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Verb argument structure

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13.1 Introduction

In syntax, an argument is defined as ‘a noun phrase bearing a specific grammatical or semantic relation to a verb and whose overt or implied presence is required for well-formedness in structures containing that verb’ (Trask 1993: 20). Arguments can be identified in two ways: in terms of syntactic roles with respect to the verb such as Subject and Object, and in terms of semantic roles in relation to the verb such as Agent (entity that instigates an action) and Patient (entity that undergoes an action). Argument structure is the specification of the number and types of arguments required for a verb in that structure to be well-formed. For instance, an intransitive structure requires one Subject argument (e.g. *James laughed*) while a transitive structure requires both a Subject and an Object (e.g. *James built the cabinet*). Stereotypically the Subject is an Agent and the Object is a Patient, as is the case in the two examples just cited. However, one does not need to look far to find exceptions to this. For example, the Subjects in *The cabinet broke* and *Sarah liked the cabinet* are not Agents since they do not perform any action (*cabinet* is a Patient, *Sarah* is an Experiencer). In addition to the intransitive and the transitive, many more complex argument structures occur and have been studied extensively (see Levin (1993) for a review of over eighty argument structures used in English). Some common structures include the passive (e.g. *The cabinet was built by James*), the ditransitive (the prepositional dative, e.g. *James gave the cabinet to Sarah*), or the double object dative, e.g. *James gave Sarah the cabinet* and the causative (the lexical causative, e.g. *James broke the cabinet*, or the periphrastic causative, e.g. *James made the cabinet break*).

All verbs in a language must be used in at least one argument structure, but most verbs may appear in two or more structures as indicated in the

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examples just cited. Thus, many researchers have argued that the lexical entry for each verb in the mental lexicon must specify which argument structures a verb permits in the form of subcategorization frames (e.g. Baker 1979, Oehrle 1976). Others have argued that subcategorization frames are unnecessary because so much of a verb’s argument structure can be derived from its meaning (e.g. Levin 1993, Pinker 1989). For example, most verbs of change of state (e.g. break, bend, melt, drop) can appear in both intransitive and lexical causative structures (e.g. *The cabinet broke, James broke the cabinet*). Other well-defined subtypes of verbs such as verbs of appearance and occurrence (e.g. appear, arise, happen, recur) can be used in the intransitive structure but not the lexical causative structure (e.g. *The rabbit appeared, *The magician appeared the rabbit*). Thus, if one can appropriately identify the relevant meaning of a given verb, one can determine the argument structure of that verb. Still other researchers have argued that it is not verb meanings but rather construction meanings that are the essential starting point for understanding argument structure (e.g. Fillmore, Kay & O’Connor 1988, Goldberg 1995). For instance, it is clear from the sentence structure alone that *John mooed the ball to Rachel* describes an event of transfer and that *John mooed the ball onto the table* describes an event of caused motion; knowing the meaning of the verb is not necessary for understanding much of the meaning of the sentences.

The main task that children face in learning argument structure is determining which verbs can appear in which argument structures. Consider an English-speaking child who wants to tell a friend about her experiences observing an otter in the zoo. How does she learn that she can describe this event by saying *I saw an otter* but not *I looked an otter*? Although both verbs have similar meanings, see is transitive and look is intransitive. If that otter then precipitously descends from the land into the water, the English-speaking child can describe that event by saying either *The otter dropped into the water* or *The otter fell into the water*. But how does she learn that *The zookeeper dropped the otter into the water* is perfectly grammatical while *The zookeeper fell the otter into the water* is not permitted? Although both verbs can be used in the intransitive structure with Patient Subjects, only *drop* can be used in the lexical causative structure. And if the zookeeper subsequently brings the otter over to show it to the child, how does she know to describe this event as *The zookeeper carried the otter to me* and not *The zookeeper carried me the otter* – in other words, that *carry* can be used in the prepositional dative but not the double object dative? Indeed, children sometimes overgeneralize argument structures belying their struggle in figuring out the appropriate patterns (e.g. *Don’t giggle me* to mean ‘Don’t make me giggle’, Bowerman 1982). Given the complexity of the system, learning argument structure is clearly no small task.

This chapter reviews a representative sample of the extensive literature on the acquisition of argument structure. Section 13.2 outlines three theoretical debates that have driven the research on argument structure.
acquisition: is early knowledge related to argument structure innate or lexically driven? Given innate building blocks, do children break into argument structure using verb meaning or sentence structure? How strong are argument structure representations at the outset and how do they develop over time? Section 13.3 illustrates the relevance of particular argument structures to these theoretical debates in a brief review of the work on the acquisition of passives and datives. Finally, Section 13.4 discusses how children can learn argument structure when arguments are often omitted in caregiver speech, and how children’s use of different forms for arguments (e.g. noun phrase, pronoun, omitted) relates to their understanding of information flow in the discourse.

13.2 Theoretical approaches

13.2.1 Bootstrapping using innate knowledge

Consistent with the generative linguistic approach to language development, one prominent theory of the acquisition of argument structure is that children are innately endowed with key knowledge that helps them break into the system. This includes (i) apparently universal syntactic categories such as noun and verb, (ii) basic understanding of the potential syntactic relations between the two such as Subject and Object, (iii) basic knowledge of the semantic roles or functions of arguments such as Agent and Patient, and (iv) expectations about the likely links between syntactic roles and semantic functions (i.e. linking rules), such as that the Agent of an action is also likely to be the Subject of a verb (Gleitman, Cassidy, Nappa, Papafragou & Trueswell 2005, Pinker 1984, 1989). Children are assumed to use this innate knowledge to ‘bootstrap’ themselves into a fully abstract and adult-like system of argument structure. The two main theories of bootstrapping highlight different starting points in the process of development: semantic bootstrapping focuses on children’s use of innate semantic knowledge to bootstrap into syntax (Pinker 1989), while syntactic bootstrapping focuses on children’s use of innate syntactic knowledge to bootstrap into verb meaning (Gleitman 1990).

13.2.1.1 Semantic bootstrapping

Under the semantic bootstrapping account, children focus first on the semantics of the event denoted by a verb, homing in on the meaning of that verb (Pinker 1984, 1989). For example, they notice through observation that a running event typically involves an Agent who does the running, and that a pushing event typically involves an Agent who does the pushing and a Patient that gets pushed. When children later hear an utterance like David runs or Paula is pushing the car, they use their innately specified linking rules to infer that the Agent is the Subject and the Patient is the Object. With repeated similar experiences, children map this
information about Subjects and Objects to facts about word order, noun and verb morphology, and other indicators of syntactic roles.

Much research supports the claim that young children are sensitive to semantic classes in relation to argument structure. Pinker and his colleagues conducted several spontaneous speech and elicited production studies indicating that appropriate and overgeneralized utterances involving various argument structure alternations are largely constrained by semantic classes (Gropen, Pinker, Hollander, Goldberg & Wilson 1989, Pinker 1989, Pinker, Lebeaux & Frost 1987). For example, they found that children’s dative overgeneralizations do not extend to verb classes that do not allow it and, in studies using novel verbs, children prefer to generalize the passive structure to novel verbs of action rather than novel verbs of experience, mirroring the verb class distribution of passives with real verbs. Gordon (2003) found evidence that even infants are sensitive to verb classes, using a habituation paradigm contrasting transfer and non-transfer semantics. In addition, Kline and colleagues (Kline & Demuth 2014, Kline, Snedeker & Schulz 2011) showed that 2- to 4-year-olds are sensitive to the different animacy and event semantics underlying Agent intransitives (e.g. Kim is painting), Patient intransitives (e.g. The box is dropping) and causal transitives (e.g. Kim dropped the box).

The semantic bootstrapping approach has been challenged on two main fronts. One challenge comes from many findings in spontaneous speech data that are not consistent with the predictions of semantic bootstrapping. First, the links between syntactic and semantic categories have been shown to vary too much across languages for universal linking rules to be plausible (Bowerman & Brown 2008, Slobin 1997d). This is especially (but not only) relevant for ergative languages, which often do not follow the standard Subject–Agent and Object–Patient linking, or have morphosyntactic cues that do not consistently conform to this linking pattern (Bavin & Stoll 2013). Second, analysis of spontaneous speech reveals that many Subjects in the first utterances of English-speaking children are not Agents, thus violating the proposed default linking rules (e.g. I like it, Pete hurt by car; Bowerman 1990, Lieven, Pine & Baldwin 1997). Third, a detailed analysis of causative overgeneralization errors indicates that they are common in verb classes that strongly prohibit the lexical causative such as verbs which are not dynamic (e.g. … the cold stayed them awake, 2;11) or for which the caused event is not brought about directly (e.g. I want to watch you this book, 4;3), and that such overgeneralizations persist until age 12, which is much later than Pinker’s theory would predict (Bowerman & Croft 2008).

The other challenge highlights the fact that lexical frequency information often has a much stronger influence on children’s acquisition of argument structure than do semantic classes, which should not be the case according to Pinker’s theory. First, overgeneralization errors occur more often with low-frequency than with high-frequency verbs (*The joke giggled / laughed the man), and decrease as children grow older and thus have more exposure to
the relevant verbs (Ambridge, Pine, Rowland & Young 2008, Ambridge, Pine, Rowland, Freudenthal & Chang 2014, Brooks, Tomasello, Dodson & Lewis 1999, Theakston 2004, Wonnacott, Newport & Tanenhaus 2008). Second, semantic class is much less relevant than frequency as a cue in learning or generalizing argument structures in artificial language learning (Abbot-Smith & Tomasello 2010). Third, Goldberg and her colleagues (Casenhiser & Goldberg 2005, Goldberg 1995, 1999, 2006, Goldberg, Casenhiser & Sethuraman 2004, 2005) have provided evidence that innate linking rules are not needed for semantic bootstrapping; rather, children can use the verb that is the most frequently used in a given construction – such as *give* for transfer verbs or *put* for verbs of caused motion – to ‘facilitate’ the association of the meaning of the verb in the construction with the construction itself, allowing learners to get a “fix” on the construction’s meaning’ (Goldberg et al. 2004: 310).

These challenges indicate that semantic bootstrapping as proposed by Pinker (1989) does not work as cleanly as he envisioned. However, research by Ambridge and colleagues on the retreat from overgeneralization errors offers an intriguing possibility for accounting for both Pinker’s semantic class theory and the effects of lexical learning and exposure within one model (Ambridge, Pine & Rowland 2012a, Ambridge, Pine, Rowland & Chang 2012b, Ambridge, Pine, Rowland & Clark 2011, Ambridge et al. 2014, Ambridge et al. 2008, Bidgood, Ambridge, Pine & Rowland 2014). Ambridge and colleagues conducted a series of studies assessing participants’ willingness to accept grammatical and overgeneralized uses of an extensive set of real and novel alternating and non-alternating verbs in three different alternation constructions – dative (*Barb gave the book to Bob / Barb gave Bob the book*), locative (*Marc loaded the wagon with hay / Marc loaded hay into the wagon*) and lexical causative (*The door opened / Gina opened the door*). Judgements of both children aged 5–10 years and adults revealed sensitivity to both narrow range semantic classes (e.g. verbs of accompanied motion) and verb frequency (e.g. *pull* is high frequency; *lower* is low frequency) in their judgements, leading to the conclusion that both semantic information (potentially innate) and statistical information (learned by exposure) are essential in constraining generalization, and are best seen as two factors in a probabilistic model such as that outlined in Ambridge et al. (2012a, 2012b, 2014). Although these data are not from young enough children to directly address the question of whether innate or learned information plays a role in children’s earliest productions, they are highly suggestive that both types of information are essential.

13.2.1.2 Syntactic bootstrapping

Another set of challenges to semantic bootstrapping comes from those who claim that semantics is not dependable as a cue to argument structure (Gleitman 1990, Gleitman et al. 2005). First, children under radically different exposure conditions (e.g. blind vs sighted, with vs without exposure to
natural signed or spoken language) acquire much the same semantic representations for verbs (Goldin-Meadow 2003b, Landau & Gleitman 1985). Second, many verbs are identical to each other except in one respect which is difficult to distinguish just from observation of the event (e.g. chase vs flee), and some verbs do not refer to observable states or events (e.g. think, know) (Gleitman 1990). Third, even for more ‘concrete’ verbs it is not a straightforward task to pick out the event in a real world scene denoted by a particular verb (Gillette, Gleitman, Gleitman & Lederer 1999, Scott & Fisher 2012, Snedeker & Gleitman 2004).

These researchers instead propose syntactic bootstrapping – that children attend first to the number of arguments a verb has and the syntactic arrangement in which they appear, and then use that information as a ‘syntactic zoom lens’ (Fisher, Hall, Rakowitz & Gleitman 1994) to bootstrap themselves into the meaning of the verb. If a child hears a sentence like The rabbit ziffs the ball to the elephant, she is likely to hypothesize that ziff is a verb of transfer such as give or throw; a verb of placement (put) or perception (see) would not fit the syntactic frame.

The efficacy of this process has been confirmed by many comprehension studies using the preferential looking paradigm (see Naigles & Swensen (2007) for a review). For example, Naigles (1990) showed two groups of children aged 2;1 a video in which a rabbit repeatedly pushed a duck into a squatting position (caused motion event) while both rabbit and duck circled their arms (non-causative event). One group heard the accompanying phrase The bunny is gorping the duck (transitive) while the other heard The bunny and the duck are gorping (intransitive). Then both groups saw the two events separated – pushing to squat on one screen and arm-circling on another – while hearing Where’s gorping now? Find gorping! The group exposed to the transitive utterance selected the caused motion event while the group exposed to the intransitive utterance selected the non-causative event. Since both groups saw the same initial video, there would be no reason to expect such a differentiation in interpretation of the verb gorp under the semantic bootstrapping account.

Numerous studies with children aged 2;1 and older have replicated and extended the basic findings about syntactic bootstrapping, demonstrating that children can interpret non-causal verb meanings (Naigles & Kako 1993), can use multiple syntactic frames to learn verb meaning (Naigles 1996), can interpret verb meaning even when information about arguments is minimal (i.e. both arguments specified with pronoun she – Fisher 1996, 2002b) and can use syntactic frames to distinguish the meanings of perspective verbs (chase, flee) and mental state verbs (think, believe) (Fisher et al. 1994, Papafragou, Cassidy & Gleitman 2007). Naigles and colleagues have shown that children aged 2–4 years tend to adjust their interpretation of a known verb to fit a new syntactic frame (e.g. acting out a bringing event upon hearing Noah goes the elephant to the ark), illustrating that they derive meaning as least as much from the syntactic frame as from
the verb – in contrast to older children (aged 5–12) who increasingly ignore the syntactic frame if it does not fit the established verb meaning, as do adults (Naigles, Fowler & Helm 1992, Naigles, Gleitman & Gleitman 1993).

A recent set of studies further reveals that children aged 2;0 to 2;5 can derive a novel verb’s subcategorization properties not only in simplified conditions with single sentences matching clear videos, but also in conditions that more closely approximate those in typical input: sentences in simple dialogues with no visual information about the actions, such as Hey … Jim is gonna blick the cat! Really, he’s gonna blick the cat? (Arunachalam & Waxman 2010, Scott & Fisher 2009, Yuan & Fisher 2009).

Another crucial finding is that children can use syntax–semantics linking to differentiate participants in opposite argument roles in reversible transitive sentences. In a preferential looking study by Gertner, Fisher and Eisengart (2006), children aged 1;9 and 2;1 were simultaneously shown two video clips with arguments in opposite roles (e.g. bunny gorping duck, duck gorping bunny). They looked longer at the screen for which the semantic role in the video event matched the syntactic role in the accompanying speech, for both Subject–Agent (e.g. The bunny is gorping the duck!) and Object–Patient (e.g. He is gorping the duck!). Similar results have been found for both German- and English-speaking children aged 1;9–2;10 using preferential looking, forced-choice pointing, and act-out tasks (Chan, Meints, Lieven & Tomasello 2010, Dittmar, Abbot-Smith, Lieven & Tomasello 2008a, 2008b, 2011, Fernandes, Marcus, Di Nubila & Vouloumanos 2006, Noble, Rowland & Pine 2011). Computational modeling studies underline the usefulness of this first-noun-as-Agent strategy as a powerful initial guide to sentence interpretation (Chang, Dell, & Bock 2006, Connor, Gertner, Fisher & Roth 2008).

Although most evidence for syntactic bootstrapping comes from studies with English-speaking children, syntactic bootstrapping is not restricted to English. Two-year-old children learning other languages where word order provides the main cue to argument roles are able to use the number and placement of arguments in a sentence to extend causative meanings to familiar verbs presented in transitive frames, and to extend non-causative meanings to familiar verbs presented in intransitive frames; this holds in languages as varied as Mandarin Chinese (Lee & Naigles 2008), Kannada (Lidz, Gleitman & Gleitman 2003) and French (Naigles & Lehrer 2002). In languages where case marking provides key information about argument roles, the case information is helpful and perhaps essential. Turkish-speaking 2-year-olds perform much better on syntactic bootstrapping tasks when case is present on the nouns (Göksun, Küntay & Naigles 2008), and Japanese-speaking 2-year-olds only succeed when both case and word order information are present (Matsuo, Kita, Shinya, Wood & Naigles 2012). Note that syntactic bootstrapping works both in languages that require Subjects and Objects to be present in speech (e.g. French) and those that allow argument omission (e.g. Japanese; see further discussion in Section 13.4).
13.2.2 Usage-based learning

The strong form of the two bootstrapping accounts just described assumes
that children break into argument structure aided by innate linguistic
knowledge. An alternative view, the usage-based learning approach, is
that children use only general cognitive mechanisms to learn argument
structure on the basis of generalizations from the input (Tomasello 2000,
2003; see also Chapter 3). This approach has its foundations in studies of
spontaneous speech. Tomasello’s (1992) detailed analysis of one child’s
speech before age 2 showed that each verb seemed to be an ‘island’ with its
own argument structure (e.g. eater for the verb eat and runner for the
verb run), a pattern later confirmed in data from several other children
that these first verb-specific argument structures are gradually generalized
by the child to more abstract categories such as Agent, Subject and intransi-
tive verb, eventually leading to verb-general representations of argument
structure only after age 3:0. This process can be seen in a detailed analysis
of the development of the transitive structure from 2:0 to 3:0 in a dense
data set from one English-speaking boy (Theakston, Maslen, Lieven &
Tomasello 2012).

More powerful evidence for the usage-based approach comes from three
types of elicited production studies: novel verb generalization, weird word
order, and training. In a typical novel verb generalization study (Tomasello &
Brooks 1998), children at 2:0 and 2:6 were taught one verb modelled as
intransitive (e.g. The ball is dacking) and another as transitive (e.g. Jim is
tamming the car). The experimenter then asked the child ‘What’s agent
doing?’ attempting to elicit transitive structures. Although children typi-
cally produced a new transitive sentence for the verb modelled as transi-
tive (e.g. He’s tamming the car), very few produced a transitive sentence for
the verb modelled as intransitive (e.g. He’s dacking the ball). Several similar
studies in English, Hebrew and Spanish investigating the intransitive/
transitive, active/passive, and dative alternations consistently show simi-
lar results, implying that children younger than 3:0 do not yet have an
abstract representation of these structures (see Tomasello (2000) and refer-
ences therein, and Sections 13.3.1 and 13.3.2).

In the weird word order paradigm, children hear an experimenter describ-
ing events using a weird word order (e.g. Ernie Bert pushing or pushing Ernie
Bert to describe Ernie pushing Bert) and are then asked to describe similar
events in their own words. When the verb is frequent (e.g. push), English,-
French-, and German-speaking children as young as age 2 typically ‘cor-
rect’ the weird word order to Subject–Verb–Object. When the verb is
infrequent (e.g. dab) or novel (e.g. meek), however, only children over 3:6
consistently correct the word order. Younger children very often use the
weird order or avoided using the verb altogether (Abbot-Smith, Lieven &
Tomasello 2001, Akhtar 1999, Matthews, Lieven, Theakston & Tomasello
The third type of elicited production study involves training children in use of either intransitive–transitive (e.g. *This tiger is bouncing / This tortoise is bouncing this tiger*) or passive–transitive alternations (e.g. *The tiger’s gonna get bounced / The tortoise is gonna bounce the tiger*) for a set of familiar verbs, then presenting them with a novel verb in either intransitive or passive and encouraging them to use it in the transitive. Trained children aged 2;6 generalized the transitive structure with novel verbs more than twice as often as a group of control children who did not receive training, indicating that developing a representation of the transitive structure is influenced by input frequency (Abbot-Smith, Lieven & Tomasello 2004, Childers & Tomasello 2001).

Overall, the results of both spontaneous speech and elicited production studies suggest that 2-year-old children typically restrict their use of a verb to the syntactic frame in which it is learned and do not easily generalize to other frames as would be predicted if they had innate knowledge of categories such as Agent and Subject (Tomasello 2000). Several of the studies cited in Section 13.2.1.1 that challenge the semantic bootstrapping view also constitute evidence for the usage-based view that lexical factors like individual verb and construction frequency play a crucial role in learning argument structure. In addition, a recent computational modeling study supports this general approach, showing that a grammar formed only through item-based information from child-directed speech can accurately predict children’s productions at age 2;0 (Bannard, Lieven & Tomasello 2009). However, adding information about lexical categories (N and V) substantially improves the model for predicting children’s utterances at 3;0.

13.2.3 ‘Weak’ or ‘graded’ abstract representations
Fisher (2002a) critiqued the strong version of the usage-based approach while acknowledging its valuable contributions to understanding the role of lexical learning in acquisition. She argued that many of the findings interpreted by usage-based theorists as lack of abstraction could rather be interpreted as evidence of syntactic priming (Bock 1986) – children persist in using the learned syntactic frames because they have just heard them so they have been primed to that frame – or as evidence of appropriate conservatism – children know that not all English intransitive verbs can be used transitively (e.g. *sleep, giggle*). More importantly, she pointed out that a non-trivial number of 2-year-olds in studies claimed to support a strong usage-based theory in fact generalized novel verbs to new sentence frames (Abbot-Smith et al. 2001, Brooks & Tomasello 1999; see also Kline & Demuth 2014) or changed ungrammatical to grammatical word orders (Akhtar 1999). Finally, she noted that virtually all of the evidence for the usage-based approach derives from production studies, which require active behavioural decision-making and thus relatively strong syntactic
representations. In contrast, comprehension studies using the preferential looking paradigm, which places fewer performance demands on children and thus is more sensitive to weak syntactic representations, have provided evidence for abstract representations of argument structures as young as 2;1 (see Section 13.2.1.2). Supported by these three types of evidence, Fisher suggested that 2-year-old children do have abstract representations of the syntactic frames in question although they are weaker than those of older children and adults. In their reply to Fisher’s critique, Tomasello and Abbot-Smith (2002: 210) conceded that young children may ‘have a weak transitive schema – one that enables certain kinds of linguistic operations but not others – whereas older children have a stronger and more robust schema based on a wider range of stored linguistic experience’. A connectionist network simulation by Chang et al. (2006) provides support for the claim that both early success in preferential looking tasks and later success in production tasks can be accounted for within one model.

More recent research has paid specific attention to better understanding the interplay between abstract representations and lexical learning. This research has two main foci: uncovering effects of performance and processing demands that reveal the differential strength of abstract representations, and applying a new testing method (structural priming) that is particularly sensitive to representation strength.

13.2.3.1 Evidence from effects of performance and processing demands

As noted by Fisher (2002a), it has become increasingly evident that children are affected by performance and processing demands in being able to use their abstract representations, and further investigation of these effects is likely to provide insight into the strength and developmental trajectory of the representations. Explorations in this domain have focused on the relative demands of different task types, the demands of materials and procedures within the task, child-specific factors, and language-specific factors.

Different task types clearly entail different processing and performance demands, which could lead to differences in performance across studies. Two studies have made controlled direct comparisons of children’s performance on the same materials using two different tasks. Dittmar et al. (2008b) found that German-speaking children aged 2;7 did not show comprehension of semantic roles in transitive sentences using novel verbs in an act-out task (relatively heavy task demands), but a different group of same-aged children did show comprehension of the same sentences in a forced choice pointing task (relatively lighter task demands). In the second study, Chan et al. (2010) compared the comprehension of semantic roles in transitive sentences in an act-out task (heavy demand) vs a preferential looking task (light demand), using the same English-speaking children as
participants in each. While the oldest two groups (aged 2;9 and 3;5) did well in both tasks, the youngest group (aged 2;0) showed comprehension only in the preferential looking task.

Forced-choice pointing is less demanding than act-out or elicited production tasks, but more revealing of children’s ability to actively use their abstract representations than preferential looking since it requires only a simple point to select one picture over another as the best match for a sentence, but indicates an active choice on the part of the child. Fernandes et al. (2006) successfully used this method to show that children aged 2;4 and 2;10 can map semantic roles to syntactic roles in transitive sentences with novel verbs; Noble et al. (2011) extended this finding to 1;11, and Dittmar et al. (2011) to 1;9. Another such task, structural priming, is discussed in detail in Section 13.2.3.2.

The procedures and materials within tasks also present differing demands that test the strength of children’s abstract representations. The amount of training received during the familiarization phase of a given task is one element of the procedure that can strongly affect children’s performance. A preferential looking study by Dittmar et al. (2008a) tested this explicitly. They found that German-speaking children aged 1;9 only succeeded in identifying the scene where the semantic roles of the arguments matched the transitive prompt when they were exposed during the familiarization phase to numerous exemplars of the same transitive syntactic structure they had to comprehend in the test phase. When the syntactic structure in the familiarization phase was neutral (e.g. Look, eating), the children performed at chance during the test phase. A difference in amount of training could also explain the apparently contradictory results for English-speaking children’s comprehension of semantic roles in preferential looking tasks: the children tested by Gertner et al. (2006) got substantial training and showed above-chance performance at 1;9, while the children tested by Chan et al. (2010) got little training and showed only chance performance at 2;0. Other examples of the effect of amount of training are discussed in Section 13.2.3.2; children show different results on priming tasks depending on how many primes are presented before the test item.

Linguistic complexity of the materials can also affect children’s ability to use their abstract representations. For example, children younger than 2;1 perform at chance in the original syntactic bootstrapping paradigm contrasting conjoined-Subject intransitives such as The bunny and the duck are gorping with single-Subject transitives such as The bunny is gorping the duck (Bavin & Growcutt 1999, Hirsh-Pasek & Golinkoff 1996), even though they show abstract representations for intransitive and transitive structures using other materials. Yuan, Fisher and Snedeker (2012) suggested that this arises from managing the linguistic complexity of the conjoined-Subject intransitive, and showed that children as young as 1;7 can derive verb meaning from syntactic frames as long as the processing demands of
the original paradigm are reduced in two ways: (a) the number of nouns children hear in a sentence matches the number of argument roles (*He is gorping vs He is gorping him*), and (b) the caused-motion and non-causative events are presented in two separate clips in the initial exposure phase instead of together in one clip. Gertner and Fisher (2012) have also acknowledged this linguistic complexity, and showed that it leads children aged 1;9 to focus simply on the number of nouns present in the sentence rather than their syntactic structure. Their participants interpreted the first noun in a sentence as the Agent and the second as the Patient, regardless of the placement of the two nouns in a sentence with respect to the verb, in sentences such as *The boy and the girl are gorping*, *The girl and the boy are gorping*, and *The boy is gorping the girl*. Even in a condition where children received prior dialogue information that a given novel verb can be intransitive (e.g. *Tom is gonna gorp. Really? He’s gonna gorp*?), they still interpret the first noun of a conjoined Subject as Agent and the second as Patient. However, Arunachalam, Escovar, Hansen and Waxman (2013) showed that children aged 1;9 can in fact interpret two nouns before the verb as a conjoined Subject when the syntax is made very explicit to aid in dealing with the linguistic complexity (e.g. *The man and the lady are gonna moop. They’re gonna moop*).

Another type of linguistic complexity affecting task performance arises from the use of novel verbs. Novel verbs are ideal for examining argument structure knowledge because they have not previously been heard by the child, allowing for careful control of both frequency and semantic class information. However, they also present a higher processing demand than familiar verbs because their meaning must be worked out during the task. They are thus useful as a tool for exploring representation strength because children show earlier evidence of abstract representations with familiar verbs than with novel verbs, and several studies have exploited this. Abbot-Smith, Lieven and Tomasello (2008) found that children aged 2;4 mostly corrected incorrect Agent–Patient assignment in transitive sentences with familiar verbs, but tended to avoid producing the structure in trials with novel verbs. Similarly, Dittmar *et al.* (2008b) found that children aged 2;7 could act out transitive sentences with familiar verbs but not with novel verbs, while children aged 4;10 correctly acted out both familiar and novel transitives. Chan *et al.* (2010) found that children aged 2;0 could comprehend transitives with familiar but not novel verbs in a preferential looking task; children aged 2;9 showed comprehension with both verb types in a preferential looking task but performed better with familiar than novel verbs on an act-out task. Dittmar, Abbot-Smith, Lieven and Tomasello (2013) explored this question from the opposite side by looking at a situation where information from verb frequency is a disadvantage. They reasoned that since the passive is not the preferred structure for familiar verbs, children should disprefer a passive interpretation for familiar verbs, but they should have no entrenched preference for novel
verbs. Children indeed showed differential performance by verb type at 2;7: they dispreferred a passive interpretation for familiar verbs and showed chance performance for novel verbs.

Child-related factors are a third way that processing demands can affect the ability of children to use their abstract representations. For example, Dittmar et al. (2011) found that both fatigue and language ability affected children’s ability to use their abstract representations in a forced pointing task with novel transitives. Children aged 1;9 performed above chance when only the first two (of three) trials per participant were analysed, but only at chance when all three trials were analysed, arguably due to fatigue by the third trial. Similarly, children with ‘low’ CDI vocabulary scores performed at chance (regardless of age), but those with ‘high’ scores performed above chance. Kidd (2012b) also found effects of vocabulary knowledge, grammatical knowledge, and nonverbal reasoning ability on performance in priming tasks, as detailed in Section 13.2.3.2.

Finally, several studies show an effect of language-specific factors: children learning different languages become productive with the same argument structure at different ages, which is unexpected if innate linking of semantic and syntactic roles is sufficient on its own to guide children to abstract representations. The most convincing evidence comes from a study comparing same-aged children learning three different languages – Cantonese, English and German – on the same act-out task differentiating argument roles in reversible transitive sentences (Chan, Lieven & Tomasello 2009). While English-speaking children used the first-noun-as-Agent strategy, children learning Cantonese and German crucially also depended on language-specific cues such as case and animacy. Indeed, numerous studies support the idea that several cues interact in determining how and when children show their knowledge of abstract representations (English: Ibbotson, Theakston, Lieven & Tomasello 2011, Naigles, Reynolds & Künntay 2011; German: Dittmar et al. 2008b; Italian: Abbot-Smith & Serratrice 2014; Turkish: Göksun et al. 2008), mostly using the framework of the Competition Model (Bates & MacWhinney 1987).

13.2.3.2 Evidence from priming studies

Structural priming, a paradigm that is relatively new to child research but well-established in adult psycholinguistic, is particularly sensitive to revealing representation strength (Bock 1986). In a typical structural priming study, participants are presented with a ‘prime’ sentence that uses one of the two options in an argument structure alternation, such as the passive The ball was hit by the boy in the active–passive alternation. The participant is then asked to produce or comprehend a ‘target’ sentence that can be expressed using the same alternation. Adults show a tendency to repeat the structural option heard in the prime (here, the passive) rather than the other possible option (here, the active). The general concensus is
that this happens because the prime strengthens the participant’s activation of the abstract mental representation of the relevant structure, independent from effects of overlap with lexical items, prosodic structures and the like (see Branigan (2007) for a review). Crucial for our discussion of child acquisition of argument structure, a child should only show structural priming if she already has at least a weak abstract representation for the structure in question, and thus can generalize that representation to a new verb. A strong nativist view would predict that young children evidence priming effects similarly to adults, a strong lexicalist view would predict that young children only show priming if lexical items themselves (i.e. verbs and/or arguments) are repeated across prime and target, and a graded representations view would predict that priming effects are weak at the youngest ages (perhaps lexically driven and susceptible to task effects) and then gradually increase in strength with age.

Research has mainly focused on whether children show a priming effect in general or only when lexical items (verbs or arguments) are identical, and what other conditions need to hold for priming to be evidenced. The earliest studies seemed to indicate that children pass through a stage where they only show priming when lexical items are shared between prime and target. Savage, Lieven, Theakston and Tomasello (2003) showed that 6-year-old English-speaking children could easily generalize the passive structure to new verbs after being primed with five passive utterances, but 3- and 4-year-olds could only generalize if all the primes were identical except for the verb (e.g. *It got pushed by it* and *It got caught by it* rather than *The brick got pushed by the digger* and *The ball got caught by the net*) and thus had high lexical overlap with the potential target utterance. A follow-up study with 4-year-olds revealed that the effect of priming was stronger when varied verbs were used in the priming phase than when a single verb was used; further, the effect of varied primes persisted for up to a month suggesting that learning occurred during the study (Savage, Lieven, Theakston & Tomasello 2006). Huttenlocher, Vasilyeva and Shimpi (2004) found productive generalization of both active/passive and dative structures with 5-year-olds using methods similar to those used by Savage et al. (2003).

However, most language acquisition researchers now support the graded representations view: 3-year-olds show weak representations of argument structures (usually passive or dative) that can be accessed under favourable experimental conditions, and this representation gradually gets more robust through the age of 5 or 6. Shimpi, Gámez, Huttenlocher and Vasilyeva (2007) found weak but productive generalization of both active/passive and dative structures with 4-year-olds when ten examples were modelled in the priming phase (i.e. double the number used by Savage et al. 2003), and with 3-year-olds when children’s responses were interspersed with the primes rather than the primes and responses occurring in separate blocks. Thothathiri and Snedeker (2008b) found stronger
priming for the dative alternation in 4-year-olds than in 3-year-olds, using an eye-tracking method where children’s eye gaze was analysed to determine whether they expected the test utterance to have the same structure as the prime utterance. Bencini and Valian (2008) found that 3-year-olds showed significant priming effects using the active/passive alternation even when the prime and target did not share either a verb or arguments, as did Kidd (2012b) for children aged 4–6 years. Rowland, Chang, Ambridge, Pine and Lieven (2012) and Peter, Rowland, Chang and Blything (2015) showed similar results for children aged both 3–4 years and 5–6 years using the dative alternation, when only one instance of the prime was presented. Messenger and colleagues showed that 3- and 4-year-olds are not simply repeating word order or semantic role structure from the prime, but that they indeed have an abstract representation: Messenger, Branigan and McLean (2011) showed productive priming from a truncated passive prime to a full passive target, while Messenger, Branigan, McLean and Sorace (2012) showed productive priming from Experiencer–Theme (The girl was seen by the boy) and Theme-Experiencer (The girl was scared by the boy) passives to Patient–Agent (The girl was kissed by the boy) passives. (See Chapter 19 for more on priming in passives.)

Two additional points are predicted to distinguish the theories (Rowland et al. 2012). Under the graded representations view, children should show larger priming effects than adults, consistent with findings that individuals with fewer or less well represented abstract structures (e.g. aphasics, L2 learners) are more susceptible to priming (Flett 2006, Hartsuiker & Kolk 1998). By the same logic, children should show a larger priming effect when the prime and target share a verb than when they do not – termed ‘lexical boost’ – and this boost should be larger in children than adults. A nativist view, however, would predict that children show a similar magnitude of priming effect and lexical boost to adults since these two groups have equivalent abstract representations. It is difficult to compare the size of priming effect between adults and children because of substantial methodological differences across studies. However, those studies that tested children and adults using the same methodology reported no significant differences in priming effect between 3-year-olds and adults despite a numerically higher priming effect in children that may reflect their greater susceptibility to priming (Messenger et al. 2011, 2012, Rowland et al. 2012). Several studies have also found no lexical boost in children compared with a clear lexical boost in adults, supporting neither view (Peter, Chang, Pine, Blything & Rowland 2015, Rowland et al. 2012, Thothathiri & Snedeker 2008a). Further studies will need to clarify these findings.

Despite these many priming studies, it is still unclear whether priming tests the same mechanisms in adults and children, and thus whether it can really be used as an indicator that children have abstract structural representations (Kidd 2012b). As Kidd (2012b) notes, child priming results
typically exhibit high variability, including a substantial proportion of children who do not exhibit any priming. In his own study of passive priming, he found that each of vocabulary knowledge, grammatical knowledge, and nonverbal reasoning ability significantly predicted whether children were primed, the magnitude of the priming effect, and the type of passives used. In contrast, age was not a significant predictor of any of these outcomes. Such results strongly suggest that it is not justified to interpret a given performance on priming tasks as an indicator of developmental level for a particular age group (Kidd 2012b). While it is clear that the priming methodology offers important insights into the question of children’s early abstract knowledge of argument structure, further research is needed to interpret these insights in a more accurate and nuanced way.

13.3 Trajectory and patterns in the acquisition of argument structure alternations

Looking at argument structure acquisition from the point of view of theory often focuses on abstract questions for which data are secondary. In the next section, we focus on argument structure acquisition from the point of view of the structures themselves – specifically passive and dative – in order to get a sense of the trajectory and patterns of development within one structure.

13.3.1 Passives

Typical passives are shown in the (b) sentences in (2) and (3), with their active transitive counterparts in the (a) sentences.

(2) a. Elizabeth chased Gisela.
   b. Gisela was chased by Elizabeth.

(3) a. Marion climbed the big tree.
   b. The big tree was climbed by Marion.

In the active transitive sentences the Agent appears in Subject position while the Patient appears in Object position. In passive sentences the linking between syntactic roles and semantic roles changes: the Patient appears in Subject position while the Agent optionally appears in an adjunct phrase introduced by the preposition by in English. This entails that the standard word order also differs for the two structures: Agent–Verb–Patient for active transitives and Patient–Verb–Agent for passives. The passive is permitted crosslinguistically for virtually all transitive action verbs like those in (2) and (3) with Agent Subjects and Patient Objects. However, only a subset of non-action verb classes for which
the Subject and Object are linked to other semantic roles permit the passive, and those classes differ across languages (Pinker et al. 1987). For instance, psychological verbs permit passivization in English (e.g. *The paintings were admired by the tourists) but verbs of pure possession do not (e.g. *A new game was had by the brothers). From the discourse perspective, the passive focuses attention on the Patient of the transitive action and defocuses the Agent.

The passive is the most frequently studied argument structure in the acquisition literature. It is an ideal test of whether children’s apparent comprehension and production of argument structures derive from a true understanding of the argument structure of a particular verb, or reflects knowledge of the real-world context or the most frequent or default pattern that occurs with that verb in the input. In addition, the differential distribution of the passive across semantic classes of verbs predicts that children will quickly learn and easily overgeneralize passives using verbs with Agent Subjects and Patient Objects, but will learn the passive of other classes of verbs more slowly (Pinker et al. 1987).

Four main findings concerning passives have been central to the literature on argument structure acquisition. First, children’s early comprehension and production of passives is strongly influenced by their reliance on the word order and linking patterns of the much more frequent active structure and by their knowledge of real-world context (see O’Grady (1997) and references therein). Both comprehension and production errors involve reversing the roles of the arguments – treating the Patient Subject as if it were the Agent and the Agent in the adjunct by phrase as if it were the Patient. Children also comprehend and produce passives earlier when the Agent and Patient are non-reversible as in (3) (i.e. one cannot say Marion was climbed by the tree) than when they are reversible as in (2), reflecting the influence of real-world plausibility of events. Indeed, English-speaking children may not fully understand the argument structure of passives until age 6 or later even though they produce passive structures earlier than that.

A second finding is that children are sensitive to semantic classes of verbs in learning the passive. Two semantic classes are typically distinguished: action verbs and non-action verbs. Sudhalter and Braine (1985) tested the ability of children aged 3–11 to identify the Agent (for action passives) or Experiencer (for non-action passives). Children aged 3–6 performed almost twice as well on passives containing action verbs (54–58%) as compared to non-action verbs (26–29%). Even for 11-year-olds there was a clear difference between the two types of verbs (85% for action; 70% to 77% for different types of non-action). Similar results have been found in other studies using both real verbs (e.g. Gordon & Chafetz 1990, Maratsos, Fox, Becker & Chalkley 1985) and novel verbs (Pinker et al. 1987). However, Messenger et al. (2012) point out that this
apparent late mastery of non-action passives may in fact be a task effect: although 3- to 4-year-old children in their study performed poorly with non-action verbs on a picture-sentence matching task like that used in most previous studies, they performed well on a relatively less demanding priming task.

Third, the timing of passive acquisition is affected by the frequency of use of passives in the input. The passive is acquired relatively late – usually sometime between 3 and 4 years of age – in languages such as English and German where it is used infrequently in child-directed speech (0.4–1.3 times per hour; Abbot-Smith & Behrens 2006, Pinker et al. 1987). However, the passive is acquired and productively used as early as 2;0 in Inuktitut, K’iche’ Mayan, Kigiriama, Kiswahili, Sesotho and Zulu, languages in which passives occur as much as forty times more frequently in the input than in English (Alcock, Rimba & Newton 2012, Allen & Crago 1996, Demuth 1989, Demuth & Kline 2006, Pye & Quixtan Poz 1988). English-speaking children’s production and comprehension of the passive improves when frequency of passive input is increased as part of experimental conditions (Baker & Nelson 1984, Brooks & Tomasello 1999, Pinker et al. 1987, Vasilyeva, Huttenlocher & Waterfall 2006). Input frequency may also explain the difference in time of acquisition between action and non-action passives since action passives are much more frequent in child-directed speech (Gordon & Chafetz 1990). In addition, Abbot-Smith and Behrens (2006) showed that the timing of acquisition of one German-speaking child’s acquisition of the adjectival (sein) vs verbal (werden) passive was strongly related to the differential frequency of his mother’s use of these two forms, as well as to the child’s and his mother’s frequency of use of other related constructions (e.g. sein copula construction, werden future).

Finally, children show evidence of abstract representations for the passive structure later than that for the active transitive, and the strength of these representations develops with age. For example, a forced choice pointing task reveals that German-speaking children interpret active transitive sentences with both familiar and novel verbs reliably by 2;3 but show much later proficiency with passives: they are at chance in interpreting passives at age 2;3, interpret them as transitives at age 2;6, correctly interpret passives with familiar verbs at 3;7, and correctly interpret passives with novel verbs only at 4;7 (Dittmar et al. 2013). Priming studies with passives reveal a similar trajectory of growth of representation strength (see Section 13.2.3.2). Overgeneralization errors are another source of evidence for weak early abstract representations for passives: such errors are virtually non-existent before 2;6, and typically do not start appearing until well after age 3 in English (Pinker et al. 1987). Examples shown here are from English (4a), German (4b) and Inuktitut (4c) (Allen & Crago 1996, Pinker et al. 1987).
a. Until I’m four I don’t have to be gone (= taken to the dentist). (3;6)

b. Der Löffel ist besuppt.
   ‘The spoon is souped.’ (3;6)

c. Siaqri-tau-vuq.
   slide-PASSIVE-INDICATIVE.3SINGULAR.SUBJECT
   ‘It was slidden.’ (3;3, child’s foot slid on a slippery surface)

Elicited production studies also show evidence of the limited early generalizability of the passive (see Section 13.2.2). Two- and 3-year-olds trained on novel verbs with the active transitive structure rarely generalize these verbs to the passive during the testing phase, even when prompted to do so with questions focused on the Patient such as What happened to the car? for an action in which Big Bird meeked the car (Brooks & Tomasello 1999b, Wittek & Tomasello 2005).

13.3.2 Dative alternation

Verbs that permit the dative alternation may appear in either the prepositional dative construction (5a) or the double object dative construction (5b).

(5) a. Elizabeth gave the book to Wolfgang.
   b. Elizabeth gave Wolfgang the book.

Most verbs of transfer that take Patient and Recipient Objects allow the alternation such as give, bequeath, take, send, slide, throw, sell, build, prepare and tell. However, the double object construction is not permitted with Latinate verbs (e.g. *Melba donated the library the book), in situations where the Recipient cannot reasonably be construed as a possessor of the Patient (e.g. *Melba sent China the book), or with a variety of semantic classes of verbs including verbs of saying (e.g. *Melba confessed Roy the secret), verbs of manner of speaking (e.g. *Melba barked Roy an order), and verbs of selection (e.g. *Melba selected Roy a new tie). The alternation is also restricted by the form in which the arguments are realized: the double object dative is atypical when the Patient is a pronoun (e.g. *Melba gave Roy it), and much more common than the prepositional dative when the Recipient is a pronoun (e.g. Melba gave him the book). From a discourse perspective, the prepositional dative highlights the transfer event while the double object construction highlights the endstate of transfer (usually possession of the Patient by the Recipient). Bresnan, Cueni, Nikitina and Baayen (2007) offer a statistical model to determine the complex interaction of several discourse and syntactic factors in predicting when the prepositional vs double object datives are likely to be used.

Children comprehend and spontaneously produce both forms of the dative alternation from a relatively early age. The first spontaneous forms appear in children’s speech in English when their utterances have
a mean length of two words; this corresponds to ages between 1;6 and 3;4 depending on the child (Campbell & Tomasello 2001, Gropen et al. 1989, Snyder & Stromswold 1997, Viau 2006). Several different verbs appear in children’s earliest dative constructions although give is one of the first verbs produced and the most frequently used. In spontaneous speech transcripts of seven children aged 1;3–5;1, Campbell and Tomasello (2001) found that the majority of children used some dative alternation verbs in both possible constructions (give, get, make, show, bring, read), some in only the double object construction (tell, feed, hand, pay), and some in only the prepositional dative construction (fix, leave, open, take); this differentiation occurs in adult speech as well (Thothathiri & Snedeker 2008a). Campbell and Tomasello (2001) also found that most verbs that appeared in one or other of the dative constructions had first appeared in the child’s data in a simple transitive construction where the child was the implied recipient (Read story, Give that) or where the child specified the recipient in later conversation (Make a cake, I may give some).

Findings from the above-mentioned studies all show that the first use of the double object construction in English typically precedes or occurs at the same time as the first use of the prepositional dative; Viau (2006) shows an average temporal gap of 3.3 months between the two in his transcript study of twenty-two children. This difference may be influenced by input frequency since the double object construction occurs more often in speech to English-speaking children, even though both dative constructions are used frequently in the input with multiple verbs (Campbell & Tomasello 2001, Snyder & Stromswold 1997). It may also be influenced by semantic differences between the two constructions such as the emphasis on motion of the Patient (prepositional dative) vs eventual possession of the Patient (double object construction) proposed by Gropen et al. (1989). Viau provides evidence that linguistic elements containing the semantic primitive HAVE, assumed to underlie possession in the double object construction, are acquired earlier than those containing the semantic primitive GO which is assumed to underlie the motion component of the prepositional data. Givenness also plays a role in children’s use of the two options: both English- and Norwegian-speaking children aged 4–6 tend to produce the prepositional dative when the Theme is given, and either produce double object datives or omit the Recipient when the Recipient is given (Anderssen, Rodina, Mykhaylyk & Fikkert 2014, Gropen et al. 1989, Stephens 2010). De Marneffe, Grimm, Arnon, Kirby and Bresnan (2012) used a statistical model to analyse the complex interaction of several discourse and syntactic factors in determining children’s choice between the double object dative and prepositional dative structures.

Evidence pertinent to the development of verb-general representations of the dative alternation comes from the same three sources as for the passive: overgeneralizations, elicited production studies, and priming
studies. Gropen et al. (1989) summarized literature showing that children rarely overgeneralize the dative alternation, that dative overgeneralizations begin appearing younger than passive overgeneralizations and continue for several years, and that they appear only after children have begun using the dative forms correctly. Their own study of transcripts from five children showed that overgeneralizations account for about 5 per cent of the double object constructions produced, and occur only once in every 4,000 or so utterances. Some examples compiled by Gropen et al. are given in (6).

(6) a. I’ll brush him his hair. (2;3)
   b. How come you’re putting me that kind of juice? (2;4)
   c. I said her no. (3;1)

White (1987) showed that children age 3–5 can interpret and act out overgeneralized double object constructions, while Mazurkewich and White (1984) found that 9-year-olds judged as grammatical almost half of the erroneous overgeneralized double object constructions on a grammaticality judgment test. Ambridge et al. (2012, 2014) also showed that children aged 5–10 accept a broad range of dative overgeneralizations with novel and familiar verbs, constrained by effects of frequency and semantic class (see Section 13.2.1.1). These results suggest that children have some abstract representation of the dative structures from relatively early in acquisition but take a long time to work out the limits of the pattern.

Gropen et al. (1989) conducted an elicited production study to test the strength of children’s verb-general representations of the dative alternation. They taught four novel verbs each denoting a novel event (e.g. sliding a ball through a tunnel to a mouse at the other end), two with the double object dative and two with the prepositional dative. After each verb was taught, they asked the child to describe the event with questions eliciting both the double object construction (e.g. Can you tell me what I’m doing with the mouse?) and the prepositional dative (e.g. Can you tell me what I’m doing with the ball?). The children in their study, aged 6–8 years, easily generalized the novel verb to the non-modelled structure. In a similar study with 3-year-olds in which the children were simply asked to describe the novel event to their caregiver, Conwell and Demuth (2007) found that virtually all child descriptions used the modelled construction. However, children in a follow-up study who heard one action described with the double object dative and the other with the prepositional dative used the non-modelled construction in 31 per cent of their own descriptions. This suggests that children have an understanding of the dative alternation that they can use productively in at least some circumstances, consistent with the ‘weak representation’ hypothesis (see Section 13.2.3). Rowland and Noble (2011) found similar evidence from a forced-choice pointing task using novel verbs. Three- and 4-year-olds correctly pointed to the transfer event (as opposed to a caused action event) for both prepositional object
and double object dative prompts, although they were successful with the double object datives only when the theme and recipient nouns were distinctively marked (here, one as a proper noun and one as a common noun). Several priming studies have tested the strength of children’s abstract representations of the dative, concluding that they are relatively weak at age 3 and strengthen with age (see Section 13.2.3.2). A computational modelling study focused on the dative alternation provides evidence for different levels of generalization emerging at different stages of learning (Barak, Fazly & Stevenson 2014).

13.4 Argument realization

Much of the literature on argument structure acquisition assumes that arguments are always present in caregiver speech to provide the full input necessary to child learners, and that children produce all the arguments that a verb requires. However, this is not always the case. The omission of arguments is common in many languages.

(7) a. Habl-o con mi abuel-a cada dia.
   speak-1SING.SUBJ with my grandparent-FEM every day
   ‘(I) speak with my grandmother every day.’

   b. Bei1.
   carry
   ‘(The child) carried (the puppy to Grandma).’ (Lee & Naigles 2005: 530)

The omission of arguments poses two challenges: how do children receive sufficient data from the input to learn argument structure, and how do they display their knowledge of argument structure?

13.4.1 Argument omission in caregiver speech

In languages where arguments are frequently omitted in caregiver speech, children have much less – and also less consistent – information about the number and role of arguments to use in learning argument structure than children learning languages (like English) where arguments are virtually always present. This presumably makes it more difficult for children to use the syntactic information about number and role of arguments to bootstrap themselves into verb meaning (syntactic bootstrapping), or to confirm their hypotheses about syntactic structure based on verb semantics (semantic bootstrapping). We might expect that children learning such languages would be delayed in learning argument structure because the data they have to work with are either not present or not consistent. However, this does not seem to be the case.
Rispoli (1995) was one of the first to pose the problem of learning argument structure in argument omission languages. He found that only 1 per cent of transitive sentences in his Japanese caregiver data had two overt case-marked arguments while 90 per cent had one or no arguments (whose syntactic role was usually not otherwise identified). Matsuo et al. (2012) have since replicated this finding in a larger and denser corpus of caregiver Japanese. Narasimhan and colleagues (Narasimhan 2013, Narasimhan, Budwig & Murty 2005) found similar results for caregiver Hindi: only 7 per cent of transitive sentences contained two arguments while 44 per cent contained no arguments. In caregiver Inuktitut, Skarabela (2006) found that fewer than 15 per cent of arguments were realized overtly (data are not separated by verb type) although most of the omitted arguments were indexed by person/number agreement markers on the verb that indicate syntactic role. Given this absence of arguments, how do children learning these languages receive the data they need to determine the argument structure of verbs in their language?

Bowerman and Brown (2008) discuss three ways in which children could receive this information from the input. First, even though any given utterance may contain only one or none of the required arguments for a verb, across several utterances it is likely that all the arguments will appear. They cite extensive evidence for this from Clancy (1996), such as one example in which a Korean caregiver refers to an event involving sticking plastic shapes to a board variously as ‘shall auntie stick?’ (Agent), ‘stick this’ (Patient) and ‘stick there’ (Location) – using all three arguments of the verb pwuthita ‘stick’ but across three separate utterances. Thus a child who is able to keep track of all of the instances of one verb will eventually have the requisite evidence to determine a verb’s argument structure. At a more general and comprehensive level, Lee and Naigles (2005) show probabilistic associations between number of arguments and verbs of different semantic classes for Mandarin Chinese, another language with frequent argument omission. In a study of 7,884 tokens of the 60 most frequent verb types in data from caregiver speech to ten different children aged around 1;10, they found that object NPs followed transitive verbs (e.g. mai3 ‘buy’) significantly more frequently than intransitive verbs (e.g. ku1 ‘cry’), full clauses followed internal/communication verbs (e.g. siao1 ‘say’) significantly more frequently than motion verbs (e.g. pao3 ‘run’), and locative phrases followed motion verbs significantly more frequently than internal/communication verbs. These and other results from their study are very similar to findings for a comparable database of caregiver English (Naigles & Hoff-Ginsberg 1995, 1998) even though Mandarin has rampant argument ellipsis and English does not. Sethuraman and Smith (2013) show, however, that the consistent presence of arguments in speech may indeed facilitate earlier argument identification. They asked children aged 2–4 years learning Tamil (arguments frequently omitted) and English (arguments rarely omitted) to map active
transitive verbs to their relational roles. Children were asked to identify which of three pictures showing different parts of the argument structure – Agent-Verb-Patient (e.g. woman actively reading a book), Agent-Patient (e.g. woman sitting with book beside her), or just Patient (e.g. book sitting on a table) – best matched a verbal prompt. The Tamil- and English-speaking groups performed similarly when the verbal prompt contained all the arguments (e.g. The girl is reading the book) but the 2-year-old Tamil-speaking children performed significantly worse when only the verb was presented (e.g. Reading). Sethuraman and Smith conclude that children learning a language in which the arguments are consistently present in speech can better identify verb meaning in a situation when the arguments are absent.

A second source of evidence for argument structure in languages with extensive argument omission is the other linguistic tendencies that co-occur with verbs of certain argument structures. Rispoli’s (1987, 1995) study of Japanese caregiver speech revealed that transitive and intransitive verbs are differentially associated with such properties as the animacy of the Agent and the speech act of the utterance in which the verb occurs. Wittek (2008) shows for German that the use of the adverbial wieder ‘again’ is a reliable cue to the semantic properties of change-of-state verbs in that language. Although German requires arguments in most cases, such a cue could also work well in a language with argument ellipsis.

A third possibility is that children can glean information even from omitted arguments because of their knowledge of discourse effects on argument realization. Adults realize arguments in various forms depending on the accessibility of the referent to the interlocutor (see Ariel (2001) and references therein). A referent newly introduced into discourse is deemed inaccessible and realized as a full noun phrase, whereas a referent just mentioned in the previous utterance is already accessible to the interlocutor and thus typically appears as a pronoun or is omitted. Children as young as 2 years are also sensitive to accessibility features in realizing arguments in their own speech (e.g. Allen 2000, Clancy 1997, Guerriero, Oshima-Takane, & Kuriyama 2006, Huang 2011, Hughes & Allen 2013, Matthews, Lieven, Theakston & Tomasello 2006, Narasimhan et al. 2005, Serratrice 2005; see Allen et al. (2008) for a review). In one typical spontaneous speech study, Allen (2000) investigated children’s sensitivity to eight accessibility features in over 3,000 arguments from four children aged 2;0–3;6 speaking Inuktitut, a language characterized by rampant argument omission. She found that children were significantly more likely to realize arguments overtly when they were newly introduced to discourse (vs given), absent from the physical context (vs present), contrasted with other referents (vs not contrasted) and ambiguous as to the referent in context (vs unambiguous). A follow-up study found that children were more likely to realize an argument the less accessible it was: fully accessible arguments were
realized overtly in only 18 per cent of cases, while arguments inaccessible for all features (i.e. newly introduced, contrasted, ambiguous) were realized overtly in 86 per cent of cases (Allen 2007). An even more nuanced sensitivity to the incremental effect of referent accessibility is shown in a study of English-speaking 2- and 3-year-olds, focusing on six accessibility features (Hughes & Allen 2015). In a typical experimental study, Matthews et al. (2006) assessed the effects of joint attention on argument realization in 100 English-speaking children aged 2, 3 and 4 years. Participants viewed ten short video clips (e.g. clown jumping, fairy eating an apple); the experimenter sometimes watched with the child (i.e. joint attention) and sometimes did not (i.e. no joint attention). After viewing each clip, children were asked to recount the clip to the experimenter with the request ‘What happened? What did you see?’ The 3- and 4-year-olds, but not the 2-year-olds, chose different linguistic forms (noun vs pronoun) to realize the referents depending on whether the interlocutor shared attention to the video or not. In another experimental study, Naigles and Maltempo (2011) presented English-speaking children with an ungrammatical sentence in which the object was omitted (e.g. The zebra brings). Children were more likely to repair the sentence when acting it out (i.e. acting out a zebra bringing something, rather than a zebra coming) if an informative context preceded the ungrammatical sentence. Although the studies just described do not directly assess whether children are able to use the input to learn argument structure in argument omission languages, they show that children manipulate argument form according to accessibility in their own speech and thus may well recognize the implicit presence of an argument in the input in situations where an argument would normally be required but is omitted for reasons of accessibility.

13.4.2 Preferred argument structure in child speech

The distribution of children’s lexical vs omitted (or pronominalized) arguments in spontaneous speech can also reveal their knowledge of argument structure. As discussed in the previous section, an argument that is not accessible in the discourse is likely to be realized as a lexical noun phrase, while an accessible argument is likely to be pronominalized or omitted depending on the typology of the language. Du Bois’s (1987) study of adult narratives in Sakapulteko Maya, as well as much further work in languages of varying typologies, reveals that choices about argument realization also have relevance to argument structure (Du Bois, Kumpf & Ashby 2003). In particular, there is a strong correlation between the syntactic role in which an argument is realized, the accessibility of that argument and the morphological form in which it appears – a pattern which Du Bois has named Preferred Argument Structure. Utterances are typically restricted to a maximum of one lexical and one
new argument per clause (usually the same argument), and new and lexical arguments are typically not expressed as the Subject of a transitive verb but rather as an Object or as the Subject of an intransitive verb. Speakers thus reveal their knowledge of argument structure through their differential expression of new vs given referents and lexical vs non-lexical arguments in different syntactic roles.

Several spontaneous speech studies have shown that young children also follow the patterns of Preferred Argument Structure. In a study of four Inuktitut-speaking children aged 2;0–3;6, Allen and Schröder (2003) found that only 0.2 per cent of children’s transitive clauses contained more than one lexical or new argument, and only 1 per cent of Subjects of transitive verbs were realized as lexical forms or arguments new to the discourse. Similar results hold for children aged 1;8–2;10 learning Korean (Clancy 2003), children aged 1;9 and 3;0 learning Japanese and English (Guerriero et al. 2006), children aged 2;10–4;3 learning Hindi (Narasimhan et al. 2005), children aged 2;0–2;5 learning Tzeltal Mayan (Brown 1998) and one child aged 4;6–5;10 learning Cree (Brittain, Allen & Acton 2014). These results are striking given the divergent typologies of the languages with respect to whether they allow argument omission and whether they mark syntactic role, and show that children across languages are highly sensitive not only to individual links between referent accessibility and argument realization but also to the broader argument structure patterns this entails. (See Clancy (2003) for arguments that the nature of children’s early activities is the underlying source of their early sensitivity to Preferred Argument Structure.)

13.5 Conclusion

As noted in the introduction to this chapter, the research on the acquisition of argument structure has been driven by determining what mechanisms children use to break into the system. Theories range from generalization from the input on the basis of initial item-by-item learning on the one hand, to guidance from innate linguistic knowledge on the other. It is clear by now that some elements of both these positions are true – children’s early knowledge of argument structure is not adult-like regardless of whatever innate knowledge they may have, yet children have much more sensitive early knowledge than was previously believed. Current research focuses on deepening our understanding of the nature of the knowledge that children bring to the task of learning argument structure, and investigating how various factors such as input frequency and processing ability interact with the argument structure system to mediate development towards adult-like knowledge.
Suggestions for further reading


