The Lexical Source of Unexpressed Participants and their Role in Sentence and Discourse Understanding*
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Abstract

This chapter presents preliminary evidence that bears on the issue of how unexpressed (agent) participants are represented and when they are included in the representations of agentless passive sentences using two experimental paradigms – self-paced reading and eye-monitoring. The results of our first experiment suggest that the logical necessity of an unexpressed agent in a described event is insufficient for it to be available for interpretation. Instead it must be lexically specified by a verb to be included in the representation of a sentence. The second and third experiments provide evidence that unexpressed agents are encoded when a passive verb is integrated into a sentence’s representation. The latter part of this chapter presents evidence that the representation of event participant information may best be characterized as sets of fine-grained entailments, rather than as categorical primitives and that lexically specified event participants help in establishing local discourse coherence.

One of the most fundamental aspects of understanding a sentence is figuring out the “who did what to whom” component of its meaning. To do this, readers and hearers have to identify not only the events described by a sentence, but who the necessary participants of each event are and the role that each plays. Much of the time, the information needed to identify an

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event’s participants is readily available from the explicit content of a sentence. For example, both of the sentences in example (1) introduce a kissing event with two participants, an agent and a patient. In both sentences, the agent (Wilma) and the patient (Fred) are explicitly mentioned.

(1)  
a. Wilma kissed Fred.
   b. Fred was kissed by Wilma.

(2)  
Fred was kissed.

But, participant information cannot always be derived from the explicit content of a sentence. For example, the short passive sentence in (2) also describes a kissing event in which Fred is the patient. But in this case no agent is explicitly mentioned. Nevertheless, the usual understanding of this sentence is that Fred was kissed by someone. What this example demonstrates is that event participant information which is part of the typical understanding of a sentence cannot always be extracted from a sentence’s explicit content. Clearly, it must be derived from other sources.

In this chapter, we focus on how readers’ sentence representations come to include unexpressed event participant information. We examine the encoding of implicit agents in short passive sentences and two sources from which they could be derived. One source is general conceptual knowledge. Alternatively, implicit agents could be derived from schematic semantic information associated with the lexical representations of verbs (e.g., verb argument structures). The encoding of an implicit participant from either of these sources has associated with it clear processing consequences. Implicit participants are either inferred via general conceptual processing mechanisms or they are encoded when we access a verb’s semantic argument structure. If, as we argue, this second alternative is correct, then a more subtle processing issue is that of when covert semantic argument information is used during comprehension. We provide evidence that implicit agents are derived from lexical sources and that they are accessed and rapidly used in interpreting a sentence. In the last section, we discuss the processing consequences of recent linguistic proposals that suggest that participant information is best characterized by sets of fine-grained entailments rather than categorical primitives such as agent and patient.
1 Conceptual vs. Lexical Encoding of Event Participants

Although there are many proposals for how our understanding of a sentence comes to include unexpressed participant information derived from general conceptual knowledge, we focus on a particularly influential model, proposed by Kintsch and his colleagues (e.g., Graesser, Singer, & Trabasso, 1994; Kintsch, 1988). In this model, forming a representation for a sentence is divided into three stages. Readers first construct a linguistic (i.e., syntactic) surface structure from the verbatim information of a sentence. From this, conceptual representations called propositions are constructed and added to a text-base. Propositions represent the gist of the information encoded in the surface structure. Finally, it is assumed that a reader’s representation of a sentence or text is partly determined by her specific and generic real-world knowledge of the situation(s) evoked by a proposition (e.g., Garnham, 1981). It is at the level of a situation model that abstract conceptual knowledge, stored for instance as schemata (e.g., Rumelhart & Ortony, 1977), is included in a reader’s representation of a sentence. Under this approach, the knowledge that someone kissed Fred in short passive sentences such as (2), comes from our situational knowledge of kissing events.

Linguistic theories suggest an alternative source for the unexpressed agent in our understanding of sentences like (2). It is widely assumed that the lexical representations of verbs include schematic semantic information known as argument structures, thematic roles, or case roles (e.g., Fillmore, 1968; Gruber, 1965; Jackendoff, 1990). While similar to situation models, in that they are abstract representations of event participants, argument structures and situation models differ in two crucial ways. First, while participant information that is derived from conceptual schemata is part of one’s general situational knowledge, participant information encoded in verb argument structures is not directly derived from general knowledge sources but instead, is part of a verb’s lexico-semantic representation. Furthermore, while situation models can include highly specific information about event participants (e.g., that Wilma kissed Fred), the participant information encoded in a verb’s argument structure is less specific and more role-like. Thus, the representation of the passive verb kissed includes an agent or “kisser” but not a listing of individuals, such as Wilma, as potential kissers.

Argument structures have typically been associated with a verb’s explicit syntactic dependents. Consider the full passive in sentence (3a). This sentence has two explicit syntactic dependents, a subject NP, Fred, and a prepositional phrase, by Wilma. These dependents correspond respectively
to the patient and agent arguments in the argument structure of the passive verb *kissed*, in (3b).

(3)  
   a. Fred was kissed by Wilma.
   b. K <X, Y> (where X = PATIENT, Y = AGENT, Fred = x, and Wilma = y)
   c. Fred was kissed.
   d. K <X, Y> (where X = PATIENT, Y = AGENT, Fred = x)

Some linguists have suggested that even when an argument of a verb is not associated with an explicit syntactic dependent, it might still be included in one’s interpretation of a sentence (e.g., Carlson & Tanenhaus, 1988; Roeper, 1987; Williams, 1987). Under these proposals, the argument structure associated with the passive verb in sentence (3c) includes both an agent and a patient argument, even though this sentence has only one syntactic dependent. The argument structure for this sentence, given in (3d), is identical to that of the full passive sentence in (3b). The only salient difference in their semantics is that a referent for the agent argument is specified for the full passive sentence while it remains unspecified for the short passive sentence. Crucially, it is this unspecified agent that corresponds to our intuition that Fred was kissed by some unspecified individual.

Much of the evidence for the encoding of unexpressed participants has come from experiments that interrogate people’s memory for what they have read (c.f., Graesser, et al., 1992 and Keenan, Potts, Golding, & Jennings, 1990 for discussion). Typically, these studies have shown that people’s recollections include information from both text and background knowledge. However, subsequent work has suggested that when readers encode covert participant information, it is often done during the recollection of a text rather than during initial comprehension (c.f., Keenan, et al. for brief review and discussion). Results of studies using more on-line methods that interrogate readers’ immediately-formed sentence representations also suggest that specific participants are rarely encoded (e.g., encoding a hammer after reading *John pounded in the nail*) (Keenan, et al.).

By contrast to earlier studies that examined whether readers encode specific participants from background knowledge, more recent research has examined whether readers encode unexpressed arguments of verbs (e.g., an agent) whose referential values are unspecified (Carlson & Tanenhaus, 1988; Roeper, 1987). Maunier, Tanenhaus, and Carlson (1995) used rationale clauses (e.g., (4d)) to probe readers’ representations of full passive, short
passive, and intransitive sentences such as (4a), (4b), and (4c) respectively. (Rationale clauses are infinitives whose successful interpretation depends on their understood subjects being anaphorically linked with a volitional agent introduced by an adjoining clause.) They found that make-sense judgments and reading times to rationale clauses following short passives whose verbs were hypothesized to include an agent patterned with those of explicit agent control sentences. In contrast, rationale clauses following intransitive sentences elicited anomaly effects in both judgments and reading times.

(4)  
   a. The ship was sunk by its owners  
   b. The ship was sunk  
   c. The ship sank  
   d. . . . to collect a settlement from the insurance company.

(5)  
   a. #The ship was sunk, but it wasn’t sunk by anyone/anything.  
   b. The ship sank but it wasn’t sunk by anyone/anything.

These results demonstrate that readers encode implicit agents in their understanding of short passive sentences. But agents may have been encoded from conceptual knowledge rather than from verb argument structures as Mauner et al. had assumed. Notice that an agent-denying clause results in a contradiction following one of Mauner et al.’s short passive sentences (e.g., 5a) but not following one of their intransitives (e.g., 5b). This indicates that an agent is logically required only in the short passive.

To determine whether implicit agents are derived from linguistic or conceptual sources, we have examined sensicality judgments to rationale clauses following short passive (e.g., (6a)) and intransitive sentences (e.g., (6b)) that both logically require an agent. (The logical necessity of an agent participant was determined in a separate study.) Since most of the agent-entailing intransitive verbs were “middle” verbs, all matrix clauses ended with a manner adverb. If the implicit agents that readers encode in their representations of short passive sentences are derived from verb argument structures, then rationale clauses (e.g., (6c)) should be difficult to process following intransitive sentences that only logically require an agent relative to when they follow short passives that both logically and linguistically require one.

(6)  
   a. The antique vase was sold immediately  
   b. The antique vase had sold immediately  
   c. . . . to raise some money for the charity.
Figure 1 presents the mean cumulative percentages of “No” judgments to the first four word positions of rationale clauses. Readers found rationale clauses equally felicitous following passive and intransitive clauses at the infinitive marker to. Moreover, there were virtually no rejections to subsequent word positions in rationale clauses following passive clauses (2% “No” judgments at the noun word position (e.g., money)). Rationale clauses following intransitive clauses elicited significantly more “No” judgments than short passives at all subsequent word positions.\(^1\) (These differences, and all others reported in this chapter, unless noted otherwise, were significant at conventional levels (i.e., p < .05) in analyses of variance.)

![Graph showing cumulative percentages of "No" judgments to the first four word positions of rationale clauses following agent-entailing short passive and intransitive sentences.]

The results of this study replicate Mauner et al.’s original findings, but

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\(^1\)There were virtually no “No” judgments to short passive main clauses (1.8%). Half of the participants also judged intransitive main clauses sensible. The other half rejected one or more intransitive main clauses (on average, 18.6% were rejected). Most of these rejections were to one item (The new carpet installed rapidly) on one presentation list which, when presented word-by-word, is unacceptable as an intransitive at the main verb, but becomes acceptable as a middle at the adverb. Since including the relatively high rejection rate for intransitive main clauses would have artificially inflated the initial level of “No” judgments to rationale clauses following intransitives, we have excluded main clause rejections from the cumulative percentages in Figure 1. However, these rejections contributed to the adjusted percentages that were submitted to statistical analyses.
with passive and intransitive materials equated for the logical necessity of an agent. It is therefore unlikely that earlier results were due to differences in the logical necessity of an agent. Instead, current and prior results are most plausibly interpreted as demonstrating that the unexpressed agent included in a reader’s understanding of a short passive sentence is derived from the semantic argument structures associated with passive verbs, and not from more general conceptual knowledge.

2 When Is Participant Information Encoded?

While our results suggest that implicit agents, and more generally, the semantic arguments of verbs, are lexically encoded, they do not address when semantic argument information is used. This issue has played an important role in theories of sentence processing which often differ in their predictions of when semantic argument information influences processing. Of most relevance for the current discussion are studies which have provided evidence for the early influence of semantic argument information. In many, the availability of verb argument structures has been correlated with syntactic cues such as subcategory information (e.g., Trueswell, Tanenhaus, & Kello, 1993), or with the preview of an additional syntactic constituent (e.g., Tabossi, Spivey-Knowlton, McRae, & Tanenhaus, 1994). In others, argument information has been correlated with conceptual factors such as the plausibility of an NP as a filler of a given thematic role (e.g., Boland, 1997; Ferreira & Clifton, 1986; Pearlmutter & MacDonald, 1992; Trueswell, Tanenhaus, & Garney, 1994). Examining when implicit agents are encoded in short passive sentences may avoid some of these drawbacks because encoding can be evaluated at the verb and because it is uncorrelated with both pragmatic and syntactic cues in this construction. Although it is typical for semantic argument and subcategory information to be correlated, in most grammatical frameworks, passive verbs do not subcategorize for agent by-phrases (e.g., Bresnan, 1982; Grimshaw, 1990; Van Valin and Lapolla 1997).

We have conducted a series of experiments to examine whether readers encode implicit agents as soon as they encounter a passive verb. The logic underlying these studies is similar to that used in some filler-gap research in which, readers, after encountering a clause-initial WH-filler, expect a gap with an appropriate semantic role that must be satisfied later in the clause (e.g., Boland 1997; Clifton & Frazier, 1986; Crain & Fodor, 1985). Rationale clauses that occur in sentence-initial position are analogous to fronted WH-fillers in that their understood subjects must be associated with a vo-
litional agent in the next clause. We used sentence-initial rationale clauses, such as (7a), to engender an “expectancy” for an agent in the linguistic representation of a subsequent clause. If our assumptions about rationale clauses are correct, comprehenders should have no difficulty processing a short passive clause such as (7b) whose verb introduces an implicit agent for the interpretation of the rationale clause. In contrast, comprehenders should experience difficulty processing an intransitive clause such as (7c), even though it describes an event in which an agent is logically required. This is because its verb does not lexically introduce an agent into the semantic representation of the clause. Crucially, if lexical argument information is used to interpret sentences as soon as a verb is recognized, then difficulty with intransitive sentences should emerge at the main verb.

(7) a. To raise money for the charity,
   b. the antique vase was sold immediately to a collector.
   c. the antique vase had sold immediately to a collector.

![Graph showing cumulative percentages of "No" judgments to agent-entailing short passive and intransitive sentences following rationale clauses.](image)

Figure 2: Cumulative percentages of “No” judgments to agent-entailing short passive and intransitive sentences following rationale clauses

The first study used self-paced reading with a stops-making-sense task. We recorded “No” judgments and also reading times to sentences that were judged felicitous (i.e., responded “Yes” to) for short passive and intransitive clauses at the auxiliary verb (e.g., had or was), the main verb (e.g., sold), adverb (e.g., immediately), and at the three words in the sentence-final
prepositional phrase (e.g., to, a, and collector respectively). Judgments to the critical regions of short passive and intransitive clauses are presented in Figure 2. As one can see, short passive clauses elicited practically no “No” judgments in the critical region. There was also no difference in judgments to auxiliary verbs. But, at the main verb position, intransitive clauses began to elicit significantly more “No” judgments than short passive clauses, and continued to do so through the end of the critical region.

For reading times analyses, only the auxiliary, main verb, and adverb word positions provided enough data for stable cell means. Sentence-final short passive and intransitive clauses did not differ significantly at either the auxiliary had or was (537 ms and 519 ms respectively), or main verb (e.g., sold) word positions (550 ms and 655 ms respectively). But, at the adverb word position (e.g., immediately), intransitive clauses (927 ms) elicited reliably longer reading times than short passive clauses (630 ms).

This pattern of judgments and reading times indicate that readers encode implicit agents as part of their understanding of short passive sentences as soon as they encounter a passive verb. However, the sensicality judgment task may induce readers to engage in early or additional semantic processing. Moreover, since self-paced reading times are longer when a sensicality judgment is imposed, this additional processing time may allow semantic argument information to be accessed at earlier word positions than would be the case had no judgment task been used. To address these concerns, we have examined the time course for encoding implicit agents in two eye-monitoring experiments.

Our first eye-monitoring study replicates the self-paced reading study just described. Because our two-clause sentences were too long to be presented on a single line, participants clicked a mouse button to replace rationale clauses with either a short passive or intransitive continuation. We recorded eye-movements for three regions in twelve short passive and intransitive clauses: a subject NP, a verb phrase (VP) which included an auxiliary was or had and the main verb, and a post-verb region which included adverbs and prepositional phrases. Examples of a rationale clause, and regioned short passive and intransitive continuations are provided in (8a), (8b) and (8c) respectively.

(8)   a. To raise money for the charity,
        b. | the antique vase | was sold | immediately to a collector. |
        c. | the antique vase | had sold | immediately to a collector. |
We analyzed both unadjusted first pass and total reading times and residual first pass and total reading times, as suggested by Ferreira and Clifton (1986) and Trueswell, Tanenhaus, and Garnsey (1994). Because there were no differences in these two sets of analyses, we present only the more intuitive unadjusted reading times.

![Graph](image_url)

**Figure 3:** Mean first pass and total reading times (ms) for NP, VP, and post-VP scoring regions of short passive and intransitive sentences following rationale clauses.

Figure 3 illustrates the mean first pass and total reading times to short passive and intransitive sentences for the three scoring regions. There were no differences in first pass reading times to short passive and intransitive sentences at either the verb or post-verb region. However, total reading times were significantly longer for intransitive than short passive sentences in the verb region and marginally so in the post-verb region. Given this data pattern, it would be reasonable to conclude that readers did not access argument structure information during their first pass through the verb regions. However, we think that this interpretation is incorrect. Readers rarely reread short passive verbs (18.6% of trials) and on average, total reading times were only 57 ms longer than first pass reading times. By contrast, readers reread intransitive verbs on 45% of trials, and total reading times were on average 232 ms longer than first pass reading times. These differences indicate that semantic argument structure information must have been processed on the first pass. Otherwise, equivalent amounts of rereading
for intransitives and short passives would have been expected. One explanation for why there was no difference in first pass reading times in the verb region lies in the fact that the verb region was typically quite short. Readers may have begun programming an eye-movement to exit the verb region almost as soon they entered it. This is plausible, given that a conservative estimate for programming an eye-movement is 150-200 ms (Matin, Shao, & Boff, 1993; Reichle, Pollatsek, Fisher, & Rayner 1998). Thus, readers may have accessed argument structure information on their first pass through a short verb region, or during the saccade exiting the region (Irwin, 1998), but realized too late to derail an eye-movement to the next region that there was no agent for the rationale clause. Support for this interpretation comes from a comparison of first pass reading times at the post-verb region to first pass reading times when first fixation times that terminated in a regression are removed. Reading times that consist only of a single fixation that terminates in a regressive eye-movement can significantly depress first pass reading times when averaged together with trials that include several fixations. This could mask potential processing difficulty or spillover effects from a previous region. This is what seems to have occurred in our data. Five of the twenty first fixations that terminated in a regression occurred in short passive sentences. Removing the 5 of 20 first fixations that terminated in a regression from passive post-verb regions increased First Pass reading times by 52 ms to 768 ms. In contrast, removing the remaining 75% of terminating first fixations from intransitive post-verb regions increased First Pass reading times from 674 ms to 787 ms. This pattern suggests that effects of argument structure information were present in first pass reading times in post-verb regions, but were masked by the high proportion of first and later fixations that terminated in a regression in intransitive sentences.

The results of this study suggest that readers interpret verb argument information at the earliest possible point, that is, while they are processing a verb. Since this study did not require readers to make any kind of judgment, it is unlikely that our earlier findings, obtained with a judgment task, were due to task demands that encouraged early semantic processing or allowed more time to access semantic argument information. Moreover, because this study used short passive and intransitive materials that were equated for the logical possibility of an agent, these results also suggest that readers are unlikely to access agent information that is conceptual rather than lexical in origin during on-line language processing. Finally, to the extent that the lexical representations of passive and intransitive verb
particples do not subcategorize for by-phrases, these results represent evidence of the immediate encoding of semantic argument information that is disentangled from subcategorization information. There is nothing in the syntactic frame of a passive verb that could mediate the encoding of an agent. However, the addition of the auxiliary verb had in intransitive sentences, which was used to equate string length across verb phrase regions, is somewhat awkward in that it requires readers to accommodate a temporal presupposition. This could have led to more anomaly effects in intransitive sentences for reasons unrelated to differences in argument structure. Moreover, longer intransitive reading times could also have been due to difficulty in accessing the argument structures of rarer "middle" verbs relative to less rare passive verbs. We have conducted a control experiment to rule out these possibilities.

In this experiment, we examined twenty passive and intransitive sentence pairs whose intransitive forms did not require a middle interpretation (e.g., did not require a manner adverb for felicity), when preceded by either a rationale clause, as shown in (9a) and (9b), or by a control clause whose interpretation did not require an agent for interpretation, such as those shown in examples (9c) and (9d). We included a sentence-final adverb and prepositional phrase so that readers would not be forced to complete processing at the main verb.

(9)  

a. To raise money for the charity, | the antique vase | was sold | immediately to a collector. |  
b. To raise money for the charity, | the antique vase | had sold | immediately to a collector. |  
c. The detective told the museum director that | the antique vase | was sold | immediately to a collector. |  
d. The detective told the museum director that | the antique vase | had sold | immediately to a collector. |  

First pass and total reading times for short passive and intransitive sentences following rationale clauses are shown in Figure 4 and following control clauses plotted in Figure 5. As Figure 4 shows, there were longer total reading times at both the verb and post verb regions when intransitive rather than short passive clauses followed rationale clauses. Additionally, intransitives elicited longer first pass reading times than short passives at the post-verb region. As Figure 5 shows, there were no differences in either first pass or total reading times to short passive and intransitive sentences fol-
The antique vase was sold immediately to a collector.

To raise money for the charity ...

The detective told the museum director that ...

Figure 4: First pass and total reading times at three scoring regions for short passive and intransitive sentences following rationale clauses.

Figure 5: First pass and total reading times at three scoring regions for short passive and intransitive sentences following control clauses.

lowing clauses that did not require an agent for their interpretation. These null differences make it unlikely that anomaly effects in earlier eye-tracking
or self-paced judgment studies were due to either the markedness of our intransitive verbs, or to an auxiliary verb that requires readers to accommodate a temporal presupposition. Moreover, the fact that longer reading times to intransitive sentences were obtained with non-middle verbs lessens the possibility that longer times to intransitives in the previous study arose because readers required more time to access the argument structures of rare middle verbs as compared to more frequent passive verbs. Taken together, the results of our eye-monitoring studies provide strong evidence for the rapid encoding of verb argument information from the lexical representations of verbs.

3 Entailment-Based Representations, Accessibility, and Discourse Status

Up to this point, we have characterized lexically-encoded participant information in terms of categories such as agent and patient, etc. However, this characterization is an oversimplification that does not fully reflect how participant information is represented. As recent work in linguistics has stressed, more fine-grained distinctions are needed (e.g., Dowty, 1991; Levin, 1993). This recent work has focused on the logical entailments associated with the semantic arguments of verbs and defines thematic roles in terms of sets of entailments associated with classes of verbs. For example, Dowty (1991) has suggested that individual thematic roles (i.e., thematic roles that are specific to an individual verb) are clusters of lexical entailments associated with specific arguments of individual verbs. Dowty reserves the term thematic role types for the more general notion of thematic role that can be associated with many verbs. Thematic role types are prototypes that represent the entailments associated with an argument position across many verbs with similar clusters of entailments. Within such a representational scheme, verbs which involve an agentive participant, for example, might be defined as a subclass of verbs involving a participant that merely initiates an event (an effector in Van Valin and Wilkins’ (1996) terminology). Members of the agentive subclass denote predicates whose participants not only initiate an event, but bear the further entailment that they willfully initiate it. If this approach is on the right track, we should expect the processing of unexpressed arguments to reflect the distinction between willful and involuntary effectors.

An example of this more fine-grained semantic distinction can be found in full passive sentences such as example (10a). Note that this sentence
has an event and a state reading. On the event reading, the young woman is volitionally responsible for tormenting the priest. On the state reading, the priest is in a state of inner turmoil, and even though the young woman is the source of this turmoil, she need not be volitionally responsible for bringing this state about. One of the interesting aspects of this event-state ambiguity is that the interpretation of the “agent” argument in a by-phrase is subtly different depending on whether the interpretation of a full passive sentence is biased toward an event or a state. This intuitive difference can be sharpened by coupling state- and event-biased full passive sentences with a sentence-final intentional adverb (e.g., intentionally), as shown in (10b) and (10c) respectively. While the intentional adverb is perfectly acceptable in the event-biased sentence, it is anomalous in the state-biased sentence.2

(10) a. The rebel priest was tormented by the young woman.
b. #The rebel priest was profoundly tormented by the young woman intentionally.
c. The rebel priest was being tormented by the young woman intentionally.

Mauner (1996) argued that this difference in interpretation can be explained on the assumption that some thematic entailments are specific to particular classes of eventualities. This can be related to Dowty’s (1991) proposals regarding entailments that are typically associated with a Proto-Agent. According to Dowty, the typical properties of agents are that they are sentient, cause events or changes of state, exist independently of the event named by a verb, and that their behavior is typically volitional or intentional. All these properties are entailed of the young woman in the sentences in (10) except intentionality, which only necessarily holds of the event-biased sentence (10c). What this means for the stative sentence in

2Mauner (1996) has demonstrated that aspectual cues are correlated with eventive and stative readings. For example, it is possible to reliably bias the interpretation of an ambiguous short passive towards a stative reading with degree adverbials such as profoundly or towards an eventive interpretation with the addition of progressive morphology (i.e., verb + ing). A rating study confirmed that readers interpret an ambiguous short passive such as (ia) as being more stative when modified with a degree adverbial (e.g., ib) and more eventive when modified with progressive morphology (e.g., ic).

i. a. The rebel priest was tormented.
b. The rebel priest was profoundly tormented.
c. The rebel priest was being tormented.
(10b) is that while the young woman may be interpreted as the cause of the priest’s torment, she cannot be interpreted as having intentionally brought about this state. Consequently, the intentional adverb is anomalous.

If a difference in the aspevtual environment of a passive sentence leads to a difference in the interpretation of an explicit agent, it may also lead to a difference in the interpretation of an implicit agent. Moreover, altering the interpretation of an implicit agent might also play a role in how accessible it is to serve as an antecedent of an implicit anaphor, such as the understood subject of a rationale clause, or an explicit anaphor, such as a pronoun, when the pronoun requires an intentional antecedent. Maunen (1996) compared the processing of rationale clauses such as (11d) following state-biased, event-biased, and unambiguously eventive short passive sentences, such as (11a), (11b), and (11c) respectively, in a self-paced reading, sensicality judgment task. If the type of eventuality introduced by biased sentences is correlated with an entailment of volition, then readers should have difficulty processing a rationale clause following state-biased (11a) but not event-biased (11b) short passive sentences.

(11)    a. The rebel priest was profoundly tormented
b. The rebel priest was being tormented
c. The rebel priest was tortured
d. . . . to gain some information about the insurgent’s hideout.

Figure 6 presents the cumulative percentages of “No” responses to the main verb in the matrix clause and the first four word positions of rationale clauses following event- and state-biased and unambiguously eventive short passive sentences. Note that at the matrix verb and at the to of the rationale clause, there were no differences in judgments across the three sentence types. Although the “No” judgments to unambiguous controls and event-biased short passives continued to rise in the critical region, event-biased short passives did not elicit more “No” judgments than control sentences. In contrast, “No” responses to state-biased short passive sentences began to diverge from event-biased and control sentences at the verb in the rationale clause. By the end of the scoring region, state-biased sentences elicited significantly more “No” judgments than either event-biased or control sentences. Reading times were not analyzed because there were too few data points to form stable means.

These results suggest that simple categories such as agent and patient do not completely capture the subtle semantic participant information that
is computed in understanding a sentence. More fine-grained properties are used in on-line sentence comprehension. Specifically, the felicity of a rationale clause is dependent on whether an implicit agent carries an entailment of volition. When preceded by an eventive short passive that introduces a volitional agent, they are easy to process. In contrast, when preceded by a stative short passive that at most introduces a nonvolitional agent,\(^3\) they are difficult to process. There is a further interesting aspect of these results; namely, they suggest that the availability of an implicit agent to serve as the antecedent for an implicit anaphor, such as the understood subject of a rationale clause, depends in part on the kinds of entailments that can be ascribed to it. As we discuss next, the same holds for explicit anaphors.

Mauner (1996) investigated how well readers process a target sentence containing an unspecific pronominal subject (e.g. they or someone) which was the intentional agent of its own sentence (e.g., 12d), when it follows a short passive context sentence introducing either a volitional or nonvolitional implicit agent as a likely referent for the pronoun. Participants read

\(^3\)State-biased short passives have often been referred to in the literature as adjectival passives. See Mauner (1996) for arguments that the predicator in state-biased passives is a verb and not an adjective.
sentences one sentence at a time, and judged whether each target sentence made sense given its context sentence. Three kinds of context sentences were possible: state-biased short passives that introduced a non-volitional agent (e.g., 12a), event-biased short passives (e.g., 12b), or unambiguously eventive short passives (e.g., 12c).

(12) a. The rebel priest was profoundly tormented for days.
b. The rebel priest was being tormented for days.
c. The rebel priest was tortured for days.
d. They wanted him to reveal where the insurgents were hiding out.
e. Was the rebel priest tortured/tormented by the ones who wanted to find out where the insurgents were hiding?

Mauner predicted that readers would find it easier to process target sentences following context sentences that provided a volitional agent to serve as an antecedent for the pronoun. Table 1 illustrates the percentages of “No” judgments and reading times for target sentences following the three types of context sentences. As one can see, targets following state-biased sentences which did not provide volitional implicit antecedents for unspecific pronouns elicited significantly more “No” judgments and longer “Yes” reading times than either type of eventive context. Targets following eventive sentences did not differ from each other in judgments or reading times.

<table>
<thead>
<tr>
<th>Sentence Type</th>
<th>% “No” judgments</th>
<th>Reading times (ms)</th>
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</thead>
<tbody>
<tr>
<td>Unambiguously eventive</td>
<td>17.9 (2.6)</td>
<td>3180 (183)</td>
</tr>
<tr>
<td>Event-biased</td>
<td>23.6 (3.1)</td>
<td>3300 (203)</td>
</tr>
<tr>
<td>State-biased</td>
<td>32 (3.5)</td>
<td>3484 (248)</td>
</tr>
</tbody>
</table>

Table 1: Mean percentages of “No” judgments, reading times and respective standard errors for target sentences following unambiguously eventive, event-biased, and state-biased short passive context sentences.

To anticipate a potential objection, it is well known that pronouns can refer arbitrarily and are not grammatically constrained to find their antecedents in a linguistic context. For this reason, a different group of participants was asked to rate, on a five-point scale ranging from 1 (“Definitely
Yes”) to 5 (“Definitely No”), how probable it was that the antecedent of the target sentence’s pronominal subject was the unexpressed agent of the context sentence. A sample rating study question is provided in example (12e). Ratings revealed that participants were predisposed to find the referent of the indefinite pronominal subjects of target sentences to be the implicit agents of context sentences, even when these agents were involuntary. Studies are currently under way to test a further prediction that readers will not accommodate definite pronominal subjects in the same way.

The results of these studies with ambiguous short passives show that implicit agents can serve as the antecedents to both implicit and explicit anaphoric expressions. Moreover, the anaphoric accessibility of implicit agents is affected by the kinds of entailments that are associated with them. Finally, these results demonstrate, as Carlson and Tanenhaus (1988) have argued, that implicit arguments are represented as unspecified entities in a discourse model. As such, like explicit NPs, they play a role in establishing local discourse coherence. Whether the discourse status of implicit arguments is established via the same processes that establish links between anaphors and antecedents, or instead, a link between linguistically introduced covert participants and explicitly expressed entities in a discourse model is established through coercive or accommodative processes, is part of ongoing research in our laboratory.

4 Summary and Conclusions

This chapter extends the basic finding, established by Mauner et al. (1995), that readers encode implicit agents as part of their understanding of short passive sentences, in a number of directions. First, we have provided evidence that implicit agents are derived from linguistic rather than conceptual sources. This evidence suggests that theories of language comprehension and lexical representation that do not distinguish between conceptual and lexical semantic levels of representation (e.g., Graesser, Singer, & Trabasso, 1994; Kintsch, 1988) are not rich enough to capture differences in the encoding of covert participant information in people’s understanding of agent-entailing short passive and intransitive sentences. We have also provided convergent evidence from self-paced reading and eye-monitoring experiments that implicit agents are encoded as soon as a passive verb is recognized. The results from eye-monitoring studies lessen the likelihood that early encoding is due to task or materials factors. Our results also provide support for the claim that implicit arguments aid in establishing local
discourse coherence by introducing discourse entities that ease the integration of subsequent sentences into a discourse model. We have shown that readers more easily integrate sentences with unspecified pronominal subjects that are volitional agents of their own sentences when they are preceded by a short passive sentence that introduces a volitional implicit agent rather than an implicit effector. This is so even when readers judge implicit agents and implicit effectors to be equally probable referential candidates for the interpretation of the pronoun.

We end with some speculations regarding the potential range of lexically encoded implicit participant information. Thus far, we have focused on the syntactically most active kinds of participants: effectors and agents. One natural question that arises out of this research is: What are the boundaries of argument information within the representation of verbs? This question is particularly interesting in cases in which the linguistic and psychological evidence is mixed. Consider, for example, the instrument phrase in (13a).

(13) a. The burglar pried open the door with a piece of wood.
b. The burglar pried open the door.
c. #The burglar pried open the door, but he didn’t use anything to pry it open.

It is often assumed that phrases such as with a piece of wood are not arguments of verbs like pry, but rather are adjuncts (c.f., Carlson & Tanenhaus, 1988; Speer & Clifton, 1998), as suggested in part by their omissibility. But, as we have seen with short passives, the fact that an argument does not receive overt syntactic expression is no guarantee of its absence from a verb’s representation. Intuitively, even in sentences like (13b) an unexpressed instrument seems to be required in the described prying event. This intuition is confirmed by the anomaly of an instrument-denying clause in example (13c). Thus, “implicit instruments” in sentences like (13b) seem to pass a requirement on the inclusion of participant information in a verb’s representation; namely, that any situation of which the verb can be predicated entails the presence of that participant.

Preliminary evidence suggests that the argument structures of verbs like pry may include implicit instruments. Bienvenue, Mauner, and Roehrig (1998) examined continuations for sentences like (13b), and sentences whose verb argument structures were not hypothesized to include instruments, but which could be completed with an instrument phrase (e.g., Jordan drank a soda). Pilot testing with similar materials regularly elicited seven seman-
tically different continuations. We used those seven categories augmented with an “other” and an ungrammatical category to determine a chance level of responding. Sentences with verbs like *pry* elicited more instrument continuations than expected by chance as well as significantly more instrument continuations than control sentences. Similar results were obtained for sentences with hypothesized implicit goals such as *Marc drove*. A plausible explanation for these results is that verbs like *pry* and *drive* include instrument and goal participants in their respective argument structures. While these results by no means unequivocally show that instrument and goal participant information is lexically encoded in a verb’s argument structure, we can rule out at least one type of conceptual information as a possible source for these continuations. With the exception of one or two items, the content of the instrument and goal phrases differed across participants. This suggests that participants were not accessing default schematic conceptual knowledge (e.g., a crowbar for sentence (13b)).

Our aim in this chapter has been to present evidence that at least some types of participant information are encoded as part of the lexical representations of verbs and are distinct from conceptually-encoded schematic knowledge of events. The work we have presented demonstrates both the need to distinguish between these sources as well as to establish how they articulate with each other in language understanding. Whether other types of unexpressed participants have similar representational sources and functions remains a challenge for future research.

References


Carlson, G., & Tanenhaus, M. (1988). Thematic roles and language com-


