Relative clauses in child heritage speakers of Turkish in the United States

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How does complex syntax develop in heritage language children? This study investigates child Turkish heritage speakers' comprehension and production of relative clauses (RCs) in Turkish and in English. RCs vary on their syntactic functions (subject, object) and show asymmetric patterns of acquisition and processing, which have been explained by linear distance, structural distance and input factors. Thirty-two child Turkish HS (ages 6–15) and 48 monolingual Turkish children (ages 3–15) completed a picture-sentence matching (comprehension) task and a sentence repetition (production) task in Turkish. The Turkish HS were tested on the RC comprehension and production tasks in English as well. The results indicated that the child HS showed (i) better performance in English than in Turkish with increasing age, (ii) better comprehension than production of Turkish RCs, (iii) replacement of complex RCs with simple juxtaposition in Turkish, and (iv) a subject advantage in comprehension. We take these findings to suggest that Turkish RCs do not fully develop in child HS of Turkish in the U.S., although the strength of this explanation must be corroborated by a study of child and adult HS. Overall, the findings are most compatible with the structural distance account and other factors that may affect production.

Keywords: heritage language acquisition, child heritage speakers, Turkish, relative clauses

1. Introduction

Heritage speakers (HS) are early bilinguals who acquire a minority language in a bilingual setting where the socio-political majority language is spoken by the community (Montrul, 2016; Valdés, 1995). Since the majority language is different from their family language, HS may be exposed to less or altered input in the heritage language compared to a monolingually-raised child; once the majority lan-

guage is introduced, acquisition of the heritage language starts to lag behind and certain aspects may not fully develop (Cuza & Miller, 2015; Jia & Paradis, 2016; Montrul, 2002, 2004; Polinsky, 1997; Silva-Corvalán, 1994). Alternatively, HS may show indications of first language (L1) attrition in later years, meaning that deterioration in some aspects of their heritage language (HL) grammar may occur even if the HL grammar has a chance to develop initially (Montrul, 2016; Polinksy, 2018).

A syntactic domain that has been found to be vulnerable in HL grammars is long-distance dependencies, particularly relative clauses (RCs) (Montrul, 2008; O'Grady, Lee & Choo, 2001). RCs are complex sentential structures involving a relationship between the gap and the head at a distance, which may lead to processing difficulties. O'Grady et al. (2001) tested knowledge of this intricate syntactic phenomenon in adult HS and second language (L2) learners of Korean. The results of a picture selection task showed that the HS did not differ significantly from the L2 learners: Both showed better performance in subject relative clauses (SRCs) than in object relative clauses (ORCs), and often interpreted ORCs as SRCs. Based on these findings, O'Grady et al. concluded that the HS show no age of acquisition advantage over the L2 group in this domain. Adult Turkish HS in Europe, on the other hand, have long been observed to show a tendency towards "the replacement of synthetic means of clause linkage and subordination (or at least their decreasing usage), especially of RCs, by simple juxtaposition [or more analytical forms]" (Backus, 2004, p.715). For instance, adult Turkish HS have been reported to avoid forming complex complement clauses (e.g., nominalization with -*DIK*) such as in (1a) and use simpler and more analytical structures such as in (1b). Having observed that RCs are acquired rather late by monolingual Turkish children (at about age 6) as well, Slobin (1977) proposed that "forms which are late to be acquired by children [such as RCs] are presumably also relatively difficult for adults to process and should be especially vulnerable to change" (as cited in Bayram, 2013, p.38).

(1) a. Complex structure
         Oyuncak-lar-ı götür-düğ-ün   için kız-dı.
         toys-PL-ACC   bring-NMLZ.POSS.2SG for annoy.PST.3SG
         'She got annoyed (with you) for bringing the toys.'
     b. Simplified structure
         Oyuncak-lar-ı götür-dün   o-nun   için kız-dı.
         toys-PL-ACC   bring-PST.2SG that-GEN for annoy.PST.3SG
         'You brought the toys, that's why she got annoyed.'

To see whether the variability that adult HS show in their knowledge of relativization can be attributed to incomplete acquisition or to L1 attrition, Polinsky

(2011) compared child HS to adult HS of Russian and to age-matched monolingual Russian speakers. The results of a picture selection task revealed that the child HS (M_{age} =7;5) patterned with their monolingual counterparts, while the adult HS differed from the monolingual adults and performed better in SRCs than in ORCs, suggesting L1 attrition in this group. Similarly, Jia and Paradis (2016) tested comprehension and production of RCs by child HS of Mandarin. Fifteen Mandarin monolingual children (ages 6;8–7;4) and 29 child HS of Mandarin (ages 6;0–9;8) completed a comprehension task and a production task. The results revealed that the child HS were comparable to their monolingual counterparts in comprehending Mandarin RCs, whereas their production abilities developed over time, suggesting a protracted developmental pattern in production of RCs in this group. Based on data from 20 child HS of Cantonese (ages 4;10–11;11) living in Australia, Kidd, Chan and Chiu (2015), however, reported that the child HS showed overall more variable performance in comprehending Cantonese RCs than Cantonese monolingual children (ages 5;2–9;2). The results also pointed to a subject-object asymmetry in the child HS, while the monolingual children performed at ceiling in their comprehension of SRCs and ORCs.

Overall, research on the acquisition of RCs by child HS of various languages has been inconclusive. While some suggest monolingual-like comprehension as opposed to non-monolingual-like production, others have shown that child HS also differ from their monolingual counterparts in comprehending RCs in their heritage language, particularly ORCs. The small number of studies investigating the production of Turkish RCs by child Turkish HS in Europe suggests that they show more variable performance compared to their monolingual counterparts and that similar to adult HS, they prefer using simple juxtaposition instead of using RCs (Backus, 2004; Bayram, 2013). However, these studies only report on production data and lack a formal account to explain the variable performance that child HS show (cf. Bayram, 2013; Bohnaker & Karakoc, 2020). Therefore, the goal of this study is to present a more comprehensive analysis of knowledge of RCs in child Turkish HS (ages 6–15) living in the U.S. and to account for the variability that these children show with respect to comprehension and production of RCs in Turkish. We consider the predictions of two structure-based accounts, namely the Linear Distance Hypothesis (LDH) and the Structural Distance Hypothesis (SDH), as well as O'Grady's (2011) emergentist account. These three accounts predict a SRC advantage for RCs in English, whereas their predictions for Turkish RCs vary due to the structural properties of Turkish, an SOV language with agglutinative morphology. Our results will show that the SDH captures the trends in RC comprehension whereas other factors may be at play in the production of RCs by the Turkish HS. The following sections present the syntactic background of RCs in English and in Turkish followed by the specific predictions of the three

formal accounts for Turkish and English, a background on the acquisition of RCs and the details of the study.
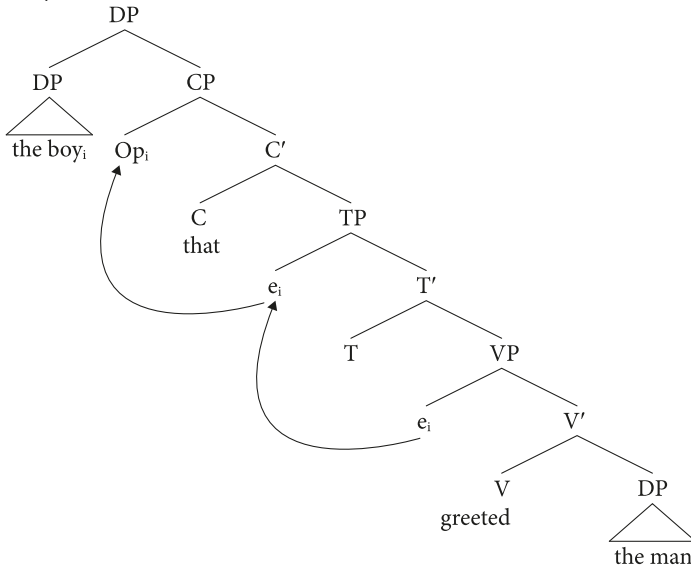
2.   Relative clauses in English and Turkish

There is a long-standing consensus that SRCs such as in (2a) are easier to comprehend and produce than direct ORCs such as in (2b) in English (Diessel & Tomasello, 2005; Gennari & MacDonald, 2008 among others).
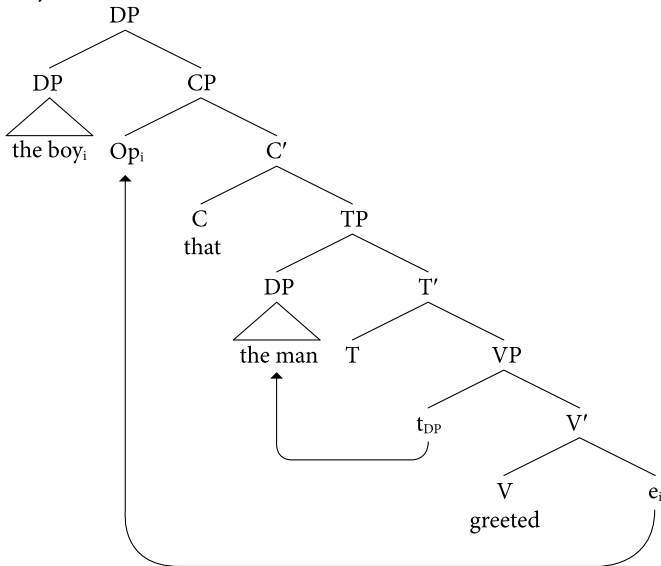
(2) a. Subject relative clause (SRC)
          the boy [that __ greeted the man]
     b. Object relative clause (ORC)
          the boy [that the man greeted __]

The contrasts in the difficulty of SRCs and ORCs are often attributed to the length of filler-gap dependencies. In (2), the modified nominal phrase (NP) *the boy* and the gap position, at which it would normally appear in a simple declarative sentence, are dependent; the former relies on its association with the latter for its interpretation. So far, two major accounts have been proposed concerning how the distance between a filler and its gap is measured: The Linear Distance Hypothesis (LDH) and the Structural Distance Hypothesis (SDH). According to the LDH, a memory-based account, distance is measured in terms of intervening discourse referents (e.g., verbs and NPs) between the filler and the gap, and the higher number of intervening elements requires more working memory resources to process as they need to be stored in memory before the gap is reached (Gibson, 1998; O'Grady, 2011). In (2a), the only intervening element is the complementizer *that* which does not introduce a new discourse referent, while there are two new elements with discourse referents in the ORC in (2b). Therefore, the LDH predicts that ORCs, such as in (2b), are more costly to process than SRCs in (2a) in English. The SDH, on the other hand, characterizes the distance between a filler and a gap in terms of abstract hierarchical representations that underlie the surface variation found across languages (Chomsky, 1981; Kwon, Lee, Gordon, Kluender & Polinsky, 2010, p.39; O'Grady, 1997; O'Grady, Lee & Choo, 2003). According to this hypothesis, SRCs are easier to process than ORCs in English since objects are embedded deeper than subjects in the phrase structure, as illustrated in (3), following an operator movement analysis (e.g., Baker, 2001; Keenan & Hawkins, 1987; O'Grady, 1997).

(3) a. Subject relative clause (SRC)

```
                        DP
              ┌──────────┴──────────┐
            DP                      CP
          △                ┌────────┴────────┐
       the boyᵢ          Opᵢ ←─────          C′
                                   │   ┌──────┴──────┐
                                   │   C            TP
                                   │  that    ┌──────┴──────┐
                                   │         eᵢ            T′
                                   │              ┌─────────┴─────────┐
                                   └──────────    T                  VP
                                              │        ┌──────────────┴──────────────┐
                                              └──────  eᵢ                            V′
                                                                              ┌───────┴───────┐
                                                                              V              DP
                                                                           greeted          △
                                                                                          the man
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  b. Object relative clause (ORC)

```
                        DP
              ┌──────────┴──────────┐
            DP                      CP
          △                ┌────────┴────────┐
       the boyᵢ          Opᵢ ←─────          C′
                                   │   ┌──────┴──────┐
                                   │   C            TP
                                   │  that    ┌──────┴──────┐
                                   │         DP            T′
                                   │        △        ┌──────┴──────┐
                                   │    the man  T            VP
                                   │        ↑          ┌──────────┴──────────┐
                                   │        └───────  t_DP                  V′
                                   │                              ┌──────────┴──────────┐
                                   │                              V                    eᵢ
                                   │                           greeted                  │
                                   └───────────────────────────────────────────────────┘
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Within an emergentist approach, O'Grady (2011) proposes that linear distance (calculated in terms of intervening new discourse referents), prominence (the salience of the relativized element within the RC) and frequency are three main factors that determine the relative ease of processing and possibly of production of RCs. Accordingly, SRCs are less costly to process than ORCs in English due to the

higher frequency of SRCs (with animate heads as opposed to ORCs with animate heads), more prominent nature of subjects than objects in RCs, and the shorter distance in SRCs than in ORCs.
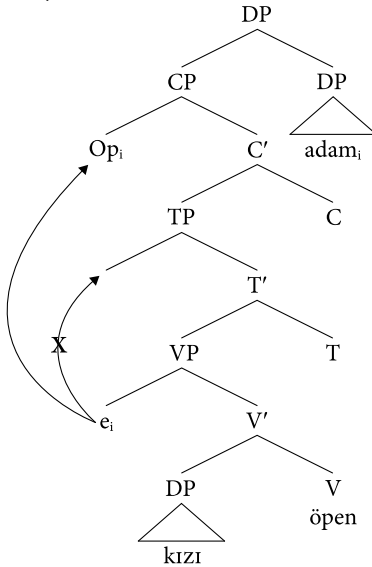
In Turkish, RCs are different from RCs in English in several important ways. As an agglutinative SOV language with relatively flexible word order, Turkish has prenominal RCs, and there is no overt relative pronoun. Instead, the embedded verb is marked with either the suffix *-(y)An* or *-DIK* [1] depending on whether the subject or the direct object is relativized, respectively. SRCs (in OVS order) do not require overt agreement morphology, while in ORCs (in SVO order), the subject is marked with the genitive suffix and the participle is followed by the possessive suffix that marks agreement with the subject, as in (4).

(4) a.   Subject relative clause (SRC)
         [__ kız-ı   öp-en] adam
             girl-ACC kiss-SRC man
         'The man that is kissing/kissed the girl.'
     b.   Object relative clause (ORC)
         [kız-ın __ öp-tüğ-ü]   adam
         girl-GEN   kiss-ORC-POSS.3SG man
         'The man that the girl is kissing/kissed.'

There have been different views regarding the choice between the *-(y)An* and the *-DIK* strategies. Recently, Öztürk (2008, p. 247) proposed that [Spec, TP] is a critical freezing position for movement in Turkish, following Rizzi and Shlonsky (2005), and that strong agreement occurs when the subject NP moves into [Spec, TP] and the *-DIK* strategy is required; *-(y)An* is used when no subject raises into [Spec, TP], as displayed in (5).

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1. *-DIK* suffix in Turkish can also mark subordination and adverbial clauses (Göksel & Kerslake, 2005). Similar to *-(y)AN*, the *-DIK* morpheme can refer to past or present depending on the context when used in RCs, and it appears as '-tüğ' in (4b) due to phonological reasons.

(5) a. Subject relative clause (SRC)

```
                              DP
                     ┌────────┴────────┐
                    CP                 DP
               ┌────┴────┐            ╱‾‾╲
             Op_i       C′          adam_i
                    ┌───┴───┐
                   TP       C
               ┌───┴────┐
                       T′
                   ┌───┴───┐
            X     VP       T
               ┌──┴──┐
             e_i    V′
                ┌───┴───┐
               DP       V
              ╱‾‾╲     öpen
             kızı
```

b. Object relative clause (ORC)

```
                              DP
                     ┌────────┴────────┐
                    CP                 DP
               ┌────┴────┐            ╱‾‾╲
             Op_i       C′          adam_i
                    ┌───┴───┐
                   TP       C
              ┌─────┴─────┐
             DP          T′
            ╱‾‾╲      ┌───┴───┐
           kızın     VP       T
                 ┌────┴────┐
           t_DP         V′
                    ┌───┴───┐
                  e_i       V
                          öptüğü
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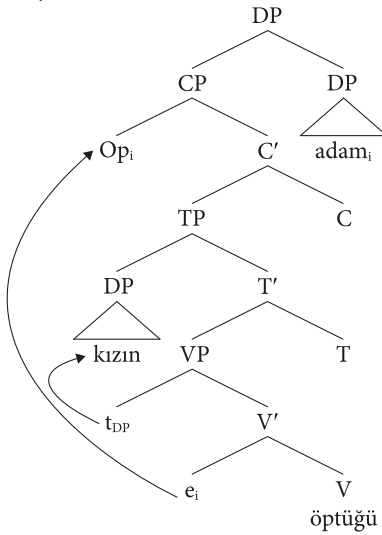
As can be seen from (3) and (5) above, Turkish and English RCs have similar hier-archical structures despite their surface differences (Meral, 2010; Öztürk, 2008). As in English, the object gap position is more deeply embedded than the subject gap position in Turkish. Therefore, the SDH and the LDH that make similar pre-dictions for RCs in English (i.e., a SRC advantage) would yield different predic-tions for RCs in Turkish. Accordingly, the LDH would predict easier processing of

ORCs than SRCs in Turkish since the gap and the filler are more distant in SRCs than ORCs, as shown in (6). However, the SDH would predict a SRC advantage in Turkish as objects are embedded deeper than subjects in the phrase structure, as in English. According to O'Grady's emergentist approach, however, not only distance but also prominence and the frequency of each type of RC are important contributors to processing and possibly production cost of RCs. SRCs enjoy a prominence and frequency advantage (Slobin, 1986), whereas ORCs enjoy a distance advantage in Turkish, as shown in (6) (repeated in (4) above). Therefore, in contrast to English, which shows a strong SRC advantage, RCs in Turkish are predicted to show at best a weak SRC advantage (due to prominence) or no advantage at all (O'Grady et al., 2011, p.32). A summary of predictions that the three views make for RCs in English and Turkish are presented in Table 1.

(6)   a.   Subject relative clause (SRC)

more frequent

more prominent

[__ kızı öpen] adam 'The man who is kissing/kissed the girl'

2 (more distant)

b.   Object relative clause (ORC)

less frequent

less prominent

[kızın __ öptüğü] adam 'The man who the girl is kissing/kissed'

1 (less distant)
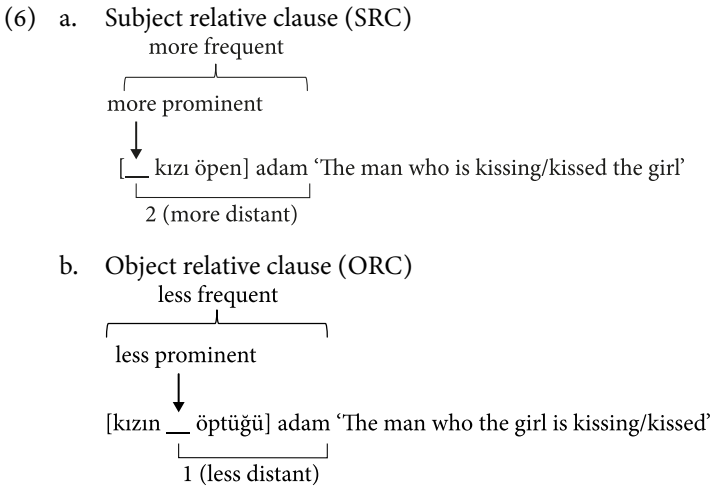
Table 1. Predictions of the LDH, the SDH and the emergentist approach (O'Grady, 2011) for processing and production cost of RCs in English and Turkish

	The LDH	The SDH	Emergentist approach
English	SRC advantage	SRC advantage	SRC advantage
	The gap and the filler are closer in SRCs	*SRC is less embedded in the hierarchical syntactic structure*	*Prominence, frequency and linear distance favor SRC*
Turkish	ORC advantage	SRC advantage	No SRC advantage
	The gap and the filler are closer in ORCs	*SRC is less embedded in the hierarchical syntactic structure*	*Prominence and frequency favor SRC; linear distance favors ORC*

This study investigates the comprehension and production of Turkish and English RCs in Turkish child HS as compared to monolingual Turkish children, who were tested in Turkish only. Although the SDH makes the same predictions for Turkish and English, the predictions of the LDH and the emergentist approach differ for the two languages (see Table 1 above). Therefore, if child HS show an ORC advantage or no advantage at all in Turkish in contrast to a SRC advantage in English, this would yield support for the LDH and the emergentist approach, respectively, but not for the SDH. Before the present study is introduced, a brief review of previous research on the acquisition of RCs in Turkish is given in the following section.

3.   Acquisition of RCs in Turkish

Research on the first language acquisition of RCs in Turkish has revealed that RCs are a late accomplishment and that adult-like acquisition of RCs does not occur until age 6 (Özcan, 1997; Slobin, 1986). There is also converging evidence that Turkish-speaking children, like adults, find SRCs easier to comprehend and produce than ORCs (Ekmekçi, 1990; Hermon, Öztürk & Kornfilt, 2007; Özge, Marinis & Zeyrek, 2009, 2010, 2015), which is consistent with the SDH account.

Slobin (1986) was among the first to investigate the acquisition of RCs in Turkish. He examined the speech of 57 English-speaking and 57 Turkish-speaking children aged between 2 and 4;8. The results revealed that Turkish-speaking adults and children produced less RCs overall and showed a strong SRC preference as compared to their English-speaking counterparts. Based on these findings, Slobin concluded that the mastery of RCs does not occur until after the age of 4;8 in Turkish-speaking children in contrast to English-speaking children who show rather early mastery of RCs.

More recently, Özge, Marinis and Zeyrek (2009, 2010) investigated the comprehension and production of Turkish RCs. Thirty-six Turkish-speaking children (ages 5–8) completed an oral elicitation task and a picture sentence matching task. In the production task, the children and the researcher had picture cards of animals with and without accessories, respectively, and the task of the child was to help the researcher identify the correct animal in her own card by describing which animal was wearing which accessory using RCs. On the other hand, in the comprehension task, the children were presented with pictures depicting three animals involved in an action and were asked to match the sentence they heard with the correct animal. The results showed that the children were more accurate in comprehending and producing SRCs than ORCs. The error analysis of the production data further revealed four major types of errors, namely avoidance

strategies, RC-type reversal errors, non-pragmatic responses and ungrammatical errors. However, the most common error type was avoidance strategies since the children often preferred structurally less complex structures instead of using RCs, particularly ORCs. Similarly, Kahyalar (2020) compared the knowledge of SRCs and ORCs in 40 monolingual Turkish-speaking children (ages 4;6–5;11) using a picture-selection task and found that SRCs were easier to comprehend than ORCs in this group and that the knowledge of ORCs developed more slowly as compared to SRCs, suggesting a subject-object asymmetry, which is again consistent with the SDH account.

Research on heritage language acquisition of RCs in Turkish children is scarce, and the limited amount of data comes from Turkish immigrants in Europe. Like adult HS of Turkish, child HS of Turkish in the Netherlands (Aarssen, 1996), in the UK (Bayraktaroglu, 1999), in Germany (Bayram, 2013; Boeschoten, 1990; Pfaff, 1991, 1994; Treffers-Daller, Özsoy & van Hout, 2007) and in France (Akinci, Jisa & Kern, 2001) show a tendency towards using simple declarative sentences instead of complex RCs (Backus, 2004). Based on these observations, Pfaff (1991) noted that "[t]he complex syntax required for embedded sentential modification is clearly late in appearing in the second-generation [Turkish] immigrant children, and for some, it may be entirely lacking" (p. 124).

Bayram (2013) investigated the knowledge of various morphosyntactic phenomena including RCs in Turkish within Processability Theory (Pienemann, 2005). Twenty-four child HS of Turkish residing in Germany (ages 10–16) completed four oral production tasks. The findings revealed that the basic nominal and verbal morphology is acquired earlier than RCs, which are acquired significantly late (i.e., at Stage 5). Bayram concluded that the child HS of Turkish in Germany differ from monolingual Turkish children particularly in their knowledge of later acquired more complex syntactic phenomena such as RCs (Bayram & Wright, 2018).

More recently, Bohnaker and Karakoc (2020) investigated the production abilities of child HS of Turkish in Sweden (ages 4–7) in a range of subordinate constructions, including RCs. The findings of an oral narrative task revealed that Turkish-Swedish bilinguals rarely produced RCs and preferred juxtaposed finite clauses instead (cf. Backus, 2004). They also showed the subject-object asymmetry found in the L1 acquisition literature on Turkish RCs (Özge et al., 2010) and in line with the predictions of the SDH account. However, unlike the monolingual children, the child HS did not perform better with increasing age, showing no further development.

In sum, RCs in Turkish are mastered rather late and show a developmental pattern in monolingual Turkish children. Unlike monolinguals, child Turkish HS in Europe produce RCs more rarely and prefer using simple juxtaposition instead.

They also show no development in the production of RCs. Similar to monolinguals, however, child HS show a subject-object asymmetry. Therefore, the predictions of the SDH seem to hold for the production of Turkish RCs by child HS in Europe. Nevertheless, there is need for more systematic research that investigates not only production but also comprehension of RCs by child Turkish HS. This study contributes to this goal by presenting comprehension and production data from child HS in the U.S. If child HS show an ORC advantage or no advantage at all in producing and comprehending RCs in Turkish as opposed to a SRC advantage in English, this would yield support for the LDH and the emergentist approach, respectively. However, a SRC advantage in both languages is expected according to the SDH.

4.   The study

The purpose of the present study is to investigate the extent to which child Turkish HS (second-generation immigrants) residing in the U.S. differ from monolingual Turkish-speaking children in their comprehension and production of RCs in Turkish using a picture-sentence matching task (PSMT) and a sentence repetition task (SrepT). By doing so, this study addresses the following research questions:

1. Do child HS of Turkish perform differently than monolingual Turkish children in their *comprehension* and/or *production* of RCs in Turkish?
2. Do child HS of Turkish show an asymmetry between SRCs and ORCs in Turkish and/or in English? If so, in which one do they perform better?
3. Does age and experience with the language play a role in the child HS' comprehension and production abilities?

Based on previous research, child HS are expected to show lower accuracy rates in producing RCs in Turkish than their monolingual counterparts (Backus, 2004). Regarding comprehension, previous studies on RCs in other heritage languages have reported monolingual-like performance (Jia & Paradis, 2016; Polinsky, 2011), whereas others have shown that child HS have weaker comprehension abilities (Kidd et al., 2015). Therefore, if child HS show non-target-like comprehension of RCs in the present study, it may suggest that they had not fully acquired Turkish RCs at the time of testing. However, if their comprehension abilities are target-like, it might suggest typical acquisition of RCs. Regarding the second research question, three predictions are made:

i.   The SDH predicts higher accuracy on SRCs than in ORCs in comprehension and production in Turkish and in English.

ii. The LDH predicts higher accuracy on ORCs than SRCs in Turkish in contrast to a SRC advantage in English in both comprehension and production.

iii. The emergentist approach predicts no difference or at best a small SRC advantage in the comprehension and production of SRCs and ORCs in Turkish, whereas a SRC advantage is expected in English.

As to the third research question, if the heritage language, being the weaker language, falls behind in development or does not develop further, then child HS are expected to show no increase in accuracy over time in comprehending and producing RCs in Turkish as opposed to a developmental increase in English RCs (Bohnaker & Karakoc, 2020).

5.   Method

5.1   Participants

Thirty-two child HS of Turkish and 48 monolingual Turkish children participated in this study. All the HS were second-generation Turkish immigrants who were born in the U.S. and were exposed to Turkish at birth, while their first exposure to English ranged between birth and age 5. Both parents of 27 child HS were native speakers of Turkish, while the rest had a Turkish-speaking parent from a different nationality (e.g., Spanish, American and Jordanian). Twenty-four out of 32 child HS also had at least one sibling.

The parents were asked to complete the language background questionnaire LEAP-Q (Marian, Blumenfeld & Kaushanskaya, 2007). The questionnaire elicited information about the language(s) used at home and in other contexts, age of first exposure to Turkish and English, and parental ratings for proficiency in both languages on a 10-point Likert scale,[2] among other questions. The parental ratings of the child HS' listening, speaking and reading skills in English were overall higher than in Turkish, as presented in Table 2. The monolingual children's group, who were matched with the HS on socio-economic-status (SES), also included younger children (3- to 6-year-olds) because we wanted to establish when in childhood Turkish children reach adult-like competence of RCs, as measured by the tasks used in this study.

Additionally, participants performed the Hawai'i Assessment of Language Access (HALA) tests in English and in Turkish separately to establish their degree of language dominance (O'Grady, Schaffer, Perla, Lee & Wieting, 2009). Partic-

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2. 0 = none, 1 = very low, 2 = low, 3 = fair, 4 = slightly adequate, 5 = adequate, 6 = slightly more than adequate, 7 = good, 8 = very good, 9 = excellent, 10 = perfect

ipants were shown a total of 110 pictures accompanied by a beeping sound, and each picture appeared on the screen at a predetermined rate. The participants were then prompted to say or describe the object in the picture as quickly as possible. The mean accuracy rates of the monolingual group ($M=71.8$, $SD=.6$, range $=28–95$) were significantly higher than the child HS group's ($M=48.3$, $SD=.8$, range $=3–87$) in Turkish ($ß=1.52$, $SE=.23$, $z=6.54$, $p<.001$). In addition, the child HS performed significantly better in English ($M=82.3$, $SD=.7$, range $=53–99$) than in Turkish ($ß=1.92$, $SE=.06$, $z=30.3$, $p<.001$), as also displayed in Figure 1. However, both groups showed an increase in their performance in Turkish as they grew older. Child HS also performed better in English with increasing age.

Table 2. Basic information about monolingual Turkish children and child HS of Turkish

	Groups					
	Monolingual Turkish			**Turkish heritage speakers**		
	Mean	*Range*	*SD*	*Mean*	*Range*	*SD*
Age (Years)	9.1	3–15	3.4	9.9	6–15	2.8
AoA English	___	___	___	1.7	0–5	1.9
AoA Turkish	at birth			at birth		
English listening	___	___	___	9.3	7–10	.9
English reading	___	___	___	8.6	4–10	2.1
English speaking	___	___	___	9.3	7–10	1
Turkish listening	9.5	8–10	.3	7.7	3–10	1.9
Turkish reading	7.5	0–10	3.5	4.2	0–10	2.9
Turkish speaking	9.7	9–10	.4	6.5	1–10	2.7

Note. AoA = Age of acquisition; SD = Standard deviation

5.2   Tasks

The study included two experimental tasks: a picture sentence matching task (PSMT) and a sentence repetition (Srep) task (see Supplementary Materials for a full list of items in the PSMT). The child HS were tested in both Turkish and English with one-day interval between the two sessions lasting approximately 1 hour in total. Half of the participants were tested in English on the first day, while the other half were first tested in Turkish. The monolingual children were only tested in Turkish in one session lasting approximately 30 minutes. In both groups, the order of the tasks was also counter-balanced.
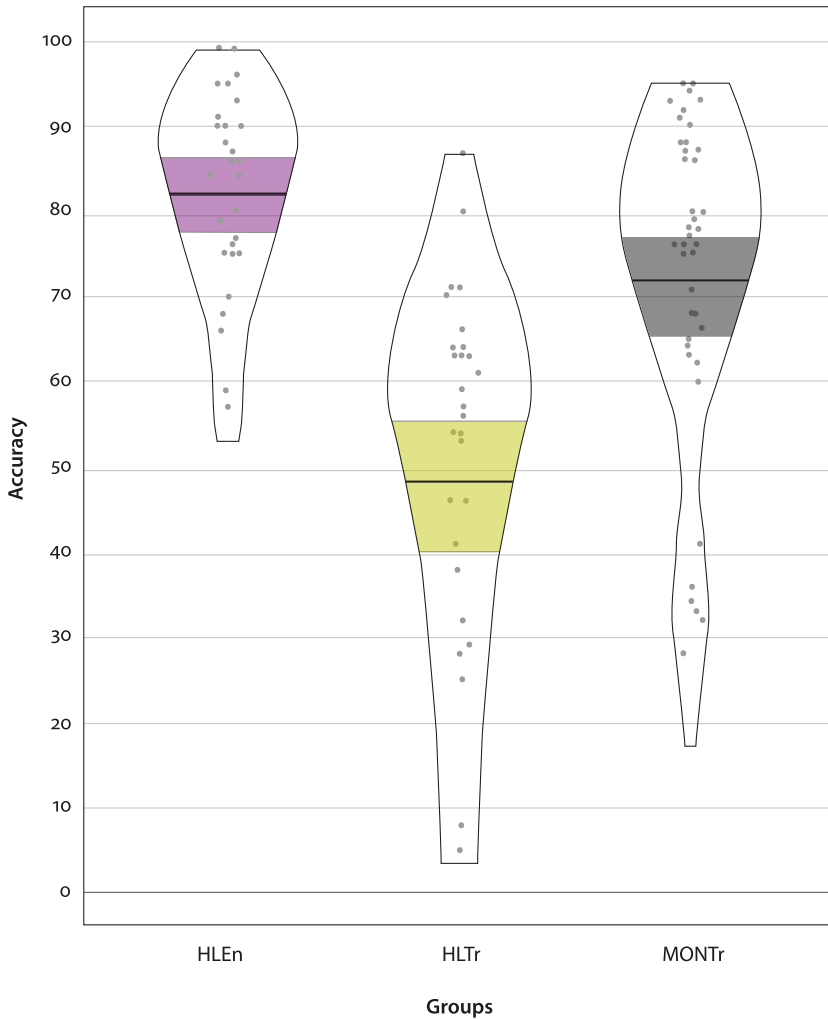
Figure 1. Accuracy percentages of both groups in the HALA tests
Note. HLEn = Heritage language in English; HLTr = Heritage language in Turkish;
MONTr = Monolingual in Turkish

### 5.2.1 *Picture sentence matching task*

Pictures built with the program Pixton.com depicted reversible events. They were
presented in pairs, A and B, side by side and were separated from each other using
picture frames. For each pair of pictures, participants heard the target sentence
within a question as shown in (7) and (8) for a SRC and an ORC, respectively, and
were asked to choose the picture matching the sentence that they heard.

(7) Subject relative clause (SRC)
     Hangisi kadın-ı   öp-en   adam?
     which   woman-ACC kiss-SRC man
     'Which one is the man that is kissing the woman?'
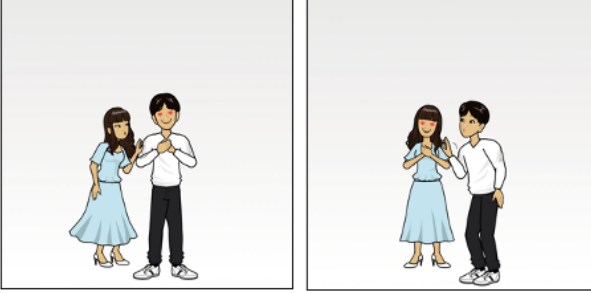
(8) Object relative clause (ORC)
     Hangisi adam-ın   gör-düğ-ü   kadın?
     which   man-GEN see-ORC-POSS.3SG woman
     'Which one is the woman that the man is seeing?'
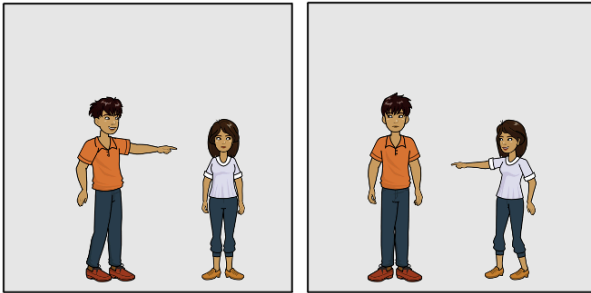
In Turkish, participants who correctly understand the SRC in (7) would choose
the picture on the right (e.g., Picture B), whereas the target response for the ORC
in (8) would be the picture on the left (e.g., Picture A).

In total, there were 12 SRCs and 12 ORCs, 24 distractors as well as 2 practice
items, a total of 50 items. The target items included transitive verbs with two ani-
mate referents. Animacy of the referents (subject and object) was not manipulated
since it was not a variable of interest in the present study. The distractors con-
tained simple sentences with a subject, an accusative-marked object and a verb
and were matched with the RCs in the number of words, case morphemes and
the word orders. Two lists were created so that participants did not see the same
picture with reversed action. Each list involved 24 pairs of pictures and sentences,
including 6 SRCs, 6 ORCs and 12 distractors, and the items in each list were pre-

sented in a pseudo-randomized in order to ensure that no two consecutive items included the same sentence type. The order of the lists and the left-right position of the pictures that indicated the correct answer were also counterbalanced. The materials in English mirrored those in Turkish.

5.2.2 *Sentence repetition task*

Sentence repetition tasks (SrepTs) are known as highly reliable indicators of language proficiency as well as of the acquisition of specific structures in the target language (cf. Marinis & Armon-Lotem, 2014). If the sentences are long enough to disallow 'parroting', then participants necessarily rely on their knowledge of lexicon and grammar to process and analyze the incoming stream and then to regenerate the sentences (Peeters-Podgaevskaja, Janssen & Baker, 2020).

For this study, LITMUS-SrepTs that were developed in Turkish (Topbaş, Aydın, Kazanoğlu & Tadıhan-Özkan, 2013) and in English (Marinis & Armon-Lotem, 2014) for school-aged children (5 years old and older) were used. Each task contained 30 sentences targeting complex structures including RCs and 2 practice items. The RCs were matched in the number of words, syllables, lexical and functional morphemes. There were a total of 6 ORCs divided into two as center-embedded and left-branching (in the Turkish SrepT) or right-branching (in the English SrepT), and all 3 SRCs in the Turkish SrepT were center-embedded. To make sure that the comparisons between SRCs and ORCs are valid and reliable, only center-embedded SRCs and ORCs are examined in this study. Since there were originally no SRCs in the English SrepT, a total of 3 SRCs were added to this test following the criteria for the LITMUS test items. An example of an SRC and an ORC from the Turkish SrepT is given in (9) and (10) below, respectively.

(9) Subject relative clause (SRC)
Keçi maymun-u   sev-en   kız-a   bak-ıyor-du.
goat monkey-ACC pat-SRC girl-DAT look-PROG-PST.3SG
'The goat was looking at the girl that pat the monkey.'

(10) Object relative clause (ORC)
Çocuk-lar iç-tik-ler-i   çorba-yı sev-di-ler.
child-PL   drink-ORC-3PL-POSS soup-ACC like-PST-3PL
'The children liked the soup that they ate.'

Participants were allowed to listen to each experimental sentence only once unless there was an interruption, such as loud noise in the background, and time was given for self-correction. All the items in the PSMT and the SrepT were pre-recorded and presented audio-visually in a PowerPoint since not all participants

were literate in Turkish (Benmamoun, Montrul & Polinsky, 2013; Montrul, 2012, 2016).

6.   Results

Participants' answers were coded as 'correct' if they named/described the pictures correctly in the target language in the HALA tests and if they chose the picture matching the sentence that they heard in the PSMT, and 'incorrect' otherwise. In the SrepT, recordings were transcribed and analyzed using the syntactic structure scoring sheet. The participants' answers were assigned a score of 0 if they made an omission error (e.g., omission of the required functional morphemes in RCs in Turkish) or a substitution error (e.g., substituting an ORC with a SRC or vice versa). All other responses were assigned a score of 1. Although the monolingual group was initially divided into two groups as younger (ages 3–5) and older monolingual children (ages 6–15), the results were later combined since no significant differences between the two groups were found in either of the tasks.

The analyses for both tasks were computed by R with the version 3.5.2 (R Core Team, 2018) using the *lme4* package (Bates, Maechler, Bolker & Walker, 2015). The pirate and line plots were produced using the *yarrr* package (Philips, 2017) and *ggplot2* package (Wickham, 2009) in R, respectively. For each task, two binomial linear mixed-effects models (Jaeger, 2008) were performed. The aim of the first model was to compare the accuracy rates of the child HS to the monolingual children's by age and RC type in Turkish. In the second model, the child HS' accuracy rates in RCs in Turkish and English were compared. For the PSMT, subjects and items were added to the first model as random effects, while the second model did not involve any random effects or slopes. For the SrepT, subjects and items were entered as random effects into the first model, while the second model only had subjects as random effects. Variables were compared using treatment coding, in which each level was compared to the reference levels for group (monolingual children), RC type (SRC) and target language (English), and the intercept was the cell mean of the reference levels. Variable selection for models was done in a backward stepwise selection method using the Akaike Information Criterion (AIC), and the model that fit the data best was chosen. Post-hoc comparisons were computed by using Estimated Marginal Means from the *emmeans* package (Lenth, Singmann & Love, 2018).

6.1   The comprehension task

The first model output revealed significant simple effects of group and RC type on the response accuracy rates, as displayed in Table 3. Accordingly, the monolingual Turkish children had significantly higher accuracy rates in SRCs ($M=91.3$, $SE=1.7$) and ORCs ($M=80.9$, $SE=2.3$) in Turkish than the child HS ($M=76$, $SE=3.2$ in SRC; $M=74$, $SE=3.2$ in ORC). Moreover, both groups performed better in SRCs than in ORCs, as also displayed in Figure 2.

Table 3. Mixed-effects regression modeling results of accuracy rates in the Turkish PSMT with the factors Group (reference level = Monolingual) and RC type (reference level = SRC)

	Estimate	SE	z ratio	p
Intercept	.22	.47	.46	.65
Group				
Bilingual	−1.69	.72	2.35	.018*
RC type				
ORC	−.74	.29	−2.5	.012*
Age	.25	.05	4.99	< .001***
Group * Age				
Bilingual * Age	−.028	.07	−3.84	< .001***

R code: Response ~ Group * Age + Sentence type + (1 | Participant) + (1 | Item)

The second model output also revealed significantly better comprehension of SRCs ($M=96.9$, $SE=1.3$) than ORCs ($M=74.5$, $SE=3.2$) in English by the child HS, who also showed better performance in English than in Turkish, as presented in Table 4.

The results also point to a significant main effect of age as well as interactions between age and group as well as age and target language: The monolingual children showed better comprehension of RCs in Turkish as they grew older, whereas the child HS performed better in comprehending RCs in English than in Turkish with increasing age, as also displayed in Figure 3. Although the child HS also showed some development in their comprehension of Turkish RCs by around age 10, their accuracy rates dropped steadily afterwards, while their comprehension of English RCs showed persistent improvement.

Overall, the monolingual children had significantly higher levels of accuracy in their comprehension of RCs in Turkish than the child HS. Both groups showed better performance in Turkish with increasing age; however, the child HS showed
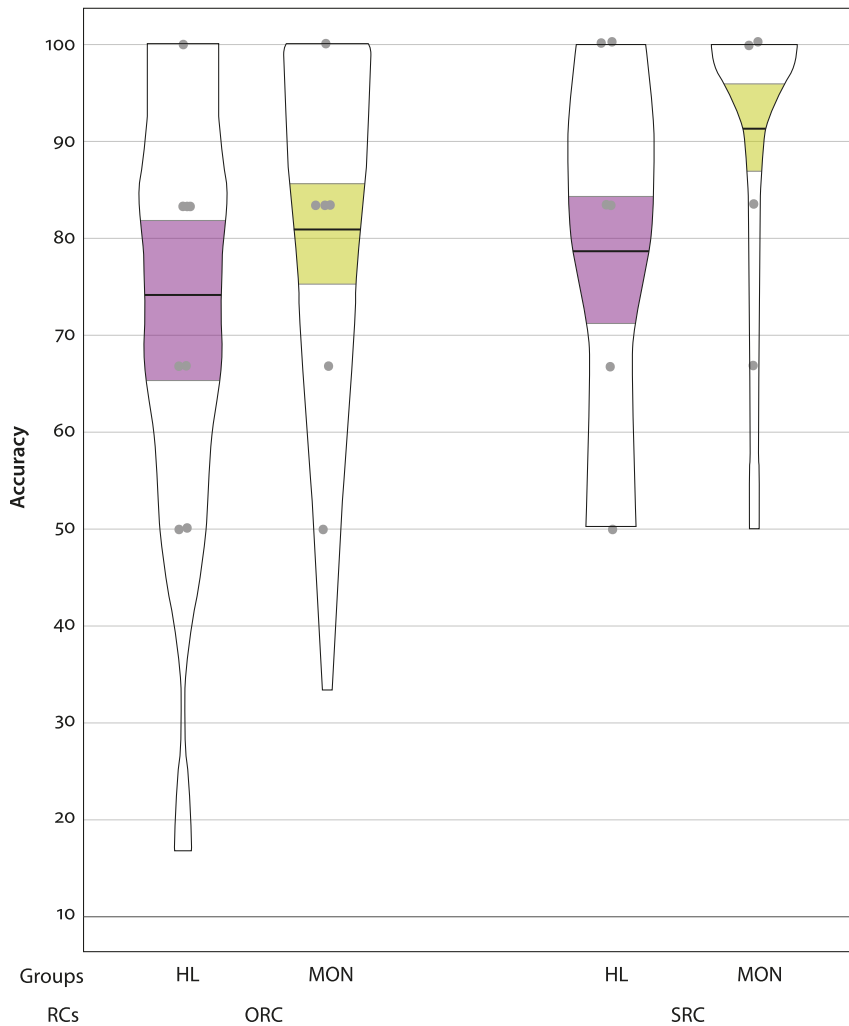
Figure 2. Mean accuracy percentages by Group and RC type in the Turkish PSMT
Note. HL = Heritage language; MON = Monolinguals; ORC = Object relative clause;
SRC = Subject relative clause

better comprehension of RCs in English than in Turkish over time. Nevertheless, both groups performed significantly better with SRCs than with ORCs with Turkish, showing a subject preference. In line with previous research, the Turkish child HS also showed a SRC advantage in English, which is again consistent with the SDH.

Table 4. Mixed-effects regression modeling results of accuracy rates in the Turkish and English PSMT with the factors Target language (reference level = English) and RC type (reference level = SRC)

	Estimate	SE	z ratio	p
Intercept	1.89	.45	4.15	< .001***
Target language				
Turkish	−1.57	−.71	−2.2	.028*
RC type				
ORC	−.82	.19	−4.27	< .001***
Age	.034	−.04	.80	.42
Target language * Age				
Turkish * Age	−.24	−.07	−3.25	.001***

R code: Response ~ Target language * Age + Sentence type

6.2   The production task

As in the comprehension task, the first model output revealed significant simple effects of group on the response accuracy rates, as displayed in Table 5. Accordingly, the monolingual Turkish children had significantly higher accuracy rates in SRCs ($M = 93.1$, $SE = 1.2$) and ORCs ($M = 95.5$, $SE = 1.2$) in Turkish than the child HS ($M = 62.5$, $SE = 4.9$ in SRC; $M = 60.4$, $SE = 3.5$ in ORC). The two groups, however, did not show a statistically significant difference in their production of SRCs as compared to ORCs in Turkish (see Figure 4 below).

The second model output also revealed significantly better production of SRCs ($M = 87.5$, $SE = 3.4$) than ORCs ($M = 68.8$, $SE = 4.8$) in English by the child HS, who also showed better performance in English than in Turkish, as presented in Table 6.

A significant simple effect of age and significant interactions between age and group as well as age and target language were also found. Accordingly, the monolingual Turkish children and the child HS showed higher accuracy rates in producing RCs in Turkish and in English, respectively, as their age increased. The child HS also performed better in Turkish with increasing age, as can also be seen in Figure 5.

Finally, the mean accuracy rates of the monolingual children in Turkish ORCs in the SrepT (95.5%) was overall higher than in the PSMT (80.9%). On the other hand, the child HS showed lower accuracy rates in both SRCs (62.5%) and ORCs (60.4%) in the SrepT than the PSMT (76% and 74%, respectively), suggesting better comprehension than production of Turkish RCs in this group.
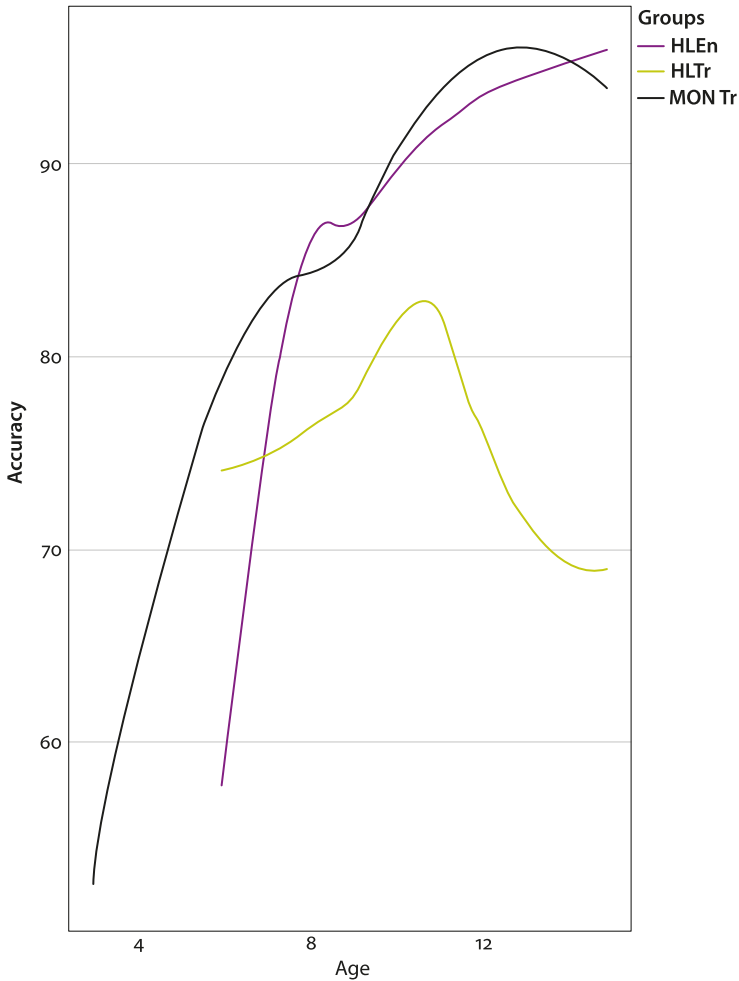
Figure 3. Correlation between age and accuracy percentages of both groups in the Turkish and English PSMT
Note. HLEn = Heritage language in English; HLTr = Heritage language in Turkish; MONTr = Monolingual in Turkish

In sum, the monolingual Turkish children show better performance in comprehending and producing RCs, particularly SRCs, than the child heritage group, and their performance increases with age. The child HS perform more variably than monolinguals in both tasks and show better comprehension than production of Turkish RCs. However, their performance also increases with age in Turkish, particularly in the production task. Both groups also show a subject-object asymmetry in the comprehension task but not in the production task. Similarly, the

Table 5. Mixed-effects regression modeling results of accuracy rates in the Turkish SrepT with the factors Group (reference level = Monolingual) and RC type (reference level = SRC)

	Estimate	SE	z ratio	p
Intercept	−2.98	2.54	−1.17	.24
Group				
Bilingual	−6.62	1.81	−3.65	< .001***
RC type				
ORC	.56	.36	1.57	.12
Age	1.06	.43	2.49	.013*
Group * Age				
Bilingual * Age	−.88	.45	−1.96	.05*

R code: Response ~ Group * Age + Sentence type + (1 | Participant) + (1 | Item)

child HS show a subject advantage in English, and they perform better in English than in Turkish with increasing age in both tasks. To better understand the nature of the variability that the child HS show with respect to Turkish RCs, particularly in the production task, an error analysis of the production data is presented in the following section.

6.3   Error analysis

The child HS made two types of errors in the Turkish SrepT: omission and substitution errors. The former involves incomplete sentences and the use of simple sentences instead of RCs, whereas the latter contains the use of the past tense marker -DI instead of the object relativizing participle -DIK, resulting in a simple juxtaposition instead of an ORC.[3] The number and percentage of errors for each RC type are presented in Table 7.

The use of a simple declarative sentence is exemplified in (11) for the intended target SRC sentence, *Tilki kuşu yakalayan kediye kızmıştı* 'The fox got angry with the cat that caught the bird'.

(11)   Tilki kuş-u   yakala-dı.
       fox   bird-ACC catch-PST.3SG
       'The fox caught the bird.'

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3. As one of the reviewers correctly pointed out, the replacement of -DIK with -DI could be a phonological error.
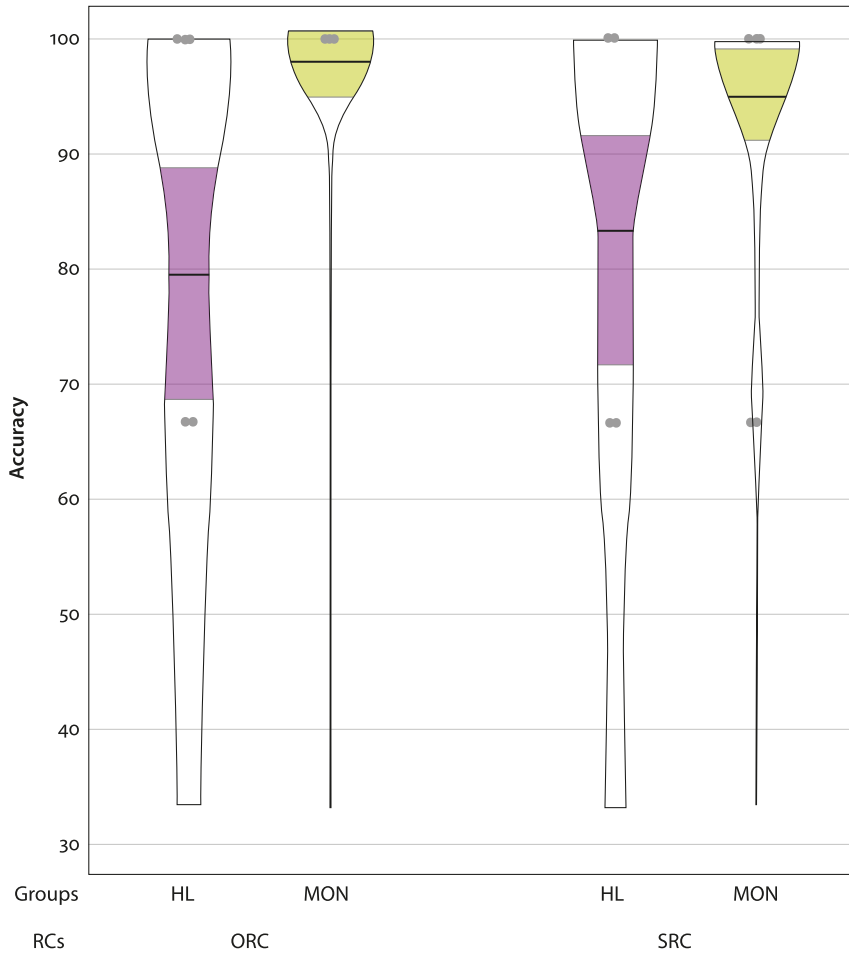
Figure 4. Accuracy percentages of both groups in SRCs and ORCs in Turkish in the SrepT

In (12), by using the finite tense morphological marker *-DI* instead of *-DIK*, the child HS avoids producing the intended RC target, *Çocuklar içtikleri çorbayı sevdiler* 'The children liked the soup that they ate', and forms two individual clauses instead.

(12) Çocuklar iç-ti   çorba-yı   sev-di-ler
      children   drink-PST.3SG soup-ACC like-PST.3PL
      'The children ate (the soup). They liked the soup.'

The finding that the child Turkish HS replace complex RCs in Turkish with simple declarative sentences or with simple juxtaposition is in line with previous

Table 6. Mixed-effects regression modeling results of accuracy rates in the Turkish and English SrepT with the factors Target language (reference level = English) and RC type (reference level = SRC)

	Estimate	SE	z ratio	p
Intercept	4.73	1.5	3.25	< .001***
Target language				
Turkish	−4.1	1.33	−3.09	.002**
RC type				
ORC	−.59	.28	−2.14	.03*
Age	−.75	.17	−4.44	< .001***
Target language * Age				
Turkish * Age	.58	.16	3.72	< .001***

R code: Response ~ Sentence type + Target language * Age + (1 | Participant)

research with child and adult Turkish HS in Europe (cf. Aarssen, 1996; Backus, 2004). Bayram (2013) reported that child Turkish HS in Germany preferred using two individual clauses that were semantically related through context instead of using RCs in an elicited imitation task, as demonstrated in (13) (p.148).

(13)   Target sentence:
       Sen-in   resim-in-de   tavşan-ı   ısır-an   bir köpek var mı?
       you-GEN picture-POSS.2SG-LOC rabbit-ACC bite-SRC a   dog   exist Q
       'In your picture, is there a dog that is biting the rabbit?'
       Child HS' response:
       Sen-in   resim-in-de   bir tavşan var   mı? Köpek tavşan-ı
       you-GEN picture-POSS.2SG-LOC one rabbit exist Q   dog   rabbit-ACC
       ısır-ıyor.
       bite-PROG.3SG
       'In your picture, is there a rabbit? The dog is biting the rabbit.'

Overall, confirming previous research, the present study has found that the child Turkish HS in the U.S. employ an avoidance strategy in producing Turkish RCs regardless of the RC type. Taken together with the lower accuracy rates of the child HS as compared to their monolingual counterparts in the comprehension task, these findings suggest that the child HS did not fully acquire RCs in Turkish. A more detailed discussion on the results is presented in the following section.
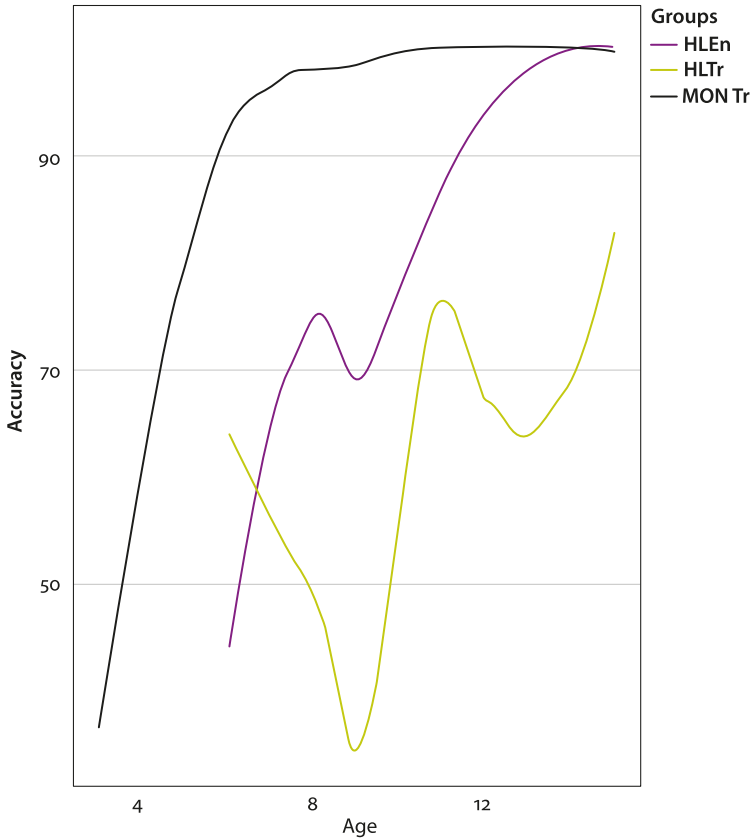
Figure 5. Correlation between age and accuracy percentages of both groups in the Turkish and English SrepT

7.   Discussion and conclusion

The purpose of this study was to investigate whether child Turkish HS living in the U.S. differ from monolingual Turkish-speaking children in Turkey in their comprehension and production of Turkish RCs. Thirty-two child HS of Turkish (ages 6–15) and 48 monolingual Turkish-speaking children (ages 3–15) were tested using a picture-sentence matching (comprehension) task and a sentence repetition (production) task. By doing so, this study investigated whether the child HS of Turkish: (i) comprehend and produce Turkish RCs to the same extent as their monolingual counterparts, (ii) show the same processing patterns as monolingual Turkish children (i.e., subject object asymmetry) in comprehension and production of Turkish RCs, and (iii) the role that age and experience play in child HS' knowledge of Turkish RCs. Below the findings are discussed within two structure-

Table 7. Error analysis of the child HS data in the Turkish SrepT

	SRCs		ORCs		Total	
	Number of errors	*Percentage of errors*	*Number of errors*	*Percentage of errors*	number of errors	Total percentage of errors
Incomplete sentences	19	63%	14	41%	33	51%
Simple declarative sentences	11	37%	8	24%	19	30%
Substitution of *-DI* for *-DIK* & Simple juxtaposition	0	0%	12	35%	12	19%
Total	30	100%	34	100%	64	100%

based formal accounts, namely the Linear Distance Hypothesis (LDH) and the Structural Distance Hypothesis (SDH), as well as O'Grady's (2011) emergentist approach. According to the LDH, the higher number of intervening discourse referents (e.g., verbs and NPs) between the filler and the gap in ORCs in English results in higher processing cost for ORCs than for SRCs. In Turkish, however, the LDH predicts that ORCs are easier to process than SRCs since there is fewer number of intervening discourse referents in ORCs. However, the predictions of the LDH for Turkish are not confirmed in this study since no ORC advantage was found in the two groups in the comprehension or the production task.

In contrast to the LDH, the SDH predicts a SRC advantage in both languages since objects are embedded deeper than subjects in the phrase structure in Turkish and in English. The results of the comprehension task support the predictions of this account: Both monolingual Turkish-speaking children and child HS show significantly better performance in SRCs than ORCs in Turkish. In English, the child HS also show a clear SRC advantage in both tasks. These findings are expected given similar findings that have been reported by a large number of previous studies on the comprehension of Turkish (Kahyalar, 2020; Özge et al., 2015) and English RCs (Diessel & Tomasello, 2005; Kim & O'Grady, 2016; O'Grady, 1997).

In contrast to the comprehension task, the findings have revealed no SRC advantage in the production task, suggesting that factors other than structural distance might be at play in the production of Turkish RCs. These findings are in line with the predictions of O'Grady's (2011) emergentist account. According to

this account, linear distance (calculated in terms of intervening new discourse referents), prominence (the salience of the relativized element within the RC) and frequency favor SRCs in English, and thus a SRC advantage is expected in this language. However, in Turkish, linear distance favors ORCs, whereas prominence and frequency favor SRCs. Therefore, RCs in Turkish are predicted to show at best a weak SRC advantage (due to prominence) or no advantage at all. A SRC advantage in production of RCs by monolingual Turkish-speaking children has often been reported based on spontaneous production data (Slobin, 1986; Uzundağ & Küntay, 2019). Nevertheless, Ekmekçi (1990) tested production abilities of 3- to 6-year-old Turkish-speaking children using an imitation task, in which children were asked to repeat after the experimenter SRCs and ORCs in Turkish. She found that children showed a developmental pattern with increasing age and performed equally well with both types of RCs by age 6. The imitation task that was employed by Ekmekçi is similar to the SrepT that was used in this study. Thus, it might be the case that monolingual Turkish children in this study (ages 6–15) were equally successful at producing SRCs and ORCs in the SrepT since they were forced to produce them, suggesting complete acquisition of the RCs in this group, but might have preferred using SRCs more extensively than ORCs in spontaneous speech if given the chance due to higher frequency and prominence of the former RC type. As compared to monolingual Turkish children, the child HS in the present study had significantly lower accuracy rates in their production of Turkish RCs regardless of the RC type. This finding is consistent with previous research done with child HS in Europe (cf. Backus, 2004). The more detailed error analysis of the production task revealed that similar to child Turkish HS studied in Europe, the child Turkish HS in the U.S. replaced RCs with simple declarative sentences or with simple juxtaposition (for examples, see Section 6.3). Therefore, similar performance in the production of Turkish SRCs and ORCs in both groups might be due to task effects or tendency to avoid producing complex structures such as RCs rather than inherent characteristics of the RCs themselves (i.e., prominence, frequency and distance). This is confirmed by the results of the comprehension task as well, which revealed a subject-object asymmetry in the comprehension of RCs in Turkish and in English in both groups.

Comprehension-production asymmetries have long been noted for child HS of other languages such as Mandarin (Jia & Paradis, 2016), Russian (Polinsky, 2011) and Korean (Li & Lee, 2001; O'Grady, 1997). In line with previous research, the child HS of Turkish in this study performed better in comprehension of Turkish RCs than their production, suggesting that they understand more than they can produce with respect to RCs in Turkish. Similarly, Jia and Paradis (2016) reported that child HS (ages 6;8–7;4) were comparable to their age-matched

monolingual counterparts in comprehending Mandarin RCs, but their production abilities developed over time, suggesting a protracted developmental pattern in production of RCs in this group. Since the heritage group was eventually able to catch up with their monolingual counterparts in their production abilities, Jia and Paradis concluded that insufficient input in the heritage language does not necessarily result in incomplete acquisition for RCs. Nevertheless, in the present study, even the oldest child HS had lower accuracy rates than their age-matched monolingual counterparts, suggesting delayed and eventually incomplete acquisition of RCs due to insufficient input in this group. This is further supported by a gradual decrease in child HS' performance in Turkish with increasing age, particularly in the comprehension task, while their overall performance in English steadily increased along with their dominance in English. Similarly, Bohnaker and Karakoc (2020) reported that in contrast to age-matched monolingual Turkish-speaking children, child HS of Turkish in Sweden (ages 4–7) did not perform better with increasing age in an oral narrative task and that there was a wide range of individual variation. Taken together with their significantly lower accuracy rates than the monolingual children, these findings suggest that the child HS in this study did not show age-appropriate grasp of RCs in Turkish at the time of testing (Montrul, 2016), which might be due to either a problem at the representational level (Lohndal & Putnam, 2020) or activation and accessing difficulty to RCs in comprehension and production (Montrul, 2021; in press; Pérez-Cortes, Putnam & Sánchez, 2019).

Finally, no major effect of the dominant/majority language on the child HS' performance in comprehending and producing Turkish RCs was found in the present study. The child Turkish HS in the U.S., where the majority language is English, showed similar performance to the child HS of Turkish in different language contact situations such as those in the Netherlands (Aarssen, 1996), in the UK (Bayraktaroglu, 1999), in Germany (Bayram, 2013; Pfaff, 1991, 1994) and in France (Akinci et al., 2001). As discussed above, child HS of Turkish avoid using Turkish RCs and prefer using simple juxtaposition instead, regardless of the RC type and language contact situation, and adhere to the word order rules of Turkish. Nevertheless, to better understand the role that the dominant language might play on the knowledge of Turkish RCs in child HS, more systematic research that examines the comprehension of not only reversal errors (i.e., interpreting SRCs as ORCs as vice versa) but also head errors (i.e., interpreting the first noun as the head in Turkish RCs as in head-initial languages like English) is needed. Although RCs in English (a head-initial language) and in Turkish (a head-final language) have similar phrasal structures, the position of the head within the RC changes, which in turn may result in incorrect processing of Turkish RCs due to transfer from the dominant language, namely English.

In sum, the findings of the present study suggest that Turkish RCs are vulnerable to delayed and eventually incomplete acquisition in child HS of Turkish in the U.S., although the strength of this explanation must be corroborated by a study of child and adult heritage speakers. As compared to the monolingual Turkish-speaking children, the child HS in the present study have overall lower accuracy rates in both tasks. Nevertheless, they are comparable to their monolingual counterparts in the patterns that they show in comprehending and producing RCs: They show a SRC advantage in comprehending RCs in Turkish as opposed to no such advantage in producing them, suggesting that factors other than structural distance might be at play in production of RCs in Turkish. In line with previous research, the child HS also show a subject-object asymmetry in comprehending and producing English RCs, which is in line with the predictions of the SDH. Overall, the results are consistent with previous research indicating that child HS have better comprehension than production abilities with respect to RCs in their heritage language, and that they have a tendency to replace RCs with simple juxtaposition in production regardless of the RC type.

Acknowledgements

Glossary

2	Second person
3	Third person
ACC	Accusative
GEN	Genitive
LOC	Locative
NMLZ	Nominalizer
ORC	Object relativizing participle
Q	Question marker
PST	Past tense
PL	Plural
POSS	Possessive
PROG	Progressive
SG	Singular
SRC	Subject relativizing participle

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Appendix I. List of experimental stimuli in the picture sentence matching task

Relative clause type	Token type	
	A	**B**
Subject Relative Clause (SRC)	Hangisi prensesi giydiren kız? *Which one is the girl that is dressing the princess?*	Hangisi kızı giydiren prenses? Which one is the princess that is dressing the girl?
	Hangisi adamı öpen kadın? *Which one is the woman that is kissing the man?*	Hangisi kadını öpen adam? *Which one is the man that is kissing the woman?*
	Hangisi adamı besleyen kadın? *Which one is the woman that is feeding the man?*	Hangisi kadını besleyen adam? *Which one is the man that is feeding the woman?*
	Hangisi adamı selamlayan çocuk? *Which one is the boy that is greeting the man?*	Hangisi çocuğu selamlayan adam? *Which one is the man that is greeting the boy?*
	Hangisi kızı yıkayan çocuk? *Which one is the boy that is bathing the girl?*	Hangisi çocuğu yıkayan kız? *Which one is the girl that is bathing the boy?*
	Hangisi kadını kucaklayan adam? *Which one is the man that is hugging the woman?*	Hangisi adamı kucaklayan kadın? *Which one is the woman that is hugging the man?*
Object Relative Clause (ORC)	Hangisi adamın gördüğü kadın? *Which one is the woman that the man is seeing?*	Hangisi kadının gördüğü adam? *Which one is the man that the woman is seeing?*
	Hangisi adamın boyadığı çocuk? *Which one is the boy that the man is painting?*	Hangisi çocuğun boyadığı adam? *Which one is the man that the boy is painting?*
	Hangisi çocuğun kovaladığı bekçi?	Hangisi bekçinin kovaladığı çocuk?

Relative clause type	Token type	
	A	**B**
	Which one is the guard that the boy is chasing?	*Which one is the boy that the guard is chasing?*
	Hangisi çocuğun izlediği kadın? *Which one is the woman that the boy is watching?*	Hangisi kadının izlediği çocuk? *Which one is the boy that the woman is watching?*
	Hangisi adamın yendiği kadın? *Which one is the woman that the man is defeating?*	Hangisi kadının yendiği adam? *Which one is the man that the woman is defeating?*
	Hangisi kadının soyduğu çocuk? *Which one is the boy that the woman is robbing?*	Hangisi çocuğun soyduğu kadın? *Which one is the woman that the boy is robbing?*

Distractors

Distractors consisted of simple sentences with a subject, an object and a verb or sentences with a verb and a subject that is a possessive noun phrase. The word order was manipulated in Turkish, resulting three different word orders such as SOV (underlying word order), OVS (as in SRCs) and SVO (as in ORCs).

1. Hangisinde çocuk kızı taşıyor?
   In which one is the boy carrying the girl?
2. Hangisinde adam kadını geçiyor?
   In which one is the man passing the woman?
3. Hangisinde adam kızı yakalıyor?
   In which one is the man catching the girl?
4. Hangisinde büyükbaba büyükanneyi gıdıklıyor?
   In which one is the grandpa tickling the grandma?
5. Hangisinde adam kadını çekiyor?
   In which one is the man pulling the woman?
6. Hangisinde polis çocuğu selamlıyor?
   In which one is the policeman greeting the boy?
7. Hangisinde çocuk kızı itiyor?
   In which one is the boy pushing the girl?
8. Hangisinde kadın adamı kurtarıyor?
   In which one is the woman saving the man?
9. Hangisinde adam maymunu boyuyor?
   In which one is the man painting the monkey?
10. Hangisinde öğretmen öğrenciyi çiziyor?
    In which one is the teacher drawing the student?
11. Hangisinde kız balığı öpüyor?
    In which one is the woman kissing the fish?
12. Hangisinde büyükbaba kediyi izliyor?

In which one is the grandpa watching the cat?

13. Hangisinde çocuğu taşıyor kız?
In which one is the girl carrying the boy?
14. Hangisinde adamı geçiyor kadın?
In which one is the woman passing the man?
15. Hangisinde adamı yakalıyor kız?
In which one is the girl catching the man?
16. Hangisinde büyükbabayı gıdıklıyor büyükanne?
In which one is the grandma tickling the grandpa?
17. Hangisinde kadın çekiyor adamı?
In which one is the woman pulling the man?
18. Hangisinde çocuk selamlıyor polisi?
In which one is the boy greeting the policeman?
19. Hangisinde kız itiyor çocuğu?
In which one is the girl pushing the boy?
20. Hangisinde adam kurtarıyor kadını?
In which one is the man saving the woman?
21. Hangisinde adamın maymunu boyuyor?
In which one is the man's monkey painting?
22. Hangisinde öğretmenin öğrencisi çiziyor?
In which one is the teacher's student drawing?
23. Hangisinde kızın balığı öpüyor?
In which one is the woman's fish kissing?
24. Hangisinde büyükbabanın kedisi izliyor?
In which one is the grandpa's cat watching?

Practice items

1. Hangisi evi gizleyen adam?
Which one is the man that is hiding the house?
2. Hangisi kutuyu kaldıran adam?
Which one is the man that is lifting the box?

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