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PROCESSING AGENTIVE

BY-PHRASES IN COMPLEX EVENT
AND NONEVENT NOMINALS
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1 Introduction

Grimshaw (1991) proposes that complex event and nonevent nominals, as in (1a–b), differ in their argument-taking properties. Event nominals lexically select arguments, and nonevent nominals do not.

- (1) a. *Event nominal*
The frequent announcement of the prices . . .
b. *Nonevent nominal*
The various announcements of the prices . . .

The consequence of this analysis is that agentive *by*-phrases occurring within complex event nominals are arguments of those nominals, but agentive *by*-phrases occurring within complex nonevent nominals are adjuncts of those nominals (see (2a–b)).

- (2) a. *Event nominal*
 The frequent collection of butterflies *by the children* . . .
 b. *Nonevent nominal*
 The various collections of butterflies *by the children* . . .

Grimshaw's claims are relevant to current sentence-processing research. Experimental studies have shown that comprehenders process arguments and adjuncts differently (Clifton, Speer, and Abney 1991; see also Kennison 1995, Liversedge 1996). In a study carried out by Clifton, Speer, and Abney (1991), experimental sentences contained argument or adjunct phrases that were argument prepositional phrases or adjunct prepositional phrases of preceding verbs or nouns. Reading time was measured in a self-paced moving window (experiment 1) and eye tracking (experiment 2). The results of experiment 1 showed that reading time was faster for argument than for adjunct conditions on the region immediately following the argument or adjunct phrase. The results of experiment 2 showed that total reading time was faster for argument than for adjunct conditions on the region containing the argument or adjunct phrase. Analyses of first-pass reading time, a measure that reflects initial processing on a sentence region, showed verb-attached phrases were read more quickly than noun-attached phrases. Clifton, Speer, and Abney (1991) conclude that "initial processing is governed by a preference to take prepositional phrases as modifying verbs not nouns, while argument vs. adjunct status has a powerful effect on overall comprehension of a sentence" (p. 264).

The differential processing of argument and adjunct phrases is consistent with several types of sentence-processing theories. On one hand, there are theories in which a structural analysis is initially built only after lexical information is consulted for the purposes of determining the possible or the preferred usages (e.g., constraint satisfaction; MacDonald, Pearlmutter, and Seidenberg 1994, Trueswell and Tanenhaus 1994). When an argument/adjunct ambiguity is encountered, the parser prefers to construct argument phrases, as they are lexically specified. On the other hand, there are theories in which a structural analysis is initially built following the application of parsing principles that are based on consulting phrase structure information (e.g., garden path theory; Frazier 1978, Frazier and Rayner 1982). When an argument/adjunct ambiguity is encountered, the parser prefers arguments. Following Late Closure, the parser prefers an attachment to the more recent part of the phrase marker. As arguments are attached as sisters of X' and adjuncts are attached as sisters of XP, the argument attachment is preferred. A third type of model specifies that the structural analysis is initially built after consulting both lexical and phrase structure information, therefore also predicting a preference for arguments (licensing parser; Abney 1989).

2 Sentence-Processing Experiment

2.1 Method

An experiment was conducted in which reading time was measured on sentences containing complex event and nonevent nominals in which agentive *by*-phrases occurred. Sample stimuli are shown in (3).

- (3) a. *Complex event nominal*
The frequent collection of butterflies by the kids amazed everyone.
- b. *Complex nonevent nominal*
The numerous collections of butterflies by the kids amazed everyone.

All complex event nominals appeared in the singular form and were preceded by an adjective consistent with an event interpretation. All complex nonevent nominals appeared in the plural form and were preceded by an adjective consistent with a nonevent interpretation. Eye tracking was used to measure reading time. This methodology provides a complete record of all eye movement behavior that occurs during reading (see Rayner and Pollatsek 1989). Further details of the method and a complete list of experimental sentences are provided in the appendix.

2.2 Results

The data were initially screened for false fixations, following the recommendations of Rayner et al. (1989). Sentences were divided into four regions for the purposes of data analysis: (1) *The frequent/numerous collection(s)*, (2) *of butterflies*, (3) *by the kids*, and (4) *amazed everyone*. Two measures of reading time were analyzed. First-pass reading time was defined as the sum of all fixations of the eye in a region from the time the eye first entered the region to the time the eye first exited the region. Total reading time was defined as the sum of all fixations of the eye in a region. Analyses of variance were carried out using sentence type as the single within-participants factor. All analyses of variance that are reported were performed for participants (F_1) and sentences (F_2). Figures 1 and 2 display mean first-pass reading time and mean total reading time for sentences containing complex event nominals and complex nonevent nominals by sentence region, respectively.

Sentences containing complex nonevent nominals were more difficult to process than sentences containing complex event nominals. Total reading time for the sentence region containing the agentive *by*-phrase (region 3) was longer for complex nonevent nominal conditions than complex event nominal conditions (Nonevent: 709 ms vs. Event: 626 ms), $F_1(1, 35) = 6.29$, $MSE = 19980$, $p < .02$, $F_2(1, 7) = 5.53$, $MSE = 4633$, $p < .05$. Total reading time for the region following the agentive *by*-phrase was numerically in the same direction and was significant by participants (Nonevent: 1059 ms vs. Event: 869 ms),

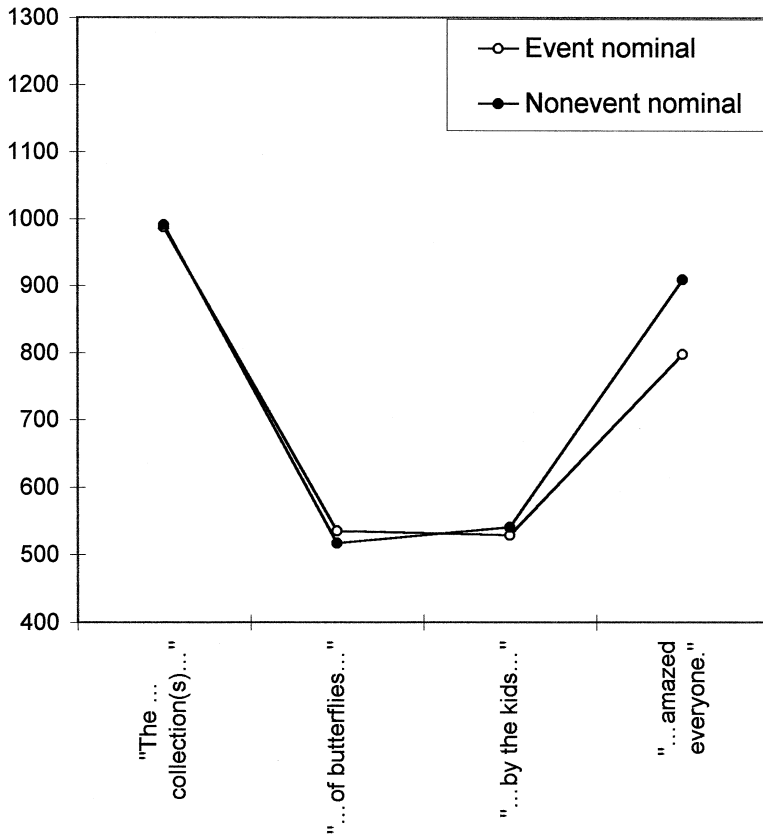


Figure 1

Mean first-pass reading time in ms for sentences containing complex event nominals and complex nonevent nominals by sentence region

$F_1(1, 35) = 6.42$, $MSE = 101490$, $p < .02$, $F_2(1, 7) = 3.82$, $MSE = 4775$, $p < .10$. The differences observed at other sentence regions were not significant in any analysis.

An inspection of first-pass reading time results indicates that the processing difficulty in sentences containing complex nonevent nominals began to emerge after readers began reading the region following the agentive *by*-phrase (region 4). First-pass reading time was longer for sentences containing complex nonevent nominals than those containing complex event nominals (Nonevent: 714 ms vs. Event: 640 ms). The difference was significant by participants, $F_1(1, 35) = 3.86$, $MSE = 57403$, $p < .05$, $F_2 < 1$. There were no significant differences in first-pass reading time at other sentence regions.

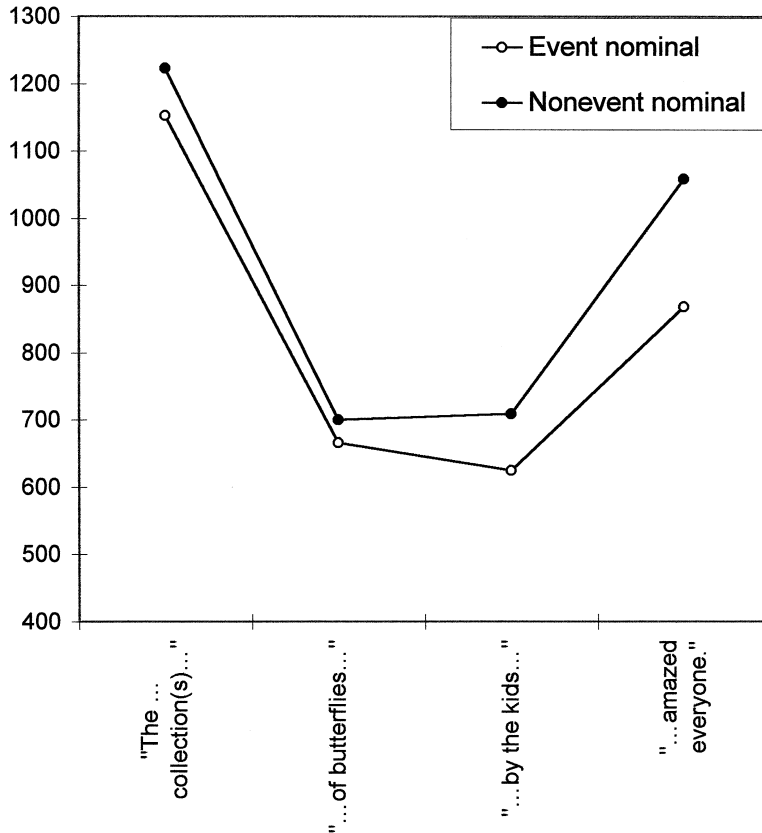


Figure 2

Mean total reading time in ms for sentences containing complex event nominals and complex nonevent nominals by sentence region

3 Discussion

The results of the sentence-processing experiment are remarkably similar to those observed by Clifton, Speer, and Abney (1991) in that the processing advantage of agentive *by*-phrases in complex event nominals (arguments) versus agentive *by*-phrases in complex nonevent nominals (adjuncts) influenced the overall comprehension of the sentence as observed in total reading time results, rather than the initial processing of the agentive *by*-phrase region as observed in first-pass reading time results. The results confirm that agentive *by*-phrases are processed differently depending on whether they occur in complex event or complex nonevent nominals. This difference in processing is expected given Grimshaw's (1991) analysis of agentive *by*-phrases as arguments in the former context and as adjuncts in the latter context. The results are consistent with prior sentence-processing experiments showing processing differences between sentences containing argu-

ment and adjunct phrases (Clifton, Speer, and Abney 1991, Kennison 1995, Liversedge 1996).

Appendix: Method and Materials

Thirty-six undergraduate and graduate students at the University of Massachusetts participated for course credit or \$5.00. All participants had normal or corrected vision and were native speakers of American English. Eye movements were recorded by a Stanford Research Institute Dual Purkinje Eye Tracker (for procedural details regarding this device, see Clifton, Speer, and Abney 1991, experiment 2). Each participant viewed 8 experimental sentences, which were intermixed with 96 sentences having a variety of syntactic structures. The two versions of each of the experimental sentences were counterbalanced to ensure that each version was viewed equally often across participants. The adjectives that preceded the complex event and nonevent nominals were matched on length (in characters) and printed frequency (as assessed in Francis and Kučera 1982). Comprehension questions appeared after each sentence to ensure that participants were fully engaged in the task. Each session lasted from 30 to 50 minutes.

The following list contains the eight experimental sentences (two versions each) that were used in the experiment. Version (a) represents the complex event nominal condition and version (b) represents the complex nonevent nominal condition.

1. (a) The frequent demonstration (b) The numerous demonstrations of the product by the salesmen annoyed many customers.
2. (a) The occasional acknowledgment (b) The sincere acknowledgments of the mistake by the author surprised the talk show audience.
3. (a) The frequent examination (b) The numerous examinations of the evidence by the authorities pleased members of the victim's family.
4. (a) The repeated prediction (b) The specific predictions of the accident by the young girl stunned many people.
5. (a) The continuous explanation (b) The specific explanations of the problem by the workers was/were overlooked by the owners.
6. (a) The sudden indication (b) The many indications of the problem by the colonel came just in time to prevent a major loss of life.
7. (a) The continuous announcement (b) The numerous announcements of the concert by the principal amused the kids.
8. (a) The frequent collection (b) The numerous collections of butterflies by the kids amazed everyone.

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