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On the acquisition of event culmination

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There is quite a high rate of acceptance of telic-perfective predicates as descriptions of non-culminating events in children learning Germanic and Romance languages. What causes children, much more so than adults, to accept non-culminating interpretations of telic-perfective sentences? In this review, I discuss learners' difficulties in each of three grammatical dimensions that contribute to event culmination: the notion of 'result' as encoded in the lexical semantics of verbs, telicity of verb phrases, and perfectivity of tense-aspect morphology. I conclude that telicity and perfectivity do not cause the non-culmination acceptance patterns. Instead, the learnability challenge for event culmination lies in the acquisition of verb meanings. I sketch several new angles for further research, including the role of agentivity of the subject.

Keywords: verb meaning, telicity, aspect, perfectivity, event culmination, completion entailment, L1 acquisition, scalar semantics, pragmatic inferences

1. Introduction

This chapter reviews research on the acquisition of event culmination in typically-developing children. Telic-perfective sentences (such as, *The child walked to the park in an hour*) entail event culmination (that is, the event was completed). Many studies on child language have, however, discovered an often high rate of acceptance of such sentences as descriptions of non-culminating events in learners of Germanic and Romance languages. This chapter discusses several explanations for children's non-culminating interpretations of telic-perfective sentences in this stage of acquisition.

There are three grammatical dimensions that, together, determine event culmination: the lexical semantics of verbs, the telicity of verb phrases and the perfectivity of tense-aspect morphology. Verb semantics involves features such as result, manner, goal, path, motion and causation, some of which are relevant for event culmination, in particular, the lexical features of result and goal. Telicity is a property of

event descriptions as expressed by verb phrases; it involves a natural culmination point as part of the verb phrase meaning. Aspect is a property of tense-aspect markers, typically expressed by morphemes on the verb. Tense-aspect markers anchor the run-time of an event on a time line by relating it to a reference time. Perfective aspect asserts the final event boundary – there is a final moment at which a given event ceases and does not continue any longer. All three dimensions interact in the grammar of event culmination. Examples of each will appear below as these topics are introduced.

The notion of event culmination has been addressed in several lines of acquisition research, which have developed more or less independently, though sometimes they intersect. One such line is work on the acquisition of verb meanings, specifically, the question of how children learn about the result component in a verb's lexical representation; another is formed by studies on the acquisition of telicity; and a final line includes studies on the acquisition of perfective versus imperfective aspect. This chapter seeks to connect these three lines of acquisition research, focusing on the culmination entailment associated with telic predicates in combination with perfective aspect. Integrating my own research on event culmination of the past twenty years with the literatures on the acquisition of lexical verb meanings, telicity and aspect, I will point out connections, similarities and contrasts in the acquisition patterns across telic constructions, tense-aspect markers, verb types and languages. I describe in detail when, in certain types of languages, children are more liberal than adults in accepting incomplete situations for telic-perfective sentences. In so doing I focus on the following question for learnability: what can explain this stage in development? The goal is to critically evaluate the explanations that have been offered in the three lines of acquisition research.

This chapter is organized as follows: Section 2 defines the semantic notions of telicity and perfectivity, pointing out how these grammatical dimensions determine event culmination. The next three sections review studies on the acquisition of: the notion of result in lexical verb meanings (Section 3), telicity (Section 4) and perfective aspect (Section 5). Throughout these sections I discuss explanations for children's non-culminating interpretations of telic-perfective sentences. Finally, by integrating new developments in semantic theory about the nature of the subject of the sentence and event culmination – whether it is an intentional Agent or a natural Cause, Section 6 develops a research agenda with novel questions about the acquisition of event culmination.

2. The grammatical dimensions of event culmination

Before turning to acquisition I define the crucial grammatical properties involved in the grammar of event culmination – verb semantics, telicity and perfectivity – and discuss how these are involved in a step-by-step construal of event culmination at different grammatical levels: verb, verb phrase and sentence. Lexical verb meaning is one of the sources of the telicity of verb phrases. Other grammatical elements in the verb phrase can also play a role in determining telicity, in particular, satellite phrases (such as particles and PPs) and the quantization properties of the direct object. The combination of a telic predicate and a perfective aspect marker leads to an entailment of completion: the natural culmination point has been reached. This section will form the grammatical basis for the subsequent acquisition sections which will discuss to what extent the expression of these notions in a given language presents a challenge to the language learner.

Telicity is a property of event descriptions – verbs and verb phrases – and characterizes the temporal contour of events. Telicity falls under the type of aspect that is called “lexical aspect” (also called: “situation type”, “inner aspect”, “Aktionsart”, “aspectual classification of verb classes”); as such it is independent of tense-aspect inflection. It contrasts with grammatical aspect, which is typically expressed by inflectional morphology on the verb (e.g., perfective prefixes in Slavic languages, perfective tenses in the Romance languages), or encoded in verbal constructions and periphrasis (e.g., the perfect tense with auxiliary plus participle in Germanic and Romance languages). Telicity has been used as a feature to classify the meanings of individual verbs (Vendler, 1957), but it is more appropriate to use it as a property of verb phrases (as pointed out by Verkuyl, 1972).

Definitions of telicity use terms such as “*telos*” (goal in Greek), “natural boundedness”, “culmination”, and “set terminal endpoint”, all of which express the idea that a verb or verb phrase is telic if its meaning includes a specific moment toward which the event it describes naturally develops (Comrie, 1976; Dowty, 1979; Klein, 1994; Smith, 1991; Verkuyl, 1993). In mereological approaches (Krifka, 1989; Rothstein, 2004), telicity is analyzed in terms of event quantization: properties that describe the part-whole structure of events, specifically, homogeneity and cumulativeness. The essential idea is that a subpart of an event described by a telic predicate does not qualify as an instance of that same event description (telic predicates are non-homogeneous). Nor does the combination of two events described by the same telic predicate qualify as one single instance of that event (telic predicates are non-cumulative). Thus, a telic expression is such that, whenever it is true of some event in the world, it is not true of any subparts of that event (at least, not necessarily, because the described event includes a culmination point and a subpart of

the event may lack this moment). For example, crossing a street entails going from one side of the street to the other, and a subpart of that distance (e.g., going from one side to the middle of the road) cannot be described as crossing a street, and so the predicate *cross a street* is telic (quantized). An atelic event description, on the other hand, can refer both to the event as a whole and to any of its subparts. A subpart of an event of sleeping on the sofa also qualifies as sleeping on the sofa, and so the predicate *sleep on the sofa* is atelic (non-quantized). The traditional test for telicity contrasts two temporal modifiers (Dowty, 1979): *in an hour* combines with telic predicates, while *for an hour* combines naturally with atelic predicates, (1).

- (1) a. The child slept on the sofa for an hour / * in an hour.
- b. The child destroyed the Lego castle *for an hour / in an hour.

Telic predicates constitute a heterogeneous class; there are at least three grammatical sources that contribute to telicity. First, verb semantics plays a role: telicity can be purely lexical, determined by the intrinsic meaning of the verb itself which crucially lexicalizes the endpoint of an event. (1) Illustrates this for the telic verb *destroy* versus the atelic verb *sleep*. Other lexically telic verbs are *kill*, *cross*, *break*, *open* and *close*. To find out if a verb lexicalizes an endpoint, one can test if one can use the verb to describe an action that lacks this endpoint. For instance, an event of dropping a vase and nearly breaking it cannot be described as “break a vase”, nor can an event of almost opening a door be described as “open a door”.

In addition to the lexical semantics of individual verbs, the computation of telicity depends on other elements in the verb phrase. One is satellite phrases to the verb. For example, in the Germanic languages, verb particles and directional PPs form constructions that lexicalize the culmination point by explicitly encoding a result or a goal, for example, *eat-eat up*, *blow-blow out*, *run-run away* (van Hout, 1996)¹. Verb phrases with a lexically atelic verb become telic when combined with such a PP, (2), or particle, (3)².

- (2) a. The child biked in the park for an hour / * in an hour.
- b. The child biked to school *for an hour / in an hour.

1. Across typologically different languages, there are various other kinds of “telicizing” constructions, including telic-reflexive clitic *se* in Spanish (Nishida, 1994), verb-verb compound constructions in languages like Mandarin (Soh & Kuo, 2005), and certain prefixes in Slavic languages (Borik, 2006; Filip, 2008).

2. Some speakers reading find the “for an hour” construction rather acceptable here and allow it to be followed by “but the box never made it all the way” This means that the particle *out* does not add maximal culmination, but merely a scale (here, in the direction of a place outside, not necessarily reaching it).

- (3) a. The child carried the heavy box for an hour / * in an hour.
- b. The child carried the heavy box out *for an hour / in an hour.

Furthermore, the semantics of the direct object matters, in particular, the quantization properties of the direct object co-determine the telicity of a transitive verb phrase (verb plus object) (Krifka, 1989; Verkuyl, 1993). This type of telicity applies to incremental theme verbs, including verbs of consumption (*eat, drink*), verbs of creation (*draw, build*), and also some verbs expressing a change of state (*fill*), (4)–(6). The essence is that the quantization of the direct object carries over to the verb phrase: a quantized object gives a telic verb phrase, (4a)–(6a), whereas a non-quantized object (a mass term or bare plural) gives an atelic verb phrase, (4b)–(6b).

- (4) a. The child ate a bar of chocolate *for an hour / in an hour.
- b. The child ate chocolate for an hour / * in an hour.
- (5) a. The child drew a snow man *for an hour / in an hour.
- b. The child drew snowflakes for an hour / * in an hour.
- (6) a. The child filled a bucket *for an hour / in an hour.
- b. The child filled buckets for an hour / * in an hour.

Coining two descriptive terms for these grammatical sources of telicity (van Hout, 2008a), I defined “predicate telicity”, illustrated in (2)–(3), in terms of the presence of “... an overt marker on the verbal predicate that carries telicity” (p. 259), and contrasted this with “compositional telicity”, illustrated in (4)–(6), as the “...joint syntactic-semantic effects ... [of] a verb’s lexical property of taking an incremental theme, ... [and] the quantificational semantics of the direct object noun phrase (mass or count term)” (p. 259).

In addition to telicity, perfectivity presents another dimension of event culmination. The perfective-imperfective opposition is the grammatical aspect distinction that presents a speaker’s perspective on an event. Definitions of perfective aspect employ terms such as “holistic event”, “event viewed from the outside” and “event viewed as a whole”, and contrast these with imperfective aspect notions such as “ongoing event”, “event viewed from the inside” and “viewed with interior composition” (Comrie, 1976; Dahl, 1985; Smith, 1991). Interval-based approaches in formal semantics define perfective and imperfective aspect as a relation between two time intervals. Perfective aspect involves the inclusion of the complete run-time of an event in a reference time interval. This entails that the full event – including its initial and final boundaries – has happened and the event no longer continues (Demirdache & Uribe-Etxebarria, 2000; Kamp & Reyle, 1993; Klein, 1994, among others). Imperfective aspect presents the mirror image of this relation: the reference time is included in the run-time of the event. Thus, imperfective aspect asserts that

the event was ongoing at a certain reference time, but does not make claims about its final boundary, as the event may have been interrupted without ever reaching culmination. This means that imperfective aspect “cuts off” the culmination point from a telic predicate: the event may or may not have reached its culmination point, and it may or may not still be continuing. This is the so-called ‘imperfective paradox’ (Dowty, 1979).

One test for perfectivity makes use of the notion of continuation (Smith, 1991). When a clause with perfective aspect is followed by a subsequent clause claiming that the event continues, there is a contradiction, (7a). With imperfective aspect, on the other hand, continuation is possible, (7b). The incongruity of (7a) reveals that a telic predicate (*cross the street*) in combination with perfective aspect – English simple past – entails culmination. In contrast, the acceptability of continuation of the same predicate with imperfective aspect – the English progressive, (7b) – shows that the culmination, which is a crucial part of the lexical meaning of the verb *cross*, does not need to be reached in the actual world (as long as there is a possible world in which culmination can be conceived, e.g., Landman, 1992). Imperfective aspect thus cancels the culmination entailment.

- (7) a. #The child crossed the street. In fact, she is still crossing the street.
 b. The child was crossing the street. In fact, she is still crossing the street.

In summary, event culmination presents a puzzle in reasoning, the pieces of which are determined by three types of grammatical elements: the lexical semantics of verbs, the telicity of verb phrases and the perfectivity of tense-aspect markers, as laid out above. The acquisition challenge for the learner is to sort out the effects of all these grammatical elements and their interplay.

The next three sections will discuss whether each of these grammatical sources can be the cause for children’s difficulties with event culmination, in particular, their over-acceptance of incomplete situations for telic-perfective sentences. Section 3 discusses studies that investigate the lexical feature of result as encoded in verb meanings. Section 4 provides a summary of event culmination interpretation patterns established in studies on the acquisition of telicity focusing on i) the aspectual roles of telic particles and clitics and ii) direct object quantization. Section 5 reviews event culmination in studies on the acquisition of perfectivity, determining to what extent children know the meaning of perfective aspect markers and their interaction with telicity.

3. Non-culmination patterns and the acquisition of the lexical meaning of verbs

There is a long tradition of research on the acquisition of verb meanings. Many studies focus on lexical features of verbs such as causation, manner, path and motion (Hirsh-Pasek & Golinkoff, 2006; Tomasello & Merriman, 1995, among many others). Nevertheless, features relevant for event culmination, specifically lexical notions of result and end state, have hardly been investigated in this tradition. The original study that addressed verb semantics associated with telicity and event culmination was Gentner (1978) (though she did not label it in these terms). Gentner investigated what children know about the meanings of the verbs *mix* and *stir* in adult English, specifically, whether they associate these verbs with a particular manner (i.e., as an atelic description) or a particular endstate (i.e., as a telic description). While stirring merely refers to a manner of action with no implications about the effect, mixing is supposed to lead to an endstate in which two substances become more homogeneous. In other words, mixing implies some form of culmination, while stirring does not. Nonetheless, Gentner found that 5-year-olds accepted *mix* for situations with no particular endstate (e.g., mixing a substance that was homogeneous from the start), and concludes that the children misinterpreted *mix* as a manner verb, not including an endstate feature. Gentner proposed the Manner Bias, arguing that children initially assume that verbs refer to manners of actions, and not results. In a study with a similar focus, comparing telic change-of-state verbs such as *fill* and atelic manner verbs such as *pour* (without labeling these verbs in telicity terms), Gropen, Pinker, Hollander and Goldberg (1991) find that preschoolers accepted situations without an endstate for change-of-state verbs (*fill*), interpreting them instead as if they were manner verbs (*pour*). Seeing that children misinterpreted change-of-state verbs as manner verbs, ignoring the feature of change that is essential in the lexical meaning of these verbs, Gropen and colleagues argue that this interpretation pattern supports Gentner's Manner Bias.

The Manner Bias provides a straightforward account of children's overly liberal acceptance of non-culminating events: if children initially do not include the notions result or endstate in their lexical-semantic specification of verbs, culmination is irrelevant. Nevertheless, there are several reasons why this account cannot be on the right track. First, the generalization draws on a very limited set of verbs (*mix*, *fill*). Second, the Manner Bias predicts that children start out assuming that all verbs are manner verbs, i.e., that no verbs include an endstate or result component in their lexical semantics. Yet, the review of the telicity studies in Section 4 will reveal that, although children indeed accept non-culmination to some extent, they also very often reject it. Thus, the lexical representation of certain verbs in child grammars

does include an endstate or a result meaning component. Finally, as with all accounts that assume a bias or a learning heuristic, there is the learnability problem of exiting the Manner Bias stage: What could trigger a child to adjust her lexical semantics for a given verb and add an endstate feature to its meaning?

Wittek (2002) also takes issue with the Manner Bias. Investigating German children's acquisition of the notion of endstate in verb meanings, Wittek compares two versions of change-of-state verbs: particle verbs such as *wachmachen* (literally, 'make awake') – which transparently encode the endstate in the particle – versus monomorphemic verbs such as *wecken* ('wake') – which also encode the endstate lexically, but in a non-transparent way. The results (of her experiment 3, see also Figure 1 in Section 4) indeed show an effect of the transparency of encoding: children rejected situations with a zero result more often for transparent particle verbs than for non-transparent verbs (e.g., a girl tries to wake up a man by making an alarm go off next to his ear, but he keeps snoring). Wittek concludes that children have acquired the lexical notion of endstate, at least for particle verbs, and argues that this goes against the Manner Bias. Nevertheless, in order to explain the relatively high rate of acceptance of non-culmination with non-transparent verbs (*wecken* 'wake'), Wittek proposes that children have what she calls a "Weak Endstate interpretation" for these change-of-state verbs: "they seem to interpret these verbs as if they specify that a particular endstate might well come about, but need not" (Wittek, 2002: 88). So, even though the verb's lexical meaning includes an endstate component, this component is optional (the endstate is weak).

Wittek (2002) supports the idea of weak-endstate verbs with a typological argument, pointing to several adult languages in which monomorphemic change-of-state verbs similarly do not imply completion: Mandarin (Talmy, 1991); Japanese (Ikegami, 1985); Hindi (Singh, 1994) and Tamil (Pederson, 1998). In fact, there is also a class of English verbs with weak endstates (e.g., *wipe*, *wash*, *sweep*): even though an interpretation including an endstate is "pragmatically favored" (terminology from Brisson, 1994), culmination can be denied in a "but"-clause, which shows that it is merely an implication, and not an entailment (Talmy, 1991). Wittek (2002) notes that this insight was originally presented, *inter alia*, by Harnish (1976) and Atlas and Levinson (1981). She argues that German children overextend the lexical representations for weak-endstate verbs to a larger class of verbs, thus locating the cause for non-culminating interpretations at a lexical level, and delegating the culmination inference of these verbs to the pragmatic domain.

In their studies on the acquisition of telicity in German, Schulz and colleagues have also stressed the importance of what they call Endstate Orientation as an acquisition strategy (Penner, Schulz & Wymann, 2003; Schulz, this volume; Schulz, Wymann & Penner, 2001). More recently, several other acquisition studies have

stressed the role of endstates in young children's event representations, all of which argue that endstates are a basic feature in infants' and children's cognitive repertoire (Lakusta & DiFabrizio, 2016; Wagner & Lakusta, 2009).

In semantic theory, the insight that pragmatics plays a role in event culmination has led to developments beyond the mereological approach of telicity outlined in Section 2. Theories of scalar structures are now used to model the flexible behavior of English "wipe"-type verbs (also called "implied fulfillment" verbs). Hay, Kennedy & Levin (1999) and Kennedy and Levin (2008) advance such a scalar approach to telicity in which event culmination is partly determined by scalar semantics and partly by pragmatics. For predicates whose meaning encodes a closed scale (e.g., *break*), culmination is an entailment – a hard, non-cancelable inference. For other verb types, which do not lexicalize a closed scale (e.g., *wipe*), a culminating interpretation comes about as a conversational implicature – a soft, cancelable inference. The difference between these two kinds is determined by the event-semantic features in the lexical representation of verbs, in particular, whether or not the verb's meaning includes a degree variable, and if so, whether it is associated with an open (*wipe*) or closed (*break*) scale. Rephrasing Wittek's proposal in terms of this scalar theory of event culmination, the cause for children's over-acceptance of non-culminating situations for change-of-state verbs may well lie in an initial misrepresentation of these verbs as having an open scale (or no scale at all), in contrast to the target lexical representation of such verbs, namely with a closed scale. I will return to the lexical semantics of verbs in my discussion of acquisition of telicity studies in the next section.

4. Non-culmination patterns and the acquisition of telicity

In an earlier review of the acquisition of telicity (van Hout, 2008a), I concluded that there are different interpretation patterns depending on the type of verb and construction. I labeled these "predicate telicity" versus "compositional telicity" (see above). The generalization was that children acquire event culmination earlier when the verbal predicate overtly and explicitly encodes a result state, as is the case for particle verbs in the Germanic languages and for verbs marked for perfective aspect in the Slavic languages. This contrasts with cases in which telicity is based on the quantization semantics of the direct object, for example, when an incremental theme verb combines with a count term object (e.g., *eat an apple*). Several studies have examined this contrast further and will be included in the present review. My earlier review was grounded in a mereological theory of telicity in which predicate and compositionally telic constructions are analyzed similarly, based on the

notions of homogeneity and cumulativity. Adopting a scalar approach to telicity as described in Section 3 (Hay et al., 1999; Kennedy and Levin, 2008), I will now re-assess the generalization that there are two patterns in the acquisition of telicity, focusing on the roles of particles, types of verbs and types of direct objects.

In the present review I have included the following studies: Hacoen (2010); Hodgson (2001); van Hout (1998); Jeschull (2007); Ogiela (2007); Ogiela, Schmitt & Casby (2014); Penner et al. (2003); Schulz et al. (2001); Schulz & Penner (2002); Schulz & Wittek (2003); Wittek (2002). I limit this review to experimental studies that tested children's interpretation, and have not included studies on children's production of tense-aspect markers in spontaneous speech, as developed in a research line on the so-called Aspect-First hypothesis (for a review, see Wagner, 2012). This choice is motivated by two reasons. First, production does not provide a direct measure of interpretation. Second, without carefully constructed contexts and contrasts, it is very hard to draw firm conclusions about children's knowledge of the meanings of tense-aspect forms and constructions.

The experimental designs systematically varied telic and atelic conditions and contrasted complete and incomplete situations. Test sentences involved one or more telic constructions (used with perfective aspect). The paradigms focused on the contrast between completed versus incomplete or ongoing situations, testing either acceptance of telic-perfective sentences in a truth-value judgment task, or preference with such sentences in a picture-selection task. The materials varied: pictures, movies, acted-out scenes. Several studies used pictures with characters involved in eating or drinking something; one character finishes his piece of food or drink and the other eats or drinks it halfway (van Hout, 1998; Ogiela, 2007; Schulz & Penner, 2002). The test sentences varied transitivity and particle verbs (e.g., *Did he eat?*, *Did he eat cheese?*, *Did he eat the cheese?*, *Did he eat up the cheese?* (see Appendix A for some picture pairs). Other studies used short movie clips contrasting situations in which either a full result was reached or nothing happened at all (e.g., a woman approaches a sleeping man and lets an alarm clock ring; the man either wakes up or does not wake up and keeps snoring, Wittek, 2002). The test sentences varied simplex and particle verbs: *Hat das Mädchen den Mann geweckt / wachgemacht / wachgeklungelt?* (has the girl the man woken / awake made / awake rung? 'Did the girl wake (up) the man?'). In yet other studies the experimenter acted out scenes of manipulating various objects, with either a partly or fully affected object as a result (e.g., for closing a box: *Hat das Mädchen 'se zugemacht?* (has the girl it closed-made 'Did the girl close it?'), Schulz & Wittek, 2003).

The crucial condition in all studies is the non-culminating situation. Non-culmination involved a partial result in all except one study: the event progressed up to a certain point and the object was partially affected (a half-eaten apple;

a partially opened box). In one study, a zero result was shown: the action did not affect the object; there was no change at all in the object (e.g., for the waking-up item, the man was still fast asleep, Wittek, 2002). Table 1 presents the details of the telicity studies. Six studies contrasted transitive clauses with and without verb particles in three Germanic languages; three additional studies only tested particle verbs; and one study focused on sentences with and without the resultative clitic *se* in Spanish.

Table 1. Overview of nine telicity studies included in review on telicity, specifying language, age range, and conditions: types of situations and types of test sentences³

Study	Language	Ages	Situations	Test sentences
van Hout 1998	Dutch	3–5	Full vs. Partial result	(1) Transitive & (2) Particle
van Hout 1998	English	3–5	Full vs. Partial result	(1) Transitive & (2) Particle
Jeschull 2007	English	3–6	Full vs. Partial result	(1) Transitive & (2) Particle
Ogiela 2007	English	3–6	Full vs. Partial result	(1) Transitive & (2) Particle
Schulz & Penner 2002	German	4–5	Full vs. Partial result	(1) Transitive & (2) Particle
Schulz et al. 2001; Penner et al. 2003	German	2–4	Full vs. Partial result	Particle
Schulz & Wittek 2003	German	4–5	Full vs. Partial result	Particle
Wittek 2002	German	4–5	Full vs. Zero result	(1) Transitive & (2) Particle
Hodgson 2001	Spanish	4–11	Full vs. Partial result	(1) Transitive & (2) Clitic <i>se</i>

Table 2 presents sample test sentences in the two conditions from these studies. The tense-aspect form used in the test sentences varied across languages, but was always a form with perfective semantics, asserting that the event ended: the present perfect (Dutch, German), simple past (English) and perfective past (Spanish preterito indefinido).

3. Ogiela's (2007) dissertation presents data from adults and children; Ogiela et al. (2014) focuses on the adult results. Extending the work by Schulz et al. (2001), Penner et al. (2003) present a wider range of participant groups.

Table 2. Sample test sentences in two conditions in nine telicity studies: transitive sentences with morphologically simple verbs and transitive sentences with particle verbs, or – in Spanish – with the reflexive clitic *se*. Two studies tested only particle verbs.

Study	Sample test sentence
van Hout 1998	Heeft het paard zijn appel (op)gegeten? (Did the horse eat (up) his apple?)
van Hout 1998	Did the horse eat (up) his apple?
Jeschull 2007	Who drank his coke (up)?
Ogiela 2007	Did the woman push the dogs (over)?
Wittek 2002	Hat das Mädchen den Mann geweckt / wachgemacht? (Did the girl wake (up) the man?)
Schulz-Penner 2002	Hat das Mädchen den Apfel (auf)gegessen? (Did the girl eat the apple?)
Schulz et al. 2001	Hat sie 'se aufgemacht? (Did she open it?)
Schulz-Wittek 2003	Hat das Mädchen 'se zugemacht? (Did the girl close it?)
Hodgson 2001	¿Quien (se) comió la madalena? (Who ate the cupcake?)

Figures 1 and 2 show how often children and adults accepted incomplete situations for telic sentences as reported in the studies above. Four- and 5-year-olds have been grouped together into one age group in some studies while other studies distinguished them as separate groups. Since the latter did not report any major age differences, I summarize here the results of the 5-year-olds, referring to the individual studies for more results of younger and older groups. For each study the pairs of bars compare the transitive condition with morphologically simple verbs versus the particle verb condition in the Germanic languages, and transitives with and without clitic *se* in Spanish. Comparing these nine telicity studies I will now discuss the following issues: rate of acceptance of non-culmination for telic-perfective sentences; age effects; variation across verbs; the form of the direct object.

Figure 1. Group means of acceptance of partial or zero result situations by 5-year-olds in nine telicity studies

Figure 2. Group means of acceptance of partial or zero result situations by adults in nine telicity studies

The first and most obvious observation is that acceptance of non-culmination *does* exist, and sometimes it is even quite high (75%). This holds across studies, languages and ages. Non-culminating interpretations are therefore not some experimental fluke, but a fact in need of a semantic explanation. There is one clear pattern across studies and languages: there is much less acceptance in the particle and clitic *se* conditions than in the transitive conditions with a morphologically simple verb, for children as well as adults. In Dutch, German and Spanish, adult participants always rejected the particle verb or reflexive *se* clauses for incomplete situations. The different patterns across morphologically simple verbs versus particle verbs support my earlier generalization that predicate telicity is easier to acquire than compositional telicity (van Hout, 2008a). Nevertheless, even particle verbs were accepted for incomplete situations, sometimes to quite a large extent: by English, Dutch and German children (around 10% in Van Hout, 1998; up to over 30% in Ogiela, 2007 and Wittek, 2002) and even by English adults (up to 22% in Jeschull, 2007). This latter finding is unexpected in a scalar theory of telicity since particles encode the maximal end of a scale.

Perhaps surprisingly, there do not seem to be any consistent differences between children and adults across studies. Dutch and German children accepted telic predicates as descriptions of non-culminating situations more often than adults (van Hout, 1998; Schulz et al., 2001; Schulz & Wittek, 2003; Wittek, 2002), whereas in other studies the rate of acceptance was similar (Ogiela, 2007, for English; Schulz & Penner, 2002 for German), or even reverse (Jeschull, 2007, for English; Hodgson, 2001 for Spanish).

Another observation is the variation in acceptance of non-culmination across studies. This is undoubtedly related to the choice of verbs in the test sentences: different verbs triggered different rates of non-culmination acceptance. The studies

tested different verbs, mostly incremental theme verbs (including *eat*, *drink*, *build*, *fix*) and change-of-state verbs (including *open*, *close*, *break*, *wake up*). The verbs are listed exhaustively in Appendix B.

Only a few studies discuss variation across verbs (the others do not mention item effects). Wittek (2002) established two patterns among the German particle verbs. For six verbs (German ‘close’, ‘open’, ‘pick’, ‘extinguish’, ‘kill’ and ‘break’), the zero result situation was mostly rejected. But for two other verbs (German ‘fill’ and ‘wake’), it was mostly accepted: 100% for *ein Glass vollmachen* ‘fill a glass’; 60% for *einen Mann wachmachen* ‘wake up a man’. Without these two verbs, the percentage of non-culmination acceptance drops from 32% to 13%, a number more similar to the German children and Dutch and English children in the other studies. Wittek notes that the ‘glass filling’ movie may have been problematic, adding that over-acceptance may also be due to the durativity of the event (the glass filling up little by little as an incremental theme) in contrast to the other items that were punctual change-of-state verbs. She does not offer any suggestions for the acceptance of *wachmachen* ‘wake up’, a transparent particle verb which she expected to lexically encode an end state.

In contrast to Wittek (2002), Ogiela (2007) and Ogiela et al. (2014) did not find item effects for their particle verbs (*eat up*, *drink up*, *push over*, *carry over*). Nevertheless, Ogiela and colleagues established variation in acceptance of non-culmination for simple, transitive verbs (*eat*, *drink*, *build*, *fix*). Even though all four simple transitive verbs were durative, incremental theme verbs, they had been categorized into two classes in the experimental design. In addition to a telic interpretation, *eat* and *drink* also allow a partitive construal (meaning ‘eat/drink of part of NP’), in which case they are atelic and allow non-culmination. *Build* and *fix*, on the other hand, are not partitive. Given this flexibility in telicity, Ogiela and colleagues expected, and indeed found, more acceptance of non-culmination for *eat* and *drink* than for *build* and *fix*. Nevertheless, there was a significant contrast with two inherently atelic verbs in a control condition: *eat* and *drink* were accepted less often for non-culminating situations than *push* and *carry*. So, even though *eat*, *drink*, *build* and *fix* are “equally” telic according to semantic theory, given that they were used in a transitive sentence with a quantized object, there turned out to be a scale of non-culmination acceptance.

One further telicity study, Hacoen (2010) on Hebrew, also established item effects across different verbs. This study was not included in the tables above because it used a different paradigm, and moreover, the children were much older than those in the studies discussed above: school-age children between 7 and 12. Hebrew past tense is not perfective, and so telic sentences in the past tense do not necessarily entail culmination. Instead, Hacoen used the infinitive verb form

embedded under ‘tell’, for example, ‘I told Tara to paint the square’. Participants watched video clips to see if the girl did as she had been told. An item analysis revealed that the verbs split into two classes, at least for the adults (in the condition with definite singular objects): acceptance of non-culmination varied between 11–33% for the three incremental-theme verbs (Hebrew ‘paint’, ‘draw’ and ‘peel’), whereas the incomplete situation was always rejected for the two change-of-state verbs (Hebrew ‘close’ and ‘empty’).

The variation across verbs as reported in these three studies – with different patterns of non-culmination acceptance for different verbs – is unexpected in a mereological theory of telicity based on quantization. It can, however, be explained using a scalar approach, as this framework presents a more “fluid” definition of telicity by incorporating effects of verb class. Verbs with a closed scale are unambiguously telic. For verbs with an open scale, on the other hand, the scalar theory offers room for ambiguity and/or underspecification of the endstate. This contrasts with a mereological approach (Krifka, 1989), in which telicity is essentially a fixed notion – defined by quantization and the notions of homogeneity and cumulativity. A mereological theory does not allow for variation across different verb classes, and so verb class effects are unexpected. The finding that predicate telicity is acquired early can be explained in the scalar approach though: for verbs that explicitly encode the closed end of the scale in the form of a particle, children do not (or much less) accept non-culmination. The challenge for learners are therefore verbs that do include an endstate in their lexical specification but do not explicitly (or transparently) encode this meaning component. This is indeed the class that takes longer to be acquired (Wittek, 2002). Moreover, several studies report differences between change-of-state verbs on the one hand and incremental theme verbs on the other (García del Real, 2015; Hacoen, 2010; Ogiela, 2007; Ogiela et al., 2014), with (much) lower rates of non-culmination acceptance for change-of-state verbs. This can be explained within a scalar approach by arguing that incremental-theme verbs involve an open scale, whereas change-of-state verbs involve a closed scale.

A final point of discussion in the telicity studies is the form of the direct object in the test sentences. In most studies the object was a singular NP. Some used test sentences with a cliticized pronoun (Schulz et al., 2001, 2003; Penner et al., 2003); others a definite NP (Hodgson, 2001; Ogiela, 2007; Ogiela et al., 2014, Schulz & Penner, 2002; Wittek, 2003); and yet others an NP possessive pronoun ‘his’ (van Hout, 1998; Jeschull, 2007), as illustrated in Table 2. It is hard to draw any conclusions about object forms across studies, but a few studies systematically varied the direct object and found effects of type of object on acceptance of non-culmination.

Ogiela (2007) and Ogiela et al. (2014) used two kinds of plural NPs – with a definite determiner (*eat the brownies*) or a cardinal number (*eat two brownies*). In

the incomplete condition in Ogiela's (2007) study, the actor engaged in a certain kind of action with two object referents, one after the other. For the first referent, the event was complete, and for the other one it was incomplete, for example, eating one brownie completely and the other halfway. Ogiela and colleagues found an interaction with verb type: for the flexible telic verbs *eat* and *drink*, there was less non-culmination acceptance in the conditions with cardinal determiners than with definite determiners. There were no effects for the other verb types though, nor for the particle verbs. The researchers argue that, given that a cardinal number (*two*) more clearly specifies the quantized amount than a definite determiner, it triggers a culminating interpretation more strongly; the latter can also be used on a partitive reading.

The main goal of Hacoen's (2010) Hebrew study was to systematically investigate the effects of different types of direct objects for non-culmination, varying three grammatical dimensions of the object NP: singular/plural ('paint the square / paint the squares'), definite/indefinite ('paint the square / paint a square') and mass/count ('paint cloth / paint a square'). The design had six conditions, four of which were telic (indefinite singular count; definite singular count; definite plural count; definite mass) and two atelic (indefinite mass (bare); indefinite plural (bare)). Overall, children and adults rejected incomplete situations in the telic conditions with count terms: both definite and indefinite noun phrases triggered rejection, and so did singular and plural nouns. This shows that the definite/indefinite and singular/plural dimensions are irrelevant for telicity, as expected by theories on quantization and telicity (Krifka, 1989; Verkuyl, 1993). On the other hand, there was a main effect of the count/mass distinction: children as well as adults accepted the incomplete situation for mass terms and bare plural objects. This suggests that, despite an overall higher acceptance rate of non-culmination in children, the relevance of count/mass for compositional telicity had been acquired.

To summarize, I have provided a comprehensive review of (i) telicity studies that compared presence and absence of particles in the Germanic languages Dutch, German and English, and the telic-reflexive clitic *se* in Spanish, and (ii) studies that varied direct object forms with different quantization properties in English and Hebrew. One conclusion is that predicate telicity, as encoded by particles in the three Germanic languages and reflexive clitic *se* in Spanish, is easier to acquire than compositional telicity, confirming my earlier generalization (van Hout, 2008a). Nevertheless, even particle verbs did not always lead to culmination interpretations; there was some non-negligible acceptance of non-culmination for particle verbs (varying between 0–35%). Moreover, there were individual verb effects: some trigger more non-culmination acceptance than others. Age did not play a consistent role across the studies. As for the aspectual role of direct object quantization, given

the variation in different kinds of objects (nouns and determiners) across different studies, in most cases with no systematic comparison, it is premature to draw any conclusions about the effect of direct object quantization on the acquisition of telicity. This remains an under-investigated area, especially with respect to the count/mass distinction.

5. Non-culmination patterns and the acquisition of perfectivity

The culmination entailment of telic-perfective sentences is jointly determined by the interaction of telicity and perfectivity. Children's interpretations are not sufficiently restrictive – they occasionally accept incomplete situations for telic-perfective sentences – which can, in principle, be caused by non-target-like knowledge of either one. So the question is: does acceptance of non-culmination arise from a non-adult-like semantics of telicity (or, at least, certain telic constructions), or rather from a non-adult-like semantics of perfective aspect? If children do not yet know the target semantics of perfective markers, acceptance of non-culmination could indicate incomplete acquisition of grammatical aspect, rather than telicity (lexical aspect). In other words, is there a developmental stage in which “perfective” markers are not yet perfective for children?

In order to determine what children know of perfectivity, I move on to review comprehension studies on the acquisition of grammatical aspect with experimental designs systematically contrasting perfective and imperfective aspect and using telic predicates. There is quite an extensive literature on this topic (for reviews, see van Hout, 2016, and Wagner, 2012). The first comprehension study on the perfective-imperfective distinction was Weist, Wysocka & Lyytinen (1991). Weist and colleagues found that English and Polish children appropriately differentiated the two aspects as early as 2;6. The Finnish children in Weist et al. (1991) did not reliably differentiate partitive and accusative case on the direct object in the aspect task until the age of 6;6 – a finding they explain by appealing to the one-to-many form/meaning mapping of the Finnish object cases.

Using the same task, albeit with somewhat different materials, however, a study by Wagner (2002) did not replicate the findings of Weist et al. (1991) regarding early mastery of the perfective-imperfective distinction: children did not perform at adult-like levels until the age of 5 years. Wagner attributes the age of acquisition gap between her results and those of Weist and colleagues to children's initially more limited knowledge of aspect as relating to the intentions of the agent of the action. The pictures in her picture-selection task only showed the resulting outcome for the object referent with no agent in view, whereas in Weist et al.'s study the pictures

showed showed a resulting state for both the object referent (a finished versus an incomplete flower) and the agent (not drawing any more versus still drawing). Wagner concludes that, for young children, information about the state of the agent is crucial for deciding about culmination.

All other acquisition studies – using pictures or movies showing agent and object referents – in several other languages established early differentiation of the perfective-imperfective distinction. In a review about the acquisition of aspect (van Hout, 2016) I summarized this literature. See Appendix C for an overview of comprehension studies on grammatical aspect that compared acquisition of perfective and imperfective aspect in ten languages, specifying the age range tested and the youngest age at which children systematically differentiated the perfective and imperfective condition and showed knowledge of the culmination entailment of perfective aspect. For reasons of space I do not discuss any further details here about verbs and aspect forms (but see van Hout, 2016). The overall conclusion of my previous review is that children acquire the perfective-imperfective distinction early. Specifically, in most studies, the target meaning of the perfective markers in the relevant language is in place at the earliest age tested. A number of the studies listed here did not, however, find fully target-like interpretation and production of *imperfective* aspect up to the age of 6. They did, however, differentiate the two aspects. Seeing, then, that children know the target semantics of perfective markers, I conclude that the cause for the acceptance of non-culmination is *not* incomplete acquisition of grammatical aspect.

This brings us back to telicity and the question: is there a developmental stage at which telic predicates are not telic for children, or certain kinds of telic predicates are not telic? The review of the telicity acquisition patterns in Section 4 revealed that there is a distinction within the class of telic predicates: predicate telicity, as encoded by particles in the Germanic languages and telic-reflexive clitic *se* in Spanish, is easier to acquire than compositional telicity. The fact that child participants are able to reject non-culminating situations for perfective sentences with particle verbs leads to the following conclusion: children know the interaction of telicity and perfectivity (i.e., they compute the culmination entailment of telic-perfective predicates, at least for particle verbs and telic-reflexive clitic *se*). Whichever aspectual theory one assumes for modeling this interaction (Section 2), the mere fact that children are adult-like with certain telic-perfective predicates suggests that they have acquired the interplay of telicity and perfectivity in their grammars. Hence, the cause of the overly liberal non-culmination pattern is *not* immature knowledge of the telicity-perfectivity interface.

Having discussed the roles of particles, direct objects and perfective markers in acquisition, and concluding that none of these can explain acceptance of

non-culmination, there is one remaining possible cause: the relevant event type properties encoded in a verb's lexical meaning. Is there a developmental stage at which lexically telic verbs (those that are not overtly encoded as such like particle verbs) are not yet telic for children? In other words, the meanings of verbs such as *cross*, *kill*, *destroy*, and *break* crucially include a result state. Can it be that these verbs, which are telic in the adult lexicon, are not (yet) telic for children?

6. Conclusions and new developments in the acquisition of event culmination

This chapter has presented a comprehensive overview of acquisition work on event culmination in three lines of research, showing that there is quite a high rate of acceptance of non-culmination by children (and adults too). I have sought to explain why, across languages, children accept non-culminating interpretations of telic-perfective sentences. Defining the elements involved in the grammar of culmination – the lexical semantics of verbs, telicity at the verb phrase level, perfective aspect at the sentence level – and discussing several possible explanations, I have concluded that the learnability challenge for event culmination, once perfectivity has been acquired, lies in the acquisition of verb meanings.

Several acquisition studies have pointed out the role of agentivity and intentionality for children's understanding of event culmination, but none have systematically varied these dimensions in the experimental designs. Interestingly, these insights from acquisition are being met by recent developments in crosslinguistic semantic theories about non-culmination in certain (adult) languages, including Mandarin, Japanese, Hindi, Thai and Salish languages (see Demirdache & Martin, 2015, for an overview). It turns out that there is a crucial role for the type of subject: whether the subject is a volitional and intentional Agent or rather a non-volitional and non-intentional natural Cause. Demirdache and Martin (2015) show that sentences with Agents sometimes allow for acceptance of non-culminating situations in these adult languages, but not Causes, revealing a crucial role for Agent control and event culmination.

This insight presents a novel angle on past acquisition studies and shapes new questions for future research, since all previous acquisition studies used Agent subjects. The question is hence, what happens with non-intentional Agents? And with Causer subjects? Demirdache and Martin's (2015) Agent Control hypothesis predicts that using other types of subjects in stimuli will lead to a lower rate of non-culmination acceptance. This novel line of inquiry has just entered acquisition research. Recent studies in various child languages revisit the non-target-like

acceptance of non-culmination by manipulating subject-type: Agent versus Causer, in order to find out if non-culmination in child language reflects the Agent Control Hypothesis (van Hout et al., 2017; Strangmann, 2015).

Research on the grammar and acquisition of event culmination over the past few decades has been done within different, more or less independent lines of research. Various linguistic theories have been proposed: mereological and scalar approaches, pragmatics and lexical-semantics. Acquisition studies have investigated verb meanings, telicity and perfectivity. This chapter has tried to connect these different strands in order to reach deeper insights which can pave the way to further research. Given the important role of verb semantics for event culmination in adult grammars, there are several questions for future acquisition research. Which features of verb semantics contribute to different patterns in the acquisition of event culmination, and how? Moreover, given the dual source for deriving culmination in a scalar approach (semantic entailment versus pragmatic implicature), the acquisition question splits as well: How do children acquire event culmination when it is an entailment, and how do they do acquire it when it is an implicature? In other words, do children know that verbs from certain classes yield culminating interpretations more robustly than verbs from other classes? And how does this vary across languages? These questions and others can be approached by systematically comparing verbs from different event-semantic classes and further developing event culmination paradigms such as the ones that have been employed in the telicity and aspect studies surveyed in this chapter.

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Appendix A. Samples of experimental materials for testing the culmination entailment

Below are some picture series and accompanying test sentences from the truth-value judgment task in van Hout (1998). The pictures were put down in front of the child one by one, while the experimenter told a short story about two animals or two people. In the middle picture the agent is eating or drinking, and in the final picture the agent has either finished his food or drink (culminating situation) or has left half of it (non-culminating situation). There were four conditions in this experiment; each is illustrated here.

Particle verb condition: *Did the light brown horse eat up his apple? Did the dark brown horse eat up his apple?*

Transitive condition: *Did the red mouse eat his cheese? Did the white mouse eat his cheese?*

Transitive with mass term condition: *Did the boy with the white cap drink coke? Did the boy with the red cap drink coke?*

Intransitive condition: *Did the boy in green eat? Did the boy in blue eat?*

Appendix B. Overview of verbs tested in nine telicity studies

This table lists, per study and per language, all verbs that were tested in the transitive and particle verb conditions, and for Spanish in the transitive and clitic *se* condition.

Study	Language	Condition	Verbs
van Hout 1998	Dutch	transitive	eten ‘eat’, drinken ‘drink’
		particle	opeten ‘eat up’, opdrinken ‘drink up’
van Hout 1998	English	transitive	eat, drink
		particle	eat up, drink up
Jeschull 2007	English	transitive	eat, drink, fold, wrap
		particle	eat up, drink up, fold up, wrap up
Ogiela 2007	English	transitive	eat, drink, build, fix
		particle	eat up, drink up, push over, carry over
Schulz & Penner 2002	German	transitive	essen ‘eat’, trinken ‘drink’
		particle	aufessen ‘eat up’, austrinken ‘drink up’
Schulz et al. 2001; Penner et al. 2003	German	transitive	–
		particle	aufmachen ‘open’
Schulz & Wittek 2003	German	transitive	–
		particle	aufmachen ‘open’, zumachen ‘close’, abmachen ‘take off’, anmachen ‘turn on’
Wittek 2002	German	transitive	schliessen ‘close’, knacken ‘crack’, pflücken ‘pick’, löschen ‘extinguish’, füllen ‘fill’, töten ‘kill’, wecken ‘wake’, zerbrechen ‘break’
		particle	zumachen ‘close’, aufmachen ‘open’, abmachen ‘pick’, ausmachen ‘extinguish’, vollmachen ‘fill’, totmachen ‘kill’, wachmachen ‘wake’, kaputmachen ‘break’
Hodgson 2001	Spanish	transitive	limpiar ‘clean’, comer ‘eat’, beber ‘drink’, hacer ‘do’, leer ‘read’
		particle	limpiarse ‘clean’, comerse ‘eat’, beberse ‘drink’, hacerse ‘do’, leerse ‘read’

Appendix C. Overview of grammatical aspect acquisition studies

Reprint of Table 25.6 (p. 607) from Ch.25 'Lexical and Grammatical Aspect' by Angeliek van Hout in "Oxford Handbook of Developmental Linguistics", edited by Lidz, J. W. Snyder, W. & Pater, J. (2016). By permission of Oxford University Press (www.oup.com).

This is a summary of aspect comprehension studies in ten languages, copied from my review in van Hout (2016); some references have been updated. Age PERF: Youngest age at which children systematically differentiated perfective vs. imperfective aspect and show knowledge of the culmination entailment of perfective aspect.

Language	Study	Ages tested	Age PERF
Basque	García del Real & Ezeizabarrena, 2011	5;0–5;11	5 ^a
Chinese	Li & Bowerman, 1998	3;11–6;4	5 ^b
Finnish	Weist et al., 1991	2;6–6;6	– ^c
Dutch	van Hout, 2007, 2008b	3–5	3 ^d
English	Matsuo, 2009	1;6–6;8	5 ^e
	Wagner, 2002	1;11–5;7	5 ^e
	Weist et al., 1991	2;6–6;6	2;6 ^f
Italian	van Hout & Hollebrandse, 2001; van Hout 2008b	3;0–6;1	4
Spanish	García del Real, 2015;	5;0–5;11	5 ^a
	Hodgson, 2003	3;0–8;0	5
Greek	Delidaki, 2006	3;0–6;5	3;0
	Konstantzou, 2014	4;0–6;11	4 ^a
Polish	van Hout, 2005, 2008	2;0–4;11	3
	Weist et al., 1991	2;6–6;6	2;6 ^f
Russian	Gagarina, 2008	3;0–6;11	3
	Kazanina & Philips, 2007	2;10–6;9	3
	Stoll, 1998	2;0–6;11	2;6
	Vinnitskaya & Wexler, 2001	3;0–6;5	3

Notes:

- a This study did not test children younger than the indicated age.
- b This reflects the data for their lexical verb class categories "Accomplishment Resultative" and "Locative".
- c Not even the oldest Finnish learners at 6;6 interpreted accusative and partitive object case appropriately in order to distinguish complete versus incomplete situations.
- d The Dutch 3-year-olds correctly rejected the perfect for incomplete situations by 63%, which was different from chance, but far from ceiling.
- e The three studies with English learners establish different ages for the acquisition of the culmination entailment of perfective aspect (English *-ed* forms in simple past or in a prenominal participle). In contrast to Weist et al. (1991), Wagner (2002) and Matsuo (2009) only showed the state of the object referent at the end of the event, not the agent of the action. The presence of agent-oriented information may be required for the younger children to be able to succeed in this task (Wagner, 2002).
- f Weist et al.'s results show that the English and Polish learners correctly differentiate the perfective-imperfective distinction at the age of 2;6. However, since no percentages correct are given for each aspect separately, we cannot tell from their report how firmly these young learners have acquired the culmination entailment of the perfective.