked whether the sentence was grammatically "correct" or "incorrect" in English. Participants pressed one of the two keys to respond a YES or NO to the question. The software collected word-by-word RTs and accuracy score for each sentence in the experiment. The presentation of items was randomized for each participant.

4.4 Procedure

All experimental tasks were conducted on an individual basis using E-prime 2.0 (Schneider, Eschman, & Zuccolotto, 2002) on a laptop and were divided into two sessions. In the initial session, both L1 and L2 groups participated in an offline background information test and completed the Grammaticality Judgment Task (GJT) in the full-sentence condition. A week later, during the second session, participants engaged in self-paced word-by-word reading.

5. Results

5.1 Accuracy and RTs on five types of grammatical wh-extractions in the full-sentence condition

Table 2. Mean accuracy scores for five grammatical wh-extraction types

Structure	Spanish (n=24)		Turkish (n=31)		English (n=31)	
	M	SD	M	SD	M	SD
OEFF (n=10)	8.21	1.44	8.43	1.50	9.81	.402
OEFFT (n=10)	7.08	1.92	7.77	1.57	8.32	1.72
OEFNONF (n=10)	8.25	1.65	9.37	.890	9.68	.541
SEFF (n=10)	7.54	1.77	7.60	2.42	9.68	.702
SEFNONF (n=10)	4.83	1.99	4.20	2.58	6.90	1.89
Total (n=50)	7.18	1.75	7.47	1.62	8.88	1.05

OEFF (Object Extraction From Finite clause), OEFFT (Object Extraction From Finite clause with *that*), OEFNONF (Object Extraction From Nonfinite clause), SEFF (Subject Extraction From Finite clause), SEFNONF (Subject Extraction From Nonfinite Clause)

Table 2 displays mean RTs, revealing overall accuracy above 70% for all groups across five types of grammatical wh-extractions. English native speakers exhibit higher accuracy (M=8.88) than Turkish (M=7.47) and Spanish learners (M=7.18). Despite group differences, accuracy profiles remain consistent. English speakers excel in object extraction, both finite and nonfinite, while Turkish and Spanish speakers show similarity to native speakers, displaying subject-object asymmetry in nonfinite and finite clauses.

A 3x2 repeated measures ANOVA investigated differences in mean accuracy scores among Spanish, English, and Turkish groups across five sentence types. The results indicated significant effects of language ($F(2, 82) = 23.43$; $p<.01$) and sentence type ($F(4, 328) = 90.18$; $p<.01$), with an interaction effect between language and type ($F(8, 328) = 3.81$; $p<.01$). Post-hoc analysis (Tukey HSD, $p<.01$) showed English speakers were more accurate than L2 learners, who did not differ significantly. However, per sentence type ANOVA revealed nuanced differences: English and Turkish L2 learners did not significantly differ in OEFFT and OEFNONF, but did in SEFF, SEFNONF, and OEFF. Spanish L2 learners were less accurate than natives on all types but similar to Turkish L2, except OEFNONF. Pairwise comparisons (Bonferroni, $p<.05$) supported subject-object asymmetry, confirming previous studies, and indicated SENONF as most difficult. SEFF was harder than OEFF. Object extraction from finite clauses with a complementizer was notably tougher than from finite and nonfinite clauses.

Mean RTs to five grammatical wh-extractions are presented in Table 2 in milliseconds with standard deviations.

Table 3. Mean RTs for five grammatical wh-extraction types

Structure	Spanish (n=23)	Turkish (n=24)	English (n=31)

	M	SD	M	SD	M	SD
OEFF (n=10)	4459	1154	4059	1038	2940	770
OEFFT (n=10)	4403	1095	4350	995	3354	952
OEFNONF (n=10)	4210	1190	3668	961	2831	722
SEFF (n=10)	4298	1065	4226	1254	2827	774
SEFNONF (n=10)	4530	1169	4650	1041	3362	997
Total (n=50)	4364	1114	4233	1097	3063	843

OEFF (Object Extraction From Finite clause), OEFFT (Object Extraction From Finite clause with *that*), OEFNONF (Object Extraction From Nonfinite clause), SEFF (Subject Extraction From Finite clause), SEFNONF (Subject Extraction From Nonfinite Clause). Mean scores indicate RTs in milliseconds.

A two-way ANOVA examined if language groups and types had significant variations in reading times. Significant effects were found for language ($F(2, 75) = 16.66$; $p<.01$), type ($F(4, 300) = 20.67$; $p<.01$), and an interaction between language and type ($F(8, 300) = 3.31$; $p<.05$). Post-hoc (Tukey HSD, $p<.05$) revealed slower reading for Spanish and Turkish L2 English speakers compared to native English speakers in all wh-extraction types, but not different from each other.

Pairwise comparisons (Bonferroni, $p<.05$) indicated significant reading time (RT) differences between subject extraction from nonfinite clauses and the other types, except for object extraction from finite clauses with a complementizer. This replicated accuracy findings, showing RT differences between subject/object extractions from nonfinite clauses, but not from finite clauses.

Three ANOVAs were conducted to analyze interaction effects separately for each language group. English native speakers showed significant type effect ($F(4, 120)) = 19.73$; $p<.01$), with longer RTs for SEFNONF than OEFNONF. No significant RT difference for subject/object extractions from finite clauses, except for object extraction with complementizer. This aligns with lower accuracy in this category.

5.2. Accuracy and RTs on five types of ungrammatical wh-extractions in full-sentence condition

Table 4. Mean accuracy scores for ungrammatical wh-extraction types

Structure	Spanish (n=24)		Turkish (n=30)		English (n=31)	
	M	SD	M	SD	M	SD
AI (n=10)	8.83	1.17	9.07	1.34	9.90	.301
CNPI (n=10)	8.33	1.79	8.93	1.41	9.58	.672

RCI (n=10)	9.00	1.33	9.50	.900	9.77	.560
SI (n=10)	8.08	1.50	9.47	.900	8.19	1.68
TT (n=10)	3.50	1.59	4.93	2.49	8.23	1.86
Total (n=50)	7.55	1.47	8.38	1.41	9.13	1.01

AI (Adjunct Island), CNPI (Complex Noun Phrase Island), RCI (Relative Clause Island), SI (Subject Island), TT (*That*-trace violation).

Overall, all groups showed better accuracy in rejecting ungrammatical wh-extractions with island violations than accepting grammatical ones (compare Table 2 to Table 4). The difference between English native speakers and L2 groups in accuracy for ungrammatical wh-extractions is less than that for grammatical ones. L2 groups excelled in judging ungrammatical items. Turkish group's accuracy is close to English native speakers, except for that-trace violations. Excluding that-trace sentences raises Turkish group's accuracy to 9.24 and Spanish group's to 8.56 in ungrammatical items. These findings strongly imply that L2 groups grasp constraints on wh-movement by correctly rejecting ungrammatical wh-extractions in L2 English. Spanish and English share overt wh-movement and island constraints, differing mainly in bounding nodes (Chapter 3). Turkish, a wh-in-situ language, involves covert movement at LF, overt-movement through scrambling, and exhibits constraints similar to English and Spanish.

Mean accuracy scores by type in each language group in Table 4 highlight the challenge of rejecting that-trace violation for all groups, particularly the Spanish learners. This suggests L1 influence as Spanish allows a subject trace after the complementizer "that." To assess significant differences in language groups by types, a two-way ANOVA was used, showing significant overall effects for language ($F(2, 82) = 30.22$; $p<.01$); for type ($F(4, 328) = 122.27$; $p<.01$; $MSe=214.65$); and interaction between language and type ($F(8, 328) = 17.28$; $p<.01$; $MSe=25.87$). Post-hoc analysis (Tukey HSD, $p<.05$) revealed L2 speakers were less accurate than English native speakers in judging ungrammatical wh-extractions. Spanish speakers were less accurate than Turkish speakers too.

A subsequent two-way ANOVA assessed mean accuracy scores across four ungrammatical types, excluding that-trace violation where both L2 groups struggled. Results indicated comparable accuracy between native English speakers and Turkish L2 learners ($p=.806$). However, the Spanish group was significantly less accurate than both native English speakers ($p=.001$) and Turkish learners ($p=.004$). These results suggest Turkish learners, despite their wh-in-situ L1 background, were as accurate as natives in rejecting ungrammatical wh-extractions except for that-trace violation. In contrast, the Spanish group was less accurate than both groups on all five ungrammatical types. Pairwise comparisons (Bonferroni, $p<.05$) highlighted incorrect rejection of that-trace (TT) violations as the most prevalent error, followed by subject-island (SI) violation and complex NP island (CNPI) violation. Correct rejections were highest for relative clause island (RCI) violations and adjunct island (AI) violation, confirming that that-trace violation is the most challenging, while RCI violation is the most accurately rejected type.

Table 5. Mean RTs for five ungrammatical wh-extraction types

Structure	Spanish (n=24)	Turkish (n=30)	English (n=31)

	M	SD	M	SD	M	SD
AI (n=10)	4255	1078	3938	917	3142	933
CNPI (n=10)	4417	1168	4186	973	3130	884
RCI (n=10)	4387	1220	3980	1057	3084	920
SI (n=10)	4746	1223	4522	1185	3843	1145
TT (n=10)	5190	1245	4885	1084	3441	1155

AI (Adjunct Island), CNPI (Complex Noun Phrase Island), RCI (Relative Clause Island), SI (Subject Island), TT (*That*-trace)

To examine language group and type variations in RTs for ungrammatical types, a two-way ANOVA was conducted with language as the between-subjects factor and type as the repeated within-subjects factor. This revealed significant effects for language ($F(2, 76) = 14.80$; $p<.01$); type ($F(4, 304) = 35.03$; $p<.01$), and their interaction ($F(8, 304) = 3.98$; $p<.05$). Post-hoc analysis (Tukey HSD, $p<.05$) showed English native speakers were significantly faster than both L2 groups in rejecting ungrammatical wh-extractions, while L2 groups did not differ significantly. Pairwise comparisons (Bonferroni, $p<.05$) of ungrammatical types indicated longer RTs for wh-sentences with that-trace and subject-island violations, but not between these two types.

5.3 RTs results from the SPRT

In this section, due to space constraints, I will only present word-by-word reading times for subject and object extractions. This will illuminate where the difficulty lies in subject extraction from finite and non-finite clauses. Additionally, I will include word-by-word reading times for ungrammatical wh-extractions with that-trace violations, aiming to pinpoint the source of processing difficulty in the L2 groups.

5.3.1 Word-by-word reading times for object and subject extractions from finite clauses

In this study, note that while all groups tended to be quicker and more accurate in judging object extractions than subject extractions from finite clauses, the difference between these types was not statistically significant. Still, it is crucial to determine whether the locus of the subject gap triggers longer RTs than the object gap, as reported in Juffs (2005). Table 6a displays mean RTs for each word in sentences with subject (e.g., "Who did the police believe shot the editor in the street?") and object extractions (e.g., "Who did the police believe the lawyer shot in the street?") from finite clauses. Table 7a excludes mean RTs for the first and last words for clarity. Examples of subject and object extractions are numbered as in Table 6.

Table 6. Subject and object extractions from finite clauses

Types	1	2	3	4	5	6	7	8	9	10	11
		did	the	police	believe	shot	the	editor	in	the	street

SEFF	Who										
OEFF	Who	did	the	police	believe	the	lawyer	shot	in	the	street

Table 7. Word-by-word RTs for subject and object extraction from finite clauses in milliseconds (ms.)
SEFF: Subject extraction from finite clauses. OEFF: Object extraction from finite clauses

L1 Groups		Word 2	Word3	Word4	Word 5	Word 6	Word 7	Word 8	Word 9	Word 10
Spanish (n=21)										
SEFF	(M)	407	384	468	563	718	530	501	436	389
	(SD)	(118)	(107)	(179)	(251)	(381)	(146)	(148)	(86)	(80)
OEFF	(M)	419	400	470	525	502	636	585	513	397
	(SD)	(144)	(135)	(145)	(187)	(160)	(237)	(213)	(167)	(66)
Turkish (n=29)										
SEFF	(M)	391	385	433	482	572	496	478	444	364
	(SD)	(145)	(117)	(218)	(234)	(317)	(130)	(227)	(197)	(71)
OEFF	(M)	349	358	396	454	443	467	484	447	401
	(SD)	(91)	(98)	(127)	(153)	(114)	(197)	(194)	(153)	(70)
English (n=30)										
SEFF	(M)	385	389	420	442	465	433	445	423	414
	(SD)	(117)	(126)	(147)	(157)	(152)	(161)	(175)	(123)	(130)
OEFF	(M)	386	385	421	443	452	453	472	431	402
	(SD)	(119)	(122)	(182)	(114)	(158)	(152)	(156)	(120)	(108)

Table 7a's mean RTs reveal longer times for the matrix verb "believe" (Word 5) than the subject NP (Word 4) in both subject and object extractions. This suggests participants link the wh-filler with the matrix object trace, as in "Who did the police believe [____]?". Notably, RTs on the embedded verb "shot" (Word 6) in subject extractions increase markedly compared to the determiner "the" (Word 6) in object extractions. This indicates difficulty processing the finite verb in subject extractions, aligning with Juffs et al.'s findings. Visualized in Figures 1 and 2, these results affirm the finite verb's role in subject extraction difficulty.

Figure 1. Word-by-word RTs for subject extraction from finite clauses

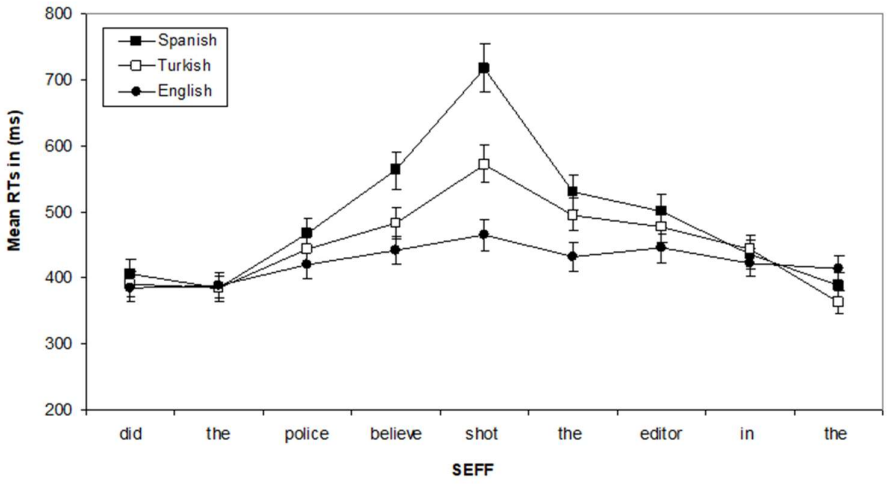
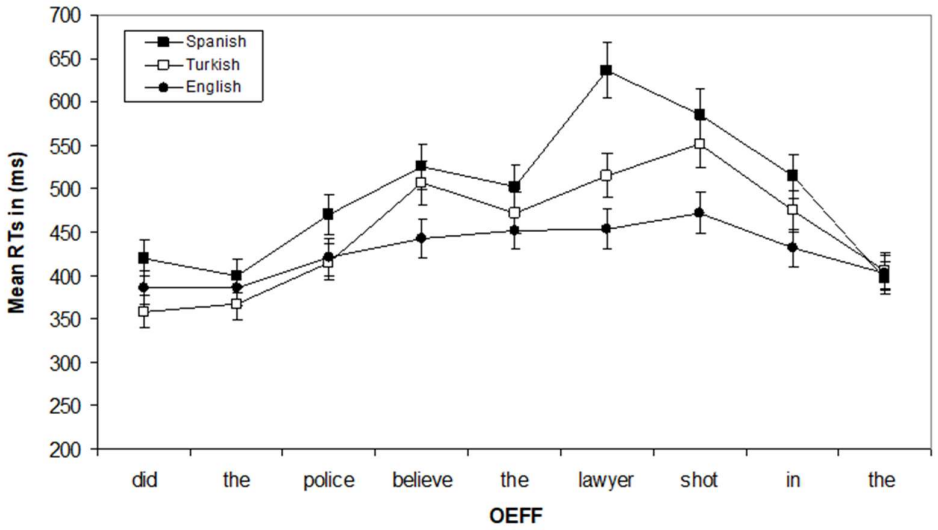


Figure 2. Word-by-word RTs for object extraction from finite clauses



A three-way repeated measures ANOVA (3x2x2) explored language group differences by type and region. Results showed a marginal language effect (F (2, 79) = 3.09; p=.051), significant main effects for type (F (1, 79) =5.37; p<.05) and region (F(1, 79) =6.69; p<.05), type by region interaction (F(1, 79) =19.54; p<.01), and a triple interaction (F(2, 79)=4.14; p>,05). Notably, Spanish learners were slower than English and Turkish learners for 'shot' (p=.039), while other groups were not significantly different.

In summary, both English native speakers and L2 groups shared a similar processing pattern, with longer RTs on the embedded verb 'shot' in subject extraction, indicating difficulty as per Juffs and Harrington (1995; 1996) and Juffs (2005). Additionally, all groups took longer on the main verb 'believe,' suggesting an attempt to link the wh-filler with its object trace or subcategorizer. Notably, Turkish and

English native speakers were significantly faster than Spanish speakers in processing Word 5 and Word 6 in subject and object extractions. The Spanish learners were also slower in processing subject extractions than object extractions. All in all, these results converge with the finding of Juffs and Harrington, 1995; 1996; and Juffs, 2005 in term of the locus of processing difficulty that subject extraction caused. However, they diverge from them with the finding that not only L2 learners but also the native speakers experienced the same processing difficulty at the critical region in subject extraction. More importantly, they show that both the Turkish and Spanish learners process the subject and object wh-extractions from finite clauses in the same way as the English native speakers.

5.3.2 Word-by-word reading times for subject and object extraction from nonfinite clauses

Recall that prior accuracy and RT analyses indicated the difficulty of subject extraction from nonfinite clauses, consistent with previous studies (Schachter, 1989; White and Juffs, 1998; Juffs and Harrington, 1995; 1996). According to Juffs and Harrington (1995), the challenge lies in the embedded object NP region. Their Generalized Theta Attachment (GTA) theory suggests that processing subject wh-phrases extracted from nonfinite clauses is more intricate than from finite clauses. The parser reanalyzes: first, from matrix object to embedded subject trace; second, from subject trace to PRO+ object trace; third, from PRO back to embedded subject trace. In contrast, object extraction's parsing involves reanalysis of structural position and theta/case assigner. Table 9 shows mean RTs and standard deviations for words in subject and object extractions from nonfinite clauses, excluding the first and last words, revealing the parsed regions.

Table 8. Regions for subject and object extractions from nonfinite clauses

Types	1	2	3	4	5	6	7	8	9	10	11
SEFNONF	Who	does	the	manager	expect	to	meet	the	job	applicants	today
OEFNONF	Who	does	the	manager	expect	to	meet	at	work	this	morning

Table 9. Word-by-word RTs for subject and object extraction from nonfinite clauses

L1 Groups	Word2	Word3	Word4	Word5	Word6	Word7	Word8	Word9	Word10
Spanish (n=21)									
SEFNONF (M)	425	367	490	593	437	478	538	596	465
(SD)	(146)	(83)	(186)	(221)	(96)	(153)	(213)	(244)	(153)
OEFNONF (M)	393	393	477	536	421	478	461	438	463
(SD)	(110)	(110)	(181)	(235)	(76)	(143)	(126)	(100)	(129)
Turkish (n=30)									
SEFNONF (M)	389	371	443	469	421	458	557	521	458
(SD)	(144)	(108)	(127)	(167)	(101)	(176)	(311)	(223)	(145)
OEFNONF (M)	372	354	399	440	421	429	437	385	405
(SD)	(99)	(82)	(107)	(135)	(95)	(126)	(147)	(85)	(110)
English (n=31)									

SEFNONF (M)	405	407	445	491	431	444	535	509	477
(SD)	(126)	(141)	(160)	(192)	(113)	(166)	(186)	(167)	(123)
OEFNONF (M)	378	383	410	443	413	419	433	434	433
(SD)	(120)	(124)	(142)	(151)	(121)	(142)	(136)	(136)	(117)

SEFNONF: Subject extraction from a nonfinite clause. OEFNONF: Object extraction from a nonfinite clause

Mean RTs on Table 9a reveal RT increases on the matrix verb 'expect' (Word 5), as participants initially linked wh-filler "who" with its object gap. RTs decreased at "to" (Word 6), but rose again at the embedded verb 'meet' (Word 7), indicating a reanalysis from matrix to embedded object NP trace, with a PRO+ embedded object NP trace. RTs on the determiner 'the' (Word 8) exceeded the verb 'meet' (Word 7), signifying a filled gap effect at the overt embedded object NP ('the job applicants'), prompting another reanalysis to integrate 'who' with its subject trace. These results align with Juffs and Harrington (1995), pointing to the challenge at the embedded object NP, inducing a filled-gap effect. Figure 3 and 4 present word level RTs for subject and object extractions in ms respectively. The figures did not display mean RTs for the first and the last words of these sentences.

Figure 3. Word-by-word reading times for subject extraction from nonfinite clauses

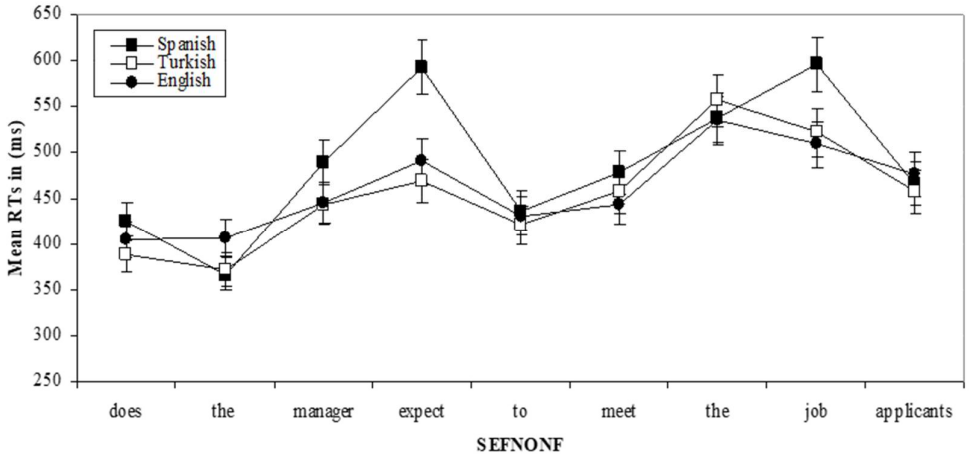
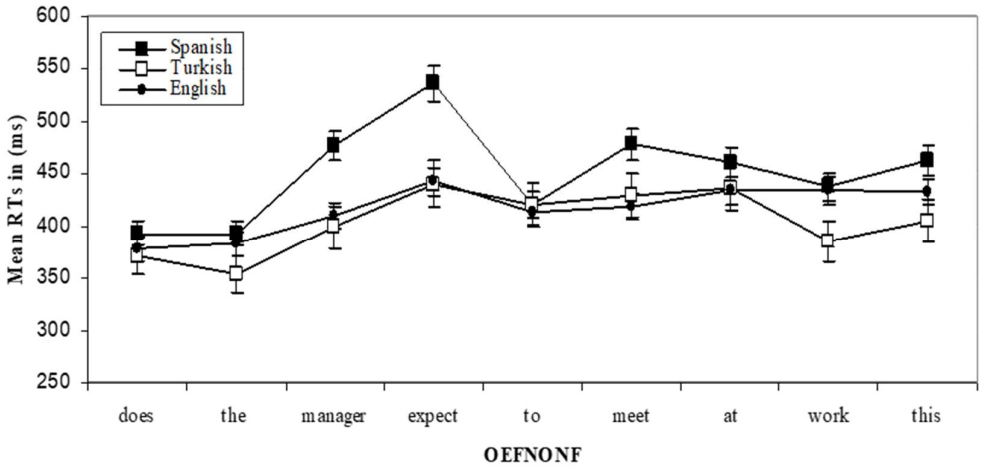


Figure 4. Word-by-word reading times for object extractions from nonfinite clauses



In Figure 3, spikes on 'expect', 'meet', and 'the' (embedded object NP) in subject extraction indicate extended RTs, implying two reanalyses occur (matrix object to PRO+ embedded object trace; PRO+ embedded object trace to embedded subject trace). The processing challenge in nonfinite subject extraction lies in the 'the' of the embedded object NP, with the longest RTs. Figure 4 depicts spikes on 'expect' in object extraction, like initial subject extraction parsing. Only Spanish speakers show increased RTs at 'meet'. Though native and L2 speakers share processing patterns, their reading speed differs.

A 3x2x2 ANOVA was performed to assess the significance of mean Reaction Times (RTs) for the main verb 'expect' (Word 5), the embedded verb 'meet' (Word 7), and the determiner 'the' (Word 8) in subject extractions. The analysis involved two extraction types (subject and object) and regions involving the specified words. The initial ANOVA focused on mean RTs for 'expect' (Word 5) and the preceding noun 'manager' (Word 4). The factors were language (English, Spanish, Turkish), type, and region. Results indicated a significant main effect for type and region, with language differences approaching significance.

Post hoc analysis of language groups demonstrated no significant difference in RTs for subject and object extractions. Type comparison revealed longer RTs for subject extraction in nonfinite clauses. Region comparison showed increased RTs for 'expect' (Word 5) compared to the preceding noun 'manager' (Word 4).

The second 3x2x2 ANOVA was conducted for RTs on the embedded verb ‘meet’ (Word 7) and the word ’to’ (Word 6) preceding it, with language (English, Spanish, and Turkish) as the between-subjects factors, type (subject and object extractions) and region (Word 6 and Word 7) as the repeated within-subject factors. The aim was to explore whether all groups spent longer RTs at the embedded verb to reanalyze the initial analysis. Results indicated only a significant main affect for region ($F(1, 79) = 9.42$; $p<.05$. A pairwise comparison of regions revealed that all participants spent significantly longer RTs on the embedded verb ‘meet’ than the words preceding it in subject and object extractions. This suggests that all groups reanalyzed the initial matrix object trace and posited a PRO + embedded object trace at this point in both subject and object extractions from finite clauses.

The third 3x2x2 ANOVA was conducted, with language (English, Spanish, and Turkish) as the between-subjects factors, type (subject and object extractions) and region (Word 7and Word 8) as the repeated within-subject factors. Results showed a significant main effect for type ($F(1, 78) = 30.01$; $p<.01$), a significant main effect for region ($F(1, 78) = 10.21$; $p<.01$) and a significant interaction between region and type ($F(1, 78) = 11.58$; $p<.05$). A pairwise comparison of types revealed that all groups spent longer RTs to Word 7 and Word 8 in subject extraction than those in object extraction. Also, a pairwise comparison of regions showed that Word 8 incurred longer RTs than Word 7. However, the significant interaction between region and type suggests differences between types in terms of RTs for Word 7 and Word 8.

A further analysis of type by region revealed that the difference in RTs for the embedded verb 'meet' (Word 7) and the following preposition 'at' (Word 8) in object extraction was not statistically significant ($F(1, 80) = .064$; $p>.05$). However, the difference in RTs for the embedded verb 'meet' (Word 7) and the determiner 'the' (Word 8) were statistically significant, which suggests that all groups experienced a filled-gap effect at the embedded object NP 'the job applicants' and revised the previous embedded object trace as the embedded subject trace.

In summary, the study's findings indicated similar reading patterns for native and L2 English speakers in processing subject and object extractions from nonfinite clauses. Participants initially associated a wh-filler with a matrix object trace at 'expect,' later revising this at the embedded verb 'meet' to posit an embedded object trace. Upon encountering the overt NP 'the job applicants,' they experienced a filled-gap effect, leading to the final reanalysis for an embedded subject trace. These results align with previous research, suggesting subject and object asymmetry in nonfinite clause wh-extractions. Ultimately, Turkish and Spanish L2 learners of English employed similar processing strategies as native English speakers for subject and object extractions from nonfinite clauses.

5.3.3 Word-by-word reading times for the ungrammatical wh-sentences with that- trace violation

Recall that, in English unlike object extractions, subjects are not allowed to be extracted across overt complementizer as in "*Who do the police believe that attacked the man last night?", because this violates the Empty Category Principle (ECP), which states that traces must be properly governed. Subject trace (t) in the [Spec, IP] position is not properly governed due to complementizer that, which prevents the trace in [Spec CP]. In order to move a subject from the subject position of an embedded clause, the complementizer must be absent. Table 11 shows RTs for each word of the ungrammatical subject extractions from finite clauses with that-trace, excluding mean RTs for the first and the last words of the sentences. The regions in this ungrammatical sentence type are given below:

Table 10. Regions in ungrammatical wh-extractions with *that*-trace violations

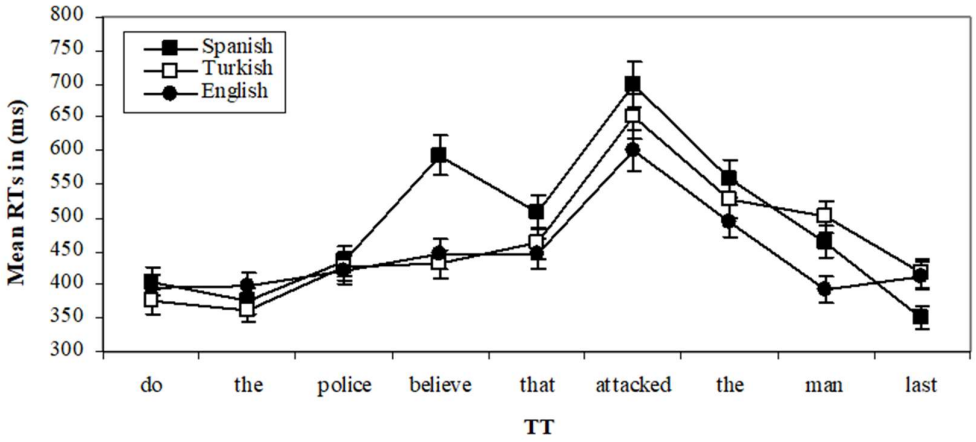
1	2	3	4	5	6	7	8	9	10	11
*Who	do	the	police	believe	that	attacked	the	man	last	night

Table 11. Mean RTs for subject extractions from finite clauses with that-trace violations

L1Groups		Word 2	Word3	Word4	Word 5	Word 6	Word7	Word8	Word9	Word 10
Spanish (n= 16)										
TT	(M)	405	376	435	593	508	699	669	464	351
	(SD)	(113)	(89)	(121)	(265)	(237)	(409)	(515)	(239)	(101)
Turkish (n=26)										
TT	(M)	376	363	427	431	462	651	527	501	417
	(SD)	(124)	(101)	(204)	210)	(155)	(345)	(232)	(311)	(127)
English (n=30)										
TT	(M)	395	398	421	445	446	601	495	394	413
	(SD)	(137)	(130)	(170)	(214)	(153)	(243)	(187)	(125)	(152)

Mean RTs in Table 11 reveal that only Spanish speakers had longer RTs for the main verb 'believe' (Word 6). Likely, English and Turkish speakers were quicker in wh-filler-gap formation and reanalysis. Table 10a also shows longer RTs for the embedded verb 'attacked' (Word 7) across all groups, especially the Spanish. This indicates a surprise at finding a finite verb after the complementizer, leading to a filled gap effect and reanalysis of the 'who' analysis. Figure 5 displays mean RTs for ungrammatical finite clause subject extraction (that-trace), excluding first and last word RTs.

Figure 5. Word-by-word RTs for the ungrammatical subject extractions from finite clauses with that-trace



In Figure 5, all three groups exhibit similar reading patterns for ungrammatical subject extractions with that-trace, peaking at the embedded verb 'attacked,' where the ungrammaticality lies. Notably, the Spanish group spends longer on the main verb 'believe.' Despite the parallel patterns, reading speeds differ. In the full sentence context, that-trace violations led to more errors and longer RTs in L2 groups, especially Spanish. Moving window analysis shows similar mean RTs: Spanish (M=2.95), Turkish (M=4.32), and English native speakers (M=7.23). To compare RTs for the main verb 'believe', a 3x2 ANOVA with language (English, Turkish, Spanish) and region (Words 4, 5) was performed. Results showed a significant region effect and language-region interaction. No significant difference existed among groups in overall RTs for Words 4 and 5. Pairwise analysis revealed 'believe' (Word 5) took longer RTs than 'police' (Word 4), notably for Spanish.

For embedded verb 'attacked', a 3x2 repeated measure ANOVA was conducted with region ('that' (Word 6), 'attacked' (Word 7)). A significant region effect emerged, while language effect or interaction was not observed. 'Attacked' incurred significantly longer RTs than 'that'.

Among language groups, Spanish differed, not showing RT discrepancy for region. This indicates lesser sensitivity to the that-trace constraint in L2 English than English natives or Turkish, showing local negative transfer from Spanish, which influences judgments of ungrammatical wh-extractions in full sentences and self-paced reading.

6. Discussion

We conducted an online grammaticality judgment task involving advanced Spanish and Turkish learners of English, along with native English speakers. The task encompassed long-distance grammatical subject and object extractions from finite and nonfinite clauses, as well as ungrammatical wh-extractions with island violations and that-trace violations. Our study aimed to address the following research questions.

1. Wh-Extraction Competence: Are L1 Spanish and Turkish speakers, who are learning English as a second language (L2), as proficient and fast as native English speakers in accepting grammatical long-distance wh-extractions and rejecting ungrammatical wh-extractions with island constraints and that-trace violations in English sentences?

2. L1 Background Influence: Is there a statistically significant distinction between the accuracy of L1 Spanish and L1 Turkish speakers in correctly accepting grammatical long-distance wh-extractions and accurately rejecting ungrammatical wh-extractions with island constraints and that-trace violations in English?

Our initial hypothesis is that if L2 speakers have access to universal principles like subjacency and the Empty Category Principle (ECP), their ability to evaluate the (un)grammaticality of long-distance wh-extractions in English will match that of L1 English speakers, regardless of their native language. Confirming this, results from accuracy assessments in the full sentence condition reveal overall accuracy exceeding 70% for all groups across five types of grammatical wh-extractions. English native speakers demonstrated significantly higher accuracy (88.8%) compared to Turkish (74.7%) and Spanish learners (71.8%).

Note that post-hoc analysis (Tukey HSD, $p<.01$) showed English speakers were more accurate than L2 learners, who did not differ significantly. However, per sentence type ANOVA revealed nuanced differences: English and Turkish L2 learners did not significantly differ in OEFFT and OEFNONF, but did in SEFF, SEFNONF, and OEFF. Spanish L2 learners were less accurate than natives on all types but similar to Turkish L2, except OEFNONF. Pairwise comparisons (Bonferroni, $p<.05$) supported subject-object asymmetry, which confirmed previous studies, and indicated SENONF as most difficult. SEFF was harder than OEFF. Object extraction from finite clauses with a complementizer was notably tougher than from finite and nonfinite clauses.

Additionally, L2 learners exhibited an accuracy hierarchy similar to native English speakers for judging grammatical wh-extractions. The most challenging was subject extraction from non-finite clauses, followed by object extraction from finite clauses with the complementizer "that," and subject extraction from finite clauses. Reaction time (RT) results from grammatical wh-extractions in the full sentence

condition support this hierarchy, where L2 learners' RTs are longest for subject extraction from non-finite clauses, followed by object extraction from finite clauses with the complementizer "that." This echoes prior research revealing L2 learners' heightened processing difficulty with subject extraction from non-finite clauses in grammatical wh-extractions (Juffs and Harrington, 1995; 1996; White and Juffs, 1998; Juffs, 2005).

RT results from grammatical wh-extractions in the full sentence condition also support this hierarchy in that although the L2 learners are slower than the native speakers, for both native and non-native groups, RTs for subject extraction from non-finite clauses incurs longest RTs among five types. This is followed by object extraction from finite clauses with complementizer “that” RTs from full the full sentence condition reveal subject extraction from non-finite clauses is the most difficult for all participants, especially L2 learners, while object extraction poses no issue. RT results reflect this pattern, with subject extraction taking the longest time. Notably, finite clauses do not show this difference, unlike Juffs (2005), but match White and Juffs (1998) and Juffs and Harrington (1995). Following Juffs and Harrington (1995), the subject-object asymmetry in non-finite clauses can be explained by Pritchett's (1992) 'Generalized Theta Attachment Theory.' This theory suggests that subject extraction involves multiple reanalyses, while object extraction requires less complex reanalysis, making subject extraction more demanding in non-finite clauses.

In terms of ungrammatical items, both Turkish and Spanish learners follow the pattern of native speakers in rejecting ungrammatical wh-extractions. However, the L2 learners' accuracy drops when judging extractions with that-trace violations. When considering RTs for various ungrammatical wh-extractions in the full sentence condition, wh-extractions with that-trace violations incur the longest RTs among the L2 groups, followed by wh-extractions with subject island violations. Overall, accuracy and RT scores suggest that L2 learners are as sensitive as native English speakers to most island constraints in L2 English.

Although there are differences among the groups, consistent accuracy profiles emerge. English speakers excel in object extraction, both finite and nonfinite, while Turkish and Spanish speakers demonstrate similarity to native speakers, revealing subject-object asymmetry in nonfinite and finite clauses. These findings suggest that regardless of their native language background, L2 speakers are knowledgeable about subjacency and ECP constraints on wh-extractions in L2 English. The accuracy gap between L1 and L2 speakers primarily stems from L2 learners' lower accuracy in subject extraction from non-finite clauses and wh-extractions with that-trace violations.

The RT results within the word-by-word moving window show a consistent RT pattern across the three groups. In grammatical wh-dependencies, an extended RT duration is observed at a specific region where the filler integrates with potential gaps. For instance, subject extractions from finite clauses lead to longer RTs for all groups at the embedded verb 'shot' following the main verb 'believe' (e.g., "Who do the police believe shot the editor in the street?"). This suggests a shared processing challenge for L2 learners in subject extraction from finite clauses. Similarly, all groups exhibit prolonged RTs at the embedded object NP 'the job applicants' following the embedded verb 'meet' in subject extraction from non-finite clauses (e.g., "Who does the manager expect to meet the job applicants today?"). This indicates a common filled-gap effect where an overt embedded object NP is present.

More specifically, self-paced reading reveals that subject extraction from non-finite clauses is the most challenging for all participants, especially L2 learners, while object extraction poses no issue. RT results

reflect this pattern, with subject extraction taking the longest time. That is, parsing steps are identical in both subject and object extractions from non-finite clauses until the embedded verb 'meet' (see Figure 3 and 4), yet these steps dramatically change just after the embedded verb. RTs on the determiner 'the' following the embedded verb 'meet' in subject extractions significantly increase, however, RTs on the preposition 'at' following the embedded verb in object extraction do not. Following a principle-based parsing account (e.g., Pritchett, 1991; 1992; Gibson, 1991; Weinberg, 1999; Gibson, Hickok and Schütze, 1999), which proposes an active gap creation, we assume that the parser initially posits a matrix object trace gap as soon it encounters the matrix verb 'expect' for the wh-filler 'who', as reflected in longer RTs at 'expect'. However, this analysis fails when the parser encounters 'to' and the embedded verb 'meet'. Thus, RTs start to increase. The parser revises the matrix object gap analysis at the embedded verb 'meet' and posits a PRO and an embedded object gap at 'meet', reflected in slow RTs at 'meet'. Upon encountering the determiner 'the' following the embedded verb 'meet', the parser experiences a severe filled gap effect because it expects an embedded object gap after the embedded verb 'meet' but not an overt NP like 'the job applicants' .

These results show that the locus of the difficulty in subject extractions for the native speakers and L2 learners is the embedded object NP. The difference between L2 learners and the native speakers in accuracy scores for this type can be attributed to the fact that for an L2 speakers recovering from a misanalysis during online processing is costlier. Thus, they are slower and less accurate than native speakers. This finding is consistent with the findings of Williams et al. (2001), which suggest that L2 learners may have more difficulty than native English speakers in recovering from a misanalysis which requires simultaneously changing theta roles and Cases

In ungrammatical wh-extractions, neither native English speakers nor L2 learners spent longer RTs at the potential gap sites inside the islands. This suggests that the two L2 groups are as sensitive as the native speakers in judging wh-extraction from adjunct island, relative clause island, and complex NP/DP island in the L2 English. However, in wh-sentences with that-trace violations, RTs results show that the locus of the difficulty for both the native speakers and L2 speakers (particularly the L2 learners) is the embedded verb 'attacked' following the complementizer that as in (*Who do the police believe that attacked the man in London?).

These results show that L2 learners are as successful as the native English speakers in accuracy in judging grammatical and ungrammatical wh-sentences, which suggests that they have abstract knowledge of overt-wh-movement and relevant constraints that restrict extraction out of islands. Morevoer, they reveal that L2 learners are basically similar to the native English speakers in the way they process grammatical and ungrammatical wh-extractions. More specifically, they use similar processing strategies to those of the native speakers in processing wh-dependencies in the L2 English even if they are slower in processing items they can judge correctly.

These findings are consistent with the findings of previous studies (i.e., White & Juffs, 1998; Juffs & Harrington, 1995; 1996) in that they provide evidence that adult L2 learners have the knowledge of overt-wh-movement to correctly accept long distance wh-extraction from finite and non-finite clauses, and of the constraints to successfully reject ungrammatical wh-extractions with island constraint violations. The findings also provide evidence for the claim that the difference observed between the native and non-native speakers in accuracy is due to a processing problem that L2 learners experience with certain types of wh-extractions rather than a deficit in L2 competence (grammar). This finding also suggests that the end-state L2 speakers are capable of achieving similar competence to native speakers

even if they may take longer to access that competence as observed by their slower processing speed (White & Juffs, 1998).

Regarding the second reserach questions, we investigate the potential impact of L1 background on the L2 judgment of (un)grammatical wh-extractions. We hypothesize that L1 Spanish speakers will exhibit higher proficiency than L1 Turkish speakers in correctly evaluating wh-extractions governed by subjacency. This presumption is rooted in the shared linguistic feature between Spanish and English—namely, overt wh-movement—coupled with their adherence to subjacency constraints. In contrast, Turkish belongs to the category of wh-in situ languages, allowing wh-movement through scrambling and deviating from the previously mentioned linguistic pattern. Furthermore, the above mentioned parallelism between native speakers and L2 groups in sentence processing patterns relates to the second question addressed in this study, namely the potential differences between the two L2 groups as well as the differences between the L2 groups and native-speakers. When we look at the overall results from accuracy responses to grammatical and ungrammatical wh-extractions in the full sentence condition, we see that L2 participants are not different in their judgments.

Results from the accuracy responses to grammatical and ungrammatical wh-questions demonstrate that Turkish learners are not significantly more accurate than the Spanish learners in overall accuracy in judging grammatical as well as ungrammatical sentences in full-sentence reading. RTs for grammatical and ungrammatical wh-extractions also display that Turkish learners are similar to the Spanish learners. The two L2 groups display the same accuracy order and RT scores in processing of grammatical and ungrammatical wh-extractions. In certain domains, the Turkish group is found to be more successful than the Spanish group. For example, the Turkish-speaking group is found to be more accurate and faster than the Spanish-speaking group in processing wh-extractions with that-trace violation.

In word-by-word reading, we see that the Turkish and Spanish L2 learners display a similar RT pattern to that of the native speakers. As we discussed above, the locus of the difficulty in subject extraction from finite and non-finite clauses is the same in the two groups. In ungrammatical items, the two L2 groups did not spend longer RTs at the critical region inside the islands, suggesting that like native speakers they are sensitive to island constraints. These results show that Turkish learners are as good as (in some cases better than) the Spanish learners in correctly judging grammatical and ungrammatical wh-dependencies in L2 English in real-time, and that they have a similar processing pattern (i.e., similar accuracy and RT pattern) for grammatical and ungrammatical wh-extractions.

Equally successful results observed in the Spanish and the Turkish groups might be interpreted in different ways. As a first account, we might say that the L1 has no particular role in L2 sentence processing. In other words, irrespective of the presence or absence of overt wh-movement in the L1, end-state L2 learners can have access to constraints on wh-movement in the L2. UG might be implicated in this successful acquisition. Alternatively, we can assume that UG is operative in the L2. Additionally, the presence of overt wh-movement via scrambling sensitizes the Turkish-speaking learners of English to wh-dependencies in the L2 English. Thus, overt movement via scrambling exhibits island constraints on movement in Turkish as in English. This explains why the Turkish group is as successful as the Spanish group. However, within this perspective, there is naturally no way to disentangle the UG role and the L1 role (Belikova & White, 2009).

The L2 groups are significantly worse than the native speakers at correctly rejecting wh-extractions with that-trace violation. The Spanish group is less accurate than the Turkish group on this type. We assume

that the low accuracy of the two L2 groups on this sentence type can be accounted for by negative L1 transfer from Spanish. In Spanish that-trace does not cause an ECP violation in subject extractions from embedded clauses. Moreover, the complementizer 'that' obligatorily precedes a subject trace in an embedded clause without violating the ECP. As a result, encountering a finite verb after the complementizer in the embedded clause as in (*Who do the police believe that attacked the man last night?) in L2 English does not surprise the Spanish speakers as much as the native English and the Turkish speakers. This effect can be observed in Spanish participants' faster RTs at the embedded verb. This suggests that the Spanish learners incorrectly accept ungrammatical wh-sentences with that-trace violation in the L2 English due to the L1 Spanish.

In sum, the findings of this study show that there is a subject and object asymmetry in wh-extractions from non-finite clauses, rather than from finite clauses. In line with the findings of Juffs and Harrington, (1995; 1996), they suggest that the locus of the difficulty in subject extraction from non-finite clauses is the overt embedded NP. Both the native speakers and L2 learners experience a filled-gap effect as soon as they encounter the embedded object NP, where they expect an embedded object NP trace. In addition, these results suggest that L2 learners process wh-dependencies in the same way as the native speakers, using similar processing strategies. Although there were differences between native and non-native speakers in terms of RT scores, it is important to note that the patterns of processing wh-sentences were the same in native and non-native groups (Williams, 2006; Dussias & Cramer Scaltz, 2007). Thus these findings diverge from the Shallow Processing Hypothesis (e.g., Clahsen & Felser, 2006; 2018; Felser & Roberts, 2007; Marinis et al., 2005), which argues for a fundamental difference between native and non-native structure-building processes during online L2 sentence comprehension.

7. Conclusion

This study examined Spanish and Turkish learners' processing of grammatical and ungrammatical wh-extractions in L2 English using Online Grammaticality Judgment Tasks (OGJT) under full sentence and self-paced reading conditions. The main goal was to determine whether these learners process wh-dependencies similarly to native English speakers and whether L1 influences the online processing of these constructions. The impact of L1 was explored, considering that Turkish exhibits overt wh-movement via scrambling and Spanish resembles English in overt movement. However, both languages share island constraints on movement. Additionally, the study investigated subject-object asymmetry in processing wh-extractions from finite and non-finite clauses.

Results in both conditions highlighted differences between L2 learners and native speakers in accuracy and response times (RTs) for grammatical and ungrammatical wh-extractions. L2 learners showed lower accuracy, particularly with subject extractions from non-finite clauses in grammatical wh-extractions and that-trace violations in ungrammatical wh-extractions. An observed subject-object asymmetry in all groups' processing of non-finite clauses suggested a similar processing pattern for native and non-native data. Despite processing speed differences, L2 learners exhibited sensitivity to island constraints, aligning with native speakers.

Regarding L1 influence, no significant disparity was found between Spanish and Turkish groups. The Turkish learners' success in correctly accepting grammatical wh-extractions and rejecting ungrammatical ones could be attributed to overt movement via scrambling and universal grammar (UG) availability in end-state L2 acquisition. However, Spanish participants demonstrated varying L1

influence, particularly accepting ungrammatical wh-extractions with that-trace violations more than other groups.

To conclude, this study sheds light on Spanish and Turkish learners' processing of wh-extractions in L2 English. While some differences were observed in comparison to native speakers, both groups exhibited sensitivity to island constraints, indicating similar processing patterns. The influence of L1 varied, with Turkish learners demonstrating more success in some aspects.

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