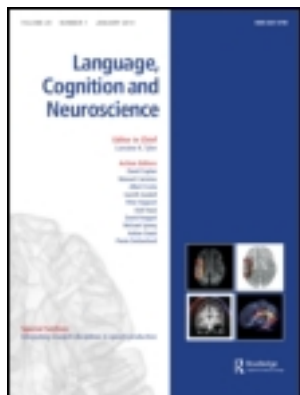


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### Early language-specificity of children's event encoding in speech and gesture: evidence from caused motion in Turkish

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## Early language-specificity of children's event encoding in speech and gesture: evidence from caused motion in Turkish

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Previous research on language development shows that children are tuned early on to the language-specific semantic and syntactic encoding of events in their native language. Here we ask whether language-specificity is also evident in children's early representations in gesture accompanying speech. In a longitudinal study, we examined the spontaneous speech and cospeech gestures of eight Turkish-speaking children aged one to three and focused on their caused motion event expressions. In Turkish, unlike in English, the main semantic elements of caused motion such as Action and Path can be encoded in the verb (e.g. *sok-* 'put in') and the arguments of a verb can be easily omitted. We found that Turkish-speaking children's speech indeed displayed these language-specific features and focused on verbs to encode caused motion. More interestingly, we found that their early gestures also manifested specificity. Children used iconic cospeech gestures (from 19 months onwards) as often as pointing gestures and represented semantic elements such as Action with Figure and/or Path that reinforced or supplemented speech in language-specific ways until the age of three. In the light of previous reports on the scarcity of iconic gestures in English-speaking children's early productions, we argue that the language children learn shapes gestures and how they get integrated with speech in the first three years of life.

**Keywords:** gesture; language; development; caused motion; Turkish

Children observe and understand many dynamic events as part of their daily life from early on and begin to communicate about them, using speech as well as gestures. This, however, is not a straightforward task. First of all, children need to tune into the requirements of the specific language they are born into since different languages package event components lexically and syntactically in different ways (Bohnenmeyer & Pederson, 201; Gentner, 1982; Gentner & Boroditsky, 2001; Hirsh-Pasek & Golinkoff, 2006; Talmy, 2000). Furthermore, gestural representations that accompany such language-specific expressions also vary in adult speakers (Gullberg, 2011; Kita & Özyürek, 2003; McNeill & Duncan, 2000; Kita, 2009). Previous cross-linguistic research has shown that children's speech is language-specific to a large extent in the encoding of event components (Allen et al., 2007; Berman & Slobin, 1994; Choi & Bowerman, 1991; Golinkoff & Hirsh-Pasek, 2008; Özçalışkan & Slobin, 1999; Slobin, Bowerman, Brown, Eisenbeib, & Narasimhan, 2011). Yet, relatively little is known about whether and how gestural expressions of events accompanying speech also

display language-specificity between one and three years of age. Previous studies on children's early speech-gesture patterns have focused mostly on English-speaking children (e.g. Özçalışkan & Goldin-Meadow, 2005, 2009).

The purpose of this study, therefore, is to provide insights about Turkish-speaking children's early gestures that represent event components and the relation of these gestures to early linguistic development (between one and three years). To do so, we focus on the domain of caused motion expressions (e.g. *she put the toy away*), where Turkish displays typologically language-specific patterning in speech (Furman, 2012). We ask whether the early development of different types of gestures (e.g. iconic and pointing) and their semantic relation to speech are modulated by the language-specific patterns of Turkish in this domain. Investigating the early development of event expressions multimodally and cross-linguistically is not only important in understanding the nature of children's event representations but is also necessary to unravel the nature of the initial links between speech and gesture.

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### *Learning to talk about caused motion across languages*

Caused motion events (e.g. a boy pulls a box into a room) are basic events where an Agent (the boy) performs an Action (pulling) that causes a Figure (box) to move in a spatial Path (into) to a Goal (the room). These semantic elements are mapped onto lexical and syntactic structures differently across languages (Talmy, 2000), leading to variation in the constructions preferred by speakers using these languages. *Satellite-framed* languages such as English tend to encode Action in a verb (e.g. *put* in (1)) and express Path in a satellite (e.g. *away* in (1)), that is outside of the verb. In contrast, speakers of *verb-framed* languages such as Turkish are more likely than speakers of satellite-framed languages to express these components in a single verb (as in (2)) – although depending on the verb type, expressing Path outside of the verb (e.g. in a spatial noun) is also possible in Turkish (Furman, 2012).

- (1) *The mother put the box away.*  
 (2) *Anne kutu-yu kaldır-di.*  
 Mother box-Accusative **put.away**-Past  
 ‘The mother put the box away.’

A number of cross-linguistic studies have examined the effects of such typological differences on children’s linguistic expressions of caused motion. An early study compared how child speakers of Korean, a verb-framed language, and English, a satellite-framed language, lexicalised components of caused motion events in spontaneous speech (Choi & Bowerman, 1991). In contrast to English, which encodes Action in a verb and expresses Path separately (e.g. *push up*), Korean, like Turkish, typically conflates Action with Path in the verb and optionally Figure and Ground in verbs to encode caused motion (e.g. *ollita* ‘cause something to ascend’). In their spontaneous speech, children showed sensitivity to language-specific patterns about caused motion from as early as 17–20 months. English-speaking children used Path particles like *up* or *in* to express caused changes of location, whereas their Korean-speaking peers expressed caused motion with verbs.

More recent studies have focused on a subcategory of caused motion, that is, *placement events*, in which an Agent causes an object to change its location by the Action of putting or taking. Slobin et al. (2011) compared how two-year-old speakers of four satellite-framed (English, Finnish, German and Russian) and four verb-framed (Hindi, Spanish, Tzeltal and Turkish) languages describe placement events. They found that children had already tuned into the typological characteristics of their language at the age of two. That is, children acquiring satellite-framed languages tended to

use various sorts of directional locative markers and focused on the Path element of the placement event. In contrast, those acquiring verb-framed languages typically used verbs, focusing on the Action of putting.

In sum, previous studies have shown that from two years onwards children are mostly sensitive to the language-specific encoding of caused motion and placement in the ambient language. However, with the exception of Choi and Bowerman (1991), previous studies have focused on placement events only and have not examined the emergence of caused motion event expressions in general. Furthermore, previous research has not taken into account differences in the argument omission patterns across languages to see which aspects of events would be encoded or omitted in languages with argument ellipsis possibilities, such as in Turkish.

### *Cospeech gestures and cross-linguistic variation*

Cospeech gestures are spontaneous and frequent accompaniments to speech, and expressions in the two modalities have been found to be tightly integrated pragmatically, semantically and temporally (Bernardis & Gentilucci, 2006; Clark, 1996; Kendon, 2004; Kita & Özyürek, 2003; McNeill, 1992, 2005). Cospeech gestures serve different semiotic functions such as pointing gestures that indexically refer to objects, iconic gestures that bear visual resemblance to the events and objects they depict (e.g. extending fist-shaped hands away from body to depict someone pushing a cart), or conventional gestures that have agreed upon meanings (e.g. both hands turned palm up with a shrug to mean, ‘I don’t know’).

Interestingly, in spite of their visual resemblance to events and objects, iconic gestures that represent event components have been found to vary cross-linguistically in adults (see Kita, 2009 for a review). Specifically, gestures are sensitive to how semantic information is packaged syntactically, that is, how event components are packaged in the verb versus distributed to other elements such as prepositions. For instance, speakers of verb-framed languages such as Japanese and Turkish encode the Manner and Path components of a spontaneous (i.e. intransitive) motion event in separate verbs and clauses in speech, and also use separate gestures for each element. In contrast, speakers of a satellite-framed language like English encode these elements within a single clause, with a verb and a satellite, and use a single gesture to represent both Manner and Path (Kita & Özyürek, 2003; Özyürek, Kita, Allen, Furman, & Brown, 2008).

In addition to being sensitive to the syntactic packaging of semantic information, what is represented in iconic gestures also seems to vary according to verb semantics of the specific language. For instance,

placement events are encoded using the simple verb *mettre* ‘put’ in French. In contrast, speakers of Dutch encode these events by using placement verbs such as *leggen* ‘lay’ and *zetten* ‘set/stand’ in accordance with the shape of the object that is placed. Paralleling these distinctions, adult French speakers have been found to use iconic gestures that encode only the Path or direction of movement in their placement descriptions, whereas Dutch speakers’ gestures represent the form of the moved object (i.e. the Figure via the hand shape) as well as the direction of movement (Gullberg, 2011).

### *Development of relations between speech and gesture*

Speech and gesture develop in close relation to each other during early and late childhood (e.g. Bates, 1976; Iverson & Goldin-Meadow, 2005; Özçalışkan & Goldin-Meadow, 2005; Özyürek et al., 2008). Research on children’s gestures and their relation to language development has focused on two aspects: the types of gestures (e.g. point and iconic) children use at different developmental stages and their semantic relation to speech (i.e. gestures reinforcing, supplementing or disambiguating what is expressed in speech) (Cartmill, Demir, & Goldin-Meadow, 2012). While most previous research on children’s early speech-gesture patterns has been conducted with English-speaking children, a few studies have recently investigated whether and how the language children speak influences the development of their gestures.

Before starting to speak, young children communicate by using gestures (Bates, 1976; Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Greenfield & Smith, 1976). First produced around 10 months of age; these are typically *pointing* gestures that refer to entities present in the immediate environment of the child (e.g. pointing at a teddy bear). In contrast to the abundant use of points, early iconic gestures are reported to comprise 1–5% of young children’s spontaneous gesture repertoire until the age of three (Iverson, Capirci, & Caselli, 1994; Nicoladis, Mayberry, & Genesee, 1999; Özçalışkan & Goldin-Meadow, 2005, 2009). Iconic gestures have been found to increase around 26 months (Özçalışkan & Goldin-Meadow, 2011), and their comprehension also progresses around this age (Namy & Waxman, 1998; Namy, 2001; Namy, Campbell, & Tomasello, 2004). It has been proposed that this increase may be due to a general development of children’s representational and/or relational thinking, which occurs after age two (Özçalışkan & Goldin-Meadow, 2011), since such gestures mostly represent the relation of entities to other objects, locations, etc.

Young children use gestures to reinforce and enhance (i.e. supplement) the information they convey in speech (Özçalışkan & Goldin-Meadow, 2005). Children

at the one-word stage supplement their speech via gestures to produce a variety of constructions such as Argument plus Argument (e.g. by saying *Mommy* and pointing at a shoe to mean ‘Mommy’s shoe’) or Verb Plus Argument (e.g. by saying *Eat* and pointing at an apple) (Özçalışkan & Goldin-Meadow, 2005, 2009). Such supplementary gesture–word combinations are found to predict children’s later language development. For instance, the onset of supplementary gesture–speech combinations is found to predict the onset of two-word speech (Iverson & Goldin-Meadow, 2005). Once children become adept at using a construction in speech, they are found to decrease their use of supplementary gestures significantly while expressing these constructions. Thus, supplementary gestures are claimed to pave the way for language development (Özçalışkan & Goldin-Meadow, 2009). However, so far there has been no description of the semantic roles speech and gesture fulfil in relation to each other when children use these constructions in the first years of life.

Another study, directly relevant to our investigation in this paper, recently examined how English-speaking children aged two and a half to five talked and gestured about a particular caused motion event elicited by description of a stimulus item where the experimenter pushed a ball across a small pool with the help of a stick (Göksun, Hirsh-Pasek, & Golinkoff, 2010). The results of this study confirmed previous findings about the late emergence of iconic gestures in an elicitation paradigm. That is, very few iconic gestures were used before the age of four to five and more points than iconics were used across all ages. Children of all ages used supplementary gestures, and the semantic elements supplemented in gesture changed with age. Younger children were more likely to supplement their speech by location gestures (points at the goal of the located object), whereas older ones used only instrument gestures (iconic gestures such as a fist-shaped hand representing the stick) as supplementary. Supplementary gestures representing only the instrument continued to augment children’s speech even at age five.

A few studies have investigated the development of representations in iconic gestures in older children (ages 3–12) learning different types of languages. These studies show that the development of the representations manifested in iconic gestures is not universal and can be modulated by the mastery of the language-specific constructions children are learning in certain languages. For example, Özyürek et al. (2008) have examined how Turkish- and English-speaking children’s gestures (aged three to nine) begin to show adult-like diversity in the expression of the Manner and Path components of spontaneous motion. While English-speaking adults express Manner in the verb and Path in the satellite (e.g. *the ball rolled down the hill*), that is, in

a single verbal clause, Turkish adults talk about Manner and Path using separate verbs in two successive clauses (e.g. *top yuvarlanarak aşağı indi* ‘the ball went down while rolling’). In line with their speech patterns, English speakers use a single gesture to conflate Manner and Path while Turkish speakers use separate gestures for each component (Manner only and/or Path only), corresponding to the use of separate verbs. The developmental study found that even though Turkish- and English-speaking children’s speech was adult-like and different from each other at age three, the gestures of both groups of children looked similar in the sense that they all expressed the Manner and Path components in separate gestures. Thus, Turkish-speaking children were target-like from the beginning, whereas English-speaking children were not. It was only around nine years of age that English-speaking children started to gesture in adult-like ways where both components were represented in a single gesture. These results suggested that early on, children prefer to separately gesture semantic elements instead of conflating them into one gesture unit. This was attributed to the fact that the unit of processing in children is smaller than a clause in early ages when it comes to aligning semantic information in speech and gesture. Thus although they were able to use one-clause constructions conveying both Manner and Path in their speech, English-speaking children could only produce separate gestures that overlapped with the semantic information either in the verb or the satellite but not one gesture that conflated the two semantic elements that spanned a verb plus satellite construction. Finally, in a recent study, Gullberg and Narasimhan (2010) have shown that in the domain of placement events, children’s knowledge of verb semantics influences the development of representations in iconic gestures in Dutch-speaking children. Unlike adults and five-year-olds who represented both the Figure that moves and the Path of movement in their gestures of placement events (e.g. fist-shaped hands moving from right to left), three-year-old Dutch children encoded only the Path in gesture (e.g. a flat hand with no discernable shape moving from right to left). Gesture use was linked to what could be expressed in the verb. That is, those children who erroneously generalised *leggen* ‘lay’ for all placement events only gestured about Path. In contrast, those who used *leggen* ‘lay’ and *zetten* ‘set/stand’ correctly for horizontal and vertical placement (i.e. thus indicating an understanding of the role of Figure orientation in verb use) also represented Figures in their gestures like adults.

While previous cross-linguistic studies examined older children, one study has compared the type of gestures used by English–French bilingual children between ages one and three and found the emergence

of iconic gestures to be linked to proficiency (measured by mean length of utterance) in each language (Nicoladis, Mayberry, & Genesee, 1999). Children used more iconic gestures in the language where they were found to use longer utterances, showing early links between type of gesture and specific language (Nicoladis, 2002; Nicoladis, Mayberry, & Genesee, 1999). This study, however, has not investigated whether such differences could be linked to the nature and the complexity of the linguistic representations children were using.

Up to now, no study has examined whether the early development (from age one to three) of different gesture types (i.e. points and iconics) and how gestures express event components in relation to speech (e.g. supplementing and reinforcing) are modulated by the type of language children learn. The aforementioned studies on the iconic gestures of older children (Gullberg & Narasimhan, 2010; Özyürek et al., 2008) suggest that the development of iconic gestures does not follow a universal path but is sensitive to the way information is expressed in verbs in different languages. If the development of iconic gestures is indeed sensitive to the information expressed in verbs, then acquiring verbs early in some languages (i.e. in the domain of caused motion expressions) might modulate not only the content of iconic gestures but even their emergence and frequency in the first years of life compared to other languages where there is less emphasis on verbs, especially in expressing caused motion.

### *Present study*

In this study, we examine how Turkish-speaking children start to talk about caused motion events by examining the spontaneous speech and gestures of eight children longitudinally from the age of 12 to 36 months. We also study children’s cospeech gestures to find out what types of gestures are used, the semantic elements encoded and how the early speech–gesture relationship develops in Turkish.

We focus on caused motion events in which a person causes an object to change place, by performing different Actions such as pulling, throwing, pouring, ripping, etc. Turkish is an interesting language to track the development of caused motion expressions because the Action and the Path components of motion can be expressed in verbs, and verbs emerge early in child speech productions as documented in corpus studies (Aksu-Koç & Slobin, 1986). This is not to claim that verbs are acquired earlier than nouns, but the available corpus comparisons of early morphology find as robust use of bound verbal suffixes as for nominal suffixes (Ketrez & Aksu-Koç, 2002), suggesting that the two lexical categories emerge simultaneously. In addition, a recent maternal report study using the adaptation of

MB-CDI (Turkish Communicative Development Inventory) found that at 16 months, 7% of the nouns and 5% of the verbs in the inventory are comprehended by children, while these percentages are 80% and 82%, respectively, at 34–36 months (Aksu-Koç et al. 2011). Thus, the use of verbs might not be as delayed in comparison to nouns as in English (Gentner, 1982; Gentner & Boroditsky, 2001).

Moreover, noun phrases can be omitted in Turkish by both adults and children (Demir, So, Özyürek, & Goldin-Meadow, 2012; Göksel & Kerslake, 2005; Güranlı, Nakipoglu Demiralp, & Özyürek, 2007; Küntay & Slobin, 1996), creating utterances where the focus is on verbs. For instance, it is perfectly acceptable to utter Verb Only constructions, as in (3), to describe a situation where one throws a ball onto a couch. In this case, the verb encodes Action (and Person through the use of the person marker), and the remaining semantic elements can be recovered from the discourse context.

- (3) *At-ti-m.*  
 throw-Past-1sg.  
 ‘(I) threw.’

All of these properties set Turkish apart from languages like English where the Path of a caused motion event needs to be expressed outside of the verb, all arguments have to be obligatorily spelled out, and there is an early bias to learn nouns compared to verbs (Gentner, 1982; Gentner & Boroditsky, 2001). We investigate whether and how the language-specific factors mentioned above influence Turkish-speaking children’s early event representations in speech and particularly in gesture, concentrating on the types of gestures used, the event components represented and the semantic relations between speech and gesture.

### Predictions

With regard to the development of verbal expressions of caused motion events, we predict that Turkish-speaking children will start to talk about these events by using Verb Only utterances encoding Action (with or without Path), similar to child speakers of other verb-framed languages that allow nominal ellipsis (Choi & Bowerman, 1991; Narasimhan & Brown, 2009; Slobin et al., 2011). Moreover, we expect children to omit basic semantic elements like Figure or Path even in later ages when they can express these elements, due to the fact that omission of nouns can be pragmatically licensed in Turkish.

With regard to the types of gestures children use, if the emergence of iconic gestures reflects a general cognitive development of relational thinking that

occurs later (Özçalışkan & Goldin-Meadow, 2011), we may expect children to use very few iconic gestures and many points early on. In this case, Turkish children would be expected to increase their use of iconic gestures later in development, like their English-speaking peers. However, if the development of iconic gestures is sensitive to the way semantic information is expressed in verbs (Gullberg & Narasimhan, 2010; Özyürek et al., 2008), we expect Turkish children to produce iconic gestures early on and as frequently as pointing gestures, unlike their English-speaking peers, due to their early preference of using verbs (in the encoding of caused motion). Turkish children, then, would be expected to use iconic gestures representing Action as well as Path early on due to the use of verbs in speech encoding these components. Children might also encode other core semantic elements in their iconic gestures such as Figure and Goal because they use verbs in speech. Since verbs are relational categories that convey events in which various noun arguments partake (Gentner & Kurtz, 2005), children may encode these arguments in gesture even if they have not expressed them in speech, a tendency we discuss below.

With regard to the development of the speech–gesture relationship, we expect gestures to reinforce and supplement speech, in line with the findings of Özçalışkan and Goldin-Meadow (2005, 2009) in English-speaking children. However, given that Turkish is a language in which arguments are omitted regularly, we might expect supplementary gestures to be used equally frequently at younger and older ages, representing basic yet omissible components of caused motion events such as Figure, Goal or Path. Gestures might continue to have a supplementary role both early on and later in life in such languages due to serving pragmatic functions, unlike in English where omission does not frequently occur. On the other hand, if supplementation through gestures simply paves the way for children’s ability of expressing the complex arguments of a verb, we would expect supplementation to decrease in Turkish-speaking children as well in later ages (even if they do omit arguments for pragmatic reasons).

## Method

### Data

Using the Koç University Longitudinal Language Development Database (Ural, Yüret, Ketrez, Koçbas, & Küntay, 2009), we sampled the spontaneous speech and cospeech gestures of eight Turkish-speaking children (six females). The children were videotaped at home while engaged in daily activities such as eating, playing and conversing with their caregivers (parents, relatives or

nannies) or occasionally with the researchers. One-hour sessions were sampled for each child every month between the ages of 12 and 36 months and on average, 18 sessions were analysed per child.

### Speech coding

In total, 980 utterances that referred to caused motion events were transcribed and then coded for the type of construction, and the semantic elements represented. A comprehensive list of verbs illustrating the different types of caused motion events children talked about is given in the Appendix.

Three main construction types were distinguished: Verb Only, Verb Plus Arguments and Argument Only. The Verb Only category denotes those utterances that included only a verb. Depending on the type of verb used, these constructions encoded either Action, as in (4a) or Action and Path as in (4b).

- (4) a. *At-acak.*  
throw-Future  
Action  
'(He/she) will throw'. (Ekin, 21 months)
- b. *Tak.*  
attach/put.on  
Action + Path  
'(You) attach/put.on'. (Ogün, 26 months)

The Verb Plus Arguments category denotes constructions that included a verb and one or more of its arguments. We also coded for the semantic elements in these constructions, such as Action and Figure (5a) or Action, Figure and Goal/Path (5b). Note that as it is very hard to distinguish between Goal and Path, in some cases in Turkish, we chose to code these semantic elements as one category. Additionally, Agents were coded only if they were mentioned as nouns or pronouns. Person marking on the verb was not coded as an Agent element since it functions mainly as an agreement marker in Turkish and does not fully specify who the Agent is, as shown in examples (4a) and (5a):

- (5) a. *Balık-lar-ı çek-iyor-lar.*  
fish-Plural-Accusative pull-Present-3pl.  
Figure Action  
'(They) are pulling the fish.' (Cansu, 30 months)
- b. *El-im-e krem sür-dü-k.*  
hand-Possessive-Dative cream spread.on-Past-1pl.  
Goal/Path Figure Action + Path  
'(We) spread cream on my hand.' (Can, 36 months)

The Argument Only category occurred very rarely and included the utterances that contained no verb and only arguments (see example 6). These constructions

were used as answers to questions posed to the child and expressed the Agent, Figure or Goal/Path.

- (6) *Ora-ya.*  
There-Dative  
Goal/Path  
'There' (Senem, 31 months, in response to experimenter's question 'Where shall I attach this?')

To assess reliability of the coding, a second coder who was a native speaker of Turkish independently coded 20% of the data and transcribed the event descriptions that had been segmented by the original coder. The agreement between the coders for speech transcription was 92%. In cases of discrepancy, the original coder's decisions were adopted.

### Gesture coding

Initially, all bodily actions accompanying relevant caused motion event speech were taken into consideration. Among these, 77 were manipulative actions on objects (e.g. actually putting a bag under a table while saying *I am putting the bag under the table*). We excluded these real actions from the gesture category since their level of communicativeness was not clear in each context, following upon most previous research on children's spontaneous gestures (but see Andrén, 2010). We coded as gestures the remaining 389 bodily actions that accompanied utterances about caused motion events for type, the semantic element represented, and the speech-gesture relationship. For type, gestures were categorised as point, showing or iconic (Bates, 1976; Bates et al., 1979; McNeill, 1992). Points were gestures where the child pointed at an object or location usually with an extended index finger, as illustrated in (7):

- (7) Speech: *Ora-ya dök-tü-m.*  
ThereDative pour-Past-1sg.  
Goal/Path Action  
'(I) poured there'  
Gesture: Index finger points at carpet.  
Goal  
(Burcu, 33 months)

Showing gestures were those where the child held an object up to show it, as in (8).

- (8) Speech: *Koy-du-m bak.*  
put-Past-1sg. Look  
Action  
'Look, (I) put (them).'
- Gesture: Holds up plastic toy cups in both hands.  
Figure  
(Tuğçe, 33 months)

Iconic gestures represented Action either on its own or with other semantic elements such as Figure and Path incorporated into the Action gesture, as in (9). Event components other than Action were rarely depicted alone. For instance, children did not represent Figures by tracing their size and shape (drawing a circular shape in the air to represent a ball):

- (9) Speech: *Tenis top-u-nu böyle duvar-a at-tı-m.*  
 tennis ball- Accusative like.this wall-Dative throw-Past-1sg.  
 Figure Goal/Path Action  
 ‘(I) threw the tennis ball to the wall like this’  
 Gesture: Right hand cupped as if holding a ball moves from right to left.  
 Action, Figure, Path  
 (Senem, 31 months)

Gestures were also coded for the semantic elements (e.g. Action, Agent, Figure, Goal, Path or any combinations of these) they represented in relation to the framing of the co-occurring speech (10a) as well as the visual features of the gesture such as hand shape and direction of movement (10b). Goal and Path were coded as separate categories in gesture since it was possible to distinguish them, as Goals were depicted with points and Paths with iconic gestures. Agent was coded in gesture only in cases where there was a separate point or iconic gesture representing it:

- (10) a. Speech: *Bura-ya koy-abilir-sin.*  
 here-Dative put-Possibility-2sg.  
 Goal/Path Action  
 ‘(You) can put (it) here’  
 Gesture: Right hand index finger points at the arm-chair.  
 Goal  
 (Can, 31 months)
- b. Speech: *Koy-muş-lar çiçek-ler-i.*  
 put-Evidential-3pl. flower-Plural-Accusative  
 Action Figure  
 ‘(they) put the flowers’.  
 Gesture: Both cupped hands move from left to right.  
 Action, Figure and Path  
 (Senem, 31 months)

Finally, gestures could be related to the co-occurring speech in three different ways (Özçalışkan & Goldin-Meadow, 2005, 2009). Reinforcing gestures expressed either the same information as, or in some cases, less information than the utterance they occurred with, as shown in (11):

- (11) Speech: *Burn-u-na sok-uyor.*  
 nose-Possessive-Dative put.in-Progressive  
 Goal/Path Action + Path  
 ‘(He/She) puts (it) in his/her nose’.  
 Gesture: Points at own nose.  
 Goal

Relationship: Reinforce  
 (Ogün, 32 months)

Supplementary gestures added semantic elements not conveyed in speech, as seen in (12):

- (12) Speech: *Kopar-dı-m.*  
 rip.off-Past-1sg.  
 Action + Path  
 ‘(I) ripped (it) off’  
 Gesture: Right hand index finger points at a notebook.  
 Figure  
 Relationship: Supplement  
 (Ekin, 20 months)

Disambiguating gestures clarified the referent of any deictic word in speech, as in (13):

- (13) Speech: *Anne şu-na da su koy-sana.*  
 Mommy this-Dative also water put-Imperative  
 Goal/Path Figure Action  
 ‘Mommy put water in that one, too’.  
 Gesture: Holds up a water bottle  
 Goal  
 Relationship: Disambiguate  
 (Ogün, 30 months)

Due to the abundance of iconic gestures in our data (unlike previous research which found mainly points for this age group), we saw that in many cases a gesture could have more than one relation to speech. Iconic gestures, by nature, frequently encoded multiple semantic elements and thus were related to speech in different ways. For instance, the gesture in (10b) reinforces speech because the semantic elements Action and Figure are represented in both modalities. It also supplements speech because it encodes Path, which is not represented in the accompanying speech. We noticed three main categories: reinforcing only, supplementing and disambiguating. The last two categories also had in many cases a reinforcing semantic relation to speech. Overall, 58% of the supplementary gestures and 22% of the disambiguating ones contained semantic elements that also reinforced speech. Since we did not want to exclude some gestures from our analyses (i.e. either those with only one relation or multiple relations to speech), gestures were categorised as *supplementary*, if they only supplemented or supplemented and reinforced speech, and as *disambiguating*, if they only disambiguated or disambiguated and reinforced speech. Gestures went into the *reinforcing* category if their sole function was to reinforce.

To establish reliability of the gesture coding, a second coder judged the gesture type (i.e. iconic, point, showing as well as real action, i.e. non-gesture), the semantic elements encoded in gesture (i.e. Action,



Agent, Figure, Goal, and Path) and the relationship between speech and gesture (i.e. reinforcing, disambiguating and supplementing) for 20% of the gesture strokes that had been identified and segmented by the original coder. The agreement between coders was 94% for gesture type,<sup>1</sup> 93% for semantic element type and 98% for speech gesture relationship. In cases of discrepancy, the judgement of the original coder was adopted.

## Results

The statistical analyses were performed with the data divided into two age groups: 14–26 months<sup>2</sup> and 27–36 months. We set the cut-off point to be 26 months because English-speaking children have been found to both comprehend (Namy, 2001; Namy, Campbell, & Tomasello, 2004; Namy & Waxman, 1998;) and produce (Özçalışkan & Goldin-Meadow, 2011) iconic gestures from this age onwards. Moreover, English-speaking children also decrease their use of gestures to supplement speech after the age of 26 months (Özçalışkan & Goldin-Meadow, 2009). We were thus interested in whether similar trends could be found in our data.<sup>3</sup>

## Speech

### Type of constructions

First, we checked if children, indeed, started to talk about caused motion events using verbs that encode Action and by omitting arguments as would be expected given the typological properties of Turkish. Table 1 presents the mean number of different construction types each child used (i.e. Verb Only, Argument Only or Verb Plus Argument) for expressing caused motion events across all sessions in each age group. To determine whether construction use changed with age, a 3 (Construction Type)  $\times$  2 (Age Group) ANOVA was conducted with age group and construction type as within subject factors. This yielded a significant main effect for construction type,  $F(2, 74) = 45.5, p < 0.001$ . That is, Argument Only constructions were used less frequently than Verb Only and Verb Plus Arguments constructions overall (Bonferroni,  $p$ 's  $< 0.001$ ). The use of different constructions in speech

did not change with age,  $F(1, 37) = 2.4, p > 0.05$ . Construction type and age, however, interacted significantly,  $F(2, 74) = 16.17, p < 0.001$ , such that the use of Verb Plus Arguments increased with age (Bonferroni,  $p < 0.005$ ). Age did not influence the use of any other construction. In the 14–26 month age-period, Verb Only constructions were used more frequently than other types of constructions (Bonferroni  $p$ 's  $< 0.01$ ). In addition, Verb Plus Arguments constructions were used more frequently than Argument Only ones during 14–26 months (Bonferroni,  $p < 0.01$ ). In the 27–36 month age-period, Verb Plus Arguments constructions were used the most frequently, while Argument Only constructions were used the least (Bonferroni,  $p$ 's  $< 0.001$ ). These results confirmed our hypothesis that Turkish-speaking children begin to talk about caused motion by using verbs on their own. Even though children increased their use of Verb Plus Arguments constructions in the later developmental period up to age three, they still continued to use Verb Only utterances and omitted arguments, as can be seen in Table 1.

### Semantic elements

We then examined the semantic elements explicitly mentioned in speech and checked whether these mentions changed with age. The mean number of utterances containing each semantic element is depicted in Table 2. We conducted a 4 (Semantic Element Type)  $\times$  2 (Age Group) ANOVA on the frequency of utterances containing different semantic elements per age group and found that children's mention of semantic elements differed significantly,  $F(3, 111) = 69.24, p < 0.001$ . Overall, Action was encoded more frequently than all other semantic elements in speech (Bonferroni,  $p$ 's  $< 0.001$ ), and Figure was represented more than Goal/Path and Agent (Bonferroni,  $p$ 's  $< 0.01$ ). Children's mention of elements also changed with age,  $F(1, 37) = 6.74, p < 0.05$ , such that all elements were encoded more frequently in later ages. There was no significant interaction between semantic element type and age,  $F(3, 111) = 1.35, p > 0.05$ .

Thus, Turkish children, as expected from the acquisition patterns of verb-framed languages, started talking about caused motion mainly by encoding the

Table 1. Mean number (SD) of each construction per session.

	Verb Only	Verb Plus Arguments	Argument Only
14–26 months	10.03 (10.01)	5.16 (8.77)	0.47 (1.25)
27–36 months	6.43 (5.71)	13.89 (11.73)	0.54 (1.06)

Table 2. Mean number (SD) of utterances containing each semantic element per session.

	Action	Agent	Figure	Goal/Path
14–26 months	15.26 (16.33)	2.37 (5.27)	2.61 (4.1)	1.55 (2.48)
27–36 months	20.32 (16.06)	4.09 (4.39)	8.54 (7.41)	5.89 (5.76)

Action element and over time increased the mention of other elements, even though in the 27–36 months period, they still continued to omit some of these event components.

Next, we investigated whether this type of event encoding had reflections in the way gestures represented event components.

### Gesture

#### Gesture type

We first examined the number of different types of cospeech gestures used by each child in their caused motion expressions per session, shown in Table 3. We had predicted that the early use of Action verbs would elicit the use of iconic gestures also encoding at least the Action element. We conducted a 3 (Gesture Type)  $\times$  2 (Age Group) ANOVA on the frequency of different gesture types and found no significant difference in children's use of gestures across the two age groups,  $F(2, 44) = 2.9, p > 0.05$ . The use of different gesture types did not change with age,  $F(1, 22) = 1.4, p > 0.05$ , and gesture type and age did not interact,  $F(2, 180) = 0.004, p > 0.05$ . Thus, all gesture types (i.e. iconic, pointing and showing) were used with equal frequency overall, with children displaying no preference for pointing gestures over iconic ones even in the 14–26 month age-period.

To further illustrate the early emergence of iconic gestures in Turkish, we report the age of onset for pointing and iconic gestures in our sample. As can be seen, iconic gestures encoding caused motion events emerge on average at 22.5 months, that is, before 26 months, the age that English-speaking children have been reported to use these gestures (Özçalışkan & Goldin-Meadow, 2011). It is also important to note that the earliest emergence of iconics was at 19 months in two of the children in our data. Interestingly, points do not seem to be used much earlier than iconic gestures in the context of caused motion constructions (Table 4).

#### Semantic elements

We then examined the semantic elements represented in gesture across the age groups. We investigated whether, similar to their speech, children's gestures would represent Action as well as the other basic semantic elements. The mean number of gestures containing

Table 3. Mean number (SD) of gesture types per session.

	Point	Showing	Iconic
14–26 months	2.24 (3.57)	1 (2.04)	1.88 (2.84)
27–36 months	2.63 (3.09)	1.39 (2.59)	2.2 (3.82)

Table 4. Age of onset (months) for pointing and iconic gestures for each child.

	Point	Iconic
Burcu	27	28
Can	15	19
Cansu	21	21
Ekin	15	19
Irem	24	25
Ogun	23	25
Senem	22	22
Tugçe	31	21

each semantic element is depicted in Table 5. We conducted a 5 (Semantic Element Type)  $\times$  2 (Age Group) ANOVA on the frequency of gestures containing different semantic elements per age group and found that children's gestural encoding of semantic elements differed significantly,  $F(4, 88) = 11.83, p < 0.001$ . Overall, Action and Figure were gesturally represented more frequently than Path (Bonferroni,  $ps < 0.05$ ), paralleling results in speech. Additionally, Agent was encoded in gesture less frequently than all other semantic elements except Goal (Bonferroni,  $ps < 0.01$ ). Age did not influence the encoding of semantic elements in gesture,  $F(1, 22) = 1.04, p > 0.05$ , and there was no significant interaction between semantic element type and age  $F(4, 88) = 1.69, > 0.05$ .

#### Speech-gesture relationship: types and semantic elements

To determine whether early speech-gesture relations also displayed language-specificity, we calculated the mean number of different types of gestures in relation to speech (i.e. reinforcing, disambiguating and supplementing) in the two age groups (see Table 6) and computed a 3 (Gesture Function Type)  $\times$  2 (Age Group) ANOVA. This ANOVA showed a difference in children's frequency of use of reinforcing, disambiguating and supplementary gestures across the two age periods,  $F(2, 42) = 5.52, p < 0.01$ . Post-hoc tests with Bonferroni adjustment revealed that overall children used supplementary gestures more than disambiguating ones,  $p < 0.01$ . There were no other significant differences. Age did not influence the production of gestures with different functions,  $F(1, 21) = .79, p > 0.05$ . There also was no significant interaction between gesture type and age,  $F(2, 42) = 2.7, p > 0.05$ .

Lastly, we were also interested in whether different gesture types were preferred in certain types of speech-gesture relations. Previous research has found different speech-gesture relations to be mainly fulfilled by points in early development (Özçalışkan & Goldin-Meadow, 2009), so we aimed to investigate whether the many iconic gestures in our data were involved in certain speech-gesture relations more than others – further

Table 5. Mean number (SD) of gestures containing each semantic element per session.

	Action	Agent	Figure	Goal	Path
14–26 months	1.91 (3.01)	0.09 (.29)	2.35 (3.71)	1.7 (2.58)	1.09 (2.61)
27–36 months	2.08 (2.98)	.08 (.27)	3.38 (4.59)	2.03 (2.42)	1.49 (2.35)

detailing the language-specificity of gesture use in a typologically different language. Figure 1 depicts the mean number of different gesture types fulfilling each function across the two age groups.

A 3 (Gesture Function) × 3 (Gesture Type) × 2 (Age) ANOVA found a main effect for gesture function,  $F(2, 40) = 4.14, p < 0.05$ , but no effect for gesture type,  $F(2, 40) = 2.77, p > 0.05$  or age,  $F(1, 20) = 1.35, p > 0.05$ . Overall, supplementary gestures were used more than disambiguating ones (Bonferroni  $p < 0.05$ ). Gesture function and type interacted significantly,  $F(4, 80) = 3.74, p < 0.01$ . Post-hoc analyses with Bonferroni adjustment revealed that both iconics and points reinforced speech more frequently than showing gestures ( $ps < 0.05$ ). All types of gestures supplemented speech with equal frequency,  $ps > 0.05$ . In contrast, both points ( $p < 0.05$ ) and showing gestures ( $p = 0.058$ ) were used more than iconics to disambiguate the information in speech. Overall, iconics reinforced and supplemented speech more than disambiguating it,  $ps < 0.05$ . Points were used with equal frequency for each function,  $ps > 0.05$ , and showing gestures disambiguated and supplemented speech more than reinforced it ( $ps < 0.05$ ). Thus, Turkish-speaking children systematically use certain gesture types in relation to speech, further illustrating the language-specificity of multimodal caused motion expression in Turkish.

**Discussion**

This study investigated whether children’s early gestures, between one and three years, representing event components show language-specificity by focusing on the domain of caused motion expressions. We focused on Turkish, where verbs are acquired early, the Action and Path components of caused motion can be

Table 6. Mean number (SD) of different types of gestures in relation to speech per session.

	Reinforcing	Disambiguating	Supplementary
14–26 months	1.09 (1.27)	0.95 (2.48)	3.82 (4.38)
27–36 months	1.9 (3.9)	2.13 (2.07)	2.41 (3.73)

expressed in verbs, and the arguments of a verb can be omitted. We asked three specific questions. First, do children start talking about caused motion, using verbs that encode Action (with or without Path) as would be expected from speakers of a verb-framed and argument-omission language? Second, does the early use of such verbs influence the type of gestures children use, and the semantic elements represented in these gestures? Third, is there any language-specific development in the relationship between speech and gesture and in how semantic elements are distributed across the two channels of expression?

**Children’s early tuning into language-specific patterns: emphasis on verbs**

We found that language-specificity in caused motion event descriptions was evident from the start. That is, Turkish children started to talk about caused motion using only verbs similar to children speaking other verb-framed languages (Choi & Bowerman, 1991; Narasimhan & Brown, 2009; Slobin et al., 2011), and unlike their peers speaking satellite-framed languages who use Path particles like *up* or *in* to describe these events (Choi & Bowerman, 1991; Slobin et al., 2011). After the age of 27 months, Verb Only constructions were partially replaced by Verb Plus Arguments constructions, suggesting that children were becoming more adept at expressing all the basic event compo-

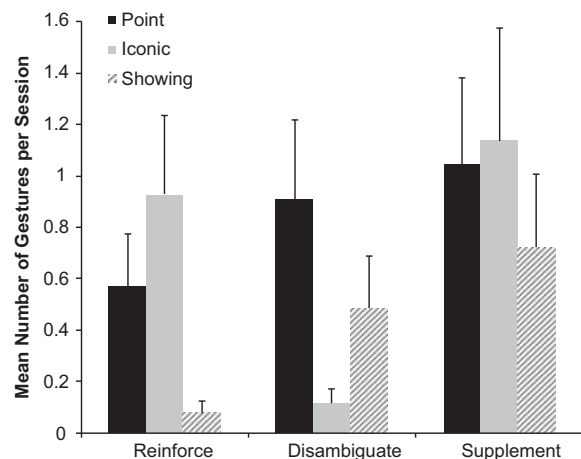


Figure 1. Mean number (error bars represent SE) of different gesture types fulfilling each function across the two age groups.

nents. However, at the 27–36 month age-period, they continued to omit arguments and used the Verb Only construction as frequently as they did during the 14–26 month-period, indicating that the use of this construction was not solely due to linguistic proficiency. That is, children's continued use of Verb Only utterances might be related to the fact that arguments can be freely omitted in Turkish in pragmatically appropriate contexts and such constructions may be used to the same extent by adults in spontaneous speech. Future research should determine the frequency of Verb Only utterances in the caused motion expressions of older children and adults in order to find out whether the rate we report here is particular to the speech of three-year-olds.

Interestingly, children's use of verbs showed not only high token but also high type frequency. That is, the type frequency of verbs per child ranged between 7 and 13, showing that each child used many different verbs. Around 75% of these types expressed both Action and Path in the verb conveying rich semantic information (see Appendix for a list of all verbs). In contrast to these results, two-year-old Turkish children have previously been found to talk about placement events by, using general verbs such as *koy*– 'put' or *at*– 'throw' (Slobin et al., 2011). One possible reason why our results show more diversity and specificity could be that the aforementioned study has focused on only one type of caused motion event, i.e. placement, whereas we studied caused motion in general.

Finally, we also found that across the two age groups, the semantic element children encoded first and most frequently in their verbal descriptions of caused motion was Action. The use of all other semantic elements increased in the period of 27–36 months compared to the earlier age period.

#### ***Early language-specificity in children's gestures: types, semantic elements and relation to speech***

Having established Turkish children's early use of verbs in spoken descriptions of caused motion, we were interested in the types of cospeech gestures children produced, the semantic elements encoded in gesture and the speech-gesture relationship at early ages. Taking all our results into account, we see that early language-specificity is also evident in children's gestures that encode caused motion.

We found that the Turkish children in our study started producing iconic gestures earlier (on average at 22.5 months) than their English-speaking peers who mainly use points until 26 months (Özçalışkan & Goldin-Meadow, 2011). Furthermore, the earliest emergence of iconic gestures was at 19 months, found in two children in our sample. It is important to note

here that our study looked at eight children only, and examined a subset of their spontaneous speech specific to caused motion – unlike previous studies that took into account all the utterances of 40 children (Özçalışkan & Goldin-Meadow, 2011). One could argue that the difference in the mean onset of iconic gestures could be more pronounced if we had a bigger sample, and examined all the spontaneous speech that children produced. With regard to pointing gestures, we noticed a late emergence in our data. However, one should again consider that our data consists of the uses of pointing gestures in the context of caused motion expressions (used for Goals and Figures). Even though children are known to use pointing gestures universally from 10 to 12 months onwards (Liszkowski, Brown, Callaghan, Takada, & De Vos, 2012), the use of these gestures to fulfil certain semantic roles integrated with speech might take a longer time to emerge. Importantly, in Turkish caused motion expressions, the emergence of this function overlapped with the timing of iconic gestures. Future studies should compare English and Turkish taking all utterances (e.g. including intransitive motion events, non-motion verbs, etc.) into account to understand further the general relations between type of linguistic encoding and type of gesture.

Why did the Turkish-speaking children in our sample use iconic gestures early on? We surmise that the type of gestures children produce is influenced by the language they speak (Kita & Özyürek, 2003; Kita et al., 2007; Özyürek et al., 2008). That is, since Turkish children start to talk about caused motion events using verb only utterances that encode Action (sometimes with Path), these are accompanied by iconic gestures that represent Action and often other relational components. Indeed, 92% of the iconic gestures used in the present study encoded at least the Action component of caused motion (while also incorporating Figure and/or Path). In contrast, English-speaking children, for instance, use many Argument Only constructions (e.g. nouns or prepositions) (Choi & Bowerman, 1991; Özçalışkan & Goldin-Meadow, 2005), and they would be expected to use pointing gestures early on, as has been previously documented (Özçalışkan & Goldin-Meadow, 2011). Indeed, Özçalışkan, Gentner, and Goldin-Meadow (2013) have found that iconic gestures emerge six–seven months after relevant verbs, which do not appear early in English-speaking children's productions. Also in line with this pattern, the very few Argument Only utterances in our data were accompanied not by iconic gestures but by points. Thus, given our results, we believe that English-speaking children's late use of iconic gestures is not due to these gestures being more cognitively demanding than the pointing ones, as has been previously argued (Özçalışkan &

Goldin-Meadow, 2011), but is rather attributable to the less frequent use of verbs in English early on. This is also in line with previous reports on the development of iconic gestures in older children, and cross-linguistic studies showing that the development of iconic gestures is modulated by the way information is expressed in verbs (Gullberg & Narasimhan, 2010; Özyürek et al., 2008).

We also found that Turkish children's gestural encoding of the core semantic elements of a caused motion event paralleled their encoding in speech. That is, Action was represented the most frequently in both modalities, followed by Figure between the ages of one and three. In addition to using gestures to represent the elements they mentioned in speech, children also encoded in gesture elements not mentioned in speech. We surmise that since verbs define relations between entities (Gentner & Kurtz, 2005) and allow for the expression of different arguments, their use may have also triggered the gestural representation of elements not mentioned in speech.

The specific language they speak also influenced children's use of gestures in relation to speech. In line with previous research showing that young children often supplement the information in their speech by representing unexpressed semantic information in their gestures (Özçalışkan & Goldin-Meadow, 2009, 2005), Turkish children used supplementary gestures as frequently as reinforcing ones. However, the use of supplementary gestures did not decrease significantly as children started expressing more semantic information in speech, unlike found previously for English (Özçalışkan & Goldin-Meadow, 2009, 2005). That is, 27- to 36-month-olds still used gestures to supplement their speech as frequently as in earlier ages, suggesting that some semantic elements continue to be encoded exclusively in gesture even after children were able to express all elements in speech. We believe that the continued use of supplementary gestures might be related to argument ellipsis in Turkish. That is to say, arguments representing Figure, Goal and Path can be easily dropped since they can be recovered from the discourse context and verb semantics (see similar arguments for Tzetzal, Brown, 2008). In such instances, gestures might be highlighting certain aspects of the visual context that can be omitted from speech and as such serving a pragmatic function throughout development. In support of this result, we have recently found that Turkish-speaking adults and children aged three to five still use supplementary gestures to represent core semantic information (Figure and Path) not expressed in their verbal descriptions of caused motion events (Furman, 2012).

Finally, our results show that there is systematicity in the choice of gesture type and the relation of the

gesture to speech, which further illustrates the language-specificity of the multimodal system. Turkish-speaking children used points and iconic gestures equally frequently to supplement their speech. While previous research has found that the supplementary gestures of English- and Italian-speaking children were mostly *deictics* (points and showing gestures collapsed into one category) (Iverson, Capirci, Volterra, & Goldin-Meadow, 2008), we found as many iconic gestures as either type of deictic in the supplementary gestures.

### Conclusions

Our findings support previous research that has shown that the encoding of information in gesture is influenced by the way it is expressed in speech (Kita & Özyürek, 2003; Kita et al., 2007; Özyürek et al., 2008). Here, we show that the effect of language on gesture is already there from the beginning of language learning. Young Turkish children encode at least the semantic element Action in their early speech about caused motion, which in turn, allows them to use iconic gestures that encode Action, Goal, Path and/or Figure in reinforcing as well as in supplementary functions. These findings show striking differences in the richness of semantic elements supplemented in gesture compared to previous studies. For example, Göksun et al. (2010) found that gestures supplement speech only with the semantic element Instrument in elicited caused motion descriptions of English-speaking five-year-olds.

Our results support the findings that the development of representation in iconic gestures is not universal but can be modulated by certain language-specific factors, especially in relation to the way information is encoded by verbs (Gullberg & Narasimhan, 2010; Özyürek et al., 2008) and in relation to certain limits in processing units. For example, in Özyürek et al. (2008), Turkish-speaking children's gestures showed an adult-like pattern from three years onwards, whereas those of English-speaking children did not. This was attributed to the fact that initially children's gestural representations aligned with the information expressed in the verb alone. Adjusting to information expressed in a verb plus satellite construction would take time (for English-speaking children), possibly due to limitations in the unit of processing. In the present study, we show that gestures are also influenced by the semantic composition of verbs that Turkish-speaking children use between ages one and three. Given these results, one could also make further predictions for intransitive motion. That is, in cases where children use only verbs and the semantic information expressed in verbs is

different cross-linguistically, we would also expect language-specificity in gesture for intransitive motion early on. For instance, English-speaking children who utter Manner-only verbs (without any Path satellites) are expected to use Manner-only gestures, while Turkish-speaking children uttering Path-only verbs should use gestures that encode only Path.

Our findings are also in line with previous cross-linguistic research on young children, which has found that French–English bilingual children use iconic gestures more frequently in the language they speak with higher proficiency (measured by mean length of utterance) (Nicoladis, 2002; Nicoladis, Mayberry, & Genesee, 1999). Our results indicate that not only the mean length of utterance but also the particular lexical items used (i.e. caused motion verbs), and the semantic elements encoded in speech affect the type of gestures children produce in the first years of life.

In sum, this study has shown that children's early event representations are specific not only in speech but also in gesture. This is the first study which has laid out in detail how event representations of a certain type are expressed in a coordinated manner in both speech and gesture in the first years of life in a language where verbs that convey rich semantic relations are acquired early and arguments can be easily omitted. Studying communicative development multimodally in languages that have different typological structures provides us with new ways to understand children's early representation of events as well revealing the existence and the specificity of the initial links between the two modalities.

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### Notes

1. Note that 20% of all actions that overlapped with caused motion speech were considered for reliability of gesture type. The categorisation by the original coder and the reliability coder had to include a 'real action' category (which later was excluded from the analyses reported here) as well the categories of iconics, points and showing gestures. In this way, we obtained reliability for isolating gestures from non-gestures in the same round that we determined the gesture types.
2. Although we started our investigation of caused motion encoding from the age of 12 months, children did not start to talk about these events before they were 14 months old and gesture before 15 months (see Table 4).
3. Since both studies by Özçalışkan and Goldin-Meadow (2009, 2011) have examined the spontaneous speech and gestures children used in their interactions with caregivers and are thus similar to our data, we feel that making comparisons across the results of these studies is justified.

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### Appendix 1. List of all verbs used

*at-* ‘throw’, *bindir-* ‘make mount, make get on’, *birak-* ‘leave on/in, put on/in’, *boşalt-* ‘empty, pour out’, *çek-* ‘pull’, *çevir-* ‘turn’, *çikar-* ‘take out, make ascend’, *dăđıt-* ‘to scatter’, *diz-* ‘line up, arrange in a row’, *dök-* ‘pour out’, *doldur-* ‘fill up, stuff’, *döndür-* ‘rotate’, *düşür-* ‘drop’, *giy-* ‘put on’, *getir-* ‘bring’, *gönder-* ‘send’, *götür-* ‘take’, *it-* ‘push’, *kaldır-* ‘lift up, put away’, *koy-* ‘put’, *kopar-* ‘break off, tear off’, *ört-* ‘cover’, *oturt-* ‘make sit down, put in a specified place’, *ser-* ‘spread out on, spread over’, *sıkıştır-* ‘catch (one’s finger etc.) in a place’, *sıyr-* ‘peel off, take off’, *sok-* ‘insert, put in’, *sök-* ‘rip out’, *sür-* ‘spread on, spread over, put on’, *tak-* ‘put on, attach, pin to’, *taşı-* ‘carry’, *topla-* ‘gather, pick up’, *uzat-* ‘extend’, *yanaştır-* ‘draw up alongside’, *vur-* ‘bump’.