

COMMENTS

Meaning Through Syntax Is Insufficient to Explain Comprehension of Sentences With Reduced Relative Clauses: Comment on McKoon and Ratcliff (2003)

Ken McRae
University of Western Ontario

Mary Hare
Bowling Green State University

Michael K. Tanenhaus
University of Rochester

The authors argue that the meaning through syntax (MTS) model proposed by G. McKoon and R. Ratcliff (2003) fails to account for the comprehension of sentences with reduced relative clauses. First, the theory's core assumptions regarding verb-based event representations and how they link to constructions are incompatible with well-established analyses from the lexical semantics literature. Second, the MTS theory provides neither a principled nor a consistent account for why some reduced relatives are hard whereas others are easy. Finally, McKoon and Ratcliff's critique of constraint-based models is flawed in that sometimes they tested a nonexistent theory and sometimes they provided evidence for the constraint-based models against which they were arguing.

Keywords: lexical semantics, sentence processing, meaning through syntax

In a chapter that helped shape the course of modern psycholinguistics, Bever (1970) observed that most people, including linguists, judged the sentence *The horse raced past the barn fell* to be unacceptable even though it was grammatical according to the dominant linguistic theory of the time. Bever proposed that reduced relative clauses such as this are perceptually difficult because people follow a noun–verb–noun (NVN) strategy, misanalyzing the first noun phrase (NP), *the horse*, as the agent in a main clause and *raced* as the past tense main verb. In contrast, the reduced relative clause requires the first noun to be understood as the patient and the verb as a passive participle. Bever further noted that multiple factors influence the likelihood that people will follow the NVN strategy. For example, *The book read on the park bench was boring* is easier to understand than *The author read on the park bench was boring* because a book is both a less typical

agent and a more typical patient of a reading event than is an author. More generally, Bever used observations about reduced relatives to argue that psycholinguists would not be able to understand sentence comprehension by assuming a simple mapping between the linguistic analysis of a sentence and how it is processed. Rather, psycholinguists would have to develop models of the perceptual processes that readers and listeners use to analyze the linguistic input.

McKoon and Ratcliff (2003) imply that psycholinguists were led down a theoretical garden path when they followed Bever's (1970) lead in assuming that the difficulty of reduced relative clauses such as *The horse raced past the barn fell* is related to temporary ambiguity. According to their meaning through syntax (MTS) approach, each verb has a single event template, and each grammatical construction has a different meaning. For a verb to be used in a specific construction, its event template must fit the requirements of that construction. The reduced relative construction requires verbs that have an external cause in their event template. McKoon and Ratcliff argue that manner-of-motion verbs such as *raced*, *walked*, *rushed*, and *paraded* and simple change-of-state verbs such as *eroded*, *rusted*, *bloomed*, and *deteriorated* do not contain an external cause and therefore cannot be used with the reduced relative construction (p. 497). Thus, *The horse raced past the barn fell* is unacceptable because it requires an ungrammatical linking between a construction, the reduced relative construction, and a verb, *raced*.

McKoon and Ratcliff further argue that the MTS approach offers a more satisfactory account of the existing experimental data on the comprehension of reduced relative clauses than the

Ken McRae, Department of Psychology, University of Western Ontario, London, Ontario, Canada; Mary Hare, Department of Psychology, Bowling Green State University; Michael K. Tanenhaus, Department of Brain and Cognitive Sciences, University of Rochester.

This work was supported by National Institutes of Health Grant MH-6051701 to Ken McRae and Mary Hare, Natural Sciences and Engineering Research Council of Canada Grant OGP0155704 to Ken McRae, and National Institutes of Health Grant HD-27206 to Michael K. Tanenhaus. We thank Gerry Altmann and N. W. C. Copeland for helpful advice. We also thank Gail McKoon for providing us with the sentences from McKoon and Ratcliff's (2003) Experiments 8 and 9.

Correspondence concerning this article should be addressed to Ken McRae, Department of Psychology, University of Western Ontario, London, Ontario, Canada N6A 5C2. E-mail: mcrae@uwo.ca

constraint-based approaches that we and our colleagues have proposed (Altmann, 2002; Hare, McRae, & Elman, 2003; Jurafsky, 1996; MacDonald, 1993; MacDonald, Pearlmutter, & Seidenberg, 1994; McRae, Spivey-Knowlton, & Tanenhaus, 1998; Trueswell & Tanenhaus, 1994; Trueswell, Tanenhaus, & Garnsey, 1994; among others). Constraint-based approaches emphasize that temporarily ambiguous sentences, including reduced relative clauses, systematically and predictably differ in difficulty according to multiple constraints that combine to provide probabilistic evidence for alternative interpretations as the sentence is processed. Thus, *The horse raced past the barn fell* is difficult to understand, but other reduced relatives with the same sequence of grammatical categories are easy (e.g., *The landmine buried in the sand exploded* or *Whiskey fermented in oak barrels can have a woody taste*).

We argue that the MTS approach to comprehension of reduced relative clauses is fundamentally flawed. We make three points, supplementing examples and results from the literature with data from two rating studies. First, the core assumptions that McKoon and Ratcliff make about verb-based event representations and how they link to constructions are incompatible with well-established results in the lexical semantics literature. Specifically, many, if not most, verbs have multiple event templates. Moreover, the most compelling evidence that constructions contribute meaning comes from evidence that they can override specifications of the verb, even for those verbs that appear to have only a single template. This is a central aspect of Construction Grammar.

Second, contrary to what McKoon and Ratcliff imply, comprehension of the reduced relative construction cannot be explained without addressing ambiguity resolution. McKoon and Ratcliff are correct to observe that there is a relationship between verb type and the probability of a verb occurring as a passive participle in a reduced relative clause. However, they repeatedly make the stronger claim that internal manner-of-motion and entity-specific change-of-state verbs are “prohibited” as a class from occurring in reduced relative constructions (e.g., 2003, pp. 497, 501, and 502). Contrary to this central claim, reduced relative clauses do not divide into the two dichotomous categories predicted by the MTS model. Reduced relative clauses with internal cause (IC) verbs can be easy to understand, and those with external cause (EC) verbs can be difficult to understand, more difficult in fact than some with IC verbs. Most crucially, the difficulty of a reduced relative is related systematically to ambiguity resolution. Difficult reduced relatives, regardless of verb class, show a larger ambiguity penalty relative to an unambiguous baseline sentence than do easy reduced relatives. The third point is that McKoon and Ratcliff’s claim that constraint-based models fail to account for the data from studies by MacDonald (1994), McRae et al. (1998), Trueswell (1996), and Trueswell et al. (1994) is empirically false. McKoon and Ratcliff mischaracterized these researchers’ claims about thematic fit (though they replicated their results), offered no account of the data from Trueswell (1996), and obtained null results when using their new item sets because they only weakly manipulated thematic fit and included sentences that were not temporarily ambiguous.

The MTS Account

The MTS account consists of two parts: lexical verb representations and constructions. As a theory of verb representation, MTS

follows work in lexical semantics, particularly that of Levin and Rappaport Hovav (1995), from whom it adopts the notions of event template and causality. An event template, on the Levin and Rappaport Hovav account, represents the parts of the verb’s meaning that determine the syntactic structure in which that verb occurs, although MTS differs from the Levin and Rappaport Hovav account in assuming that multiple syntactic structures may be determined by the same event template. The template includes information about causality: IC verbs are intransitives whose single argument has some property that is responsible for bringing about the event that the verb describes. EC verbs such as *break* are those for which the immediate cause of the event is not the entity that becomes broken but instead is some agent, instrument, or natural force (Levin & Rappaport Hovav, 1995).

The template’s relationship with the syntax is established through linking rules (also taken from Levin & Rappaport Hovav, 1995) that relate arguments in the event template to positions in the sentence structure. Two example rules are given in the text: By the *immediate cause rule*, the entity denoting the immediate cause of an event appears in subject position, whereas the *directed change rule* links the entity undergoing a directed change to direct object (DO) position. Thus, as McKoon and Ratcliff (2003) point out, in the sentence *John broke the window*, “the fact that *John* is subject conveys that something John did is the immediate cause of the breaking event, and the fact that *the window* is direct object conveys that the window changes state as a result of the event” (p. 495).

To this point, MTS is identical to the account in Levin and Rappaport Hovav (1995). However, Levin and Rappaport Hovav also note that some events may be construed as either internal or external cause, so that a single verb may have more than one event template. MTS makes the sharply contrasting claim that a verb has only one template unless it is truly ambiguous (McKoon & Ratcliff, 2003, pp. 495, 510, and 511), that is, unless it has unrelated meanings, like *ring* does in *The bell rang loudly* and *The Australian capital was ringed by fire*. Note that this excludes polysemous verbs, which exhibit highly related senses, as *ring* also does in *The doorbell rang* and its causative form *I rang the doorbell* (Klein & Murphy, 2001; Rodd, Gaskell, & Marslen-Wilson, 2002). These, according to MTS, are limited to a single template.

The second part of the MTS account draws on work in Construction Grammar (Fillmore, Kay, & O’Connor, 1988; Goldberg, 1995, 2003), showing that constructions—form–meaning pairings above the level of the individual word—have meaning independent of that contributed by the verb. On the MTS account, the reduced relative construction is used to denote a discourse entity that is characterized by participation in an event caused by some force or entity external to itself (McKoon & Ratcliff, 2003, p. 492). The template of an IC verb is incompatible with this restriction.

If the conclusions drawn from the two elements of MTS are correct, the account predicts that reduced relatives with IC verbs, such as *the river swollen by torrential rains* or *the horse raced past the barn*, are ungrammatical. In what follows, however, we argue that certain assumptions of MTS are not entirely valid, given the theories they are based on. We begin by showing that the MTS version of the constructional account is overly simplistic. We then look at the assertion that each verb has only a single event template and demonstrate not only that it is at odds with the linguistic data,

as McKoon and Ratcliff themselves show, but also that it leads to damaging inconsistencies in the MTS account.

Constructions

McKoon and Ratcliff's (2003) interpretation of constructional meaning does not follow from the usual treatment of constructions. The strongest evidence for the claim that the construction carries meaning independent of that of the verb comes from examples such as *Frank sneezed the tissue off the table* (Goldberg, 1995, cited in McKoon and Ratcliff, 2003). *Sneeze*, an intransitive verb, does not code for caused motion, yet the entire transitive expression has that interpretation and is grammatical and easily interpretable. This illustrates the process of *coercion*, which applies when the interpretation coded by a particular verb does not meet the requirements of the construction. In this case, "to the extent that the occurring lexical items can be coerced by a construction into having a different but related interpretation, the entire expression will be judged grammatical" (Goldberg, 1995, p. 159). In their basic sense, IC verbs are indeed intransitive and so do not passivize. The verb in this type of reduced relative is a passive participle, and McKoon and Ratcliff are correct to assume that intransitives will not occur in the passive. But many IC verbs also have related transitive senses that are compatible with the reduced relative construction. For such verbs, nothing in Construction Grammar necessarily blocks the coercion process, and speakers should find them acceptable in reduced relatives. Rating Study 2, described below, shows that this is the case.

Single Verb Template

According to MTS, as we have shown above, the lexical template determines the syntax. It follows that syntactic variability requires differences in the template, and for this reason previous accounts have used syntactic as well as semantic criteria to determine the causality of a verb in a given structure. One such criterion is transitivity: IC verbs must be intransitive because there is only one argument in their lexical template, and that argument must be the subject because it is the immediate cause of the event. Therefore, if a verb that is IC in its basic sense occurs in a transitive frame with its original argument as DO (as many IC verbs do), it follows from the theory that the verb must be EC in that frame (Levin & Rappaport Hovav, 1995, pp. 97 and 145). As one example, Levin and Rappaport Hovav note that in the presence of a directional phrase (e.g., *past the barn*), otherwise IC manner-of-motion verbs are acceptable in the transitive: *John raced his horse past the barn*. Because transitivity is diagnostic of external cause, they propose that under these circumstances the verbs change to unaccusatives (and so to EC). *His horse*, as the entity undergoing a directed change, links to DO. Subject position is left available and is filled by an external cause (Levin & Rappaport Hovav, p. 188; see also Perlmutter, 1978; Burzio, 1986).

McKoon and Ratcliff (2003) disagree. The MTS account of reduced relatives requires that the IC–EC distinction be categorical, so that all IC verbs are excluded from the reduced relative, and that it hold for all uses of the verb. Thus when IC verbs occur in the transitive (*The waves eroded the beach*), the single-template restriction requires that the verb still be IC. McKoon and Ratcliff point out semantic restrictions on the subject but offer no explanation for the syntax. In other work, however (McKoon & Mac-

Farland, 2002), MTS adopts the Levin and Rappaport Hovav (1995) analysis outlined above. But on that account, *the waves*, by virtue of appearing in subject position, must be the external cause. As a result, this analysis will not apply if the verb has only an IC template.¹ Thus if MTS maintains the single-template restriction, it cannot account for these common transitivity alternations. This undermines the theoretical claim developed on pages 493–495 that the template determines the syntax—and without this claim, MTS cannot explain the difficulty with certain reduced relatives.

McKoon and Ratcliff (2003) agree that manner-of-motion verbs are often used in the transitive (Corpus Study 1) and argue that these are "extensions from the basic activity template" (p. 498), citing the Levin and Rappaport Hovav (1995) analysis. Although they are not clear on this point, the implication is that these extensions are also IC, and semantic constraints on the subject are offered in support. But these constraints are also noted by Levin and Rappaport Hovav, who nonetheless analyze this construction as EC. In fact, one interesting finding of McKoon and Ratcliff's corpus analyses is that many manner-of-motion verbs that had not previously been analyzed as undergoing the causative alternation (Levin, 1993) were found to allow it (see McKoon & Ratcliff, 2003, p. 498).

If comprehenders reject the reduced relative on the basis of the causality of the verb, then they must be sensitive to the IC–EC distinction. To test whether comprehenders' construal of the events described by these verbs matches the MTS claims, we ran a rating study on a set of verbs that allow transitivity alternations. Rating Study 1 included 60 verbs, 30 EC and 30 IC, taken from McKoon and Ratcliff (2003) and Levin (1993). Separate groups of 20 participants from Bowling Green State University saw the verbs in transitive and intransitive frames (see Table 1 for sample items). Each participant rated the likelihood that the event involved an external cause on a 5-point scale in which 1 corresponded to *definitely does not have an external cause*, 3 to *equally likely to have or not have an external cause*, and 5 to *definitely has an external cause*. What it means for an event to have an external cause was described in the instructions. If the IC verbs are interpreted consistently as internal cause regardless of structural frame (as required by MTS), then their distribution in the participants' ratings should be distinct from that of the EC verbs in their transitive as well as in their intransitive use. Importantly, the ratings also should not change when the verb is placed in a transitive frame. However, if some verbs may be construed as either IC or EC (as predicted by Levin & Rappaport Hovav, 1995), there will be more variability in the ratings, reflecting the different interpretations, so that the IC and EC verbs will not fall into dichotomous classes. Verbs should also be rated as more strongly EC in the transitive frame. That is what we found. There was a small overall difference between IC and EC verbs (IC: $M = 3.82$, $SE = 0.12$; EC: $M = 3.92$, $SE = 0.11$) that was significant by

¹ Levin and Rappaport Hovav (1995) have four linking rules, only two of which are given as examples by McKoon and Ratcliff. Of the four, only the immediate cause rule links an argument to subject position; the other three link arguments to DO. There are other approaches to linking rules (e.g., Gropen, Pinker, Hollander, Goldberg, & Wilson, 1989; Jackendoff, 1990; Pinker, 1989) but *none* that would license a link between subject position and an adjunct, as *the waves* must be if it is truly optional and not syntactically required, as claimed on page 495.

Table 1
Sample Items for Rating Studies 1 and 2

Condition	Sentence
Rating Study 1	
IC, intransitive	<i>The horse galloped across the prairie.</i>
IC, transitive	<i>The rider galloped the horse across the prairie.</i>
EC, intransitive	<i>The snow steadily melted.</i>
EC, transitive	<i>The warm sun steadily melted the snow.</i>
Rating Study 2	
IC, RR, easy	<i>The path traveled by many settlers extended far to the west.</i>
IC, RR, hard	<i>The soldiers marched for five hours straight were exhausted.</i>
IC, FR, easy	<i>The path that was traveled by many settlers extended far to the west.</i>
IC, FR, hard	<i>The soldiers that were marched for five hours straight were exhausted.</i>
IC, pass, easy	<i>The path was traveled by many settlers.</i>
IC, pass, hard	<i>The soldiers were marched for five hours straight.</i>
EC, RR, easy	<i>The movie directed by Robert Redford won three Academy awards.</i>
EC, RR, hard	<i>The waiter served a steak enjoyed it immensely.</i>
EC, FR, easy	<i>The movie that was directed by Robert Redford won three Academy awards.</i>
EC, FR, hard	<i>The waiter who was served a steak enjoyed it immensely.</i>
EC, pass, easy	<i>The movie was directed by Robert Redford.</i>
EC, pass, hard	<i>The waiter was served a steak.</i>

Note. IC = internal cause verb; EC = external cause verb; RR = reduced relative; FR = full relative; pass = passive.

participants, $F_1(1, 38) = 4.86$, but not by items, $F_2 < 1$ (for all inferential statistics reported herein, $p < .05$ unless otherwise noted). This difference was due to a small effect of verb type (IC: $M = 3.37$, $SE = 0.14$; EC: $M = 3.54$, $SE = 0.13$) in the intransitive frame, which again was significant by participants, $F_1(1, 38) = 7.33$, but not by items, $F_2(1, 104) = 1.55$, *ns*. Most important, there was no effect of verb type in the transitive frame (IC: $M = 4.27$, $SE = 0.12$; EC: $M = 4.30$, $SE = 0.12$), $F_1 < 1$, $F_2 < 1$, illustrating that when IC verbs occurred in the transitive, participants did not rate them as less external than the EC verbs. This comparison is crucial because the reduced relative is based on the transitive construction.

Furthermore, the verbs were rated as more external in the transitive than in the intransitive frame (intransitive: $M = 3.45$, $SE = 0.08$; transitive: $M = 4.28$, $SE = 0.04$), $F_1(1, 38) = 22.49$; $F_2(1, 58) = 117.05$. The effect of sentence frame was significant for both the IC ($M = 3.37$ vs. 4.27), $F_1(1, 42) = 24.94$; $F_2(1, 58) = 68.64$, and the EC verbs ($M = 3.54$ vs. 4.30), $F_1(1, 42) = 17.78$; $F_2(1, 58) = 48.95$.²

In summary, it is crucial to the MTS account of reduced relative clauses that IC verbs remain IC in all uses, but it is clear that they do not. McKoon and Ratcliff's criteria for the internal-external distinction in different frames are never made clear, especially because they eschew the use of aspectual criteria and of Levin and Rappaport Hovav's syntactic criterion that IC verbs must be intransitive (e.g., McKoon & Ratcliff, 2003, p. 497; also McKoon & MacFarland, 2002, p. 13; see Filip, Tanenhaus, Carlson, Allopenna, & Blatt, 2002, for further discussion of this point).

Although there is evidence for the IC use of many verbs in the intransitive frame, no compelling argument is offered to support the assumption of one template per verb, which seems highly implausible and to the best of our knowledge is inconsistent with the assumptions of any existing linguistic framework. Furthermore, by insisting on the one-template-per-verb restriction, McKoon and Ratcliff leave MTS unable to account for syntactic structures that do commonly occur. They themselves eventually acknowledge that at least for manner-of-motion verbs, "internal causality can be overridden" in the transitive (McKoon & Ratcliff, 2003, p. 498). This is interesting because the verb in the reduced relative clause is a passive participle, and so it encodes the transitive sense. Hence, if internal causality can be overridden in the transitive, the verb as it occurs in the reduced relative is perfectly compatible with the meaning constraints of that construction, and there is nothing in the MTS account to explain why it is sometimes difficult to comprehend.

Ambiguity Resolution

Standard approaches to explaining the difficulty of sentences with reduced relative clauses focus on the temporary ambiguity between the preferred main clause continuation and the less preferred reduced relative continuation. For example, in serial two-stage models, the preferred main clause interpretation is selected initially and then revised on the basis of multiple sources of information that are not used during initial structure building (Clifton, 1993; Ferreira & Clifton, 1986; Frazier, 1987; Pickering & Traxler, 1998; Rayner, Carlson, & Frazier, 1983; Sturt, Scheepers, & Pickering, 2002). In the constraint-based models that we prefer, alternatives are weighted and evaluated using multiple constraints. In both classes of models, gradient difficulty for reduced relatives arises as a function of the difficulty of ambiguity resolution. In contrast, MTS predicts that the difficulty of a reduced relative should be primarily a function of whether it uses an IC or EC verb.

We evaluated these competing alternatives in Rating Study 2. There were 32 participants from Bowling Green State University and the University of Western Ontario. We constructed 24 sentences using EC verbs and 24 using IC verbs (see Table 1 for sample items). All verbs were identical in their past tense and past participle form. For each verb, reduced relative, full relative, and passive sentences were constructed. In addition to manipulating the verb, we created easy and hard sentences. Twelve internal and 12 external verbs were used in sentences that we predicted would be "easy," and 12 internal and 12 external verbs were used in sentences that we predicted would be "hard." To create the easy and hard sentences, we manipulated thematic fit of the initial NP and the presence and type of postverbal prepositional phrase, factors that have been examined in the ambiguity resolution literature. Participants rated how easy each sentence was to understand on a 7-point scale, where 1 = *extremely easy to understand*, 4 = *moderately easy to understand*, and 7 = *makes no sense*.

The data are presented in Table 2. The ratings highlight two points that are consistent with ambiguity-based approaches (both two-stage and constraint-based models) but problematic for MTS.

² The full details regarding Rating Studies 1 and 2 can be found at <http://rowan.bgsu.edu/corpora.html>.

Table 2
Mean Sentence Acceptability Ratings by Condition for Rating Study 2

Construction	External				Internal			
	Easy		Hard		Easy		Hard	
	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>
Reduced relative	1.96	.14	5.15	.16	2.44	.20	4.73	.21
Full relative	1.91	.16	2.44	.17	1.93	.13	3.16	.19
Passive	1.48	.09	1.90	.14	1.55	.11	2.95	.22

First, reduced relatives with EC or IC verbs can be rated as relatively easy or relatively difficult to understand. Planned comparisons showed that the reduced relatives with IC verbs that were predicted to be easy were rated as easier to understand than those with EC verbs that were predicted to be hard (mean rating difference = 2.71), $F_1(1, 60) = 312.31$; $F_2(1, 72) = 187.51$. Reduced relatives with IC verbs may be relatively rare, but they clearly are not prohibited as claimed by MTS and can, in fact, be easier to understand than those with EC verbs.

Second, most of the variance in the difficulty of the reduced relatives in each verb class was due to variables identified by two-stage and constraint-based theorists as central to ambiguity resolution. Reduced relatives predicted to be hard showed a larger ambiguity effect, as compared with related unambiguous constructions, than did easy reduced relatives. The relative clause type (full vs. reduced) by difficulty (easy vs. hard) interaction was reliable for both the EC, $F_1(1, 30) = 118.24$, $F_2(1, 18) = 120.38$, and IC verbs, $F_1(1, 30) = 16.24$, $F_2(1, 18) = 17.11$.

In addition, verb class, including event structure, can influence the difficulty of a reduced relative. Note, for example, that there was no reliable ambiguity effect for the easy sentences with EC verbs (mean rating difference = 0.05; $F_1 < 1$, $F_2 < 1$), whereas there was a reliable ambiguity effect for the sentences with easy IC verbs (mean rating difference = 0.51), $F_1(1, 60) = 11.06$; $F_2(1, 72) = 6.64$. Also, the easy reduced relatives with EC verbs were rated as more comprehensible than the easy reduced relatives with IC verbs (mean difference = 0.48), $F_1(1, 60) = 9.80$; $F_2(1, 72) = 5.88$.

Finally, although the hard reduced relatives with IC verbs show a larger ambiguity effect than the easy reduced relatives, there is also a large increase in the rated difficulty of the corresponding passive and full relative sentences. For the hard reduced relatives with IC verbs, the passive form is rated more difficult than the passive form for the IC verb reduced relatives predicted to be easy (mean difference = 1.40), $F_1(1, 60) = 83.35$; $F_2(1, 72) = 50.04$. The same holds for the corresponding IC full relatives (mean difference = 1.23), $F_1(1, 60) = 64.34$; $F_2(1, 72) = 38.63$. Thus the corresponding reduced relatives are hard for two reasons. The first is difficulty in resolving the temporary ambiguity. The second is that they are difficult to understand when used in passive constructions. This undermines two central claims made by McKoon and Ratcliff (2003). The first is their claim that the difficulty of internal verbs is specific to the reduced relative construction (e.g., p. 507). The second is their claim that full relatives are an inappropriate control condition for examining ambiguity effects with reduced relatives (p. 515).

McKoon and Ratcliff imply that ambiguity is not relevant to reduced relative clauses by arguing that reduced relative and full relative clauses are constructions with different meanings and that therefore it is inappropriate to compare them. Thus, they argue, claims about processing difficulty that are tied to these comparisons are suspect. If we accept this argument, then temporarily ambiguous reduced relative clauses need to be compared with unambiguous reduced relative clauses before we can conclude that ambiguity is responsible for any of the processing difficulty associated with temporarily ambiguous reduced relative clauses. What McKoon and Ratcliff overlook, however, is that many of the major empirical results with reduced relative clauses have been replicated using just this comparison, which is possible because some English verbs have different past tense and passive participle forms (e.g., *took, taken; saw, seen; stole, stolen, showed, shown*). MacDonald (1993), Spivey and Tanenhaus (1998), Trueswell et al. (1994), Trueswell and Tanenhaus (1991), and Spivey-Knowlton, Trueswell, and Tanenhaus (1993) all report studies that compared ambiguous reduced relatives to unambiguous reduced and full relatives. In all of these studies, when readers encountered the disambiguating region of a reduced relative in which the constraints were biased initially toward a main clause, they slowed down and/or made more regressive eye movements as compared with unambiguous controls. Moreover, the pattern of results is remarkably similar with both reduced relative and full relative controls.

The failure to consider the ambiguity that results from real-time processing makes the assumptions of MTS problematic. Take, for example, *The horse raced past the barn fell*. The first three words, *the horse raced*, are consistent with several constructions—an intransitive main clause with the horse as the agent, a transitive main clause with the horse as the agent, and a reduced relative clause with the horse as the patient—each of which would presumably have a different meaning according to MTS. How does the reader or listener know which of these constructions to link the verb's event template to? This problem cannot be finessed, because temporary ambiguity is ubiquitous; most sentences will be temporarily ambiguous between two or more constructions. McKoon and Ratcliff could claim that commitments are delayed until a single construction is identified. However, that claim would be inconsistent with the large body of results in the literature showing rapid integration of syntactic, semantic, and pragmatic information (Marslen-Wilson, 1975; Tanenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1995). Alternatively, McKoon and Ratcliff could weight the probability of alternative constructions, perhaps evaluating the degree to which each was consistent with the event template of the

verb. However, this would turn MTS into a type of constraint-based model. A third possibility is to claim that construction ambiguity is resolved prior to interpretation, with ambiguity resolution accounting for little of the variance in difficulty among reduced relatives. The difficulty of reduced relatives with IC verbs could then be attributed to the event-template/construction mismatch. However, as we have seen, the variable of predicted difficulty, which reflects factors that independently are known to affect ambiguity resolution, clearly accounts for more of the variance than verb class, which is predicted to be the single most important variable by the MTS approach.

Flawed Analyses of Constraint-Based Models

McKoon and Ratcliff (2003) contrast MTS with constraint-based models. In this section, we argue that first, their characterization of constraint-based models, and particularly of those models' treatment of semantics and syntax–semantics interactions, fails to reflect the current literature. Second, McKoon and Ratcliff experimentally tested constraint-based models by examining the influence of thematic fit, but they failed to test the correct theory in the majority of their analyses. In the cases in which they tested the correct theory, they found evidence supporting the influence of thematic fit on sentence comprehension. Finally, consistent with constraint-based theories, McKoon and Ratcliff provided further evidence that comprehenders possess and use knowledge of statistical tendencies for specific verbs to be used in the active or passive voice when interpreting reduced relative clauses.

McKoon and Ratcliff state that constraint-based theorists, and psycholinguists in general, rarely are interested in meaning or in the interaction between meaning and syntax. "The two domains of interest rarely interact with each other, with the consequence that questions about how syntax and semantics interact are rarely addressed. The research described in this article is an initial attempt to begin to fill this gap" (McKoon & Ratcliff, 2003, p. 523). This characterization of the literature is incorrect. Psycholinguistic research has focused increasingly on issues of meaning and interpretation, including interactions among syntax, semantics, and pragmatics in sentence comprehension. For example, there exists an extensive body of research concerning semantic bootstrapping that focuses on semantics–syntax interactions in the acquisition of verb usage (Fisher, Gleitman, & Gleitman, 1991; Gropen, Pinker, Hollander, & Goldberg, 1991; Pinker, 1989). Furthermore, a number of recent articles investigate how verb sense correlates with subcategorization preferences and how this interaction influences resolution of the DO–sentential complement ambiguity (Argaman & Pearlmuter, 2002; Hare et al., 2003; Hare, McRae, & Elman, 2004; Roland & Jurafsky, 2002). Moreover, there is a body of literature on the main-clause/reduced-relative ambiguity itself, focusing on the influence of the pragmatics of a short preceding discourse (Altmann & Steedman, 1988; Spivey & Tanenhaus, 1998; Trueswell & Tanenhaus, 1991). Finally, much of the thrust of the literature using eye tracking with spoken language is to ground studies of language processing, including syntactic processing, in events and actions (for reviews, see Henderson & Ferreira, 2004).

McKoon and Ratcliff also overlook a number of articles that investigate verb-specific thematic role concepts, thematic fit, and the use of this conceptual information in resolving temporarily

ambiguous structures such as the reduced relative, as well as in sentence processing more generally (Altmann, 2002; Altmann & Kamide, 1999; Ferreira, Ferraro, & Bailey, 2002; Ferretti, McRae, & Hatherell, 2001; Garnsey, Pearlmuter, Myers, & Lotocky, 1997; McRae, Ferretti, & Amyote, 1997; McRae, Hare, Ferretti, & Elman, 2001; Pearlmuter & MacDonald, 1992; Pickering & Traxler, 1998; Taraban & McClelland, 1988, among others). Similar ideas have been examined in language development (Tomasello, 1992). McRae and colleagues' theory of verb-specific thematic role concepts states that much of people's knowledge about the thematic roles is conceptual, developing from knowledge accrued over many experiences with events in the world, as well as linguistic descriptions of events. Schematic verb representations include information about the types of people and things that are part of events denoted by specific verbs. These researchers assert that this information, which has been described in terms of prototypes (not as frequency statistics), is an intrinsic part of verb meaning.

In conclusion, there indeed has been a great deal of psycholinguistic research on semantics and syntax–semantics interactions in structural ambiguity resolution, sentence interpretation, and how children acquire knowledge of verb meaning and usage. Furthermore, much of this work has been conducted by constraint-based theorists. In contrast to McKoon and Ratcliff's characterization of these theories, there is more to constraint-based models than mere statistics.

McKoon and Ratcliff present tests of constraint-based models, focusing on thematic fit and statistics involving the usage patterns of specific verbs. Studies of thematic fit began with Ferreira and Clifton (1986), who construed their investigation in terms of animacy. The basic idea was that animate entities generally tend to be agents, whereas inanimate objects generally tend to be patients. It was assumed that \pm animacy might be encoded in verb representations as a selectional restriction and that this might influence online sentence interpretation. However, Trueswell et al. (1994), following Carlson and Tanenhaus (1988), noted that the tendencies might better be considered in terms of specific combinations of events and entities/objects. In terms of verb-specific thematic fit, inanimates can be good agents and animates are often good patients (*The speeding car hit the pedestrian*). Certainly, there is more involved than simply animacy. Trueswell et al. were careful when pairing specific animates and inanimates with specific verbs and found strong effects on how people understand reduced relatives, as well as correlations with thematic fit for reduced relatives with inanimates (for related results, see Clifton et al., 2003). MacDonald (1994) also found an influence of verb-specific thematic fit when comparing animates versus inanimates.

The constraint-based literature moved beyond an animate–inanimate distinction more than 10 years ago. Pearlmuter and MacDonald (1992) demonstrated an influence of thematic fit on the comprehension of reduced relatives using only animate initial NPs, as did McRae et al. (1997, 1998) and Tabossi, Spivey-Knowlton, McRae, and Tanenhaus (1994) (but cf. Binder, Duffy, & Rayner, 2001). In the latter three articles, thematic fit was defined explicitly as the conceptual fit between a verb-specific thematic role concept and the meaning of a specific NP. This usually is measured using norms that ask participants to judge, for example, "How likely is it that a lawyer investigates someone/something?" This method *purposely* abstracts away from specific

linguistic constructions (such as a reduced relative) to tap people's world knowledge of events.

McKoon and Ratcliff did not consider that this method is used by design. When they state, "In previous applications of constraint-based models . . . , typicality values for the agents and patients of verbs were not calculated from large corpora, because none were available, but instead were calculated from typicality ratings collected from subjects" (McKoon & Ratcliff, 2003, p. 520), the implication is that corpus norms offer a more valid estimate of fit. However, the method of counting the number of times that a noun and verb co-occur in a particular way has not been used, for two reasons. First, owing to sparse data problems, corpus estimates for specific noun-verb combinations are likely to be highly unreliable. Second, and crucially, this corpus-based frequency count method of measuring typicality fails to measure the fit between a prototypical agent or patient for a specific verb (event) and the specific NP (entity or object) being used. Consequently, McKoon and Ratcliff's analyses in which the independent variable is the probability of any animate or inanimate NP occurring as an agent or a patient of a verb are irrelevant to the claims that constraint-based models make about thematic fit.

McKoon and Ratcliff used a whole sentence reading task to test whether thematic fit influences reading time for sentences containing reduced relatives (Experiments 8–11). Their studies replicated all three previous experiments that featured carefully controlled materials (MacDonald, 1994; McRae et al., 1998; Trueswell et al., 1994). These thematic fit effects replicated despite differences in procedure, such as using whole sentence reading times. However, McKoon and Ratcliff (2003) failed to find an influence of thematic fit on whole sentence reading times with two new sets of items, which they "based closely on naturally produced sentences from the corpus" (p. 515), and used their own intuitions to select either the animate or inanimate initial NPs, whichever were not in the sentences derived from the corpus.

The thematic fit ratings presented in McKoon and Ratcliff's Table 11 (2003, p. 521) provide further insight into why they obtained null effects. These ratings are presented herein in Table 3 in a slightly different format. Note that the ratings for McRae et al. (1998) do not match those presented in McKoon and Ratcliff's Table 11 because McKoon and Ratcliff combined the ratings for the good agents and good patients. In McRae et al., there is a large difference (nonoverlapping distributions) in thematic fit for both good agents and good patients. For both MacDonald (1994) and Trueswell et al. (1994), the good agents actually were rated slightly better as patients than as agents, as was the case with McKoon and Ratcliff's Experiment 9 items (ratings were equal for

McKoon and Ratcliff's Experiment 8 good agents). The illuminating difference lies in the good patients. The good patients have much higher patienthood than agenthood ratings in the three experiments in which thematic fit showed its influence (i.e., the experiments that McKoon and Ratcliff successfully replicated). However, this is not the case for McKoon and Ratcliff's two item sets for which the mean good patient patienthood rating is only 4.2 (vs. 6.0, 5.4, and 5.9 in the other studies). Thus, McKoon and Ratcliff's initial NPs were not a strong cue for a reduced relative because they were not particularly good patients; weak manipulations of thematic fit produced null results.

There were a number of additional issues regarding McKoon and Ratcliff's Experiment 8 and 9 corpus sentences. First, across the 32 sentences that constituted the two sets, one verb was used three times and seven verbs were used twice. One of these was *recognized*, which was used in its infrequent sense (i.e., to formally acknowledge) both times, as in *the securities dealers recognized by the Federal Reserve Bank*. This is problematic because it is safe to assume that participants in McKoon and Ratcliff's role-filler typicality rating task rated fit according to the much more frequent meaning of *recognized* (to identify), thus making the ratings irrelevant. In addition, in three sentences, the head of the initial NP was not the target NP of interest, so that agenthood ratings were irrelevant (*Relief to farmers hurt by low prices and bad weather cost . . .*). Furthermore, three sentences began unambiguously as reduced relatives, so that there was no ambiguity for thematic fit to resolve (*The proportion of Cuban families considered to be at the poverty level . . .*). Finally, two sentences used *people* and one used *person* as the critical noun, which are general nouns that are not biasing (how common is it to hit a person vs. to be hit by a person?). In summary, there are a number of reasons that McKoon and Ratcliff found null effects with the items that they created.

The correlational analyses reported by McKoon and Ratcliff between reading times and thematic fit ratings also are problematic. For the dependent variable, they calculated the reading time difference for each sentence pair (good agent reading time minus good patient reading time). They then introduced noise by transforming this to reading time difference per word. For example, imagine that a difference in thematic fit of some specific magnitude causes a difference in reading time of 100 ms. If a sentence is 10 words long, the thematic fit difference is used to predict a 10 ms/word effect. However, if there is also a 20-word sentence with the same fit difference, it is now used to predict a 5 ms/word effect. This will reduce the size of any correlation. Furthermore, correlational analyses of this sort in previous studies have used as the

Table 3
Thematic Fit Ratings for Sets of Sentences Used in McKoon and Ratcliff (2003)

Experiment	Good agents		Good patients	
	Agenthood	Patienthood	Agenthood	Patienthood
McRae et al. (1998)	6.3	2.5	2.0	6.0
MacDonald (1994)	4.0	4.7	1.8	5.4
Trueswell et al. (1994)	4.5	5.3	1.8	5.9
McKoon and Ratcliff (2003) Experiment 8	4.6	4.6	2.1	4.2
McKoon and Ratcliff (2003) Experiment 9	3.8	4.1	2.3	4.2

dependent variable reading time in a relatively small ambiguous or disambiguating region to avoid this type of problem.

McKoon and Ratcliff also tested the influence of verb voice, the tendency for a specific verb to be used in the active versus passive voice. This is a factor that has been shown to be relevant to reduced relative ambiguity resolution in previous research (Trueswell, 1996). McKoon and Ratcliff distinguished between active and passive voice verbs using a split at 0.5. They did not take thematic fit into account, but they controlled for mean Kuçera and Francis (1967) word frequency and mean sentence length in words (but not length in letters). McKoon and Ratcliff found a null difference in overall mean whole sentence reading times. In contrast, when they used Trueswell's verbs, which differ clearly in their use in the passive versus active voice, McKoon and Ratcliff found a significantly greater proportion of corpus reduced relatives for verbs that tend to be used in the passive voice. Thus it appears that McKoon and Ratcliff offer additional evidence in support of constraint-based models, and their null findings are not surprising given their choice of materials.

Conclusions

The MTS model proposed by McKoon and Ratcliff (2003) claims that a reduced relative is hard to understand when it involves a prohibited linking between the reduced relative construction and a verb that does not have an external cause in its single event template. They further argued that MTS is superior to current constraint-based models. The present commentary highlighted two fundamental problems with the MTS approach.

First, we argued that certain assumptions of MTS are not fully valid given the theories on which they are based. McKoon and Ratcliff's version of the constructional account is overly simplistic and misses important facts regarding how constructions can coerce a verb's meaning. In addition, we argued that the MTS assertion that each verb has only one event template is at odds with the linguistic data, and Rating Study 1 showed that it is at odds with psycholinguistic data as well. These facts lead to damaging inconsistencies in the MTS account.

Second, contrary to the MTS predictions, the difficulty of reduced relative clauses is not accounted for primarily by the internal-external distinction. Rather, the difficulty of reduced relatives is tied integrally to temporary ambiguity, as typically is assumed in the literature. Reduced relatives that are difficult show a larger ambiguity effect compared with unambiguous controls than reduced relatives that are easy. Some reduced relatives with IC verbs are difficult, but others are easy. Moreover, when the variables influencing difficulty of ambiguity resolution are manipulated, reduced relatives with IC verbs can be easier than those with EC verbs. We should emphasize that none of these criticisms depends on rejecting three claims that McKoon and Ratcliff make. First, different constructions, even closely related ones, may make different contributions to interpretation, and it is important to understand how constructions influence language processing (Goldberg, 1995). Second, the event representations of verbs are a crucial component of lexical semantics and play a central role in language comprehension. Third, corpus analyses can play an important role in developing and evaluating models of language processing. Although we agree with each of these claims, the correctness of these assumptions neither entails the MTS approach

nor supports it against the constraint-based models that McKoon and Ratcliff criticize.

Finally, we noted a number of problems with McKoon and Ratcliff's critique of constraint-based models. They present null results that can largely be attributed to weak manipulations. When they used materials with stronger manipulations taken from previous studies, they replicated the positive results. McKoon and Ratcliff also misconstrued the notion of thematic fit, thus conducting analyses that do not bear on the theory of verb-specific thematic role concepts.

In conclusion, we want to emphasize that understanding the relationship between verb sense and event structure plays an important role in understanding language comprehension. In fact, this is the impetus for much of the research that we conduct. We also believe that investigations of construction-specific processes are informative. However, investigations of event structure, other aspects of lexical representation, and the processing of constructions will need to take into account how this information is computed and integrated with other information in real-time processing. Moreover, understanding the contributions of these variables raises fundamental questions about mechanism. For example, the sense of a verb is correlated with how frequently it occurs in different types of constructions, which reflects the fact that different senses often denote events with different types of participants. This means that information tied to both form and meaning can influence processing. Teasing apart the contributions of form-based and meaning-based constraints is a fundamental challenge for models of language processing (see MacDonald, 1997, for an informative discussion), and one that is currently central to work within constraint-based approaches.

References

- Altmann, G. T. M. (2002). Predicting thematic role assignments in context. In P. Merlo & S. Stevenson (Eds.), *The lexical basis of sentence processing: Formal, computational, and experimental issues* (pp. 281–302). Philadelphia: John Benjamins.
- Altmann, G. T. M., & Kamide, Y. (1999). Incremental interpretation at verbs: Restricting the domain of subsequent reference. *Cognition*, *73*, 247–264.
- Altmann, G. T. M., & Steedman, M. J. (1988). Interaction with context during human sentence processing. *Cognition*, *30*, 191–238.
- Argaman, V., & Pearlmuter, N. J. (2002). Lexical semantics as a basis for argument structure frequency biases. In P. Merlo & S. Stevenson (Eds.), *Sentence processing and the lexicon: Formal, computational and experimental perspectives* (pp. 303–324). Amsterdam: John Benjamins.
- Bever, T. (1970). The cognitive basis for linguistic structures. In J. R. Hayes (Ed.), *Cognition and the development of language* (pp. 279–362). New York: Wiley.
- Binder, K. S., Duffy, S. A., & Rayner, K. (2001). The effects of thematic fit and discourse context on syntactic ambiguity resolution. *Journal of Memory and Language*, *44*, 297–324.
- Burzio, L. (1986). *Italian syntax: A government-binding approach*. Dordrecht, the Netherlands: Reidel.
- Carlson, G. N., & Tanenhaus, M. K. (1988). Thematic roles and language comprehension. In W. Wilkins (Ed.), *Thematic relations* (pp. 263–288). New York: Academic Press.
- Clifton, C., Jr. (1993). Thematic roles in sentence parsing. *Canadian Journal of Experimental Psychology*, *47*, 222–246.
- Clifton, C., Jr., Traxler, M. J., Mohammed, M. T., Williams, R. S., Morris, R. K., & Rayner, K. (2003). The use of thematic role information in

- parsing: Syntactic processing autonomy revisited. *Journal of Memory and Language*, 49, 317–334.
- Ferreira, F., & Clifton, C., Jr. (1986). The independence of syntactic processing. *Journal of Memory and Language*, 25, 348–368.
- Ferreira, F., Ferraro, V., & Bailey, K. G. D. (2002). Good-enough representations in language comprehension. *Current Directions in Psychological Science*, 11, 11–15.
- Ferretti, T. R., McRae, K., & Hatherell, A. (2001). Integrating verbs, situation schemas, and thematic role concepts. *Journal of Memory and Language*, 44, 516–547.
- Filip, H., Tanenhaus, M. K., Carlson, G. N., Allopenna, P. D., & Blatt, J. (2002). Reduced relatives judged hard require constraint-based analyses. In P. Merlo & S. Stevenson (Eds.), *The lexical basis of sentence processing: Formal, computational, and experimental issues* (pp. 255–279). Philadelphia: John Benjamins.
- Fillmore, C. J., Kay, P., & O'Connor, M. C. (1988). Regularity and idiomaticity in grammatical constructions: The case of *Let alone*. *Language*, 64, 501–538.
- Fisher, C., Gleitman, H., & Gleitman, L. R. (1991). On the semantic content of subcategorization frames. *Cognitive Psychology*, 23, 331–392.
- Frazier, L. (1987). Sentence processing: A tutorial review. In M. Coltheart (Ed.), *Attention and performance XII: The psychology of reading* (pp. 559–586). London: Erlbaum.
- Garnsey, S. M., Pearlmutter, N. J., Myers, E., & Lotocky, M. A. (1997). The contribution of verb-bias and plausibility to the comprehension of temporarily ambiguous sentences. *Journal of Memory and Language*, 37, 58–93.
- Goldberg, A. E. (1995). *Constructions: A construction grammar approach to argument structure*. Chicago: University of Chicago Press.
- Goldberg, A. (2003). Constructions: A new theoretical approach to language. *Trends in Cognitive Science*, 5, 219–224.
- Gropen, J., Pinker, S., Hollander, M., & Goldberg, R. (1991). Affectedness and direct objects: The role of lexical semantics in the acquisition of verb argument structure. *Cognition*, 41, 153–195.
- Gropen, J., Pinker, S., Hollander, M., Goldberg, R., & Wilson, R. (1989). The learnability and acquisition of the dative alternation in English. *Language*, 65, 203–257.
- Hare, M. L., McRae, K., & Elman, J. L. (2003). Sense and structure: Meaning as a determinant of verb subcategorization probabilities. *Journal of Memory and Language*, 48, 281–303.
- Hare, M., McRae, K., & Elman, J. L. (2004). Admitting that admitting verb sense into corpus analyses makes sense. *Language and Cognitive Processes*, 19, 181–224.
- Henderson, J. M., & Ferreira, F. (2004). *The interface of language, vision, and action: Eye movements and the visual world*. New York: Psychology Press.
- Jackendoff, R. (1990). *Semantic structures*. Cambridge, MA: MIT Press.
- Jurafsky, D. (1996). A probabilistic model of lexical and syntactic access and disambiguation. *Cognitive Science*, 10, 137–194.
- Klein, D. E., & Murphy, G. (2001). The representation of polysemous words. *Journal of Memory and Language*, 45, 259–282.
- Kučera, H., & Francis, W. N. (1967). *A computational analysis of present-day American English*. Providence, RI: Brown University Press.
- Levin, B. (1993). *English verb classes and alternations: A preliminary investigation*. Chicago: University of Chicago Press.
- Levin, B., & Rappaport Hovav, M. (1995). *Unaccusativity: At the syntax-semantic interface*. Cambridge, MA: MIT Press.
- MacDonald, M. C. (1993). The interaction of lexical and syntactic ambiguity. *Journal of Memory and Language*, 32, 692–715.
- MacDonald, M. C. (1994). Probabilistic constraints and syntactic ambiguity resolution. *Language and Cognitive Processes*, 9, 157–201.
- MacDonald, M. C. (1997). Lexical representations and sentence processing: An introduction. *Language and Cognitive Processes*, 12, 121–136.
- MacDonald, M. C., Pearlmutter, N. J., & Seidenberg, M. S. (1994). The lexical nature of syntactic ambiguity resolution. *Psychological Review*, 101, 676–703.
- Marslen-Wilson, W. D. (1975). Sentence perception as an interactive parallel process. *Science*, 189, 226–228.
- McKoon, G., & MacFarland, T. (2002). Event templates in the lexical representations of verbs. *Cognitive Psychology*, 45, 1–44.
- McKoon, G., & Ratcliff, R. (2003). Meaning through syntax: Language comprehension and the reduced relative clause construction. *Psychological Review*, 110, 490–525.
- McRae, K., Ferretti, T. R., & Amyote, L. (1997). Thematic roles as verb-specific concepts. *Language and Cognitive Processes*, 12, 137–176.
- McRae, K., Hare, M., Ferretti, T. R., & Elman, J. L. (2001). Activating events from typical agents, patients, instruments, and locations via event schemas. In *Proceedings of the 23rd Annual Meeting of the Cognitive Science Society* (pp. 617–622). Princeton, NJ: Erlbaum.
- McRae, K., Spivey-Knowlton, M. J., & Tanenhaus, M. K. (1998). Modeling the influence of thematic fit (and other constraints) in on-line sentence comprehension. *Journal of Memory and Language*, 38, 283–312.
- Pearlmutter, N., & MacDonald, M. C. (1992). Plausibility and syntactic ambiguity resolution. In *Proceedings of the Fourteenth Annual Conference of the Cognitive Science Society* (pp. 498–503). Hillsdale, NJ: Erlbaum.
- Perlmutter, D. (1978). Impersonal passives and the unaccusative hypothesis. In *Proceedings of the Fourth Annual Meeting of the Berkeley Linguistics Society* (pp. 157–189). Berkeley: University of California, Berkeley Linguistics Society.
- Pickering, M., & Traxler, M. J. (1998). Plausibility and recovery from garden-paths: An eye-tracking study. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 24, 940–961.
- Pinker, S. (1989). *Learnability and cognition*. Cambridge, MA: MIT Press.
- Rayner, K., Carlson, M., & Frazier, L. (1983). The interaction of syntax and semantics during sentence processing. *Journal of Verbal Learning and Verbal Behavior*, 22, 358–374.
- Rodd, J., Gaskell, G., & Marslen-Wilson, W. D. (2002). Making sense of semantic ambiguity: Semantic competition in lexical access. *Journal of Memory and Language*, 46, 245–266.
- Roland, D., & Jurafsky, D. (2002). Verb sense and verb subcategorization probabilities. In P. Merlo & S. Stevenson (Eds.), *The lexical basis of sentence processing: Formal, computational, and experimental issues* (pp. 325–345). Philadelphia: John Benjamins.
- Spivey, M. J., & Tanenhaus, M. K. (1998). Syntactic ambiguity resolution in discourse: Modeling the effects of referential context and lexical frequency. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 24, 1521–1543.
- Spivey-Knowlton, M. J., Trueswell, J. C., & Tanenhaus, M. K. (1993). Context effects in syntactic ambiguity resolution: Discourse and semantic influences in parsing reduced relative clauses. *Canadian Journal of Experimental Psychology*, 37, 276–309.
- Sturt, P., Scheepers, C., & Pickering, M. J. (2002). Syntactic ambiguity resolution after initial misanalysis: The role of recency. *Journal of Memory and Language*, 46, 371–390.
- Tabossi, P., Spivey-Knowlton, M. J., McRae, K., & Tanenhaus, M. K. (1994). Semantic effects on syntactic ambiguity resolution: Evidence for a constraint-based resolution process. In C. Umiltà & M. Moscovitch (Eds.), *Attention & performance XV: Conscious and nonconscious information processing* (pp. 589–616). Cambridge, MA: MIT Press.
- Tanenhaus, M. K., Spivey-Knowlton, M. J., Eberhard, K. M., & Sedivy, J. C. (1995, June 16). Integration of visual and linguistic information in spoken language comprehension. *Science*, 268, 1632–1634.
- Taraban, R., & McClelland, J. L. (1988). Constituent attachment and

- thematic role assignment in sentence processing: Influences of content-based expectations. *Journal of Memory and Language*, 27, 597–632.
- Tomasello, M. (1992). *First verbs: A case study of early grammatical development*. Cambridge, England: Cambridge University Press.
- Trueswell, J. C. (1996). The role of lexical frequency in syntactic ambiguity resolution. *Journal of Memory and Language*, 35, 566–585.
- Trueswell, J. C., & Tanenhaus, M. K. (1991). Tense, temporal context and syntactic ambiguity resolution. *Language and Cognitive Processes*, 6, 303–338.
- Trueswell, J. C., & Tanenhaus, M. K. (1994). Toward a lexicalist framework of syntactic ambiguity resolution. In C. Clifton, L. Frazier, & K. Rayner (Eds.), *Perspectives on sentence processing* (pp. 155–180). Hillsdale, NJ: Erlbaum.
- Trueswell, J. C., Tanenhaus, M. K., & Garnsey, S. M. (1994). Semantic influences on parsing: Use of thematic role information in syntactic ambiguity resolution. *Journal of Memory and Language*, 33, 285–318.

Received December 29, 2003

Revision received June 14, 2004

Accepted June 24, 2004 ■

Postscript: Rejoinder to McKoon and Ratcliff (2005)

Ken McRae
University of Western Ontario

Mary Hare
Bowling Green State University

Michael K. Tanenhaus
University of Rochester

McKoon and Ratcliff (2005) respond to our critique by appealing to data about external and internal cause verbs that, although interesting, are not directly relevant to (a) their account of the difficulty of some reduced relatives, (b) our critique of that account, and (c) constraint-based approaches to language processing. They make the problematic claim that ambiguity resolution, a well-established factor that has powerful and well-documented effects on lexical, syntactic, and referential processing, should be appealed to only as a last resort; a similar claim about, for example, frequency (or event structures) would be equally problematic. They challenge our claims about lexical semantics and Construction Grammar and our claim that these are combined in the meaning through syntax (MTS) model in ways that do not cohere. We encourage readers to examine the cited literature for themselves and/or to consult with a linguist colleague who is familiar with that literature. We agree that internal cause manner-of-motion and change-of-state verbs differ from other verb classes in inter-

esting ways, some of which McKoon and Ratcliff have documented in this and other work. Crucially, however, MTS does not have a mechanism for blocking reduced relatives with internal cause verbs, because the framework allows internal cause verbs to be augmented by an external cause. McKoon and Ratcliff (2003) argued that “language users have strong intuitions about how individual verbs can be used” (p. 495). However, other than to suggest that our participants’ acceptability judgments are not valid data, they offer no explanation for why participants rated our “easy” reduced relatives with internal cause verbs to be (a) more acceptable than the “hard” reduced relatives with external cause verbs, (b) more acceptable than the full relatives and simple passives for “hard” internal cause verbs, and (c) as acceptable as the full relatives for the hard external cause verbs. Finally, and most problematically, the centerpiece of McKoon and Ratcliff’s proposals concerning reduced relatives is the claim that sentences such as *Indonesian officials feared that many of the beaches eroded by the tsunami would never again attract tourists* are “prohibited” in English.

References

- McKoon, G., & Ratcliff, R. (2003). Meaning through syntax: Language comprehension and the reduced relative clause construction. *Psychological Review*, 110, 490–525.
- McKoon, G., & Ratcliff, R. (2005). “Meaning Through Syntax” in sentence production and comprehension: Reply to McRae et al. (2005). *Psychological Review*, 112, 1032–1039.

E-Mail Notification of Your Latest Issue Online!

Would you like to know when the next issue of your favorite APA journal will be available online? This service is now available to you. Sign up at <http://watson.apa.org/notify/> and you will be notified by e-mail when issues of interest to you become available!