Verb Aspect and the mental representation of situations

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> For God, history is a landscape of events. For Him, nothing really follows sequentially since everything is co-present.
>
> Virilio (2000)

In contrast to the perspective alluded to above, human beings are unable to process situations in an atemporal manner. Indeed, every situation occurs at a certain time and endures for a certain duration. Just as it is impossible to experience situations without a temporal perspective, reference to time in language is likewise inescapable. Any situation description, no matter how simple, provides temporal information. The manner in which the temporal structure of situations is coded in language corresponds to the multitude of possible situation sequences that occur in our everyday experiences. One can make a phone call right now, tomorrow, yesterday, every Tuesday, while taking a walk, before eating breakfast, for three hours, etc. Accordingly, language offers tense markers on verbs (*called, will call*) as well as adverbial markers (*yesterday, after lunch*) that cue comprehenders to represent a situation as occurring before, during, or after some point on a timeline. Tense markers locate situations relative to the time of utterance, whereas adverbials and sequential ordering of situation descriptions provide cues for situating situations relative to each other on a narrative timeline.

Despite the fact that all situations are concisely coded in language through sequential, discrete phrases, situations as they are experienced in the real world are not so neatly packaged. Instead, they have varying duration, do not always occur in continuous sequence, and do not always wait for the previous situation to finish before beginning, which can make the ordering of situations quite complicated. For instance, reading a book takes a considerable amount of time, whereas opening a book is finished as soon as it begins. Washing a pair of jeans is a situation with multiple stages that progress toward a clear and natural endpoint, but wearing a pair of jeans is a homogeneous situation that endures indefinitely, until it is discontinued. The temporal variation found between and within situation types is of course

directly related to how the participant(s) and objects of each situation contribute to the ongoing and completed development of those situations. This close relationship between the temporal and causal structure of situations is crucial for specifying how they are organized. These characteristics of the structure of situations must therefore be adequately captured in language if successful understanding of situation descriptions during language comprehension is expected to ensue. The present chapter examines how verb aspect temporally references situations as ongoing versus completed thereby influencing the mental representation of situations.

The chapter begins by introducing the characteristic properties of verb classes and aspectual categories, as well as how they interact to produce the temporal properties of sentences. Following this, problems associated with the classification schemes are discussed, and possible lines of improved analysis are mentioned. This theoretical discussion is followed by an overview of empirical research on grammatical verb aspect within the field of cognitive psychology. Recent psycholinguistic studies examining the role of aspect in constraining discourse model construction are reviewed. Finally, special issues involving verb aspect's interaction with situation types and tense are discussed, and future research directions that would contribute to the psychological relevance of aspectual distinctions are proposed.

Verb classes

A number of different philosophers and linguists have proposed verb classification schemes (e.g., Dowty 1979; Lyons 1977; Mourelatos 1981; Nordenfelt 1977; Vendler 1967; Verkuyl 1972, 1993; see also chapter 2, section 4 of this book), and it its generally agreed that verbs denote situations that fall into one of the following three core classes; states (e.g., *know*), events (*arrest*), and processes (*walk*). In addition to these classes, a fourth class, called accomplishments (e.g., *build*), is identified as having properties of both processes and events, and thus considered a complex class or compound class (Dowty 1979). These classes are found in all languages and are considered by many to be ontological categories (Kiel 1979; Lyons 1977).

Although these classes are generally agreed upon, there is far less agreement as to the composition of the classes. The disagreement among linguists arises from trying to categorize verbs into discrete classes on the basis of the presence or absence of particular temporal properties. Table 1 displays the semantic dimensions of the different verb classes. The main problem with this approach is that the meaning of individual verbs actually overlaps

with the properties of multiple verb classes. The following discussion illustrates the overlapping nature of the classes.

Table 1. Semantic dimensions of the different verb classes.

Semantic Dimensions	States	Events	Processes	Accomplishments
	(achievements)		(process+event)	
Exist	+	–	–	–
Happen	–	+	+	+
Durative	+	–	+	+
Momentary	–	+	–	–
Homogenous	+	–	–	+
Heterogenous	–	+	+	+
Progressive	–	–	+	+
Cyclical	–	–	+	–
Telic	–	+	–	+
Atelic	+	–	+	–

The most basic semantic distinctions identified by linguists as distinguishing between the verb classes are that between situations that exist versus those that happen, those that are continuous or durative (i.e., extended in time) versus punctual or momentary, between those that are homogenous or unchanging versus heterogeneous and changing, and finally the distinction between telic and atelic situations (Comrie 1976; Dowty 1979; Lyons 1977). Telic situations (e.g., *build*) are those situations that are directed toward a goal, and when the goal is reached, a change of state occurs and the situation is complete. Atelic situations are those that do not have a natural endpoint (Comrie 1976).

States are the simplest of the situation types and are characterized as existing, are homogenous or unchanging throughout their duration, and are continuous because they do not have endpoints. The lack of a natural final endpoint makes states atelic. Non-stative or dynamical situations (*events* and *processes*) are characterized as happening since they involve change. If there is a single change of state, the situation is considered momentary or punctual and is called an *event* (also known as *achievements*). If an event is under control of an agent, the event is called an *act* (Lyons 1977). Because events involve a natural endpoint (i.e., the end of a change of state), but do not have a process leading up to the eventual change in state (i.e., they are punctual), they are considered to be pseudo-telic. If the situation is extended

in time (i.e., durative or continuous) and includes multiple changes of state the situation is considered a *process*. However, because processes are continuous they do not have an intrinsic endpoint and are therefore considered atelic. Processes can be progressive (e.g., *lift*) or cyclical (*walk*), and if they are under control of an agent they are called *activities* (Lyons 1977). Finally, *accomplishments* such as "build", are special in the sense that they include properties of both processes and events. For example, "build" involves a process that leads up to an intrinsic endpoint (i.e., something is built). The presence of an intrinsic endpoint makes accomplishments telic in nature.

The foregoing discussion indicates that the verb classes all have features in common with one another, and therefore, the categorization of the situation types is not "clear cut." To summarize, both events and processes are differentiated from states because they happen (i.e., involve changes of state). Processes are distinguished from events and are similar to states because they are extended in time and can be homogenous. Events are similar to states because they both lack an internal phase. Finally, accomplishments share features with processes and states because they involve duration, and also with events because they involve a natural endpoint.

Aspectual categories

The grammatical category of aspect captures the different ways language refers to the temporal structure of situations through grammaticalization in the morphology (cf. chapter 2, section 3 of this book). The linguistic analysis of aspect is complicated by the fact that the languages of the world are extremely varied in how aspectual distinctions are grammaticalized and, as a result, there are many different aspectual classification schemes (Comrie 1976; Lyons 1977). From a language independent perspective, there appear to be three aspectual categories that are grammaticalized to various degrees in the world's languages, and these include the perfective (also called the *completive* by many linguists), imperfective, and perfect aspects (Johnson 1981; Lyons 1977).

Perfective aspect is differentiated from the other two categories by referencing the whole event and the different phases or parts that make up an event are ignored. Thus, the situations they denote are often considered punctual or bounded. When events and processes are used with the perfective they are viewed as a whole, or bounded, while states are viewed as unbounded, as well as bounded because their temporal properties do not include endpoints (Smith 1991).

The *imperfective aspect* makes specific reference to the internal structure of situations by focusing on their ongoing development, but does not make reference to their terminative phases. The imperfective category is frequently subdivided by linguists into *progressive* and *habitual* categories. The English progressive has received a lot of attention in the linguistic literature (e.g., Comrie 1976; Dowty 1979; Langacker 1982; Vlach 1981; Zhang 1995). This form of verb aspect is marked with the verbal form be - ing (e.g., is scoring, was scoring, will be scoring). The progressive form focuses on the internal phases of a dynamical situation (e.g., 1), and does not always occur with verbs expressing states (2).

(1) Dave was climbing a tree. (Dynamical situation)

(2) *Dave was knowing the answer. (Stative)

However, some stative sentences can be in the progressive form, and when this happens it has the effect of changing the state into an event (see *aspectual coercion* below). For instance, sentence (3) describes a stative verb in the progressive that is given an event interpretation, while in (4) it is not (Zhang 1995).

(3) They were living in Texas. (state → event)

(4) They lived in Texas. (state)

Events can also appear in the progressive form (e.g., 5), and when this happens the focus is on the preliminary phases of the event with no information as to its outcome (Smith 1991). Thus events used in a progressive form are much like accomplishments as they denote stages prior to the terminative stage of the event (i.e., phases leading up to, but not including the actual "winning" of the race). However, some verbs denoting events are odd in the progressive because it is hard to imagine them having preliminary phases, such as "finding" in (6).

(5) Dave was winning the race.

(6) ? Dave was finding his watch.

The habitual form of the imperfective aspect differs from the progressive form in that it refers to a series of a particular event, or the iteration of a process several times (Comrie 1976; Smith 1991). For example, in the following sentence the process of playing hockey is iterated several times.

(7) Dave used to be playing hockey.

The *perfect aspect* refers to times later than the situation and places emphasis on the resultant phases (or states) of situations rather than on inceptive phases (Comrie 1976). In English this aspectual category is marked with to have + past participle (e.g., has scored, had scored, will have scored). In general, the perfect functions to indicate the continuing relevance of a past situation into the present or to other reference times (Comrie 1976). The perfect aspect appears with all situation types.

The above discussion on the verb classes and the aspectual categories was purposefully laid out in a manner to that would illustrate some of the problems that linguistic theories of aspectuality have to overcome. Two problems that are immediately apparent for linguistic theories is how to account for lack of clear boundaries between the verb classes, and how to explain why members from the same verb class interact variably with aspectual categories (e.g., "winning" combines more readily than "finding" in the progressive form of the imperfective). These problems are difficult to handle by linguistic theories that try to partition classes into discrete categories on the basis of the presence or absence of particular properties (e.g., Mourelatos 1981; Vendler 1967), or try to account for the classes on the bases of rules that govern aspectual composition, such as model-theoretic semantics (e.g., Dowty 1979).

A more appropriate line of analyses that can handle these difficulties is to employ a prototype theory of aspectuality (e.g., Zhang 1995). From this perspective, verb classes are not defined by strict criteria that are necessary and sufficient for defining membership, but rather their membership can be a matter of degree (Rosh 1978). This view of using a prototype is consistent with the notions of other cognitive linguists (e.g., Langacker 1982, 1987; Talmy 1988) who suggest that aspectual classes emerge from a child's interaction with the entities and things in their environment, and it is this interaction that allows the child to develop the conceptual basis for classifying the situations that occur in the world. In this view, our knowledge of the world is embodied, that is, rather than existing independently in the world, conceptual knowledge is grounded in bodily movement, perception, and all of our social and physical experiences (Lakoff 1987). When viewed from a cognitive view point, the "fuzzy" boundaries between aspectual notions is not unexpected.

Another line of cognitive linguistic analysis that seems to be promising with respect to solving these problems has been proposed by Narayanan and colleagues (Chang, Gildea & Narayanan 1998; Narayanan 1997). In this

view, the compositionality of verb classes are grounded in sensory-motor control primitives such as goal, periodicity, iteration, final state, duration, and other parameters such as force and effort. Aspectual expressions are considered to be "linguistic devices that refer to schematized processes that recur in sensory-motor control". The schematized properties have been implemented in a computational model that provides a semantic representation of aspect that is grounded in the execution of the model. The semantic representation of aspect naturally falls out of the executing model without the need for special interpretation rules (such as those proposed by model theoretic models). The viability of this model is demonstrated by its ability to simulate a number of important characteristics of aspect that have traditionally been problematic, such as accounting for cross-linguistic variation in aspectual expressions, verbs that are difficult to classify, and the interaction between verb class and aspectual categories.

Empirical investigations of verb aspect

The use of verb aspect in discourse provides comprehenders with a good deal of temporal information about the described situations. Exactly how verb aspect constrains representations of described situations has traditionally been the focus of linguistic and philosophical discussions, such as many of those cited above, but recently this topic has also become the focus of a growing number of empirical investigations in the area of cognitive psychology. This line of research has shown that verb aspect provides two types of information about the situations it is used to describe. Specifically, verb aspect has been shown to provide information about a situation's completion status, as well as information about the availability of people, entities, and features of the described situation. These two sets of findings will be summarized and discussed below.

The mental representation of ongoing versus completed situations

There have been several investigations of how verb aspect serves to constrain comprehenders' representations of situations with respect to completion status. In general, these studies have considered the distinction between the perfect or perfective (completive) aspects and the imperfective aspect. As described above, linguists have argued that the perfect aspect emphasizes the resultant rather than inceptive phases of situations, and the perfective aspect describes situations as complete wholes, without focus on internal

phases or parts that make up the situations. As the perfect aspect focuses on resultant phases, and the perfective aspect collapses across the phases of a situation, treating it as an indivisible unit, both aspectual categories should yield representations of completed situations. Therefore, these aspectual categories are often compared to the imperfective aspect, which makes specific reference to the internal phases of situations while ignoring their terminative phases. Indeed, several studies in the arena of cognitive psychology have shown that the imperfective aspect focuses representations on the ongoing development of situations, whereas the perfective and perfect aspects focus representations on the endpoint or resulting phases of situations.

For instance, Magliano and Schleich (2000) have demonstrated that situations described in the imperfective aspect are comprehended as still ongoing, whereas situations described in the perfective aspect are more often understood as completed. In a set of 4 experiments, they presented comprehenders with stories in which a critical situation was described either in the imperfective or perfective aspect (i.e., was changing a tire vs. changed a tire). This critical sentence was followed by three sentences describing situations that could be understood to occur either during or after the critical situation. In Experiment 1, participants were asked a question regarding whether or not the critical situation was ongoing or completed at four positions in the story; after the critical sentence and after each of the three subsequent sentences. Across the four question positions, participants were more likely to respond that the critical situation was still ongoing when the imperfective aspect had been used rather than the perfective aspect.

Experiment 2 employed the same design as Experiment 1 with the addition of a manipulation of the typical duration of the critical situation (i.e., was writing/wrote a check vs. was writing/wrote a novel). Again, participants were more likely to respond that the critical situation was still ongoing when the imperfective aspect had been used rather than the perfective aspect. Only in the imperfective condition did typical duration have an effect, in that short duration situations were more likely to be judged as completed than long duration situations, although this effect was only observed at the late question position (three sentences after the critical sentence). These two experiments demonstrate that the use of verb aspect indeed constrains situation representations with respect to completion status. Moreover, Experiment 2 also demonstrated how comprehenders more often used the linguistic construction of verb aspect over world knowledge about the typical duration of situations to determine whether a situation was ongoing or completed.

Morrow (1985) also provides elegant demonstrations of how verb aspect constrains the temporal focus of situations. In these experiments, partici-

pants first memorized the layout of a model house and then read short narratives describing a sequence of situations that took place in that house. Across experiments, Morrow found that participants were more likely to locate target references in the path room rather than the goal room after reading sentences in the progressive past such as "She was walking past the study to the bedroom", whereas the opposite was true after reading sentences in the simple past such as "She walked past the study to the bedroom." This effect was clearly measurable over and above effects of prepositions (e.g., from/through/past, to/into) as well as order of mention of source and goals rooms (e.g., from the study to the bedroom, vs. to the bedroom from the study). Thus, this provides another demonstration that the imperfective aspect (progressive past) focuses representations on the ongoing development of a situation, whereas the perfective aspect (simple past) focuses representations on the endpoint or resulting phases of a situation.

Madden and Zwaan (2003) used a picture verification task to demonstrate how the perfective aspect constrains representations to the endpoint of a situation. In Experiment 1, participants read sentences either in the perfective ("The boy built a doghouse.") or imperfective aspect ("The boy was building a doghouse."), and then chose which of two pictures best matched the sentence. The two pictures illustrated the described situation either in progress (half-built doghouse) or completed (finished doghouse). Participants were more likely to choose the completed picture after having read a perfective sentence, but chose the in-progress and completed picture equally often after having read the imperfective sentences. In Experiment 2, only a single picture was presented (either in progress or completed) and participants were to judge as quickly as possible whether the picture matched the sentence. Although accuracy did not differ for the completed and in progress pictures, responses to verify that the picture matched the sentence were faster for the completed picture rather than the in progress picture after having read a perfective sentence. There was no difference in response speed for the two picture versions after having read an imperfective sentence. Experiment 3 reversed the order of presentation, so that one of the picture versions was presented first, and then participants were asked to judge whether a subsequent sentence matched the depicted situation. Once again, only on the perfective sentences were participants faster to respond if they had previously viewed the completed pictures than if they had viewed the in-progress pictures. Participants responded to imperfective sentences equally fast whether they had viewed the in-progress or completed pictures.

In this study, all three experiments showed that participants preferred pictures showing completed situations to pictures showing ongoing situa-

tions upon reading perfective sentences but showed no picture preference upon reading imperfective sentences. This apparent lack of constraint in the imperfective construction does not necessarily mean that participants were not activating ongoing representations of the imperfective sentences. Rather, this lack of effect was hypothesized to arise from the fact that ongoing situations may be represented in various stages of completion, even approximating the endpoint of the situation. Therefore, it is more difficult to capture the appropriate stage of completion that would effectively match the participants' representations of the imperfective sentences in the picture stimuli. Conversely, the endpoint of a situation is temporally well-specified, and thus it is easier to pictorially capture the appropriate stage of completion that would effectively match the participants' representations of the perfective sentences.

Finally, Rohde, Kellar, and Elman (2006) have also demonstrated how verb aspect constrains the temporal focus of a situation. Participants were presented with transfer sentences followed by an ambiguous pronoun (e.g., "John handed a book to Bob. He _____") and were required to continue the second sentence. Given the ambiguity of the pronoun at the beginning of the second sentence, participant's responses could either continue that sentence with reference to John, the source of the transfer situation, or with reference to Bob, the goal of the transfer situation. When the initial sentence was presented in the imperfective aspect (was handing), participants were more likely to continue the second sentence with reference to John, but when the initial sentence was presented in the perfective aspect (handed), participants continued the second sentence with respect to John and Bob equally often. This demonstrates that verb aspect can impinge on the influence of typical subject preference (Crawley, Stevenson & Kleinman 1990) and first-mention privilege (Gernsbacher & Hargreaves 1988) in resolution of pronoun ambiguity. When the imperfective aspect is used there is a clear focus on the source of the transfer situation, but this focus shifts in favor of the goal or end state of the situation when the perfective aspect is used.

Verb aspect and the activation of participants, objects, and locations of situations

In addition to providing information about situation completion status, verb aspect has also been shown to influence the availability of people, entities, and features of described situations. For instance, Carreiras et al. (1997) tested the influence of verb aspect on the availability of characters in short narratives. In this study, participants read short passages in which the ac-

tions of two characters were described. The target character was described as doing something either in the imperfective or the perfect aspect, and subsequently, that character's name was presented as a probe word. Participants were faster to respond to the probe when the actions of that character were described in the imperfective rather than the perfect aspect. Thus the imperfective aspect acts as a cue to keep a character in the focus of the mental model for the unfolding narrative.

Ferretti and colleagues (2007) used both behavioral and neurocognitive methodology to test how verb aspect influences the availability of typical locations of situations. In their first experiment, they used a semantic priming paradigm in which participants had to read a verb phrase silently and then name a noun (location) aloud. The verb-noun pairs could be related (was skating – arena) or unrelated (was praying – arena). Furthermore, the verb could either be presented in the past imperfective (was skating, was praying) or in the past perfect (had skated, had prayed). Participants' times to name the location word showed a semantic priming advantage for related over unrelated pairs in the past imperfective, but no relatedness difference occurred for naming times of locations that followed the past perfect verbs. Thus, these results show that location information is more available when the imperfective aspect is used rather than the perfective, and that this difference in availability is evident very quickly when verbs are read.

In a second experiment involving a sentence completion task, participants generated a larger proportion of locative prepositional phrases as continuations to sentence fragments with past imperfective verbs ("The cow was grazing ____") compared to sentence fragments with past perfect verbs ("The cow had grazed ____"). Furthermore, a third experiment utilizing Event-Related Brian Potential (ERP) methodology examined online reading of sentences with high-expectancy locations ("The diver was snorkeling/ had snorkeled in the ocean.") and low-expectancy locations ("The diver was snorkeling/had snorkeled in the pond."). Only the sentences in the past imperfective yielded a larger N400 (a ERP component known to index the ease of semantic integration of words in text) for low-expectancy locations than for high-expectancy locations. The past perfect sentences showed no expectancy difference in the N400. Also, slow cortical potentials that developed over the prepositional phrases were more negative following perfect than imperfective verbs, indicating that locative prepositional phrases following perfect verbs were more difficult to integrate. Finally, early sensory ERP components known to be sensitive to visual processing and visual selective attention (e.g., P1, P2) also varied systematically as a function of aspect and expectancy. Specifically, within 200 ms of the onset of location nouns, the

amplitudes of these components were most reduced for typical locations following perfect verbs relative to all other conditions. Although these early ERP component results need further investigation, they suggest that verb aspect acts as a cue to actively suppress location information following perfect verbs.

Not only do characters and locations become more accessible when the imperfective aspect is used rather than the perfect or perfective aspects, but also typical instruments such as hammers and knives are more active when their corresponding situations are described in the imperfective rather than the perfect aspect. Truitt and Zwaan (1997) presented short texts in which one of the described actions implied the use of a specific instrument, such as a hammer. Participants were faster to verify that the instrument had been mentioned in the preceding text after reading the target action sentence in the imperfective aspect ("Jason began pounding the nails into the board.") rather than in the perfective aspect ("Jason pounded the nails into the board."). Likewise, when the instrument had not been mentioned in the previous text, participants were slower to reject the probe word "hammer" after reading the imperfective than the perfective version of the target action sentence. These findings demonstrate that instruments are more available in a reader's mental model when situations are described as ongoing (imperfective) rather than completed (perfective).

Finally, we revisit Magliano and Schleich's (2000) study as it also provides evidence that verb aspect can influence the time course of overall activation of a situation. Specifically, this study demonstrates that the imperfective aspect increases activation for an entire situation more so than the perfective aspect. In their third experiment, participants read texts that introduced a target activity either in the imperfective or the perfective aspect. At two later points in the story a probe verb phrase that was related to the target activity was presented (change tire), and participants were required to judge whether the verb phrase corresponded to one of the activities mentioned in the story. Across time points, the probe verb phrases were responded to more quickly following imperfective activity descriptions than perfective activity descriptions. Furthermore, their fourth experiment reveals that high span comprehenders are better able than low span comprehenders to maintain activation of activities described in the imperfective aspect. This finding provides evidence that the imperfective aspect acts as a cue to maintain activation of a situation, whereas situations described in the perfective aspect are allowed to become less active.

Taken together, empirical investigations on this topic have shown that verb aspect has an important role in language comprehension. Verb aspect

provides cues in composing the temporal structure as well as the focus of situation representations. The preceding section has discussed several demonstrations that situations described in the imperfective aspect are represented as ongoing while situations described in the perfect or perfective are represented as completed (Madden & Zwaan 2003; Magliano & Schleich 2000; Morrow 1985; Rohde et al. 2006). Subsequently, we discussed studies showing that situations described in the imperfective rather than the perfect and perfective aspects lead to greater and longer activation of the situations as well as their features (Carreiras et al. 1997; Ferretti et al. 2007; Magliano & Schleich 2000; Truitt & Zwaan 1997). While this discussion has provided insight on how aspect constrains the mental representation of situations in general, the following section will take a closer look at how aspect differentially affects the representation of various classes of verbs.

The interaction of aspect and verb classes to constrain mental representation

As previously discussed in the beginning of this chapter, the semantic properties of the different verb classes (Events, Processes, Accomplishments, States) lead to differences in how the classes interact with aspectual morphemes. In the following section we explore the notion that interactions between the verb classes and aspect have consequences on how mental representations of situations are constructed during language comprehension. There has been relatively little direct empirical investigation of how aspect and verb classes combine to constrain the construction of mental representations of situations in the cognitive and psycholinguistic literature. In most cases, research in these fields involved sets of verbs that came from a single verb class (e.g., Madden & Zwaan 2003; Morrow 1985), or involved multiple verb classes without the purpose of directly contrasting the classes (e.g., Ferretti et al. 2007).

Recall that one of the main differences between accomplishments and processes is that the later do not have a natural endpoint and are thus considered atelic. As a result, using aspect to denote processes as completed, and thus with an endpoint, may lead to greater difficulty constructing mental representation of those situations relative to completed accomplishments which have lexical semantics that include natural endpoints. Thus, there may be a perfective advantage in terms of processing costs for accomplishments and, alternatively, and imperfective advantage for processes. A recent study by Yap, Kwan, Yiu, Chu, Wong, Matthews, & Shirai (2006) investigated this

possibility using a forced-choice picture matching task similar to Madden and Zwaan (2003). Across two experiments, native Cantonese speaking participants were presented with auditory sentences that either contained activity or accomplishment verbs marked with perfective and imperfective aspect. Immediately following these sentences, two pictures were displayed on a computer screen. One of these pictures depicted the situation mentioned in the auditory sentences as complete, whereas the other picture depicted the same situation in progress. Participants indicated as quickly as possible which picture was the best match for the situations described in the auditory sentences. The results demonstrated that verb aspect had a different influence on responses to accomplishment and activity verbs. For accomplishment verbs, people took significantly longer to select the matching pictures when they depicted ongoing versus completed situations. On the other hand, matching pictures for activity verbs were verified more slowly when they depicted completed situations. These results show that forcing completion status on situations that do not have natural endpoints, or forcing ongoing status to situations that have well-defined endpoints, comes with a processing cost.

Often in cases like these, when the grammatical aspect of a verb is at odds with that verb's inherent temporal semantics, the semantic system employs a function called aspectual coercion. Aspectual coercion refers to the forcing of an alternative interpretation of a particular situation when the usual interpretation does not fit with the grammatical constraints of the sentence context (Moens & Steedman 1988). For instance, the inherent temporal semantics of the verb *sleep* are intact when we say that a child slept for three hours, because the process of sleeping can endure for three hours. However, the inherent temporal semantics of the achievement verb *jump* are incompatible with a duration of three hours, so when we say that a child jumped for three hours, the alternative interpretation of iterative jumping is forced to supplant the usual single jump.

While little empirical evidence has addressed the topic of aspectual coercion, a couple of studies have shed some light on the representational underpinnings of this process (Piñango, Winnick, Ullah, & Zurif 2006; Piñango, Zurif, & Jackendoff 1999). Piñango and colleagues showed that the function of aspectual coercion was associated with a processing cost during sentence comprehension. Participants heard sentences that did or did not require aspectual coercion (e.g., *The insect hopped/glided effortlessly until it reached the far end of the garden that was hidden in the shade*.). In this example, hopping is an achievement that is over almost as soon as it begins, whereas gliding is a process that can endure for a specified period of time, such as

indicated here with the temporal modifier, "until". Thus, hopping requires an alternative interpretation, whereas gliding can be interpreted in a straightforward way. While participants heard these sentences, they were also required to make a lexical decision to a word presented on the screen, a secondary task that is assumed to compete for resources with the primary task of sentence comprehension. The lexical decision word was presented 250 ms after hearing the temporal modifier "until," which was presumed to be when comprehenders would be engaged in the semantic selection process for the temporal interpretations of the gliding/hopping situations.

Indeed, Piñango and colleagues observed significantly longer lexical decision times when the concurrent sentence required aspectual coercion than when the concurrent sentence afforded the straightforward interpretation of the verb (Piñango et al. 2006; Piñango et al. 1999). Longer lexical decision times were not observed when the lexical decision had to be made 250 ms earlier, at the point when the constraining syntactic information is presented, suggesting that this semantic selection process of aspectual coercion operates at a delay (Piñango et al. 2006). Todorova, Straub, Badecker, & Frank (2000) further demonstrated that this processing cost is associated with the operation of aspectual coercion rather than merely the representation of iterativity in general.

The verb classes discussed in this chapter capture the main differences between all of the situation types. However, within these types of situations there are of course groups of verbs that overlap semantically in more specific ways than the properties outlined in Table 1. Due to the large variability in the temporal and causal structure of the situation types, it should not be surprising that several different classes have been identified and shown by linguists to have relatively specific syntactic behavior as a result of their lexical semantic properties (see Levin 1993 for a discussion of many of these more specific verb classes and their syntactic alternations). To date however, there has been little empirical research on how these more specific verb classes interact with the morphosyntactic properties of verb aspect to constrain mental representation of situations. To our knowledge, only the recent research by Rohde et al. (2006) has directly examined how verb aspect interacts with the lexical semantic properties of more specific verb classes. Recall that participants in this study read sentences that included verbs of transfer (*give, send*) that were in either imperfective or perfect form. They were then provided with a pronoun that was ambiguous with respect to whether it referred to the source participant or goal participant in the preceding transfer situation. Participants were required to generate sentence continuations that seemed natural to them (*Jim gave the book to Tom.*

*He*_____). Rohde et al. also examined how specific semantic differences within verbs of transfer, such as whether the participants are co-located (e.g., co-located – *give*; not co-located – *mail*) and whether the verbs guarantee transfer (*give*) or not (*mail*), interact with verb aspect to constrain sentence completions. Their results demonstrated similarities and differences in how these specific lexical properties influence completions. For example, across all three of their conditions (co-located, guaranteed transfer/co-located, no guaranteed transfer/not co-located, no guaranteed transfer), they found that people were more likely to generate completions in which the ambiguous pronoun referred to the source rather than the goal participants in the preceding sentences, but only when imperfective aspect was used. When the sentences were in perfective form they also found a greater number of source completions, but this was only true for verbs of transfer that did not involve co-location of participants and did not guarantee transfer. The other two verb classes had approximately equal source and goal continuations. Thus, differences in co-location of participants between verbs of the same broad verb class (i.e., verbs of transfer) can lead to differences in how people focus on participants mentioned in situations and thus how people resolve the resolution of ambiguous pronouns in discourse.

The foregoing discussion indicates that more general lexical semantic features that distinguish the main verb classes (e.g., telic vs atelic), as well as more specific semantic features that comprises sets of verbs within these broad classes (e.g., co-location of participants), have important consequences for how verbs combine with verb aspect morphemes. Understanding how these general and specific semantic features associated with the situation types interact with and are coerced by verb aspect is crucial to understanding how people construct the mental representation of situations during language comprehension. Thus, it is important that future research on verb aspect is conducted to identify which verb-specific semantic features are critical for constraining the way aspect interacts with the various situation types. Finally, it should also be noted that it is critical that researchers are in general aware that such differences in the lexical semantic properties between and within verb classes will influence the pattern of results obtained in their experiments.

The interaction of aspect and tense to constrain mental representation

At the outset of the chapter, we briefly discussed how situations are located with respect to the time of utterance (most often now). This temporal infor-

mation is coded in language through tense operators. The past tense locates situations earlier than the time of utterance, the present tense locates situations during the time of utterance, and the future tense locates situations later than the time of utterance. Most research on verb aspect and situation representations has been conducted within the past tense, and this is for several reasons. First, much of our discourse about situations concerns accounts of what has occurred prior to the time of utterance, and the past tense is the natural manner of discussing these situations. Therefore, the past tense is an ecologically valid setting for research on situation representations. Second, and more important, is the fact that verb aspect behaves differently within the different tenses. Because of the diversity of possible internal situation structures, some situations are accommodated quite easily in the past, present, and future tenses whereas other situation structures are not. Likewise, some grammatical aspects occur within certain tenses with straightforward interpretations, while other grammatical aspects force unusual interpretations in some tenses. These tense-aspect interactions will be discussed below.

In the present tense, situations are anchored to the time of utterance, which normally corresponds to the current now. However, whereas the past and future are durative regions of time, the current now is in fact a point in time without duration. This creates problems for any situation that has duration, as a durative situation cannot be accommodated within a non-durative point in time. When an infinitely small point in time like the present attempts to encapsulate a situation that takes time, such as drinking coffee, representational problems will naturally occur. In this case, alternative interpretations are forced. As discussed in the previous section, an alternative interpretation of a particular situation can be coerced when the situational aspect and the grammatical aspect of that situation are at odds (Moens & Steedman 1988; Piñango et al. 2006; Piñango et al. 1999). Aspectual coercion also occurs when the situational aspect of a verb and the tense of the sentence are at odds, as is often the case for the present tense.

Because the progressive present tense (i.e., *am drinking*) describes a situation from an imperfective perspective in which the onset of the situation has already occurred and the endpoint has not been reached, situations with duration can be accommodated in the present tense when this construction is used. The situation is represented as ongoing at the current point in time. However, the simple present tense is especially sensitive to aspect, as it describes a situation from a perfective perspective in which the entire situation, including onset and endpoint are collapsed into a complete whole. Thus, when processes or events are presented in the simple present tense, they are

not interpreted in a straightforward manner, but rather coerced to yield alternative interpretations. These include iterative or habitual interpretations, or idiosyncratic interpretations such as the historical present used in news reports and joke telling. For instance, when we use the simple past tense to say, *Peter parked Susan's car*, we assume that this happened once. But when we use the simple present, as in *Peter parks Susan's car*, then a habitual interpretation is assumed in which Peter often parks Susan's car for her. Likewise, the simple present is often used to recount situations that occurred in the past as if they are being experienced now, as in newspaper headlines (*Mayor funds new recreation center*") and joke telling (*A man walks into a bar*.). These alternative interpretations of situations are forced because of the incompatibility of the point in time that is the present tense, and the normal duration of these situations. Although language users have become quite adept at automatically re-interpreting situations when aspectual coercion is required, this process nonetheless incurs a processing cost (Piñango et al. 2006; Piñango et al. 1999).

Not all durative situations are problematic for the simple present tense. A state (*being sick, having a car*) is temporally unbounded, yet is easily accommodated in the simple present tense (*John is sick, I have a car*). This is because states are homogeneous and have no dynamic properties. They can be sampled at any point in time, always yielding the same evaluation. Thus, the state of being sick or having a car can be true at the current point in time and likewise produce straightforward interpretations when described in the simple present tense (perfective). However, as mentioned in the previous section, states do not lend themselves to the imperfective aspect in any tense in English (*John was/is/will be having a car*). Even though the idea of an unbounded state seems to fit nicely with the idea of an ongoing situation, and indeed states are described in the imperfective in many other languages, states are not described using the imperfective aspect in the English tenses. Because the English imperfective is employed to make an event more like a state (the state of an event as ongoing and continuous), this construction is not compatible with situations that are already inherently stative.

A further complication with aspectual distinctions in the present tense is that the present perfect (*John has eaten*) is often wrongly categorized as a past tense. This is a result of the fact that its grammatical aspect refers to a completed situation. However, this construction is technically categorized as a present tense, because it refers to the resultant state of that completed situation and its relevance for the present situation. This becomes clear when speaking of a deceased person, as we cannot say that he has eaten.

The present auxiliary (have) implies relevance of having eaten for the present situation, and thus demands that the agent be alive and present.

This dynamic interaction between tense and aspect is especially difficult for young children to grasp, and not only in the tricky case of the present perfect. In fact, some theorists argue that very young children are generally unable to correctly map both forms of grammatical information onto the situations they describe. The *Aspect First Hypothesis* claims that during the early stages of language learning, children first understand whether a situation is completed or not, rather than whether it occurred in the past, present, or future (Wagner 2001). According to this hypothesis, children code for aspect rather than tense in their verbal morphology during this stage. Wagner (2001) provides evidence for this claim in a study in which two and three year old children watched a toy cat perform various actions, such as drawing, jumping, or emptying a container, multiple times along a path. The children were then asked to point where the cat is/was jumping. In the case that actions were completed in the past (a complete face was drawn and a container was emptied entirely) but incomplete in the present (the question was asked mid-action), the aspect and the tense information were complimentary, and children responded correctly to the questions with regard to tense. However, when the children watched the cat perform a sequence of incomplete actions (only a half face was drawn, or some contents of the container remained) then the youngest children had difficulty making decisions on the tense questions. At the very least, this demonstrates that children sometimes use aspectual information about a situation's completion status at the expense of tense information about the temporal ordering of situations. It is argued that this bias for aspectual information arises because the completion status of a given situation is a more basic construct for children to understand than the temporal ordering of several situations.

The current discussion demonstrates how tense and aspect interact to produce dynamic perspectives on the semantic representations of situations. Indeed there are complications that arise during this process, as the two types of grammatical information do not always accommodate each other very well. In these cases, alternative interpretations of situations are coerced so that the temporal structure of the situation can be accommodated within a given tense. Furthermore, we have also seen that in the case of very young children, tense information can even be ignored. Understanding how the temporal structure of situations (verb aspect) interacts with and is coerced by the temporal ordering of situations (tense) provides important insights into mental representations of situations. While most research on verb aspect has been conducted in the past tense, it is important that more research is

conducted in the present and future tenses to better understand the nature of the tense-aspect interaction during language comprehension.

Conclusions

The present chapter presents an overview of how the topic of verb aspect has been addressed in the domain of cognitive psychology. We began by detailing the traditional classification schemes of temporal situation structure, as well as describing how the verbs that describe these situations fall into the separate aspectual classes. In doing so, several shortcomings of the current classification schemes were revealed, and innovations in addressing these shortcomings were cited. A potential solution resides in prototype theories of aspect that emerge from actual experience in the environment and allow degrees of membership within aspectual categories. In addition, recent theories that ground the verb classes in sensory-motor control primitives such as goal, periodicity, iteration, final state, duration, and force offer promising innovations for the system of aspectual classification. These novel classification schemes provide a fruitful area for future research, as it is important for researchers to empirically validate the representational underpinnings of the aspectual classifications.

In subsequent sections, we reviewed empirical research on grammatical and situational verb aspect within the field of cognitive psychology. A discussion of recent studies revealed that verb aspect yields two important sources of information during language comprehension. First, several studies have demonstrated how verb aspect provides information about a situation's completion status, whereby the perfect and perfective aspect yield a representation of a completed situation, and the imperfective aspect yields a representation of the situation as ongoing. Second, verb aspect provides information about the availability of people, entities, and features of the described situation. Several studies show that properties of situations such as agents, instruments, and locations are more available when the situations are described in the imperfective aspect rather than the perfect or perfective aspects. While these studies offer much information about the representation of a situation described in the imperfective, it remains unclear exactly how perfect and perfective situations are represented. It has been shown that the perfect and perfective aspects are represented as completed or complete situations, but this conception requires further clarification in order to better understand the construction of mental models during language comprehension.

Finally, we discussed special issues involving the interaction between verb aspect and various situation types, as well as the interaction between verb aspect and tense. Of special interest in these sections is the process of aspectual coercion, in which an alternative interpretation of a situation is forced under conditions wherein the inherent aspectual characteristics of a verb do not mesh with its tense or grammatical aspect. Although there have been some preliminary investigations of this issue (Piñango et al. 2006; Piñango et al. 1999; Todorova et al. 2000; Wagner 2001), more research is required to understand how inconsistencies in the various sources of temporal information are identified and resolved during language comprehension.

In closing, it should be restated that the aspectual distinctions and characteristics discussed in this chapter are not only relevant for theories of verb classification and the temporal representation of situations. Surely, these grammatical and semantic distinctions also stand to influence the pattern of results obtained in experiments in all areas of language and situation comprehension. Thus, researchers in any domain that employs the presentation of verbs should be aware of the aspectual issues raised in the present chapter.

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