

15. First Language Acquisition

Laura Wagner

1. Introduction

As this volume shows, the syntax and semantics of tense and aspect are complex, and vary in interesting ways across languages. From the perspective of a child who has to learn the particular temporal system of her language, the complexity and variability pose very real learning problems. Children face several critical challenges in acquiring tense and aspect. One challenge concerns the variability in linguistic marking, which encompasses a wide range. Some languages mark only grammatical aspect while others mark only tense (compare Mandarin and Modern Hebrew); when a language does grammatically encode these elements, it can do so via many methods, including modifications to the verb stem (as in Russian), separate particles (as in Mandarin), verb morphology that combines aspectual and tense information together (as in French), and implicit signaling using case marking on nouns (as in Finnish). Thus, simply finding the relevant morpho-syntactic elements that express temporality is a non-trivial task for the learner. Another challenge concerns the complexity of the temporal semantic system. Tense and aspect consist of several overlapping and related elements that interact with one another; moreover, the specific types of interaction that a language allows depend on the specific instantiation of the semantic elements in that language. For example, the combination of imperfective aspect with stative predicates is allowed in some languages but not others. In particular, when the imperfective form in a language has a progressive flavor to it, languages tend to disallow it (as in English). Thus, children must learn fine-grained semantic distinctions so that they can create the right system across their temporal elements. A final challenge for children stems from their cognitive immaturity: children must be able to understand the concepts that underlie temporal semantics, as well as be able to identify situations in the world

that correspond to those concepts. Temporal concepts are quite abstract, including notions such as event boundedness, dynamic change over time, and deictic temporal center. They are not the kinds of concepts that children can easily observe in the world. When children begin the acquisition process, it is not clear whether they can fully entertain underlying temporal concepts, nor is it clear what evidence from their experiences they would draw on to determine what concepts were being used by others.

Nevertheless, despite these challenges, children do use tense and aspect morpho-syntax from a young age, and by and large, they appear to use it correctly. The sections below will discuss specific evidence illustrating the nature of children's competence with temporal semantics, beginning with an analysis of an apparent error (an under-extension) in children's early production and then proceeding to specific evaluations of children's knowledge of *Aktionsart* (lexical aspect), grammatical aspect, and tense.

1.1. Definition of Terms

Given the nature of this volume, a full linguistic account of *Aktionsart*, grammatical aspect, and tense would be redundant.¹ Nevertheless, a few words about how these terms will be used in the current discussion seems warranted. *Aktionsart* will be used to refer to the aspectual properties that are linked to the semantics of the predicates themselves; that is, the familiar Vendler/Dowty classes (Vendler, 1967; Dowty, 1979). The term *grammatical aspect* will be used to refer to the speaker's temporal perspective on an event; that is, to the perfective/imperfective distinction. Grammatical aspect shares with *Aktionsart* a focus on the temporal properties of the event, but the two are independent of each other. For example, telic predicates can be described in either perspective (perfective: *Natasha fell*; imperfective: *Natasha was falling*) as can atelic predicates (perfective: *Audrey rode*; imperfective: *Audrey was riding*). In contrast to both of these aspectual elements,

tense will be used to refer to the deictic function that locates an event in time relative to an origin moment – usually, the time of utterance. Unlike the aspectual categories, tense does not specify or interpret event properties; it simply locates them on a timeline. It does, however, share with grammatical aspect the fact that it contributes independent information to sentence meaning above and beyond the lexical information in the predicate. Thus, Aktionsart, grammatical aspect, and tense all contribute to the temporal interpretation of events, but they do so in different, and largely independent ways.

2. Aspectual Under-Extensions in Children's Production

The literature on children's acquisition of aspect has been dominated by a cross-linguistically robust phenomenon found in children's language production. As will be discussed shortly, children fail to use all the tense-aspect combinations available to them, effectively under-extending their semantics. As the course of typical language development is dominated by children's successes, the discovery of a genuine error in children's speech – even the subtle error of under-extending the use of forms – has naturally drawn the attention of researchers. Moreover, the systematic nature of children's temporal under-extensions suggests that they arise from general principles of children's semantic organization and/or their cognitive architecture. Understanding the phenomenon, therefore, is potentially illuminating about both the nature of temporal semantics as well as the processes of language development.

2.1. The Phenomenon

Examinations of young children's speech (i.e., before age two and half years or so) have found that children tend to restrict their language's past tense and perfective markers to telic predicates while also restricting their language's present tense and imperfective markers to atelic predicates. Thus,

children commonly say things like *broke* (past + perfective + telic) and *riding* (imperfective + atelic) but rarely say *breaking* (imperfective + telic) or *rode* (past + perfective + atelic). The overall pattern is shown in Table 1: children tend to produce forms that conform to the classes defined by the vertical columns and they tend to avoid combinations that would require cross-class groupings. Note that the trend is statistical; cross-class groupings are not wholly absent in children's speech, they are just less likely to occur.

Table 1

Two critical classes in children's early aspectual use

	Class 1 (Compleitive)	Class 2 (Ongoing)
Aktionsart	Telic	Atelic
Grammatical Aspect	Perfective	Imperfective
Tense	Past	Present

This pattern constitutes an under-extension because children systematically under-use the options available to them. There is nothing ungrammatical, or even unusual, about forms that cross these category lines. It is even a little bit surprising that children seem to not want to talk about ongoing bounded events that would warrant a telic + imperfective + present combination (e.g. *Look mom, I'm making a sandwich!*) or completed activities that would warrant an atelic + perfective + past combination (e.g. *I played in the sandbox*). Moreover, based on the forms that children do produce, it is clear that they have some command of the relevant morphological forms. The gaps in their production therefore seem significant and have drawn the attention of researchers.

Across languages, children's specific instantiation of this pattern does vary somewhat – in some languages, children produce tense morphology while in other languages they use grammatical aspect morphemes or morphemes that combine both tense and aspect. However, children's preference for the vertically defined classes has been found in many languages, including English (Bloom, Lifter, & Hafitz, 1980; Shirai & Andersen, 1995; Johnson & Fey, 2006), French (Bronckart & Sinclair, 1973; Labelle, Godard, & Longtin, 2002), Greek (Stephany, 1981), Hebrew (Berman, 1983), Italian (Antinucci & Miller, 1976), Japanese (Rispoli, 1981), Mandarin (Li & Bowerman, 1998), Polish (Weist, Wysocka, Witkowska-Stadnik, Buczowska, & Konieczna, 1984; Bloom & Harner, 1989), Russian (Stoll, 1998), and Turkish (Aksu-Koç, 1998). Thus, it appears that whatever drives this phenomenon does not depend on specific structural properties of any particular language, but requires a more general explanation.

A related phenomenon of children's early language – the so-called Root Infinitive (or Optional Infinitive) stage – provides additional support for the idea that children's production is guided by the vertically defined temporal classes. In children's early production, not all verb forms

are produced with adult-like morphology; instead, children produce some verbs in their infinitival form or some variety of a bare form (see Poeppel & Wexler, 1993, and Hoekstra & Hyams, 1998 for different approaches to the phenomenon). These infinitive forms are the sole verb in the root clause (hence, Root Infinitive) and co-exist in children's speech at the same time period with appropriately tensed forms (hence, Optional Infinitive). Investigations of children's interpretations of these Root Infinitive forms have shown that they are influenced by both Aktionsart and grammatical aspect. For example, Brun, Avrutin, and Bayonyshev (1999) looked at the Root Infinitives of children acquiring Russian, and used the context of the utterance to determine the probable temporal reference that the children intended. They found that children overwhelmingly used perfective verb stems to refer to past times and imperfective verb stems to refer to present times. Temporal reference was defined contextually in this case, but even so, it was tied to the vertically defined classes just as standard tense marking would be. Similarly, Hyams (2007) reviews data from several languages, including Greek, Dutch, and English, and argues that both grammatical aspect and Aktionsart (in particular, the telic/atelic distinction) contribute to the temporal interpretation of Root Infinitives. Even when tense marking is not specifically used, past tense interpretations are linked to telic verbs and verbs marked with perfective aspect while present tense interpretations are linked to atelic verbs and verbs marked with imperfective aspect.

Beyond the production data itself, additional evidence for the power of the vertically defined classes comes from experimental studies that investigated children's willingness to use tense and grammatical aspect morphology to generalize the meaning of a novel verb (Behrend, 1990; Behrend, Harris, & Cartwright, 1995; Carr & Johnston, 2001). In these studies, pre-school aged children acquiring English were shown novel events containing a distinctive action, instrument and result state. For example, they might see the experimenter use a book-end to scoop up some clay and deposit it in a small box. Each event was described with a different nonsense verb that used

either past perfective morphology (“He zivved!”) or present imperfective morphology (“He is zivving!”). At the test phase, children were shown variations of the original event and asked to say which variations could also be called by the novel verb. Three-year-old children generalized the verbs according to the morphology in which they were presented: novel verbs with past perfective marking were taken to specify the result state of the event while novel verbs with present imperfective marking were taken to specify the action involved in the event. These result and action features correspond conceptually to the telic/atelic distinction. Thus, these children are drawing inferences in accordance with the vertically defined classes: given past + perfective marking, a child will infer a telic Aktionsart and given present + imperfective marking, a child will infer atelic Aktionsart.

Interestingly, there are two groups of children who have been tested who failed to make this inference. The first group are five-year-olds (Behrend, 1990; Behrend et al., 1995). As children get older, the vertically defined classes become less strong. Children under-extend their morphology usage much less (although even adults continue to do it to some extent; see below), and apparently the classes weaken to the point where they no longer support inferences within them. Given the genuine independence of tense, grammatical aspect and Aktionsart, this weakening is a desirable outcome of children’s language development. The second group who fail this task are children with Specific Language Impairment (SLI). SLI is a language disorder that is characterized by problems with linguistic elements (including inflectional morphology in particular) with no concomitant problems with hearing or in general cognition (see Leonard, 1998 for an overview). Carr and Johnston (2001) found that neither three- nor five-year-old children with SLI made inferences from morphology to Aktionsart; moreover, unlike the neuro-typical 5-year-olds they tested, the SLI children also failed to show a bias to analyze the events in terms of their result state more generally. Carr and Johnston argue that the SLI failures are reflective of their larger difficulties with language

acquisition. Indeed, as the forthcoming discussion will demonstrate, a recurring theme in the acquisition of tense and aspect is that children with SLI have trouble with several dimensions of temporal semantics.

2.2. Theoretical Approaches to Children's Temporal Under-extensions

As will be discussed shortly, there are different theoretical approaches to children's temporal under-extensions. However, across all approaches, there is widespread agreement that there is something natural about the classes defined by the vertical columns. Some researchers (e.g. Bloom et al., 1980; Shirai & Andersen, 1995; Wagner, 2009) find the naturalness in the cognitive domain. For example, Shirai and Andersen (1995) argue that the categories define cognitive prototypes. Each category corresponds to an idealized, or prototypical, event representation. The completive class is best exemplified by a bounded event type done to its inherent completion point at some point in the past (i.e. telic + perfective + past). The ongoing class is best exemplified by an unbounded event type that is still ongoing in the present time (i.e. atelic + imperfective + present). These event prototypes help organize early cognition as well early language use.

Other researchers find the naturalness in the linguistic domain (e.g. Bickerton, 1981; Olsen, Weinberg, Lilly, & Drury 1998; van Hout, 2005). These researchers appeal to theoretical accounts that identify the within-class combinations as less marked or as involving less semantic coercion than the cross-class combinations (cf. De Swart, 1998; Bohnemeyer & Swift, 2004). They see the naturalness primarily as a function of linguistic organization, and children's adherence to the vertically defined classes reflects their implicit appreciation of linguistic defaults. Thus, all approaches agree that children's under-extensions reflect the easiest semantic combinations to produce and understand. However, the particular sense in which these classes are easier differs across theoretical positions.

The first theoretical approach focuses on children's comparatively limited conceptual abilities. Early research (Bronckart & Sinclair, 1973; Antinucci & Miller, 1976) into this phenomenon drew heavily on the theories of Piaget (1969) and his ideas about how children construct knowledge. From this perspective, the reason that children restrict themselves to the vertically defined classes is because they don't have the conceptual resources to understand deictic tense, and possibly not even grammatical aspect. Children must build these higher-level concepts out of information that can be interpreted in the here-and-now, namely Aktionsart. Thus, children's cognitive limitations guide their early language use. This general position has fallen out of favor for two main reasons. First, advances in the field of developmental Psychology have shown even infants have the capacity for abstract thought, including thinking about event components and events over time (for reviews, see Bauer, 2006; Wagner & Lakusta, 2009). These early capacities do not prove that young children understand the linguistic instantiation of tense and aspect, but they do mean that we cannot assume *a priori* that they do not. Second, and more importantly, various studies (see discussion below) have shown that young children can comprehend the meaning behind tense and grammatical aspect markers, including in cross-class combinations (e.g., Weist, Wysocka, & Lyytinen, 1991; Weist, Lyytinen, Wysocka, & Atanassova, 1997; Weist, Atanassova, Wysocka, & Pawlak, 1999; Wagner, 2001; Valian, 2006; Kazanina & Phillips, 2007). Although conceptual deficits alone cannot account for children's behavior, nevertheless, children's more limited cognitive abilities in general play an important role in the information processing approach discussed below.

The second general type of approach treats children's produced forms as a more-or-less direct reflection of their grammars. Children's omissions are taken as evidence that children do not possess (or do not yet fully possess) the grammatical resources needed to produce and represent them. The specific instantiations of the grammatical approach are as varied as the range of linguistic

theories available. At one extreme, some researchers have suggested that children cannot initially build or otherwise specify the features for the functional projections required of tense and grammatical aspect in a syntactic tree (e.g. Radford, 1990). Children restrict their use of these morphemes according to Aktionsart type because Aktionsart is the only semantic category they can actually represent in their syntax. Other researchers see the vertically defined classes as instantiating the initial settings of Universal Grammar; children prefer the vertically defined classes because those are the default parameter settings (Bickerton, 1981; Olsen et al., 1998). Indeed, some languages do have grammatical restrictions that correspond to these classes (e.g. Russian restricts present tense to imperfective grammatical aspect), so children's under-extensions may reflect a possible grammar for a language, perhaps even a default grammar for a language. A more limited version of the grammatical approach can be seen in Wagner (2001). She suggests that children may have initially mis-mapped grammatical aspect semantics onto tense morphology; the alignment of those two categories within the vertical classes would therefore be a simple by-product of this mistake. At the other extreme, researchers coming from a more constructivist point of view have argued that the fact that children's forms are largely restricted to the vertically defined classes is evidence that children's grammars do not have a fully articulated temporal structure (see Shirai & Andersen, 1995; Li & Shirai, 2000). That is, children do not have separate representations of Aktionsart, grammatical aspect, and tense; instead what they have are representations that correspond to the vertically defined classes.

One intriguing piece of evidence for this last position comes from work showing that the pattern of under-extension found in children's early production is also found in adult speech, including their speech directed at children (Shirai & Andersen, 1995; Aksu-Koç, 1998; Wulff, Ellis, Römer, Bardovi-Harlig, & Leblanc, 2009). Like children, adults tend to use present and imperfective morphology with atelic predicates, and perfective and past morphology with telic

predicates. Adults tend to be a bit less extreme in their under-extension, using more cross-class items, but they do show the same general pattern. Moreover, Li and Shirai (2000; see also Zhao & Li, 2009) have proposed that a recurrent connectionist network² can take the adult distribution as input and produce the child's more extreme distribution as output. The data from adults raises the possibility that children are just mirroring the distribution of forms that they hear; if this is the case, there is no reason to posit any detailed grammatical representations to the child at all.

This grammatical type of approach has faltered as an explanation for children's temporal under-extensions for several reasons. First, children's under-extensions are a statistical trend, not a categorical phenomenon (see, for example, Bar-Shalom, 2002). In all the studies documenting the phenomenon, examples of cross-class combinations have been found; these combinations are less frequent, but they do occur in noticeable quantities. If the vertically defined classes are a true reflection of children's grammars, then what is the status of these forms that fall outside of those classes? One possibility is that they are simply errors; another possibility is that children are in the process of shifting from one grammar to another – that is, from a grammar oriented around the vertical classes to the adult grammar. Regardless, some additional process has to be invoked to account for the cross-class forms, and that process undermines the central appeal of this approach, namely that what children produce is a direct reflection of their grammar. Second, and more generally, it is unclear how tenable it is to draw a direct line from what children say to what their grammar looks like. This idea has been criticized on two fronts. On the one hand, what children say may over-estimate what children know. This point has been made forcefully in the language development literature by Tomasello and colleagues (see Tomasello, 2003 for a review). Within the domain of temporal semantics, Shirai and Miyata (2006) showed that young Japanese children used contrastive forms of tense (that is, they used the very same verb in both past and present tenses) for several months before they had linked them to appropriate meanings (that is, before they used the

past tense forms to refer to past time situations). Simply having the relevant forms does not mean children are using them for the adult meanings. On the other hand, there is a growing consensus in the field of temporal semantics that what children say may under-estimate what they know. The sections below will focus on children's comprehension of temporal semantics, and the dominant finding will be that that children understand many forms they don't produce themselves. To the extent that children's comprehension outstrips their language use, it again suggests that the pattern found in production is driven by elements outside of the child's grammar.

The final type of approach to the pattern of under-extension is the information-processing point of view (e.g. Weist et al., 1991, 1997; van Hout, 2005; Kazanina & Phillips, 2006; Wagner, 2009). This approach focuses on the fact that appropriate use of temporality requires children to coordinate a range of information – from the morpho-syntactic forms, to the specific semantic interactions, to the evaluation of truth conditions with respect to the world. The relative difficulty in processing any of these information elements can influence how hard it is for children to produce (or understand) a particular tense-aspect combination. The vertically defined classes reflect the semantic combinations with the lowest information processing demands, and hence, are preferentially produced by children. Proponents of this view typically assume that children have a fairly complete set of the relevant semantic elements at their disposal; children are presumed to distinguish among tense, grammatical aspect and Aktionsart. What children must learn is how their native language specifically instantiates each of these elements. The difficulty of this learning task will depend on how easy it is for children to find the right morpho-syntax (cf. van Hout, 2005), how easy it is for children to determine which concept is being referred to (see Wagner, 2001 for discussion of the difficulties of teasing apart concepts like past and completion), and perhaps even the specific concepts a language encodes (see the argument in Weist, Pawlak, & Carapella, 2004 that children acquire the imperfective in Polish before they do in English because of the semantic

differences between them). Indeed, as will be discussed below, the ease with which children understand particular combinations can be manipulated by manipulating the evidence in the larger situation; moreover, the less information available to children, the more likely they are to depend on the vertically defined classes (Kazanina & Philips, 2006; Wagner, 2009).

In addition, the information processing approach provides an alternative perspective on the fact that adults show the same pattern of under-extension as children. First, the fact that parents exhibit the under-extension pattern will limit the data that children have access to: children need exposure to the full range of morpho-syntactic options in order to learn them, and less evidence about the cross-class combinations could lead to slower learning of those elements. Second, and more importantly, the information processing approach offers an explanation for why adults show the same pattern of under-extension as children. Adults may have more advanced information processing abilities, but in principle, they are subject to the same kinds of constraints as children and the same combinations of forms should be easier for them to produce and understand. and indeed, Wagner (2009) has shown that when given less information about a situation, adults do show dips in performance along the same lines as children's under-extension.

For researchers, the field's focus on children's under-extensions and the importance of the vertically defined classes has been very useful for identifying phenomena and refining theoretical positions. However, these theories must ultimately account for more than just a particular quirk of children's production; they must explain how children come to correctly produce the full range of tense and aspect combinations as well as how children develop their understanding of the meanings of these forms. The following sections provide an overview of what is known about how children acquire Aktionsart, grammatical aspect, and tense. These will each be treated as the separate semantic elements that they are; however, as much of this research was inspired by a desire to

understand children's under-extensions, much of the discussion will be focused on children's ability to distinguish among the various semantic levels.

3. Acquisition of Aktionsart

No languages mark Aktionsart directly – that is, no languages have a morphological marker for verbs when they are in telic as opposed to atelic predicates. Instead, the various aspectual classes generate a variety of syntactic reflexes that occur more or less reliably across languages. Asking whether or not children have acquired Aktionsart, then, is tantamount to asking whether they appreciate the aspectual relevance of these syntactic reflexes.

Based on children's production data, it appears that they do distinguish among a range of Aktionsart types. As noted in the previous section, there is ample evidence that children tend to restrict past and perfective marking to telic predicates and present tense and imperfective marking to atelic predicates. Moreover, the trend to restrict past and perfective marking for telic predicates tends to be stronger for punctual achievements (*reach, die*) than for durative accomplishments (*climb, build*), suggesting that children may make relatively fine-grained distinctions among the Aktionsart types. In addition, the studies that have found the under-extension typically also find evidence for morphological restrictions on stative predicates: children acquiring English typically reserve the 3rd singular *-s* marker for statives (Bloom et al., 1980) and children acquiring Greek typically restrict stative predicates to the present imperfective form (Stephany, 1981); similarly, root infinitives are generally restricted to eventive (i.e., non-stative) verbs (Hoekstra & Hyams, 1998; Gavrusseva, 2003).

However, grammatical aspect and tense markers are not actual reflexes of Aktionsart, and children's use of them cannot constitute evidence that they know how their language signals

Aktionsart information. Investigations of actual reflexes, such as sentence particles and argument structure, have found that these also appear to be linked to Aktionsart for children at a young age.

In Germanic languages, particles such as English *up*, German *auf*, and Dutch *op* all help to signal bounded, or telic meaning; children use these particles for that purpose from early on. Penner, Schulz, and Wymann (2003) found that children acquiring German use such particles to signal telicity from their very earliest uses. Moreover, the study also found that children who fail to understand the connection between particles and telicity may be at risk for developing Specific Language Impairment (SLI). Similarly, van Hout (2000) found that 3-year-old children acquiring Dutch could use particles to choose between bounded and unbounded events. Finally, Wagner and Carey (2003) (also Wagner, 2006) found that 2- and 3-year-old children acquiring English could successfully use prepositional phrases to help them establish telic interpretations in an individuation task. Prepositions, either used as verb particles or as the heads of prepositional phrases, are among the earliest elements in children's vocabularies (Fenson et al., 1994), and children link them to telic interpretations from early on as well.

Another reflex of the telic/atelic distinction is transitivity. Argument structure is, of course, not a direct marker of aspect; however, telic predicates tend to appear in transitive structures while atelic predicates tend to appear in intransitive structures, and this connection is at least partly motivated by the semantics of telicity itself (Hopper & Thompson, 1980; Tenny, 1994). Children's understanding of argument structure has been the focus of much language acquisition research, and in general, children have been shown to be able to link semantic features, such as causality, to structures by 2 years of age (e.g., Naigles, 1990). In addition, Wagner (2006) and Wagner (2010) have shown that 2-year-old children can link transitivity to telicity in particular. For example, in Wagner (2010), children were asked to generalize the meaning of a nonsense verb as a function of whether it appeared in a transitive or intransitive sentence. The children treated nonsense verbs in

transitive frames as telic, generalizing them to events with similar results, and verbs in intransitive frames as atelic, generalizing them to events with similar actions. Thus, children were sensitive to this argument structure reflex of telicity as well.

It appears, therefore, that before children are 3-years-old, they appreciate that differences among the Aktionsart classes can be reflected with various morpho-syntactic markings. Indeed, an over-reliance on this appreciation may partially account for the pattern of under-extension discussed in section 2. Nevertheless, the appreciation itself suggests Aktionsart is important for children and is integral to their early grammars.

4. Acquisition of Grammatical Aspect

The morphological forms of grammatical aspect (and tense) tend to be acquired quite early. The existence of the under-extension phenomenon discussed above in section 2 in fact depends on children producing recognizable tense/aspect morphology. Within English, children as young as 18-months-old appreciate that the progressive *-ing* is distributionally dependent on the auxiliary verb (Santelmann & Jusczyk, 1998) and the progressive *-ing* and past tense *-ed* are among children's earliest used morphemes (Brown, 1973). Moreover, two-year-old children understand that these morphemes can be segmented as separate units from the verbs they are attached to. In Hohenstein and Akhtar (2007), children were given a nonsense verb (e.g. *tamming*) and were encouraged to produce the bare form of the verb (e.g. "What will he do now? He wants to..."). The children were able to identify the tense/aspect morphology and strip it off the verb in their own production. Importantly, they only did this for verbs; when a new noun happened to end with the same sound (e.g. "This is my tamming"), children never deleted the final syllable in their speech. As grammatical aspect morphology tends to be highly frequent, it is not particularly surprising that children are able to identify it from an early age.

Investigations into the meaning of grammatical aspect have been largely motivated by the under-extension phenomenon, and many have focused on children's ability to distinguish grammatical aspect from Aktionsart on the one hand and from tense on the other. Indeed grammatical aspect is the pivot point of the phenomenon: it is similar to Aktionsart within the semantic domain and similar to tense within the syntactic one. Thus, demonstrating that children understand the specific contribution of grammatical aspect goes a long way towards showing that children can differentiate all the levels of semantic representation. In addition, grammatical aspect also plays an important role in structuring discourse, and researchers have investigated children's knowledge of this function as well.

4.1. Grammatical Aspect vs. Aktionsart: The Imperfective Paradox

To determine if children can distinguish between grammatical aspect and Aktionsart, researchers have asked children to interpret perfective and imperfective forms when they are paired with children's disfavored type of event, in order to see whether children can correctly interpret telic + imperfective and atelic + perfective combinations. These combinations have figured prominently in the theoretic literature in the context of the Imperfective Paradox. The paradox is this: Why does the imperfective version of a sentence entail the perfective version with some predicates (sentence (1) entails (2)) but not others (sentence (3) does not entail (4))? The solution to the paradox rests on the fact that the Aktionsart of the predicate interacts with the way that entailments work for grammatical aspect. For atelic predicates, perfective and imperfective aspects have equivalent entailments. That is, sentence (1) entails sentence (2), and vice versa.

- (1) Pierre was walking.
- (2) Pierre walked.

(3) Marya was building a house.

(4) Marya built a house.

Although there are indeed subtle semantic differences in the interpretation of these two sentences, the homogeneous nature of atelic events effectively neutralizes any difference in completion entailments. By contrast, for telic predicates, perfective and imperfective aspect have very different effects. Parallel to the atelic case, the perfective version of a telic predicate (4) entails the imperfective version (3); however, as noted by the paradox, the reverse is decidedly not the case. Evidence for the absence of a completion entailment comes from the continuation sentence in (5) – this sounds quite reasonable after (3) but becomes a contradiction after (4). The inherent ending-point included in the meaning of a telic predicate defines a unique point that is entailed by perfective, but not imperfective aspect.

(5) But she never finished it.

Researchers have long noted that the difference between sentences like (3) and (4) can be exploited in an experimental paradigm. In seminal work, Weist and colleagues (Weist et al., 1991, 1997, 1999) showed children pairs of pictures illustrating different phases of an event. One picture would show a completed event (for example, a girl sitting by a completed house) and the other, an incomplete event still in progress (for example, a girl busily hammering a nail into a partial house). Children were asked to match either sentence (3) or sentence (4) to the correct picture. To succeed in this task, the child must be able to correctly interpret both a perfective + telic combination (cf. sentence 3) that is similar to the kinds of sentences they would produce themselves, as well as an imperfective + telic combination (cf. sentence 4) that is something they would rarely say on their

own. Children acquiring both Polish and English were able to succeed at interpreting both those combinations by age 3 years (see also Vinnitskaya & Wexler, 2001; Wagner, 2009; Wagner et al., 2009).

This basic success supports the idea that children have both the conceptual and the grammatical resources to understand grammatical aspect independently of Aktionsart. Additional studies have demonstrated the ways that different informational conditions influence that understanding. For example, the specific encoding of grammatical aspect matters. Weist et al. (1991) also tested children acquiring Finnish along with the children acquiring English and Polish. Unlike the latter two languages, which mark grammatical aspect as part of the verb, Finnish typically marks this information through the choice of case marking on the nouns. The Finnish children succeeded at the task on average two years later than their English and Polish counterparts. However, when Finnish children were tested with periphrastic verbal encodings of grammatical aspect, they too were able to succeed at age three years. (See also van Hout, 2008, for a related argument to explain differences in children's performance with Dutch, Italian, and Polish).

In addition, children's ability to interpret grammatical aspect is influenced by how much information is available to them, either in the situation or in the larger discourse. For example, children acquiring English succeed with telic + imperfective combinations around age three years if the situation explicitly depicts a person in the midst of the action (as in the studies of Weist and colleagues) but it takes until children are around five years old to succeed when the situation shows only relevant objects from the event, such as contrasting a completed and a half-complete house (Wagner, 2002; Matsuo, 2009; and see Wagner, 2009 for a direct comparison of the informational conditions). This particular result may depend on the fact that the English imperfective form is a progressive one, which may semantically highlight the notion of ongoingness – a notion which is more easily conveyed through the presence of an agent. Regardless, the results suggest that children

must not only know the meaning of the grammatical aspect form, but they must know how to evaluate the world to find the meaning it connects to.

4.2. Grammatical Aspect vs. Tense: Past Imperfective Forms

To determine if children can distinguish between grammatical aspect and tense, researchers have focused on past imperfective forms. As with the research from the previous section, the motivation for investigating this particular form is that it is a combination that children rarely utter in their own speech. Indeed, in children's speech production, the past + imperfective combination appears to be especially difficult for children. For example, in Bronckart and Sinclair (1973), children did not regularly produce the French version (the *imparfait* form) until they were around 6 years old – several years after they had been reliably producing a wide range of other tense and grammatical aspect forms. Similarly, in Weist, Pawlak, and Carapella's (2004) investigation of the spontaneous speech of children acquiring English and Polish, they also found that past + imperfective combinations were produced after children had acquired other combinations of tense and grammatical aspect (though long before the children were 6 years old).

Investigations of children's ability to interpret grammatical aspect independently of tense have found that children do in fact have difficulty understanding these forms early on. For example, in Wagner (2001), children watched an experimenter enact two tokens of an event at two distinct places along a road. While the second event token was still being enacted, children were asked a target question in either the present + imperfective form or the past + imperfective form: e.g., "Where is/was the cat filling in the puzzle?"). The first event token was the correct answer for the past tense question and the second, ongoing event was the correct answer for the present tense question. Critically, the trials differed with respect to whether or not the past time event was completed or incomplete (e.g., a puzzle might have been finished, or there might still be a piece still

needing to be fit in). Three and four-year-old children succeeded in this task, correctly matching the past tense question to the past time event and the present tense question to the ongoing event; moreover these children succeeded regardless of whether or not the past time event was completed. Two-year-old children, however, were only able to succeed with the past tense question when the past time event was completed. This pattern of data suggests that these young children are not using the deictic temporal information to solve the task, but instead are using the completion information to do it; they succeeded when the situation contrasted a complete and an incomplete event, but not when it contrasted two incomplete events. Since completion information is the very semantic information that grammatical aspect actually does encode, these data suggest that children may not be aware that tense information is independent, and can differ from, grammatical aspect.

Very similar methods were used by Kazanina and Phillips (2007) to investigate children acquiring Russian. They found that children linked past tense forms to events that had been completed in the past, regardless of whether or not the verbs were in perfective or imperfective aspect. Similar to Wagner (2001), it appeared that children did not understand the separate semantic contributions of tense and grammatical aspect, and interpreted all past tense forms as if they were past + perfective. However, Kazanina and Phillips also found that they could improve children's performance by adding information to the discourse. They recognized that past + imperfective sentences presuppose a particular temporal anchor point, and that it is difficult to infer such an anchor from a single sentence uttered out-of-the-blue. They added a context sentence to their targets (e.g. "While the boy was washing the dishes") and found that even three-year-old children could now correctly interpret past + imperfective forms and distinguish them from past + perfective forms. Children did better with more information, even when the additional information made the sentences themselves more complex.

In addition, as has been seen with other aspects of temporal semantics, children with SLI also have difficulty distinguishing between tense and grammatical aspect. Leonard and Deevy (2010) used the task from Wagner (2001) with neuro-typical and SLI children. The neuro-typical children were 5 years old, and they successfully interpreted the past + imperfective forms with both completed and incomplete events. The SLI children did poorly overall, and interestingly, they did not do better when the past event was completed. This finding echoes findings with SLI children discussed previously: this population does not seem to focus on completion information as much as their neuro-typical peers do, and does not seem biased to connect it to their linguistic categories. These children not only have difficulty learning the adult-like mappings of temporal semantics, they also seem to have difficulty with the vertically-defined classes.

4.3. Discourse Functions of Grammatical Aspect

Beyond the semantic interactions with Aktionsart and tense, grammatical aspect is also used for various discourse and pragmatic functions in language. To the extent that children tend to acquire discourse uses, particularly narrative discourse uses, later in development, their knowledge of how grammatical aspect encodes such functions is also later. However, examinations of children's early narratives – that is, narratives of children from as young as three years old – consistently show that children do use grammatical aspect in ways that are largely consistent with their adult narrative functions. That is, children tend to describe events with perfective aspect when they want to convey that the events happened sequentially and tend to use imperfective aspect to convey that events happened simultaneously (for data from Thai, see Winskel, 2007; see also the articles in Berman & Slobin, 1994). Obviously, there are a variety of subtle differences across languages in precisely how grammatical aspect helps to structure a narrative, but children's ability to tell stories and their ability to use grammatical aspect to do so appears to develop together.

Moreover, there is some evidence that grammatical aspect understanding is linked to broader abilities in discourse function (Vinnitskaya & Wexler, 2001; Stoll, 2005). One particularly intriguing piece of evidence comes from Vinnitskaya and Wexler's study of children's understanding of the imperfective in Russian. The Russian imperfective, beyond its temporal meaning, can also signal that information is presupposed within a discourse. Thus, it is possible to talk about a completed event with a past + imperfective form, but only if the speaker and listener already know about the completion. That is, if the completion information is discourse-old, then an imperfective form is fine. If the completion is a new addition to the discourse, then it must be referred to with the perfective form. Vinnitskaya and Wexler looked at children's uses of past + imperfective forms while they were telling short narrative stories. They found that even three-year-old children did use some past + imperfective forms; more importantly, they found that the children used the forms in contexts where they were presupposing listener knowledge. Three-year-old children often have difficulty keeping track of the content of a discourse and tend to presuppose that their listener knows more than they do. One marker of this difficulty is the use of unheralded pronouns in children's narratives—that is, children often fail to supply proper antecedents for their pronouns and may introduce a new character in a story by simply saying *he*. Vinnitskaya and Wexler found that sentences containing past + imperfective forms were also more likely to contain unheralded pronouns of this type. The children in this study clearly had much to learn about how to tell a well-formed narrative, including learning what information they can and cannot assume their listener already knows. However, with respect to grammatical aspect, these children demonstrated quite impressive knowledge about how it links to discourse functioning.

5. Acquisition of Tense

The morphological forms of tense overlap largely with those of grammatical aspect; therefore, just as grammatical aspect forms are acquired early, so too are tense forms. In addition, it is also worth noting that around the age of 3 years, children begin over-regularizing the past tense forms (e.g. they say *goed*), suggesting that they have abstracted a rule about application of this form (Marcus et al., 1992; Maratsos, 2000). Some children do not acquire tense forms on schedule, but go through a prolonged period during which they produce bare or infinitive forms of the verb; this kind of delay in correctly using tense morphology is a common characteristic of children with SLI (e.g. Rice et al., 1995; Marchman et al., 1999). As has been noted previously, children with SLI seem to have particular problems in acquiring both form and meaning in the domain of temporality.

In the semantic domain, the presumption has been that children will have difficulties with the deictic element of tense because some tenses (past and future) necessarily force children to consider times outside of their preferred time, the here-and-now (cf. Piaget, 1969). and indeed, research using a variation of the Wug task³ (Akhtar and Tomasello, 1997) found that two-year-old children could not reliably attach past tense morphology to a novel verb in their own produced forms.

However, tests of children's comprehension have found that even two-year-old children understand tense marking. Valian (2006) provided a very straightforward demonstration of tense knowledge in children acquiring English. Children were shown two targets in the same state (e.g., two teddy bears wearing happy faces); then one of the targets changed state (e.g., one teddy bear put on a sad face). Children were simply asked to "Show me the one who is/was happy." With items like this in which the tense information is simply carried through the copula verb, two-year-old children reliably differentiated the forms.

When tense is combined with grammatical aspect, two-year-old children do not fare as well. As noted previously, Wagner (2001) found that two-year-olds could successfully differentiate past from present only when the two events also differed with respect to completion. That is, children asked to interpret a past + imperfective form (e.g. “The kitty was filling in a puzzle”) could do so only when the past event was also a completed event (i.e., the puzzle was completely filled in). Further support for this position comes from Valian’s work. She tested children with all atelic predicates so there was no possibility of a completion contrast because atelic events have no inherent completion point. As with the copula case, she showed children two targets, one of which underwent a simple change of state, and asked children to identify a target using a progressive form (e.g., “Show me the one who is/was wearing socks”). Both two- and three-year-olds failed in this condition; it was not until children were age four years that they could correctly interpret a past progressive form.

Children’s performance in these tense tasks also improves when the test sentences contain temporal adverbs (e.g., *right now*, *already*, *before*). Wagner (2001) found that the presence of temporal adverbs boosted the correct performance of all children, but she tested them only with situations where pastness and completion information were confounded. Valian (2006) found that adverbs could not help two-year-olds with a pure tense contrast – indeed, adverbs do not even improve their performance when tense is marked only on the copula verb. Slightly older children (three-year-olds), however, were able to use the adverbial information to help them succeed. It is unclear precisely how the adverbial findings should be interpreted. On the one hand, they suggest support for the information processing approach to temporal semantics: adding information to the discourse helps children do better. On the other hand, it is possible that the adverbs provide enough information on their own that children do not have to rely on tense at all when they are present. The

success with the adverbs certainly shows that children have the conceptual resources to understand time and to order things deictically, but it does not constitute knowledge of linguistic tense itself.

In addition, it should be noted that examinations of children's ability to understand tense often show that Aktionsart does not influence that understanding at all. The children in Wagner's (2001) study succeeded with both telic and atelic predicates. Moreover, Delidakis and Varlokosta (2003) similarly showed that children acquiring Greek understand tenses equally well with both telic and atelic predicates. (But see Matsuo & van der Feest, 2001 and Grinstead et al., 2009 for some possible counter-evidence.) Given the fact that the link between tense and Aktionsart is not direct, but seems to be mediated by grammatical aspect, it is perhaps not surprising that the two do not directly interact with each other.

5.1. Future Tense

For some researchers, the future tense is not properly a tense at all, but should more rightly be considered a modality. The future necessarily has irrealis properties that stem from the fact that it is applied only to events that have not yet actually happened; and, since the future is in principle unknowable, the events may never happen. Investigations of children's acquisition of tense have regularly included the future and, in general, the results have found that children acquire contrasts involving the future tense before they can differentiate the past from the present tense.

For example, Weist et al. (2004) examined the spontaneous production of children acquiring Polish and English. The key measure used was the presence of contrastive forms; that is when the very same verb was used with more than one morphological form. Children produced contrastive pairs involving the future tense (future vs. past) earlier – in some cases, as much as half a year earlier – than produced pairs contrasting past and present tense.

Moreover, comprehension studies regularly find that two-year-olds succeed robustly with contrasts involving the future tense. For example, in Valian (2006), the condition in which two-year-olds did the best involved an auxiliary contrast between *will* and *did*. That is, the children succeeded at identifying the correct target given a sentence like this: “Show me the duck that did/will drink?” Similarly, the youngest children in Wagner (2001) performed most clearly with the future target (e.g., “Show me where the kitty is gonna fill in a puzzle”), decidedly more clearly than they did with either the past or present tense targets. Similar results have also been found for Greek by Delidakis and Varlokosta (2003). Moreover, the early success with tense found for English, Polish, and Finnish by Weist and colleagues (Weist et al., 1991, 1997, 1999) may be partially attributable to the fact that those studies always contrasted the past with the future tense.

The idea that children are better earlier with the future tense than with the past or present tenses suggests that the realis/irrealis distinction is particularly salient for children and may play an important role in helping them break into the linguistic domain of event-anchoring more generally. However, systematic investigations have yet to be done to tease apart various alternative hypotheses, such as the possibility that future forms are easier to find in the input, or that parents provide more contextual support for future interpretations.

6. Summary

Tense and aspect are central semantic elements in every language, and they are among the earliest grammatical elements that children acquire. Children produce tense/aspect morphology in their early spontaneous production, but on their own, they tend to align their usage within general semantic classes. That is, they preferentially produce forms that combine past + perfective + telic or else combine present + imperfective + atelic. This under-extension in their production, however,

does not translate into an equivalent omission in their comprehension. Before children are three years old, they understand the basic semantic contribution of tense and grammatical aspect, and they can interpret both regardless of the Aktionsart of the predicate on which the morphology appears. Similarly, they have also learned at least some of the syntactic reflexes used by Aktionsart in their language. Children do have some initial trouble disentangling tense from grammatical aspect, but this is largely resolved by the time children are three years old, and later difficulties are greatly ameliorated by providing children with more information, either through the situation or through the linguistic discourse.

There are, of course, a number of open questions remaining to be investigated. Even at a descriptive level, there are many elements of children's tense and aspect knowledge we know little about. For Aktionsart, only a handful of potential syntactic reflexes have been investigated and little work has examined children's ability to make fine-grained distinctions among Aktionsart types. For grammatical aspect, most of the work has focused on the presence/absence of completion entailments, while little attention has been paid to other semantic distinctions in this area, such as the difference between progressive and non-progressive imperfective forms. For tense, very little is known about how children interpret remote tenses and how tense interpretations might be influenced by reference to proximal or distal time periods. At a more conceptual level, this chapter has argued that the information processing point of view provides the best theoretic account of children's temporal knowledge, but very little is known about what kinds of information really matter for children. It is clear that both discourse and situational factors matter, but which factors in particular are most important for interpreting each of the many temporal elements in a language needs a great deal of further study. Finally, although there is evidence that having early difficulties with temporality may be diagnostic of the presence of a language disorder such as SLI, it is unclear why this link exists and whether it is best described in terms of the syntax or the semantics of

temporal elements. Nevertheless, the existing data do show that even very young children (i.e. two-year-olds) have the basic building blocks of temporal semantics in place. Tense and aspect are core elements not only within languages, but also within the process of language acquisition.

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¹ See Hewson on tense, Filip on lexical aspect, and de Swart on grammatical aspect, in this volume.

² Recurrent connectionist networks are a type of domain-general learning device. They are notable because in some cases, rule-like regularities emerge in their output even though they were not explicitly programmed into the network's architecture. See Elman et al. (1997) for a full set of arguments in favor of connectionist approaches to development.

³ The wug task was pioneered by Berko (1958) and is used to test children's ability to productively apply a morphological rule. Children are given a nonsense word and encouraged to produce the target morphology with it. For example, to target the past tense, the experimenter would say "This girl wugs every day. Yesterday, she..." Children who command the past tense would respond with the form *wugged*.