Children develop causatives despite pervasive ellipsis: Evidence from Turkish

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Abstract

Children use causative verbs in language to express causality. The learning of causatives relies on cues in children's interaction with caregivers. Argument structure has been widely posited as a facilitative cue for learning causatives. However, it may lack reliability due to ellipsis allowed in many languages, thus affecting children's acquisition of causatives. In this study, we investigate the role of object ellipsis in the learning of two prevalent types of causatives, namely lexical and morphological causatives. We take Turkish as a test case, which employs both types of causatives. The results show that the ellipsis in child-directed speech is pervasive in both causatives, with morphological causatives exhibiting a substantially lower proportion of ellipsis. However, by examining children's developmental trajectory, we show that lexical causatives develop with a pattern strikingly similar to the general development of verbs, whereas morphological causatives develop more slowly, despite less object ellipsis and explicit morphological marking. The findings suggest that argument structure may not play a major role in the learning of causatives. Our general conclusion is that children acquire causatives despite the challenge posed by pervasive ellipsis.

Keywords: Ellipsis, Turkish, Causative

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Introduction

Causality is one of the cornerstones in human cognition (Corrigan & Denton, 1996; Miller & Johnson-Laird, 1976; Piaget, 1927). Through causal inference, humans manage to understand the interrelations between entities (Trabasso & Van Den Broek, 1985; Pearl, 2009). The ability of causal inference can be attested at an age as young as 6 months (Leslie & Keeble, 1987), and causal expressions later become a crucial component of children’s language at early stages (Bartsch & Wellman, 1995; Dunn, 2010; Hood et al., 1979). The question remains how causal language emerges for children in their early years. Here, we address this question by surveying a longitudinal acquisition corpus. We aim to examine children’s development of causal language and investigate the relevant cues in the learning process.

As an important part of causal language, various types of causative verbal constructions are used to express causality, including lexical (e.g., “raise” in English, denoting “cause to rise”) and morphological causatives (e.g., the suffix *-Dir* that changes *ye* “eat” to *yedir* “feed” in Turkish). The seemingly easy causal inference of these causatives can be challenging for young children, since (i) the caused event is usually implicit and unexpressed in lexical causatives and (ii) children may not recognize the morphological causative marking. As Piaget (1927) first pointed out almost a century ago, understanding the causal link between events may not mature even for children up to 8 years of age, and such understanding is often achieved with careful guidance by adults. It has been shown that adults’ causal language addressed to their children is helpful in children’s developing causal understanding (Bonawitz et al., 2010; Callaghan et al., 2011; Legare et al., 2017). Hence, understanding the causal implications of the causatives could heavily rely on children’s interaction with their caregivers. It has been posited that linguistic cues in parent-child interaction, such as nominals and the argument structures parents form in child-directed speech (CDS), are crucial for inferring the semantics of causatives (e.g., Fisher et al., 2010; Gleitman, 1990). This cue-based acquisition, however, becomes problematic for languages that allow pervasive omission of linguistic units, namely ellipsis. It is not yet clear how the reliability of these cues impacts children’s causal understanding, especially in languages where both lexical and morphological causatives coexist. Turkish, for instance, employs both types of causatives extensively, and a Turkish speaker may

choose between a lexical causative and a morphological causative to convey causality² (Comrie, 1989). With the formal marking available in morphological constructions, the acquisition of different causatives becomes a more sophisticated phenomenon. We thus take Turkish as a prototypical representative language to study how children develop their use of causatives and how ellipsis might play a role therein.

Of the two types of causatives, lexical causatives commonly exist across languages. Lexical words pertaining to this category, such as “open”, “close” and “raise”, convey an event that causes a change of state in the patient (Shibatani, 2002). For instance, the verb “raise” in “I raise the chair” entails the event “the chair rises”, therefore making “raise” a lexical causative. Most studies, when defining lexical causatives, emphasize the involvement of two events and the presence of both the agent and the patient of the verb (Comrie & Polinsky, 1993; Haspelmath, 2001). Hence, the processing of lexical causatives, by definition, fundamentally relies on the recognition of the two arguments in the utterance, especially the patient that experiences the change. Besides, unlike explicit markers in morphological causatives, lexical causatives lack formal marking that aids causal inference. Acquiring lexical causatives can thus be a difficult process, where children have to disentangle the agent-patient information in the speech to achieve causal understanding.

Previous studies have focused on the structural information that accompanies lexical causatives in their acquisition (Gleitman, 1990; Naigles, 1990, 1996). Naigles (1996) tested children’s comprehension of causal events upon hearing structural frames that contained different numbers of arguments in speech. It was found that children capitalized on such structures to discriminate between causal and non-causal events. Others have followed this track to suggest the important role of syntactic frames in verb learning (Lidz et al., 2003; Messenger et al., 2015; Yuan et al., 2012). In Turkish, particularly, Göksun et al. (2008) tested the role of the number of noun phrases (NPs) for Turkish children up to age 5 in the causal enactment upon linguistic prompts. The results showed that the number of NPs in an utterance was a predictor for causal enactment, although the effect was weaker than that in English (Naigles et al., 1993). It has thus been widely posited that

²The lexical and morphological causatives are not always interchangeable, as subtle semantic difference may exist. For instance, both the lexical causative *at* and the morphological causative *fırla-t* can convey the meaning of “to throw”, but *at* can express a more direct action.

children’s lexical learning relies on at least some syntactic structures, either granted as innate capability or developed in an item-specific manner (Fisher, 2002; Tomasello, 2003; Yang, 2004). Either way, children are believed to infer, or activate, the structural rules from the input they hear to support further verb learning (e.g., Chomsky, 2014; Tomasello, 2003). A critical issue arises that syntactic structures can lack consistency and reliability in their representations in language. This can be exemplified by the elliptical structures in many languages.

In Turkish, for example, both the agent and the patient of a causal event can be omitted in an utterance without rendering the sentence ungrammatical. While the information of the omitted agent can be retrieved from the subject agreement in the verb, there is a lack of morphological marking to indicate the omitted patient. Such missing patients can only be referenced in discourse and extra-linguistic contexts (Şener & Takahashi, 2010), making the processing rather implicit.

- (1) (sen o-nu) Aç-acak mı-sın?
 (2SG 3SG-ACC) open-FUT Q-2SG
 ‘Will (you) open (it)?’

For instance, in example (1)³, the object “it” that bears the caused event is missing, leading to a seemingly intransitive structure. Thus, the argument structure here is implicit and no formal marking can be capitalized on to make further causal inference. The causal inference might be possible from the discourse, such as a preceding utterance “Bak, burada bir kutu var (Look, there is a box here)”, where the object “it” can be recovered as “box” in the discourse context. Nevertheless, with the additional burden of recovering them from surrounding context in discourse, the ellipsis of objects may still pose a great challenge for processing the causal meaning in lexical causatives. Ellipsis of objects is found to be pervasive in CDS in Turkish (Gürçanlı et al., 2007; Hatice & SUCAK, 2018; Küntay & Slobin, 1996). In particular, Küntay & Slobin (1996) pointed out that objects can be elided for transitive verbs in CDS, especially when the object is evident in context. Consequently, even if argument structure is facilitative for causal inference, it is unlikely to be the primary source children capitalize on for inferring causal meaning. It has been conceived that cues lacking reliability might severely harm the learning of related linguis-

³1 = first person, 2 = second person, 3 = third person, ACC = accusative, CAUS = causative, DAT = dative, FUT = future, GEN = genitive, PL = plural, PST = past, Q = question particle, SG = singular.

tic aspects (Bates & MacWhinney, 1987; Bates et al., 1989; Dittmar et al., 2008; Kempe & MacWhinney, 1998). The question therefore arises whether ellipsis affects children’s acquisition of lexical causatives.

Previous studies have sought to explore non-syntactic cues that may facilitate children’s verb learning (Allen, 2000; Clancy et al., 2003; Göksun et al., 2008; Huang, 2012; Narasimhan et al., 2005). For instance, in the same study where the number of NPs was tested, Göksun et al. (2008) also examined the morphological cues and found a significant effect of accusative marking for acting out causal actions. Also, Narasimhan et al. (2005) revealed that despite substantial argument ellipsis in Hindi CDS, 3-4 year-olds managed to produce error-free transitive constructions thanks to their exploitation of multiple cues such as context in discourse, verbal morphology and extra-linguistic cues. Similar discourse cues have been found in other typologically diverse languages as well, such as Inuktitut (Allen, 2000), Korean (Clancy et al., 2003), and Mandarin (Huang, 2012). With various cues, it is plausible that children can remedy the issue of unreliable syntactic frames for their causal inference. Yet, little evidence has been supplied regarding the potential hindrance by ellipsis for the development of lexical causatives for Turkish children.

Ellipsis concerns the acquisition of morphological causatives as well. In addition to lexical causatives, morphologically complex languages such as Turkish language employ morphological constructions to express causal meaning. For instance, the suffix “-DIr”⁴ can directly causativize a non-causal event. As in “güldürmek” (to make someone laugh), “-dür” marks the causal meaning as opposed to “gülmek” that denotes the non-causal meaning “to laugh”. Example (2) shows a sentence with a morphologically causativized verb.

- (2) ben-i gül-dür-dü-ler
 1SG-ACC laugh-CAUS-PST-3PL
 ‘They made me laugh’

With the causative marker *-DIr* attached to the intransitive *güldüler*, the verbal construction now can take the patient *me* and expresses a clear causal relation between *they* and *me*. A similar phenomenon of valency change (i.e., change of the number of verbal

⁴Variant forms due to consonant assimilation and vowel harmony in Turkish language: *dir*, *-dır*, *-dür*, *-dur*, *-tir*, *-tır*, *-tür*, *-tur*

arguments) can be seen in example (3). With the causative suffix *-Ar*⁵, the non-causal meaning “come out” of *çık* is causativized to “take off” as in *çık-ar*, while a patient, namely “your shoes”, is introduced to the construction.

- (3) ayakkabı-lar-ın-ı çık-ar
 shoe-PL-GEN-ACC come.out-CAUS
 ‘Take off your shoes.’

To showcase the productivity of causative markers in Turkish, example (4) displays a sentence involving secondary causation rendered by *-Dir*. That is, causativization with morphological marking is permissive even for verbs that already involve causal meaning in themselves, namely lexical causatives such as *aç* (open) in example (4).

- (4) ban-a kutu-yu aç-tır-dı-lar
 1SG-DAT box-3SG.ACC open-CAUS-PST-3PL
 ‘They made me open the box’

Eliding the arguments, especially the patients, in the morphological causative constructions above can jeopardize causal inference in the same way as in lexical causative constructions, in that inferring causality of both causatives relies on the recognition of the agent and the patient. For instance, if “me” in example (2) or “your shoes” in example (3) is dropped, the causal relation becomes opaque without the presence of a patient. Concretely, if “me” is dropped in example (2), namely if given only the verb form *güldürdüler*, without knowing the causative marker, no semantic difference can be established between this causativized verb and the non-causative form *güldüler* (they laughed). The same issue occurs to the ellipsis of “your shoes” in example (3) as well. Both *çık-ar* (with an elided patient) and *çık* can stand alone in an utterance without context, and the causal meaning of *çık-ar* is difficult to be distinguished from the non-causal meaning of *çık*, if the causative marker *-ar* is not known. Children may recognize the same verb stem in both forms, but with the patient ellipsis, the discrimination of causal meaning here is almost as challenging as for lexical pairs of a causative and a non-causative.

Even in the situation with secondary causation in example (4), ellipsis poses a similar, if not more severe, issue for processing the causal meaning. Here, the lexical causative *aç* (open) is attached with the causative marker *-tır*, and this introduces an extra dative

⁵Two variant forms: *-ar*, *-er*

argument that bridges two agent-patient relations, namely *they & me* and *me & the box*. If the intermediary argument *bana* is elided in this construction, there is a lack of cues for differentiating the resulting sentence “kutuyu açtıldılar” from “kutuyu açtılar” (no causative marker), the latter of which conveys the simple causal meaning “they opened the box”.

Without reliable arguments in the context, the acquisition of the causal meaning of morphological causative markers in Turkish might be delayed (e.g., Bates et al., 1989). In fact, previous studies have supplied mixed results regarding the development of morphological causatives. For instance, Aksu-Koç & Ketrez (2003) and Ketrez (1999) both found that emergence of productive causative marking occurs at around 2 years of age in Turkish child speech (CS). However, Göksun et al. (2008) revealed no facilitation of causative marking up to 5 years of age for the task of enactment of causal actions. Such a delay of acquisition has been shown for essential morphemes such as the evidential marker as well, whose comprehension was not attested in experimental settings until about 6-7 years of age (Ozturk & Papafragou, 2016). Another interesting observation by Ketrez (1999) was that children produced wrong argument structures for morphological causatives, whereas they had no difficulty uttering simplex lexical words with appropriate argument structures. If argument structure is indeed a factor for causal inference, ellipsis should exert an equally large influence on the learning of both lexical and morphological causatives. Moreover, as Bates et al. (1989) would predict in the competition model, the more reliable cue of explicit morphological marking, with its flexible use in Turkish, should aid the acquisition of morphological causatives. Hence, it is worth asking to what extent ellipsis occurs in both causatives, so that it could hint at the development of causatives.

So far, we know very little about the extent of the ellipsis of arguments, especially the ellipsis of objects, and its potential effect on the learning of causal meaning. It is also largely unknown how object ellipsis with its effect varies between morphological and lexical causatives. Whereas ellipsis has not been clearly quantified as of yet, a couple of corpus studies have examined the development of causatives, albeit without concretely depicting the developmental trajectories. For example, Ketrez (1999) evaluated the productivity of morphological causatives, with a focus on the causativization upon verbs within the same recording session of spontaneous speech (i.e., both the non-derived verb form and the form with a causative marker should exist in the same session, such as *çık*

and *çık-ar*). However, this scenario rarely occurs in that it requires particular conditions of elicitation and a substantial amount of speech. On a different vein, Aksu-Koç & Slobin (1985) looked at overregularization as an indication of productive causative marking. Both approaches do not attend to the issue of item-specificity and thus fail to reflect the general development of causative use. Limited insights are hence yielded regarding the generalization of causative marking.

Here, we propose a new measure that quantifies the flexibility of causative use. Concretely, we employ the NSB entropy estimator (Nemenman et al., 2001), which measures variability with correction for the under-sampling issue. Longitudinal acquisition corpora, including the corpus we use in this study (Küntay et al., Unpublished), are commonly featured with the small sample size and the lack of representativeness of the sample. NSB estimator, by employing a Bayesian framework in its estimation, remedies this issue and has shown desirable results (Nemenman et al., 2001). With this estimator, we seek to maximally capture the extent of the generalization of causative use despite the challenge posed by the small data size.

We thus rely on the entropy estimation to depict the developmental trajectory of both lexical and morphological causatives. Meanwhile, we quantify the extent of object ellipsis in both causative constructions to look into the impact of ellipsis on the development of causatives. The aim of this study is to investigate the role of ellipsis in the Turkish children’s development of both causatives. We strive to answer (1) how pervasively the ellipsis of the essential patient argument for causal meaning occurs in both causatives in CDS and (2) how both causatives are acquired over time, in relation to the respective extent of object ellipsis.

Methods

Corpus

Our data come from a longitudinal Turkish corpus (Küntay et al., Unpublished), which includes naturalistic speech of 8 target Turkish children the speech of their caregivers. The recordings cover an age span from 8 to 36 months (see corpus details in Table 1). In our study, we included the data of 7 children, and left out the data of one child whose recordings stopped before 2 years old. The recordings were made in children’s home setting for 1 hour twice a month over a period of 29 months (8–36 months of age). Four

of the children came from a low socioeconomic background (parents with 5 or 8 years of education), and three came from a high socioeconomic background (parents with 11 or 15 years of education). At the beginning of the data collection, mothers had a mean age of 25.5 ($SD = 4.7$, range = 21–34) and fathers had a mean age of 29 ($SD = 3.5$, range = 26–35)⁶. None of the children had siblings.

Table 1: Details of the Turkish longitudinal corpus

Child	Sex	Hours of recordings	CDS		CS	
			Utterances	Words	Utterances	Words
1	F	57	15,121	53,073	12,061	23,224
2	M	40.5	25,272	81,484	17,118	32,526
3	F	51	27,610	105,653	17,472	32,601
4	F	56	34,241	105,966	19,561	30,473
5	M	41.75	20,600	67,259	15,547	25,755
6	F	46	30,192	103,689	15,495	32,342
7	F	51	31,371	102,033	16,107	23,725

Annotation

The corpus was partially annotated, namely the part-of-speech (POS) tagging, the morphological analysis and the syntactic parsing were incomplete. In order to target the verbs in the corpus and obtain the information of causative marking and argument structure, we employed an automatic parser, the ITU Turkish Natural Language Processing Pipeline (Eryiğit, 2014).

In addition, since our focus was on object ellipsis, we checked the performance of the parser with respect to the annotation of objects in the dependency parsing. We randomly extracted a subset of 100 utterances with at least one verb in each utterance, and manually examined the object ellipsis of all verbal constructions. The parsing results reached a micro F1-score of 0.82, ensuring the reliability of the ellipsis analyses.

⁶Note that the data for the age of parents of one child was missing.

Manual correction and categorization of lexical causatives

After the POS tagging by the ITU NLP pipeline, we extracted all the tokens tagged as verbs (864 stem types) that appeared in both CS and CDS. Subsequently, the second author (a Turkish native speaker) checked all the verb stems and removed 51 wrongly-tagged stems (non-verbs). There were also 53 stems that were in fact only partially parsed for morphological markers. These were further manually parsed, where both the causative and the passive markers were noted down for later analyses. Our analyses were based on the verb stems automatically stemmed by the parser.

In order to identify lexical causatives among the verbs, we used Shibatani’s criterion (Shibatani, 2002) that a lexical causative has to entail a change of state in its object (including a location state, a form state and a psychological state in our categorization). Relying on this criterion, the second author (a Turkish native speaker) and another native speaker manually coded the verbs that occurred in the corpus for causatives or non-causatives. The agreement was 88.9% (Kappa= .76).

Entropy estimation

Shannon (1948) originally proposed the entropy measure for quantifying the variability of a population. The entropy can be calculated as below:

$$H = - \sum_{i=1}^N p_i \log p_i \quad (1)$$

where N is the number of types in the population and p_i is the probability of the i -th type.

In practice, the estimation is done with a plug-in manner, namely the observed probability of each type and the observed total number of types are plugged in to determine the estimate. It has been shown that the negative bias of this plug-in estimator is inevitable, and it can be particularly severe if there are unobserved types (Basharin, 1959; Chao & Shen, 2003). The Nemenman-Shafee-Bialek (NSB) entropy estimator (Nemenman et al., 2001) was therefore proposed to remedy the under-sampling issue and showed desirable results. NSB is a Bayesian estimator that employs a mixture of Dirichlet distributions as its priors, which are later updated by the observed counts in the sample to yield the posterior estimate.

We used this estimator to measure the flexibility of causative use in this paper. In addition, NSB requires the information of the cardinality of the prior distribution. This cardinality means the total number of types in the population for which we estimate the entropy. We thus further employed the Smoothed Good-Tuning estimator (SGT) (Orlitsky et al., 2016) to help estimate this cardinality.

For lexical and morphological constructions, the cardinality estimated from SGT was based on different observations. For lexical causatives, the potential number of verb stem types was estimated with the observed lexical causatives. By contrast, the cardinality for morphological causatives should be the number of verb stem types that can theoretically take a morphological marker. Thus, the second author examined the verb stems in the corpus and ruled out a small number of stems that are ineligible to take a causative marker (26 stems, including equipollent or suppletive pairs and some reflexive verbs). The tokens of the remaining eligible stems were used to estimate the cardinality for the entropy estimation for morphological causatives.

Analyses

We conducted two analyses to investigate the object ellipsis of both causative constructions in CDS and children’s individual developmental trajectory of both constructions.

Analysis 1: ellipsis in CDS

We first conducted an analysis on the object ellipsis of both causative constructions in CDS. The idea was to quantify the proportion of object ellipsis in causative constructions that children hear, thus examining the reliability of the argument structure for causal inference. We excluded verb tokens used in passive voice, as the passive construction raises the patient to the subject position and might exhibit a different pattern of ellipsis (only 1.91% of the tokens were excluded; 4,086 out of 204,386). The causative constructions were bootstrapped (with replacement) for 1,000 iterations, 1,000 samples in each iteration, and we took the average ellipsis level over the 1,000 iterations for the statistical analysis. A multi-level Bayesian regression model was then built to test the difference between the ellipsis rate in lexical causative constructions and that in morphological causative constructions.

Analysis 2: development of causative constructions in children

We applied the entropy estimation in both CDS and CS, and later calculated the ratio of the entropy estimate in CS to that in CDS (henceforth referred to as “developmental ratio”) (Mazara & Stoll, 2019), so as to indicate how much children’s production has reached the respective adults’ level. We first measured this developmental ratio for the causative use. Then, to better position the development of causatives in the general picture of verb learning, we also measured the ratio for two other verb groups, namely non-causatives and all verbs.

Preliminary data analysis revealed a stage-like development of verbs for many individuals, where the child rapidly approaches the adults’ level after an initial flat growing stage, before s/he again stabilizes the development. We thus employed segmented analysis to identify the break points for such developmental trajectories. We primarily modeled the trajectories with two break points, with one break point as the alternative. With the segmented regression models, we compared the development across different verb groups.

Results

Analysis 1

Ellipsis is shown to be pervasive in both constructions (lexical: $M=.66$, $SD=.08$; morphological: $M=.56$, $SD=.23$; see the ellipsis levels for every individual in Fig. 1 for lexical causatives and Fig. 2 for morphological causatives). Morphological causatives exhibit a substantially lower ellipsis rate than lexical causatives (see Fig. 3).

Analysis 2

First, we compared lexical causatives with two other groups: non-causatives and all verbs. The development of lexical causatives shows little difference from the other two groups in terms of the break points and developmental rate in each stage. All three groups generally experience a 3-stage development for each child. For some children, nonetheless, the development of lexical causatives can exhibit a slight time lag or a slower developmental rate (see Child 4, 5, and 6 in Fig. 4: the development slope of lexical causatives in the first phase for Child 4 is slightly flatter; Child 5 starts the rapid development of lexical causatives a bit later than the other two groups; Child 6’s second phase of development is slower than the other two categories). It should also be noted

Figure 1: Object ellipsis of lexical causatives in child-directed speech

Figure 2: Object ellipsis of morphological causatives in child-directed speech

that the development of all three groups stabilizes at a ratio close to 1.0 from the age of around 800 days, which suggests an adult-like level of generalization of lexical causative semantics.

Figure 3: Comparison of object ellipsis between causative constructions. 95% credible interval of the posterior predictive distribution is displayed for each construction. Lexical: (0.62, 0.67); morphological: (0.50, 0.60)

Figure 4: Development of entropy ratio for all 7 children: lexical causatives, non-causatives, and all verbs.

Second, we compared morphological causatives with all verbs. The development of morphological causatives displays a clear difference compared to the overall development

Figure 5: Development of entropy ratio for all 7 children: Morphological causatives versus all verbs.

of verb lexicons (see Fig. 5). First, the onset of flexibility in the use of morphological causatives (i.e. non-zero entropy) is usually much later (ranging from 487 to 812 days of age) than that of general verb use (ranging from 253 to 430 days of age). Secondly, two major patterns of developmental trajectories are shown among different individuals. For Child 2 and 5, there is a clear stabilization phase of development in the end, but the developmental ratio for morphological causatives stays lower than that for all verbs, and this gap remains in the final phase. For the other children (except Child 6, for which the ratio drastically drops at around 3 years of age), there is not yet a stabilization phase for morphological causatives, especially for Child 1. Instead, there seems to be steady development, eventually approaching the level of the development of all verbs.

Discussion

Overall, our results suggest that children develop causatives in their first three years of life, despite the pervasive ellipsis in the speech they hear. Also, the pattern of development differs between lexical and morphological causatives. In the first analysis of object ellipsis, we found a large proportion of such ellipsis for both lexical and morpho-

logical causative constructions in CDS. More than half of the causative constructions, in either category, elide their object, which in theory poses a great challenge for children to infer the argument structure (Bates & MacWhinney, 1987; Bates et al., 1989; Kempe & MacWhinney, 1998). With such ellipsis of essential causal information, the acquisition of both causative constructions might be hindered. However, for lexical causatives, our Analysis 2 shows no major difference between the developmental trajectories of lexical causatives, non-causatives, and all verbs. Children’s use of lexical causatives by the age of 3 years becomes nearly as flexible as adults’ use.

We suggest that many other cues might be relevant to the acquisition of lexical causative meaning. First, morphological cues may substantially support verb learning, such as the accusative marker (Göksun et al., 2008; Ural et al., 2009) and verbal morphology like tense marking (Ural et al., 2009) in Turkish. More specifically, both Göksun et al. (2008) and Ural et al. (2009) have found that while the number of NPs/nominals stayed as a significant factor (a weaker effect shown by Göksun et al., 2008, compared to English claimed by Naigles et al., 1993; a small, significant effect shown by Ural et al., 2009), morphological devices exhibited clear facilitation in verb learning. Secondly, as others have previously pointed out (Narasimhan et al., 2005; Huang, 2012), discourse and extra-linguistic cues might be relevant to the acquisition of lexical causative meaning as well. As introduced earlier, objects retrieved in discourse or detected in the physical environment can remedy the missing essential units in the current linguistic expression.

For discourse contextual cues, in particular, supportive evidence includes the emergence of semantic and structural regularities from simple linear word co-occurrences (Mintz et al., 2002; Perfors et al., 2006; You et al., 2021). Inference of causative regularities might not necessarily rely on the explicit presence of the patient, but rather raw contextual linguistic units in discourse without presumptive syntactic knowledge. For instance, the repetition of lexemes across situations in the same discourse, often referred to as variation sets (Küntay & Slobin, 1996; Onnis et al., 2008), are prevalent across typologically diverse languages (Moran et al., 2019). These repetitive patterns can facilitate statistical inference that helps children discriminate causatives from other semantic categories. Explicit argument structure is thus not the prerequisite of lexical causative learning.

As for morphological causatives, the development shows a different pattern than lex-

ical causatives. We observed deviated development of morphological causatives from the growth of overall verb use. Instead of profiting from the explicit causative markers, morphological causatives overall do not exhibit a faster developmental rate. Further, as shown in Fig. 3, morphological causative constructions in fact involve less object ellipsis, which theoretically provides a more consistent and reliable cue for acquiring causal meaning (e.g., Bates & MacWhinney, 1987). The joint cues of argument structure and explicit marking thus do not play predominant roles in the acquisition of morphological causatives.

This lag of morphological causative development is in line with Göksun et al.’s (2008) findings regarding causal enactment with causative markers. Up to at least 5 years of age, children acquiring Turkish are still developing their causative morphology, thus being not fully capable of comprehending the morphological constructions. This has been recently corroborated by Ger et al. (2021), where they found late abstraction (at around age 4;10) of causative morphology for Turkish children in an experimental study. Similar late development of causative morphology has been observed in other morphologically complex languages as well, such as Quechua (Courtney, 2002) and Inuktitut (Allen, 1998).

Booij (1996) attributed the late acquisition of context-related inflections to their strong correlation with semantics. Coincidentally, in our study, some children (Child 2, 5, 7 in Fig. 5) only start to develop their causative marking when the lexical knowledge is established, as indicated by the almost stabilized development of all verbs. Also, many children (Child 1, 3, 4, 6, 7) keep the growth of morphological causatives at a moderate rate after the overall lexical developmental rate stabilizes, before eventually reaching the adult-like level. It is likely that morphological development is heavily contingent on semantic grounds. Advanced semantic understanding of lexical words might have to precede the generalization of morphological marking. Such lexical ground for grammatical development has been found in previous studies as well (Devescovi et al., 2005; Hoff et al., 2018; Marchman et al., 2004; Parra et al., 2011).

This link to semantics could in turn partly explain why morphological causative constructions in CDS render less object ellipsis. As Shibatani and Pardeshi (Shibatani & Pardeshi, 2002) suggested, the causal meaning expressed by morphological constructions is less direct than lexical words, thus lacking semantic saliency and requiring structural amendment. This can be exemplified by the sentence *bana kutuyu açtırdılar* (they made

me open the box) in example (4), where secondary causation is involved. Here, the ellipsis of *bana* (me) would make both causal relations implicit. As introduced earlier, the patient “me” can be seen as an intermediary agent that shows a higher level of agentivity, since it serves as the agent of the action of “open” as well. Consequently, the causal meaning can be difficult to infer without specifying this patient (intermediary agent) “me” in this sentence. Hence, the patient could be less elided to facilitate the inference and make causal meaning more transparent.

To summarize, we have found no hindrance of pervasive object ellipsis for Turkish children to generalize lexical causative meaning, and explicit argument structure is not a clear facilitator for the development of lexical and morphological causative constructions. Crucially, the lower level of ellipsis for morphological causatives in CDS shows no facilitation in children’s development of causative morphology, thus lending little support to the effect of structural information in meaning generalization at an early stage. In addition, we have observed a general lag of development of morphological causatives across individuals, and this effect is suggested to correlate with general lexical learning. Our general conclusion is that children learning Turkish, by the age of 3 years, acquire causative constructions despite the challenge posed by pervasive ellipsis. Future studies should pay more attention to discourse, morphological, and extra-linguistic cues that might better facilitate causative acquisition.

Data availability

Codes and encrypted and anonymized data can be accessed in <https://github.com/G-You/turkish-causative-acquisition>.

Acknowledgments

The results of this research are part of the project “The role of causality in early verb learning: language-specific factors vs. universal strategies” (Swiss NSF Grant agreement No. 100015_169712, Stoll, Daum), the project “Acquisition processes in maximally diverse languages: Min(ding) the ambient languages (ACQDIV)” that has received funding from the European Research Council (ERC) under the European Union’s Seventh Framework Programme FP7-2007-2013 (Grant agreement No. 615988; Stoll), and the NCCR Evolving Language, Swiss National Science Foundation Agreement No. 51NF40_180888 (Stoll, Daum).

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