Sedivy (2002) proposed that using only and prior referential context to specify contrastive focus can guide the parsing of relative clause ambiguities. We report two studies investigating this hypothesis, using sentences that either temporarily allowed or disallowed a transitive main clause interpretation. Sentence-completions demonstrated that only and interrogative contexts jointly influenced the frequency of relative clause completions to ambiguous fragments. Eye tracking demonstrated that conjoint effects of only and context influenced initial parsing decisions only when the active transitive analysis was unavailable. The results are consistent with previous observations that the influence of contrastive focus on sentence processing depends on which syntactic analyses are available to the parser (Liversedge, Paterson, & Clayes, 2002; Paterson, Liversedge, & Underwood, 1999).

There is a long-standing debate concerning whether processes involved in establishing the reference of a linguistic expression can influence decisions about which analysis to assign to a syntactic ambiguity (e.g., Altmann & Steedman, 1988; Altmann, Garnham, & Dennis, 1992; Altmann, Garnham, & Henstra, 1994; Altmann, van Nice, Garnham, & Henstra, 1998; Binder, Duffy, & Rayner, 2001; Britt, 1994; Britt, Perfetti, Garrod, & Rayner, 1992; Ferriera & Clifton, 1986; Frazier & Clifton, 1996; Murray & Liversedge, 1994; Sedivy, 2002; Spivey-Knowlton & Tanenhaus, 1994; Spivey-Knowlton, Trueswell, & Tanenhaus, 1993). Much research informing this debate has involved the study of sentences that contain temporary syntactic ambiguities (e.g., 1).

1. The businessmen loaned money at low interest were told to record their expenses.

In (1), the phrase loaned money at low interest is temporarily ambiguous between a main clause analysis specifying what the businessmen did and a reduced relative clause analysis specifying which businessmen are under consideration. It is syntactically disambiguated at were.

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told as a reduced relative clause sentence. Sentence (2) is made unambiguous by including who were.

2. The businessmen who were loaned money at low interest were told to record their expenses.

Garden path theory (e.g., Frazier & Rayner, 1982) requires that the parser computes syntactic analyses serially, with initial parsing decisions made solely on the basis of knowledge about permissible grammatical structures. Readers preferentially adopt a main clause analysis of the ambiguity in sentences like (1) because it is structurally less complex than a relative clause analysis. Consequently, they should experience difficulty when sentences like (1) are disambiguated as reduced relatives. After the parser has made an initial syntactic choice, a thematic processor uses a broad range of information to account for the quality of the resulting interpretation (e.g., Rayner, Carlson, & Frazier, 1983), and potentially to guide its reanalysis.

An alternative approach (Crain & Steedman, 1985; also Altmann & Steedman, 1988) requires that readers adopt whichever analysis produces the least referentially complex semantic representation. Crain and Steedman argued that part of the process of interpreting text involves the reader constructing a mental representation of its meaning (i.e., a discourse model) and incrementally integrating each phrase with the existing discourse model. On encountering an ambiguity, each alternative syntactic analysis is made available to a semantic processor, which preferentially selects an analysis that refers to existing discourse entities or accommodates the fewest referential presuppositions about entities that are not made explicit in the text.

Sentence (1) begins with a definite expression (i.e., the businessmen) that presupposes a unique referent in the prior discourse context (e.g., Heim, 1982). During semantic integration the processor attempts to establish an anaphoric link between this expression and its referent. When a single potential antecedent exists in prior discourse context then readers can readily establish a unique anaphoric link. However, if the context contains two or more potential antecedents then readers will require modifying information, such as that supplied by a relative clause, to uniquely identify the referent. Crain and Steedman argued that readers are predisposed to adopt the relative clause analysis of an ambiguity when it disambiguates the referent of an expression, thereby eliminating reading difficulty for ambiguous sentences such as (1). In the absence of preceding referential context, or when context does not include a previously established referent, readers may accommodate referential presuppositions by instantiating a unique referent in the discourse model. As modifying information is not required to disambiguate the referent, readers will adopt the main clause analysis of a relative clause ambiguity and experience difficulty if it subsequently is disambiguated as a relative clause.

Some evidence suggests that prior referential context can affect the processing of syntactic ambiguities (e.g., Altmann & Steedman, 1988; Altmann et al., 1992; Altmann et al., 1994; Altmann et al., 1998; Seditiv, 2002; Spivey-Knowlton & Tanenhaus, 1994; Spivey-Knowlton et al., 1993). However, other evidence suggests that referential factors have a limited role in parsing (Britt, 1994; Britt et al., 1992; Clifton & Ferreira, 1989; Ferriera & Clifton, 1986; Murray & Liversedge, 1994).

Although Crain and Steedman (1985) originally presented their account as the Referential theory of sentence processing, several subsequent theories include referential factors as one of several possible extra-semantic influences on parsing, most notably Constraint-satisfaction theories (e.g., McRae, Spivey-Knowlton, & Tanenhaus, 1998; MacDonald, 1994; MacDonald, Pearlmutter, & Seidenberg, 1994; Tanenhaus & Truewell, 1995). Constraint-satisfaction requires that the alternative analyses of a syntactic ambiguity are constructed in parallel and compete for adoption. Multiple factors, including verb sub-categorization preferences, semantic plausibility, and discourse context, impose constraints that favor the alternative analyses, and processing difficulty occurs when a constituent is encountered that conflicts with the currently most favored analysis. Constraint-satisfaction predicts an effect of referential context on parsing, with the magnitude of this effect being dependent on the relative strength of this constraint in relation to other constraints favoring the alternative analyses. Its advocates (e.g., Spivey & Tanenhaus, 1998; Spivey-Knowlton & Seditiv, 1995) often use offline data, such as analyses of corpora or sentence completions, to quantify the relative strength of constraints favoring alternative syntactic analyses at a particular point in the sentence.

With the present studies we were concerned with an extension of the Referential theory by Ni, Crain, and Shankweiler (1996), which requires that the referential presuppositions of focus particles such as only can determine how a syntactic ambiguity initially is analyzed. Focus particles are used to indicate contrastive focus, and according to Rooth (1992), only presupposes a contrast between a focus set of entities that is made explicit in the sentence and a set of alternatives. Ni et al. argued that on encountering a phrase that includes only, e.g., only businessmen in (3), the reader immediately attempts to incorporate its presuppositions by determining which focus and contrast sets are to be included in the discourse model.

3. Only businessmen loaned money at low interest were told to record their expenses.
In principle, readers may contrast a focus set denoted by the head noun with another set of entities (e.g., businessmen with lawyers) or, alternatively, they might contrast subsets of the head noun and anticipate modifying information, such as that supplied by a relative clause, that disambiguates the focus set. Ni et al. argued that readers preferentially contrast subsets of the head noun as this avoids referential presuppositions about entities that are not made explicit in the text. Thus, on encountering only businessmen in (3), readers will contrast two sets of businessmen and anticipate modifying information that disambiguates the focus set, thereby predisposing readers to adopt a relative clause analysis of the ambiguity.

In an eye-tracking experiment Ni et al. found that only eliminated reading difficulty for the disambiguating phrase (e.g., were told in 3) of ambiguous sentences. However, including a pronominal adjective (e.g., only wealthy businessmen) reintroduced reading difficulty, as in this case the need for modifying information was satisfied by the adjective, and the readers no longer anticipated modifying information in the form of a relative clause. A self-paced reading study by Sedivy (2002, Experiment 1), comparing definite versions of sentences with and without only (e.g., only the businessmen compared with the businessmen), also showed that contrastive focus can eliminate reading difficulty for syntactic ambiguities. However, Clifton, Bock, and Rado (2000) found no effects of only on the parsing of relative clause ambiguities, and Paterson et al. (1999) argued that only may affect sentence processing without imposing on initial parsing decisions.

Paterson et al. (1999) noted that Ni et al. (1996) had used a large disambiguating region for many items, often comprising two words (e.g., were told in 3), and argued that reading times at this region might include fixations made during syntactic reanalysis as well as during initial parsing. Consequently, the effects they obtained might have been due to only aiding recovery from an initial misanalysis rather than guiding parsing decisions. To address this possibility, Paterson et al. conducted an eye-tracking study using materials that were syntactically disambiguated at a single word. They used sentences such as Only teenagers allowed a party invited a juggler straightaway, that temporarily permitted an active transitive analysis with the second noun-phrase being analyzed as a direct object (e.g., Only teenagers allowed a party in the evening). Previous research had suggested that readers are predisposed to adopt the active transitive analysis of a syntactic ambiguity whenever it is available (MacDonald, 1994; Townsend & Bever, 2001), and that the preference cannot be over-ridden by prior referential context (Britt et al., 1992; Ferriera & Clifton, 1986; Murray & Liversedge, 1994).

Paterson et al. (1999) compared ambiguous sentences with unambiguous counterparts that were created by adding who were after the head noun. There was clear evidence that readers experienced difficulty due to initially misanalyzing the ambiguity, with longer first pass reading times at the critical verb (e.g., invited) of ambiguous items, and no modulating effect of only. However, only did affect other aspects of sentence processing. More time was spent reprocessing text following the disambiguation of sentences without only, which Paterson et al. interpreted as evidence that only had facilitated the reanalysis of ambiguous items when they were disambiguated as reduced relative clause constructions. Furthermore, first pass reading times were longer at the critical verb of both ambiguous and unambiguous sentences without only. Paterson et al. took this to demonstrate that using only to create an expectation for modifying information had affected the semantic integration of relative clause information. As the critical verb marked the completion of the relative clause of unambiguous sentences and disambiguated the ambiguous ones, it may have provided the first opportunity for readers to integrate the relative clause with the discourse model. It appeared that relative clause information was more easily integrated when it satisfied the need for modifying information that only created.

A follow-up eye-tracking study by Liversedge et al. (2002) used sentences such as Only motorists stopped in the car park received a warning about their outdated permits. These included a prepositional phrase (e.g., in the car park) that ruled out the possibility of an active transitive analysis, and were temporarily ambiguous between an intransitive analysis and a reduced relative clause analysis. With the most strongly preferred analysis ruled out, readers must select between two relatively dispreferred analyses. Under these circumstances syntactic processing might be susceptible to extra-syntactic factors, such as the processing of contrastive focus. Liversedge et al. found no effects in first pass reading times but readers made fewer regressive saccades and spent less time re-inspecting text following syntactic disambiguation for sentences with than without only, which they took as evidence for an effect of only on initial parsing decisions. Readers also took longer to complete reading the remainder of the ambiguous sentences irrespective of whether they included only. Thus, although there was an effect of only at disambiguation, it did not fully eliminate reading difficulty for ambiguous sentences.

One possibility, suggested by Sedivy (2002), is that the influence of only is modulated by the availability of contrast sets in the prior referential context. Sedivy's (2002) Experiment 1 employed Ni et al.'s (1996) materials, using the same disambiguating region. Therefore, Paterson et al.'s (1999) arguments concerning the use of large disambiguating regions would apply to Sedivy's replication of the study too.

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1 Sedivy's (2002) Experiment 1 employed Ni et al.'s (1996) materials, using the same disambiguating region. Therefore, Paterson et al.'s (1999) arguments concerning the use of large disambiguating regions would apply to Sedivy's replication of the study too.
proposed that when an explicit contrast is made available in the prior context then only causes the reader to establish a contrast between this set and one denoted by the noun it modifies. As the need to establish a contrast has been satisfied, the reader will not anticipate further modifying information. However, when prior context does not include an explicit contrast then only will cause the reader to contrast subsets of the head noun and anticipate modifying information that specifies how the subsets differ. Under these circumstances, only and prior referential context might over-ride parsing preferences, causing readers to adopt the relative clause analysis of an ambiguity.

Sedivy conducted four phrase-by-phrase self-paced reading experiments. With her first experiment, Sedivy replicated Ni et al.’s (1996) findings, using their materials. In Experiment 2, Sedivy investigated the interactive influence of only and prior referential context on parsing. She used materials with one- or two-referent contexts (which she referred to respectively as “no contrast” and “contrast” contexts) and temporarily ambiguous sentences that were syntactically disambiguated as reduced relative or main clause constructions (e.g., 4).

4. All the secretaries (and accountants) were made to take a tough computing course. Only secretaries prepared for the exam (passed) and earned pay raises for their work.

The ambiguous sentences always included only and relative clause versions differed from main clause counterparts by including a disambiguating verb (e.g., passed). One-referent contexts introduced a single set of entities (e.g., secretaries) that was repeated as the head noun of the ambiguous sentence, and two-referent contexts introduced two sets (e.g., secretaries and accountants) with one repeated as the head noun of the ambiguous sentence. Sedivy obtained an interaction of context and ambiguity. She attributed this effect to the disambiguating phrase of ambiguous main clause items (e.g., and earned) being read more quickly in two- than one-referent contexts and, conversely, the disambiguating phrase of ambiguous reduced relatives (e.g., passed) being read more quickly in one- than two-referent contexts, although, importantly, neither contrast was statistically reliable. No such effects were found for sentences without only in Experiment 3. Thus Sedivy took the results of Experiments 2 and 3 to demonstrate that only and prior referential context jointly created expectations for modifying information that dictated how the ambiguity was to be analyzed.

Sedivy’s results are important because they demonstrate the context dependency of only, and show how using a combination of only and prior referential context can affect the processing of structurally ambiguous sentences. However, although the results clearly demonstrated that only and prior referential context can affect sentence processing, they did not unambiguously demonstrate that these factors determined how the ambiguity initially was analyzed. As noted above, Paterson et al. (1999) also demonstrated that the need to satisfy referential presuppositions can facilitate the processing of relative clause information in sentences with only. However, by comparing the processing of ambiguous and unambiguous items, Paterson et al. showed that facilitation occurred independently of initial parsing decisions. In her second experiment, Sedivy examined the influence of only and prior context on the processing of sentences containing relative clause ambiguities but without examining their effect on unambiguous counterparts. Thus, it is not possible to determine whether Sedivy’s effects occurred during the construction of an initial syntactic analysis or if they occurred later in processing, and were therefore similar in nature to the semantic integration effects that Paterson et al. obtained.

The present studies used eye tracking to examine the influence of only and prior context on the parsing of relative clause ambiguities. We did not compare sentences with only to sentences without only, as this difference was investigated in previous work (e.g., Liversedge et al., 2002; Paterson et al., 1999). Instead, the current studies were designed primarily to investigate how only interacts with context. In conducting these studies, we used interrogatives (e.g., which, who, whether) to set up different expectations for information provided in a relative clause sentence (e.g., Frazier & Clifton, 2002; Pesetsky, 1987). Several previous studies have made effective use of wh-words and indirect questions to generate contextual expectations (e.g., Altmann et al., 1998; Hanna, Spivey-Knowlton, & Tanenhaus, 1996; Liversedge, Pickering, Branigan, & Van Gompel, 1998; Liversedge, Pickering, Clayes, & Branigan, 2003). In Experiment 1, we investigated whether only and an interrogative context could eliminate reading difficulty for relative clause ambiguities that temporarily permit an active transitive analysis. In Experiment 2, we examined whether these factors affected the processing of relative clause ambiguities that cannot be assigned an active transitive analysis, but which are temporarily ambiguous between a relative clause analysis and an intransitive analysis.

Experiment 1

Experiment 1 investigated the influence of only and interrogative context on the parsing of relative clause ambiguities that temporarily permitted an active transitive analysis. Paterson et al. (1999) had previously shown that the initial parsing of the syntactic ambiguity
in this form of construction was impervious to the influence of *only*. Participants read sentence pairs comprising a context sentence followed by a structurally ambiguous or unambiguous relative clause sentence (e.g., 5).

5. Tom wondered [who/which builders] fitted a kitchen. Only builders (who were) paid a deposit fitted a kitchen within the week.

The ambiguous sentences began with *only* and had an initial NP V NP structure (e.g., *Only builders paid a deposit*) that temporarily permitted an active transitive analysis with the second noun-phrase analyzed as a direct object. The unambiguous sentences were identical to the ambiguous ones, except for the inclusion of a relative pronoun and auxiliary verb (e.g., *who were*), which disambiguated the sentence structure. The interrogatives which and who were used to set up different expectations for information provided in the relative clause sentence. *Which*-phrases indicated that a contrast was to be made between two subsets of a noun (e.g., *builders*). The subdivided noun was repeated as the head of the following sentence, and the relative clause analysis of the ambiguity provided modifying information that specified how the sets differed. *Who*-phrase contexts queried which set of entities performed a particular action, with the answer provided by the head noun of the relative clause sentences. Thus, whereas *which*-contexts supported *only* in specifying a contrast between subsets of the head noun, *who*-contexts did not.

The contextual manipulation used in the present experiment (and in Experiment 2) was not of the type often is used when testing claims made by the Referential theory (e.g., *Altmann & Steedman, 1988*). In these experiments, the propositional content of the relative clause in ambiguous sentences satisfies referential presuppositions by uniquely specifying a referent in the prior discourse context. For example, given a context that introduces two businessmen, one who had received a loan and one who had not, a relative clause analysis of *the businessmen loaned money at low interest* will uniquely identify one of them. However, both *Ni et al.*’s (1996) extension of the theory, and Sedivy’s (2002) investigation of context effects, require that when *only* subdivides a noun into two sets of entities, then the reader anticipates further information that specifies how the sets differ, and on encountering modifying information, such as a relative clause, accommodates it as part of their discourse model. The contextual manipulation used in the present experiments directly tests this latter claim, and in this respect is comparable to the contextual manipulations employed by Sedivy.

We made the following predictions. According to Garden path theory, readers initially should adopt the main clause analysis of an ambiguous reduced relative clause sentence and we would therefore expect reading times at syntactic disambiguation to be longer for ambiguous than unambiguous sentences with *only*, with no modulating influence of context. In line with this, *Paterson et al.* (1999) also predicted that reading times at syntactic disambiguation would be longer for ambiguous than unambiguous sentences, despite the presence of *only* and irrespective of prior referential context, since the processing of ambiguous reduced relatives that temporarily permit an active transitive analysis is impervious to referential manipulations. *Paterson et al.* argued that rather than guiding initial parsing decisions, the processing demands associated with the computation of contrastive focus instead might facilitate the semantic integration of modifying information with the discourse model, in which case the relative clause sentences might be most easily integrated in *which*-contexts, that potentially will facilitate the reanalysis of the ambiguity.

Sedivy (2002) required that *only* and prior referential context jointly influence initial parsing. Given that our *which*-contexts predispose readers to anticipate modifying information; then they were similar to Sedivy’s “no contrast” contexts. Thus, *only* and *which* should eliminate reading difficulty for ambiguous items. As our *who*-contexts do not create an expectation for modifying information, then it seems reasonable to assume that Sedivy would predict that *only* and *who* would have a lesser effect on initial parsing decisions. Similarly, Constraint-satisfaction accounts predict an effect of referential context on parsing, with the magnitude of this effect dependent on the relative strength of constraints favoring alternative analyses. Before conducting the eye-tracking experiment, we conducted a sentence completion study to quantify the strength of these constraints, and to generate predictions on behalf of the Constraint-satisfaction theory.

Method

Participants

Twenty-eight native English speakers with normal or corrected vision from the University of Derby participated.

Materials and design

We used the 36 target sentence stimuli listed in the Appendix of *Paterson et al.* (1999). Sentences were temporarily ambiguous reduced relatives or unambiguous counterparts. The relative clause sentences followed a context sentence that contained a *who-* or *which*-phrase. Thus, there were two independent variables: sentences were ambiguous or unambiguous, and appeared in *who-* or *which*-contexts.

Items were divided into four lists, each including one version of each item, with equal numbers of items in each of the four conditions. Each list also contained 16 filler items, and 28 items from an unrelated experiment.
on pronoun resolution. The context and relative clause
sentences appeared on the screen at the same time.
Materials were double spaced across three lines of
text, with the critical region falling at the center of line
two. A full set of experimental items is included in
Appendix A.

Before conducting the eye-tracking study we collect-
ed sentence completions from 40 participants from the
University of Derby (who did not participate in the
eye-tracking study) for reduced relative clause materials
that were truncated after the ambiguity and began with
only, e.g., Only builders paid a deposit... Items were pre-
sented in which- or who-contexts. Thirty-six filler items
were included with the 36 experimental items. Signifi-
cantly more relative clause completions were produced
for sentence fragments in which- than who-contexts
(46.1% vs. 32.3%), \( t_{513} = 5.1, p < .001; t_{513} = 8.6, p < .001 \). Thus, the results indicated that only and which
created a significantly greater expectation for modifying
information than only and who, thereby promoting the
production of relative clause completions. However,
their combined influence was not sufficient to create an
overall preference for the relative clause completions
(with less than 50% relative clause completions).

On the basis of these results we generated the follow-
ing Constraint-satisfaction predictions. Neither context
created an overall preference for the relative clause anal-
ysis; therefore, we would not expect only and an inter-
rogative context to eliminate reading difficulty at the
ambiguity. Nevertheless, only and which created a stron-
ger relative clause bias than did only and who, suggesting
that readers should experience less difficulty at syntactic
disambiguation when the sentences are in a which-rather
than a who-context.

Procedure
A Fourward Technologies Dual Purkinje Generation
6 eye-tracker monitored gaze location and participants’
right eye movement during reading. The eye-tracker
has an angular resolution of 10 min of arc. A PC dis-
played materials on a VDU 60 cm from participants’
eyes. Tracker output was sampled to produce a sequence
of fixations recorded as x and y character positions, with
start and finish times. Before the start of the experiment,
the eye-tracking procedure was explained and partici-
pants were instructed to read normally and for compre-
sension. Participants were seated at the eye-tracker and
placed on a bite-bar to minimize head movements. Par-
ticipants then completed a calibration procedure.

Before the start of each trial, a fixation box appeared
in the upper left half of the screen. Once participants fix-
ated this box the experimenter prompted the computer
to present a target text, with the first character of the
text replacing the fixation box. The experimenter re-
ceived feedback on the estimated position of partici-
pant’s fixation point. If this did not match with the
eye-tracker. Participants took breaks as required. Once
a participant completed reading each sentence, they
pressed a key, and the computer displayed a compre-
hesion question such as Did some builders fit a bathroom?
Half of the questions had ‘yes’ and half had ‘no’ answers.
Participants responded by pressing a key, with feedback
on their responses.

Results

Regions
Items were divided into scoring regions, as indicated
by vertical lines in (6).

6. Tom wondered who (which builders) fitted a kitch-
en. region1 region2 region3 region4 region5 region6 region7

Region 1 was the context sentence. Region 2 was the
first noun-phrase (e.g., Only builders) for ambiguous
sentences and the first noun, relative pronoun and aux-
iliary for unambiguous sentences. Region 3 was the first
verb and the indefinite article. Region 4 was the follow-
ning noun. Region 5 was the critical region, containing
the main verb, which disambiguated argumentless sen-
ences. Region 6 was the following noun-phrase, and Region
7 was the remainder of the sentence.

Analysis
An automatic procedure pooled short contiguous fix-
ations. Fixations less than 80 ms were incorporated into
larger adjacent fixations within one character and fixa-
tions of less than 40 ms that were not within three char-
acters of another fixation were deleted. Fixations over
1200 ms were truncated. Prior to analyzing the data we
eliminated trials where participants failed to read the
sentence or there had been tracker loss. Specifically,
we removed those trials where two or more adjacent re-
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Advocates of Constraint-satisfaction theory might interpret the effect as evidence for competition during the initial processing of the ambiguity.\textsuperscript{2} There were no other significant effects at Regions 3 or 4.

At Region 5, the critical region, there was no effect of context (234 vs. 244 ms), but reading times were longer for ambiguous than unambiguous sentences (249 vs. 228 ms). Importantly, context and ambiguity did not interact. Thus, reading difficulty was experienced at syntactic disambiguation regardless of prior context. At Region 6, the effect of context was not reliable, with numerically longer reading times in who- than which-contexts (262 vs. 240 ms), and no other significant effects. There were no effects at Region 7.

Regression path reading times

See Fig. 2 for a graphical representation of regression path effects. At Region 5, the critical region, ambiguous sentences had longer reading times than unambiguous counterparts (378 vs. 313 ms). There were no other significant effects, indicating that context did not modulate the difficulty in processing the rela-

\textsuperscript{2} It could be argued that the first verb (\textit{paid}) is the first point in the sentence at which it can be determined that a relative clause analysis of the ambiguity does not uniquely refer to an entity in the discourse context, causing readers to abandon an initial relative clause analysis in favor of the main clause analysis. Thus, early reanalysis of an initial relative clause analysis might account for the processing cost at this verb. However, it is not obvious how this explanation would account for the same effect in the Paterson et al. (1999) study, which did not include a discourse context. Therefore, it seems more likely that this is an ambiguity effect, with readers incurring an additional processing cost when they are required to select between possible analyses of an ambiguity.

Table 1

Mean first-pass and total reading times for Regions 2–6, and mean regression path reading times for Regions 5 and 6 of ambiguous and unambiguous sentences with only in which- and who-contexts for Experiment 1, with standard errors in parentheses.

Table 2 shows inferential statistics.

<table>
<thead>
<tr>
<th>Regions</th>
<th>Measure (ms)</th>
<th>Context</th>
<th>Which</th>
<th>Unambiguous</th>
<th>Ambiguous</th>
<th>Who</th>
<th>Unambiguous</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>First-pass time</td>
<td>Ambiguous</td>
<td>467 (29.0)</td>
<td>760 (39.1)</td>
<td>510 (27.4)</td>
<td>855 (45.4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total time</td>
<td>731 (48.9)</td>
<td>1095 (75.8)</td>
<td>843 (56.5)</td>
<td>1341 (106.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>First-pass time</td>
<td>Ambiguous</td>
<td>318 (21.1)</td>
<td>253 (14.4)</td>
<td>317 (21.8)</td>
<td>258 (18.4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total time</td>
<td>603 (52.5)</td>
<td>462 (39.7)</td>
<td>642 (54.3)</td>
<td>450 (50.8)</td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>First-pass time</td>
<td>Ambiguous</td>
<td>242 (13.7)</td>
<td>233 (15.6)</td>
<td>238 (13.7)</td>
<td>244 (14.9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total time</td>
<td>378 (28.8)</td>
<td>334 (24.5)</td>
<td>419 (31.0)</td>
<td>356 (22.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>First-pass time</td>
<td>Ambiguous</td>
<td>243 (12.9)</td>
<td>224 (12.5)</td>
<td>255 (15.2)</td>
<td>232 (15.8)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regression path</td>
<td>380 (47.6)</td>
<td>269 (17.4)</td>
<td>371 (23.0)</td>
<td>309 (39.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total time</td>
<td>383 (24.1)</td>
<td>313 (20.0)</td>
<td>416 (26.2)</td>
<td>363 (27.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>First-pass time</td>
<td>Ambiguous</td>
<td>252 (20.5)</td>
<td>228 (11.7)</td>
<td>258 (17.6)</td>
<td>266 (17.6)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regression path</td>
<td>418 (33.7)</td>
<td>361 (41.1)</td>
<td>547 (58.4)</td>
<td>452 (41.5)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Total time</td>
<td>353 (29.9)</td>
<td>294 (23.0)</td>
<td>353 (30.1)</td>
<td>342 (24.3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First-pass reading time

See Fig. 1 for a graphical representation of first-pass reading time effects, with error bars showing 95% confidence intervals (Masson & Loftus, 2003). Region 2 reading times were longer in who- than which-contexts (683 vs. 614 ms), probably due to repetition priming of the head noun in which-contexts. Longer reading times for unambiguous than ambiguous sentences (808 vs. 489 ms), were due to these sentences containing additional words. The interaction was not reliable. Region 3 reading times were longer for ambiguous than unambiguous sentences (318 vs. 256 ms). Paterson et al. (1999) had attributed the same effect to increased processing load when the verb was ambiguous than when it was syntactically disambiguated by the preceding text. Advocates of Constraint-satisfaction theory might
### Table 2
Statistical values for analyses of reading time data for Experiment 1

<table>
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<th>Source of variance</th>
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<th>$F_1$ value</th>
<th>$MSe$</th>
<th>$F_2$ df</th>
<th>$F_2$ value</th>
<th>Min $F'$ df</th>
<th>Min $F'$ value</th>
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<td>1,35</td>
<td>.22</td>
<td>1,59</td>
<td>.15</td>
</tr>
</tbody>
</table>

(continued on next page)
At Region 6, the regression path reading times were longer for ambiguous than unambiguous sentences (353 vs. 318 ms), and sentences in who-contexts had longer reading times than those in which-contexts (348 vs. 324 ms), with no interaction. Thus, it appeared that while the relative clause sentences were easier to process in which- than who-contexts, this did not impinge on parsing decisions.
Total reading time

Region 2 reading times were longer in who-contexts (1092 vs. 913 ms). This effect also was obtained in first pass times and attributed to repetition priming of the head noun in which-contexts. Reading times also were longer for unambiguous sentences (1218 vs. 787 ms), due to these sentences containing additional words. The interaction was unreliable.

The pattern of results for Regions 3-6 were similar, with longer reading times for ambiguous than unambiguous sentences, and no modulating effect of context. At Region 3 there was an effect of ambiguity (623 vs. 456 ms), but no effect of context (533 vs. 546 ms) and no significant interaction. At Region 4, there was an effect of ambiguity (399 vs. 345 ms), but the effect of context was unreliable (356 vs. 388 ms), and there was no interaction. At Region 5, there was an effect of ambiguity (400 vs. 338 ms), and an effect of context, with longer reading times in who- rather than which-contexts (390 vs. 348 ms), but no interaction. Finally, at Region 6 there was an effect of ambiguity (353 vs. 318 ms), but the effect of context was not significant (324 vs. 348 ms), and the interaction was not significant.

Total reading time effects at each of these regions indicated that readers experienced difficulty as a consequence of the syntactic ambiguity, with no interactions to indicate a modulating effect of context. However, context did have a main effect at the critical verb, without impinging on initial parsing decisions, reading times being shorter for both ambiguous and unambiguous sentences in which- than who-contexts. The critical verb disambiguated the relative clause in ambiguous sentences, and marked the completion of the relative clause in unambiguous counterparts. Therefore, this verb provided the first opportunity for readers to integrate information provided by the relative clause as part of their current discourse model. The reading time effects suggested that it was easier to process the relative clause information when it was anticipated in which-contexts but not in who-contexts. There were no effects at Region 7.

To further test the predictions of a Constraint-satisfaction account we used linear regression to determine whether the frequency of relative clause completions to ambiguous sentence fragments in an off-line task predicted the on-line reading cost for these sentences following syntactic disambiguation (see Table 3). The independent variables were the number of relative clause completions for sentences beginning with only in either a which- or a who-context. The dependent variables were the differences in reading time between ambiguous and unambiguous sentences (in which- and who-contexts) in first pass, regression path, and total time measures for Regions 5 and 6. No effects were obtained for either first pass or regression path reading times at Regions 5 or 6 ($R^2 < .06, F_s < 2$). However, there was a significant negative relationship between the frequency of relative clause completions and total reading times for sentences in who-contexts ($R^2 = .22, F = 9.32, p < .01$), indicating that there was less processing difficulty for sentences with high than low rates of relative clause completions. There were no other significant effects ($R^2$'s $< .08, F_s < 2.7$). Thus, it appeared that the off-line completions did not predict the cost of syntactic disambiguation in measures of early sentence processing, and only predicted the overall reading difficulty for sentences in one of the contextual conditions.

Discussion

We obtained two key findings in the reading time measures. First, participants had difficulty in processing ambiguous sentences despite only and regardless of the interrogative context. There were longer first pass and regression path reading times at the critical verb, and longer total reading times for Regions 4, 5, and 6, for ambiguous items. The magnitude of these effects did not differ across which- and who-contexts. Thus, initial parsing decisions were impervious to the influence of only and context.

The second finding relates to the evidence that our referential manipulation had an influence on sentence processing, albeit without modulating initial parsing decisions. We found that total reading times at the critical verb, and regression path reading times at the following region, were shorter in which- than who-contexts, and attributed this effect to readers finding it easier to semantically integrate sentential information when it satisfied contextual expectations. Which-contexts required modifying information that specified the nature of a contrast between two subsets of the head noun, and this information was supplied by the relative clause of unambiguous items and the relative clause analysis of ambiguous items. By contrast, who-contexts required the specification of a set of entities, this information being
provided by the head noun. Thus, relative clause information was more easily integrated with context when it was anticipated in which-contexts than when it was unanticipated in who-contexts.

Our results were consistent with previous demonstrations that ambiguous reduced relatives that temporarily permit an active transitive analysis are impervious to referential factors (e.g., Britt, 1994; Britt et al., 1992; Ferreira & Clifton, 1986; Frazier & Clifton, 1996; Murray & Liversedge, 1994; Paterson et al., 1999). They also are consistent with Paterson et al.'s finding that processing demands associated with contrastive focus can facilitate the semantic integration of relative clause information without impinging on initial parsing decisions. Thus, the present results were compatible with modular theories of parsing such as the Garden path theory, which predicts that ambiguous reduced relatives will be harder to process than unambiguous unreduced relatives, irrespective of the context. In contrast with Sedivy (2002), there was no evidence that single-referent (or "no contrast") contexts (i.e., which-contexts) eliminated reading difficulty for ambiguous reduced relatives with only. The reading time results can be accommodated by Constraint-satisfaction theory if it attributes the absence of an effect to strong syntactic preferences for adopting an active transitive analysis of the ambiguity being impervious to constraints imposed by referential factors.

However, the absence of a relationship between offline sentence completions and on-line parsing decisions is problematic for advocates of this account who use sentence completion data to quantify the relative strength of constraints supporting the rival analyses of an ambiguity at a particular point in a sentence (e.g., Spivey & Tanenhaus, 1998; Spivey-Knowlton & Sedivy, 1995). Our sentence completion data suggested that only with a which-phrase would create a stronger bias for adopting the relative clause analysis of the ambiguity than only and a who-phrase. However, the nature of the interrogative context did not modulate reading times during on-line ambiguity resolution. Instead, it affected how easily the relative clause information supplied by both ambiguous and unambiguous sentences was semantically integrated with the discourse context. Importantly, item-by-item regression analyses showed that offline sentence completion data did not predict reading times. Thus, it appears that offline sentence completions are not predictive of on-line parsing preferences, for the present experiment at least (see also, Liversedge et al., 2002, for similar findings).

Experiment 2

Thus far we have demonstrated that only and prior context do not influence the initial parsing of ambiguous reduced relative clause sentences that temporarily permit an active transitive analysis. This finding is consistent with other studies that have shown such decisions to be impervious to referential factors (Britt, 1994; Britt et al., 1992; Clifton & Ferreira, 1989; Ferreira & Clifton, 1986; Murray & Liversedge, 1994; Paterson et al., 1999).

In Experiment 2 we examined the parsing of relative clause ambiguities that do not temporarily permit a transitive analysis, but which instead are temporarily ambiguous between a relative clause analysis and an intransitive analysis. We used sentences from Liversedge et al. (2002), such as Only motorists stopped in the car park received a warning about their outdated permits. For these sentences, a prepositional phrase (e.g., in the car park) ruled out the active transitive analysis prior to syntactic disambiguation. Liversedge et al. had argued that with the most strongly preferred analysis ruled out, readers must select between two relatively dispreferred analyses, and that under these circumstances syntactic processing might be susceptible to extra-syntactic factors, such as the processing of contrastive focus. Liversedge et al. found that readers experienced short-lived difficulty at the disambiguating verb when processing ambiguous sentences without only, with no such effect for ambiguous sentences with only. They took this as evidence that using only to create an expectation for modifying information could influence parsing decisions for this type of ambiguous sentence. Given Liversedge et al.'s findings and given that Experiment 1 did not produce effects of only and an interrogative context on initial parsing decisions, then the likelihood of obtaining such effects might be greater if we use sentences that rule out the possibility of assigning a transitive analysis. In Experiment 1, we examined the processing of a relative clause ambiguity in a which-context and in a who-context. The who-context was effectively a null context, since it neither supported nor inhibited the relative clause analysis. Given the subtle nature of the ambiguity investigated in the present experiment it was possible that readers would adopt a relative clause analysis of the ambiguity regardless of whether the context supported this analysis or provided a null context. To avoid this possibility, we strengthened the contextual manipulation in Experiment 2 by replacing the null who-context with one that was designed to inhibit the adoption of a relative clause analysis. Sedivy (2002) had used contexts containing two referents, with one repeated as the head noun of the ambiguous sentence, to bias readers into adopting a main clause analysis of an ambiguity, arguing that when context supplies an explicit contrast set, readers are not predisposed to adopting the relative clause analysis. We also used a two-referent context to inhibit a relative clause analysis, but included an interrogative (i.e., whether) to emphasize that a contrast was to be made between the two referents. An example material is shown in (7):
The relative clause sentences were either temporarily ambiguous or were disambiguated by including a relative pronoun and auxiliary verb (i.e., *who were*). The *which*-phrase context indicated that a contrast was to be made between two subsets of a noun and required further information about how these sets differed. The sub-divided noun was repeated as the head noun of a relative clause sentence, and the relative clause supplied modifying information that specified how the sets differed. We expected a combination of *only* and a *which*-phrase to bias readers into adopting the relative clause analysis of the ambiguity. The *whether*-phrase context set up an explicit contrast between two sets of entities (e.g., *motorists and pedestrians*), creating an expectation for further information that specified which entities performed a particular action. The head noun of the relative clause sentences provided this information. Thus, whereas *which*-contexts created a need for further modifying information, *whether*-contexts were designed to obviate this need, thereby inhibiting the adoption of a relative clause analysis of the ambiguity.

We made the following predictions. Garden path theory required that readers initially would adopt the syntactically less complex of the potential analyses, irrespective of the context. Since the intransitive analysis is syntactically less complex than the relative clause analysis, the theory required that readers initially adopt this analysis of the ambiguity, experiencing difficulty when it is disambiguated as a reduced relative clause. By contrast, Constraint-satisfaction theory requires that the analysis that is assigned to a syntactic ambiguity will depend on the relative strength of constraints imposed thus far. Thus, for *only* and *which*-contexts to create a preference for the relative clause analysis will depend on the strength of the constraints that these factors impose and the relative strength of competing constraints that become available prior to disambiguation. As in Experiment 1, we collected sentence completion data to test the off-line effectiveness of our manipulations and to generate Constraint-satisfaction predictions. In line with the predictions of a Constraint-satisfaction account, Sedivy (2002) proposed that readers adopt the relative clause analysis of an ambiguity when prior context does not supply an explicit contrast set, and adopt the main clause analysis of the ambiguity when it does. As our *which*-contexts were functionally equivalent to Sedivy’s one-referent (“no contrast”) contexts, and did not supply a contrast set, they should predispose readers to adopting a relative clause analysis of the ambiguity. By contrast, our *whether*-contexts were functionally equivalent to Sedivy’s two-referent (“contrast”) contexts, supplying an explicit contrast set. These contexts should obviate the need for modifying information, causing readers to initially adopt a main clause analysis of the ambiguity. Thus, following Sedivy, we would expect readers to have difficulty in processing the ambiguous sentences in *whether*-contexts, but not in *which*-contexts. Liversedge et al. (2002) proposed that the processing of contrastive focus might affect the parsing of sentences that are ambiguous between an intransitive analysis and a relative clause analysis, since for these sentences there is not a strong syntactic preference for adopting one of the alternative analyses, which is also in line with the predictions of a constraint satisfaction approach.

Method

Participants

Thirty-two native English speakers with normal or corrected vision from the University of Leicester participated.

Materials and design

We used the 32 sentence stimuli listed in the Appendix of Liversedge et al. (2002). All sentences began with *only*, included a prepositional phrase before the critical verb, and were temporarily ambiguous reduced relative clause sentences or unambiguous counterparts. Sentences appeared in *which*- or *whether*-contexts. For *which*-contexts, the interrogative modified a noun that was repeated as the head of the relative clause sentence. *Whether*-contexts specified two referents. Thus, there were two independent variables: relative clause sentences were ambiguous or unambiguous; and contexts included a *which*- or *whether*-phrase.

Materials were divided into four lists, each including one version of each sentence, and with equal numbers of items from each of the experimental conditions. Each list had 48 additional filler items, including 28 that were materials from an unrelated experiment concerning the processing of quantifier scope ambiguities. The context and relative clause sentences appeared on the screen at the same time. Materials were double spaced across three lines of text, with the critical region falling at the center of line two. A full set of experimental items is included in Appendix B.

We collected sentence completions from 32 native English speakers from the University of Derby (none of whom participated in Experiment 1 or in the current eye-tracking experiment) for 32 filler items and 32 experimental items that were truncated after the ambiguity. The relative clause sentences began with *only*, e.g., *Only motorists stopped in the car park. . .* and were presented in *which*- or *whether*-contexts. There was an overall high rate of relative clause completions, probably because participants were selecting between two relatively equally dispreferred alternative analyses. Significantly more
relative clause completions were produced for sentences in *which-* than *whether*-contexts (79.3% vs. 57.8%),
(t_{1}(31) = 5.46, \ p < .01; \ t_{2}(31) = 4.83, \ p < .01). From these off-line results we would predict on behalf of Constraint-satisfaction theorists that *which* and *only* should create a strong preference to adopt a relative clause analysis of the syntactic ambiguity. It should be sufficiently strong to eliminate reading difficulty for the ambiguous sentences. *Only* and *whether* also created a preference for the relative clause analysis; however, this preference was significantly weaker than that obtained for *only* and *which*. Thus, while we would also expect a *whether*-context to reduce the reading difficulty for ambiguous sentences it should not be as effective at doing so as a *which*-context.

**Procedure**

We employed the same procedure as used in Experiment 1, using a Fourward Technologies Dual Purkinje Generation 6 eye-tracker located in the Leicester Psychology laboratories and operating the same data collection and analysis software as used in Experiment 1.

**Results**

**Regions**

Sentences were divided into regions, as indicated by vertical lines in (8).

8. Simon wondered [which motorists/whether the motors or the pedestrians] received a warning region1 Only motorists [who were] region2 stopped region3 in the car park region4 received region5 a warning region6 about their outdated permits region7.

Region 1 was the context sentence. Region 2 was the first noun-phrase for ambiguous items; and the first noun, relative pronoun and auxiliary for unambiguous sentences. Region 3 was the first verb. Region 4 was the prepositional phrase. Region 5 was the critical verb that disambiguated ambiguous items. Region 6 was the following noun or noun-phrase, and Region 7 was the remainder of the sentence.

**Analysis**

We employed the same automatic procedure as used in Experiment 1 to pool contiguous fixations, to delete short fixations, and to truncate long ones. Prior to analyzing the fixation time data we eliminated trials where participants failed to read the sentence or there had been tracker loss. This involved removing trials where two or more adjacent regions had zero first pass reading times, accounting for 5.3% of the data. Participants gave correct responses to comprehension questions on 91% of trials, with no significant differences between conditions (F < 1.3).

We computed the same measures as used in Experiment 1. Data for each region were subjected to two 2(context) · 2(ambiguity) ANOVAs, treating participants (F1) and items (F2) as random variables. We also calculated min F. Table 4 shows mean first pass, regression path, and total reading times for Regions 2–6, and Table 5 shows inferential statistics.

### First pass reading time

At Region 2, first pass reading times were longer for unambiguous sentences, due to the these sentences having additional words at this region (725 vs. 441 ms), with no other effects. At Region 3, there was no significant

### Table 4

Mean first-pass and total reading times for Regions 2–6, and mean regression path reading times for Regions 5 and 6 of ambiguous and ambiguous sentences with *only* in *which*- and *whether*-contexts for Experiment 2, with standard errors in parentheses

<table>
<thead>
<tr>
<th>Regions</th>
<th>Measure (ms)</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Which</td>
</tr>
<tr>
<td>2</td>
<td>First-pass time</td>
<td>444 (25.7)</td>
</tr>
<tr>
<td></td>
<td>Total time</td>
<td>589 (35.8)</td>
</tr>
<tr>
<td>3</td>
<td>First-pass time</td>
<td>322 (21.8)</td>
</tr>
<tr>
<td></td>
<td>Total time</td>
<td>493 (35.6)</td>
</tr>
<tr>
<td>4</td>
<td>First-pass time</td>
<td>665 (30.3)</td>
</tr>
<tr>
<td></td>
<td>Total time</td>
<td>986 (50.0)</td>
</tr>
<tr>
<td>5</td>
<td>First-pass time</td>
<td>280 (13.6)</td>
</tr>
<tr>
<td></td>
<td>Regression path</td>
<td>368 (26.6)</td>
</tr>
<tr>
<td></td>
<td>Total time</td>
<td>409 (23.1)</td>
</tr>
<tr>
<td>6</td>
<td>First-pass time</td>
<td>324 (15.6)</td>
</tr>
<tr>
<td></td>
<td>Regression path</td>
<td>380 (19.0)</td>
</tr>
<tr>
<td></td>
<td>Total time</td>
<td>451 (20.1)</td>
</tr>
</tbody>
</table>
Table 5
Statistical values for analyses of reading time data for Experiment 2

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>Region 2</th>
<th>Region 3</th>
<th>Region 4</th>
<th>Region 5</th>
<th>Region 6</th>
<th>Total reading time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F&lt;sub&gt;1&lt;/sub&gt;</td>
<td>MSe</td>
<td>F&lt;sub&gt;2&lt;/sub&gt;</td>
<td>Min F*</td>
<td>F&lt;sub&gt;1&lt;/sub&gt;</td>
<td>MSe</td>
</tr>
<tr>
<td></td>
<td>df</td>
<td>F&lt;sub&gt;1&lt;/sub&gt; value</td>
<td>df</td>
<td>F&lt;sub&gt;2&lt;/sub&gt; value</td>
<td>df</td>
<td>F&lt;sub&gt;2&lt;/sub&gt; value</td>
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<tr>
<td><strong>First-pass reading time</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context</td>
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<td>0.00</td>
<td>9,471</td>
<td>1,31</td>
<td>0.08</td>
<td>1,39</td>
</tr>
<tr>
<td>Ambiguity</td>
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<td>186.02**</td>
<td>13,909</td>
<td>1,31</td>
<td>181.54***</td>
<td>1,62</td>
</tr>
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<td></td>
<td></td>
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<tr>
<td>Context</td>
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<td>1.60</td>
<td>2,624</td>
<td>1,31</td>
<td>1.17</td>
<td>1.61</td>
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<tr>
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<td>2.63</td>
<td>3,642</td>
<td>1,31</td>
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<td>13,260</td>
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<td>1.59</td>
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<td>Ambiguity</td>
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<td>4.83*</td>
<td>17,954</td>
<td>1,31</td>
<td>8.49**</td>
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<td>13,755</td>
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<td>1.03</td>
<td>1.59</td>
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</tr>
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<td>3,001</td>
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<td>1,954</td>
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<td>3,542</td>
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<td><strong>Regression path</strong></td>
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<td></td>
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</tr>
<tr>
<td>Region 5</td>
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<tr>
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<td>19,194</td>
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<td>0.22</td>
<td>24,463</td>
<td>1,31</td>
<td>0.23</td>
<td>1.62</td>
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<tr>
<td>Region 6</td>
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<tr>
<td>Context</td>
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<td>3.15+</td>
<td>24,262</td>
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<td>23,858</td>
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<td>4.50*</td>
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<td>Context × Ambiguity</td>
<td>1,31</td>
<td>6.64*</td>
<td>22,520</td>
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<td>9.14*</td>
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<tr>
<td><strong>Total reading time</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region 2</td>
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<td></td>
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<tr>
<td>Context</td>
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<td>41,791</td>
<td>1,31</td>
<td>123.84***</td>
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<td>45,555</td>
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<td>Region 3</td>
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</tr>
<tr>
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<td>1,31</td>
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<td>11,987</td>
<td>1,31</td>
<td>0.68</td>
<td>1.57</td>
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<td>Region 4</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Context</td>
<td>1,31</td>
<td>3.77+</td>
<td>25,473</td>
<td>1,31</td>
<td>3.66+</td>
<td>1.62</td>
</tr>
<tr>
<td>Ambiguity</td>
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<td>1,31</td>
<td>3.97+</td>
<td>1.49</td>
</tr>
<tr>
<td>Context × Ambiguity</td>
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<td>0.08</td>
<td>26,209</td>
<td>1,31</td>
<td>0.07</td>
<td>1.62</td>
</tr>
<tr>
<td>Region 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context</td>
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<td>0.03</td>
<td>5,958</td>
<td>1,31</td>
<td>0.00</td>
<td>1.50</td>
</tr>
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<td>Ambiguity</td>
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<td>0.15</td>
<td>12,052</td>
<td>1,31</td>
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<td>1.38</td>
</tr>
<tr>
<td>Context × Ambiguity</td>
<td>1,31</td>
<td>2.08</td>
<td>11,519</td>
<td>1,31</td>
<td>3.73**</td>
<td>1.57</td>
</tr>
</tbody>
</table>

(continued on next page)
main effect of context (321 vs. 310 ms), no significant main effect of ambiguity (324 vs. 307 ms), and no significant interaction. Region 4 reading times were longer for ambiguous than unambiguous sentences (664 vs. 612 ms), with no other significant effects, suggesting that readers had more difficulty in processing the prepositional phrase when it was structurally ambiguous, irrespective of whether the context supported a relative clause analysis. At Region 5, the critical region, there were no significant effects. At Region 6, the main effect of ambiguity was not significant (328 vs. 311 ms), with no other effects. Thus, first pass reading times provided no evidence of readers having difficulty in processing the sentences following syntactic disambiguation.

Regression path reading times

There were no significant effects at Region 5. At Region 6, the post-critical region, the main effect of context was not significant (383 vs. 342 ms). However, reading times were longer for ambiguous than unambiguous sentences (343 vs. 376), and there was a significant interaction (see Fig. 3). Reading times were longer for ambiguous than unambiguous sentences in whether-contexts (392 vs. 366 ms), with no such difference in which-contexts (380 vs. 385 ms). The interaction was exactly of the form that Sedivy (2002) would have predicted, with readers having difficulty in processing the ambiguous sentences in two-referent contexts (i.e., whether-contexts) but not in one-referent contexts (i.e., which-contexts). Thus, the effect was consistent with the combined influence of only and the interrogative context affecting how the ambiguous sentences were processed.

Total reading time

At Region 2, total reading times were longer for unambiguous than ambiguous sentences (929 vs. 613 ms), due to these sentences having more words at this region, with no other significant effects; and no significant effects at Region 3. At Region 4, the effect of context approached significance, with numerically longer reading times in which-contexts (970 vs. 915 ms). The effect of ambiguity was not reliable (963 vs. 923 ms), with no interaction. At Region 5, there were no significant main effects and the interaction was not significant. Finally, no significant effects were found at Region 6. The absence of total time effects at Regions 5 and 6 suggests that the effect obtained in the regression path reading times was short-lived.

As with Experiment 1, we used linear regression to determine whether the frequency of relative clause completions to ambiguous sentence fragments predicted the reading time costs for the ambiguous sentences following syntactic disambiguation (see Table 3). The independent variables were the number of relative clause completions for fragments with only occurring in either a which- or a whether-context. The dependent variables

Table 5 (continued)

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>$F_1$</th>
<th>$MSe$</th>
<th>$F_2$</th>
<th>$Min F'$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>df</td>
<td>$F_1$</td>
<td>df</td>
<td>$F_2$</td>
</tr>
<tr>
<td>Region 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Context</td>
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<td>10,988</td>
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<td>Context $\times$ Ambiguity</td>
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<td>0.73</td>
<td>6,318</td>
<td>1,31</td>
</tr>
</tbody>
</table>

* $p < .05$.
** $p < .01$.
*** $p < .001$.
+ .1 > $p > .05$.

Fig. 3. Mean regression path reading times, with 95% within-subject confidence intervals based on the ambiguity effect, for Regions 5 and 6 of ambiguous (Panel 1) and unambiguous (Panel 2) sentences used in Experiment 2.
were the differences in reading time between ambiguous and unambiguous sentences (in \textit{which}- and \textit{whether-}
contexts) in first pass, regression path, and total time measures for Regions 5 and 6. No effects were obtained in
first pass reading times ($R^2 < .07$, $F < 2.2$). However, there was a significant positive relationship between
the completion data and regression path reading times for sentences in \textit{which}-contexts at Region 6 ($R^2 = .22,
F = 9.32$, $p < .01$). As the relationship was positive, it
was in the opposite direction to that predicted by Con-
straint-satisfaction theorists, indicating that readers
had more processing difficulty for sentences that re-
ceived high rather than low rates of relative clause com-
pletions. A similar, but non-significant effect, was
obtained in total reading times at Region 5 for sentences
in \textit{which}-contexts ($R^2 = .10$, $F = 3.48$, $0.05 < p < .10$),
with no other effects ($R^2 < .03$, $F < 1$). Thus, the sen-
tence completion data do not enable us to predict the
reading time cost following syntactic disambiguation
as Constraint-satisfaction theorists have proposed (e.g.,
Spivey & Tanenhaus, 1998; Spivey-Knowlton & Sedivy,
1995).

\textbf{Discussion}

This experiment showed that readers had difficulty in
processing ambiguous sentences in \textit{whether-}
contexts but not in \textit{which}-contexts. It should be noted that the effect
obtained in \textit{whether-contexts} was short-lived (found
only in the regression path measure) and occurred at
the region following the disambiguating region. The
transitory nature of the effect was not surprising, since
the effect that Liversedge et al. (2002) obtained for this
form of ambiguity also occurred for re-reading time,
but not in first pass or total reading times. Re-reading
time is a measure that captures effects in fixations made
when text is being re-inspected. In both cases, the effect
may have been short-lived because it is relatively easy
for the parser to recover from an initial misanalysis
when one of two relatively dispreferred analyses turns
out to be incorrect compared with when a single strongly
preferred analysis of an ambiguity turns out to be
incorrect.

It may be of concern to some that we did not obtain
first pass effects of context in Experiment 2, given our
argument that context influences initial parsing deci-
sions. However, we do not believe that the failure to ob-
tain first pass reading time effects is in any way
problematic for our account. When a reader encounters
a portion of a sentence that causes them processing dif-
ficulty, there are three possible oculomotor responses
that they may make: (1) remain fixating the difficult
word, (2) make a leftward regression to reinspect text
to assist in processing the difficulty, (3) make a right-
ward saccade to inspect novel text that could also facil-
itate processing. The regression path reading time
measure (Koniczyn et al., 1997; Liversedge, Paterson,
et al., 1998, 1998), which showed our effects, is sensitive
to both the first and the second of these possible behav-
iors. It provides an index of the time the participant
spent initially detecting a problem and then re-reading
the text (presumably in an attempt to overcome process-
ing difficulty) prior to fixating novel linguistic material.

A strong, and in our view reasonable, argument has
been made that the existence of a regression path ef-
fect unambiguously indicates that disruption to early
processing has occurred even if a proportion of that ef-
fect reflects recovery rather than initial detection of the
difficulty (Clifton et al., 2003). Note also, that since we
obtained a regression path reading time effect, but no

To be clear, we believe that the disruption to process-
ing that we observed occurred because readers initially
adopted a main clause analysis of the ambiguity in
\textit{whether-contexts}, and then experienced difficulty when
the sentence was disambiguated as a reduced relative
clause. An alternative possibility is that the effect may
have been due to readers initially adopting the relative
clause analysis of the ambiguity, regardless of the con-
text, and having difficulty in integrating this analysis
with the \textit{whether-context}, since the \textit{whether-context} did
not set up an expectation for modifying information.

We considered this latter explanation to be somewhat
unlikely, however. If the effect was due to readers having
difficulty in integrating relative clause information with
context, then we would have expected it to occur for
both ambiguous and unambiguous sentences, and not
exclusively for the ambiguous ones. Crucially, irrespec-
tive of the origins of the \textit{whether-context} effect, no corre-
sponding effect was obtained in \textit{which-contexts}. Thus, it
appeared that readers had initially adopted the relative
clause analysis of the ambiguity in this context, since
they had no difficulty in processing the sentence when
it was disambiguated as having a reduced relative clause
structure.

The present results are consistent with Liversedge
et al.’s (2002) claim that contrastive focus might influ-
ence the parsing of a relative clause ambiguity when
the preferred active transitive analysis is unavailable.

The reading time data are also consistent with Sedivy’s
(2002) claim that \textit{only} and prior referential context can
jointly affect the processing of syntactic ambiguities.

However, the sentence completion data were not consist-
tent with her account of how \textit{only} and discourse context
interact during language processing. According to Sedi-
vy, contexts containing two referents (i.e., “\textit{contrast}”
contexts) should bias the readers into adopting the main
clause analysis of an ambiguity. However, the sentence completions for fragments with only in whether-contexts (which were comparable to Sedivy’s two-referent contexts) indicated that readers did not have a preference for the main clause analysis of the ambiguity (participants producing 58% relative clause completions). One possibility is that the two-referent contexts eliminate the expectation that only creates for modifying information, without creating a preference for adopting the main clause analysis of an ambiguity. That is to say, when the reader encounters only in a sentence, it causes them to instantiate focus and contrast sets in their discourse model, and to seek information that specifies how these sets differ. When this information is not readily available then readers will anticipate further modifying information, such as that supplied by a relative clause. However, when context specifies the nature of the contrast, then readers will not anticipate further modifying information, but neither will they be biased into adopting the main clause analysis of an ambiguity.

The results are problematic for the Garden path theory, since they suggest that contrastive focus can affect the processing of some forms of syntactic ambiguity; although advocates of the theory might argue that effects of context in cases like this could be a result of rapid reanalysis, with context affecting reanalysis processes rather than guiding initial parsing decisions (e.g., Frazier, 1995). The results are readily accommodated by theories that allow referential factors to influence initial parsing decisions, including the Constraint-satisfaction theory.

General discussion

We have reported two eye-tracking experiments that are informative about the conditions in which using only and an interrogative to indicate contrastive focus can affect the processing of a relative clause ambiguity. In conducting these experiments, we distinguished between main clause/relative clause ambiguities which do or do not permit an active transitive analysis. Previous research (Liversedge et al., 2002; Paterson et al., 1999) suggested that whereas the parsing of ambiguities that allow the transitive analysis might be impervious to the processing demands of contrastive focus, the parsing of ambiguities that do not permit this analysis might be susceptible to its influence. The results of the present studies suggest that this is indeed the case.

In Experiment 1 we found that readers had difficulty in parsing relative clause ambiguities that temporarily permitted the active transitive analysis, despite the presence of only, and irrespective of an interrogative context. In Experiment 2, the structure of the ambiguous sentences ruled out the possibility of a transitive analysis, with the sentences being ambiguous between a relative clause analysis and an intransitive analysis. Under these conditions, contrastive focus did affect how the ambiguity was processed. Readers had no difficulty when only and a which-phrase created an expectation for modifying information. But they did have difficulty when a whether-phrase specified a contrast between two sets, thereby obviating the need for modifying information, as observed in increased regression path reading times for the post-critical region of ambiguous sentences.

A second key finding from Experiment 1 was that although only and an interrogative context did not affect syntactic processing, it did affect how easily sentences were semantically integrated with the reader’s current discourse model. Sentences were processed more easily when they provided information that was congruent with expectations generated by wh-word contexts, irrespective of whether the sentences were ambiguous or unambiguous. Thus, we found that regression path reading times for the post-critical region, and total reading times for the critical region were shorter for both ambiguous and unambiguous sentences when these occurred in which-contexts rather than who-contexts. We took this to show that the semantic integration of relative clause information was easier in which-contexts that had created an expectation for modifying information than in who-contexts that had not. This finding demonstrated that our interrogative manipulation had influenced the processing of the relative clause sentences used in Experiment 1, but, crucially, that it had done so without affecting initial parsing decisions.

It should be clear that, when considered together, the results from Experiments 1 and 2 are problematic for modular processing accounts, such as Garden path theory, which require that the initial parsing of syntactic ambiguities is unaffected by extra-syntactic factors. Contrary to this theory, our results suggest that referential factors can affect the processing of syntactic ambiguities, particularly when the most strongly preferred analysis is unavailable and the parser must select between dispreferred alternatives. We noted, however, that proponents of Garden path theory (e.g., Frazier, 1995) might argue that these effects are due to context triggering rapid reanalysis of the ambiguity rather than guiding initial parsing decisions.

The present results are also problematic for Ni et al.’s (1996) account in terms of Referential theory. Ni et al. claimed that contrastive focus can eliminate parsing difficulty for syntactic ambiguities; however, our results indicate that this depends on the ambiguity, some forms of ambiguity being more susceptible to its influence than others. Similarly, whereas Sedivy (2002) claimed that only and prior referential context jointly determine
which analysis of an ambiguity is initially selected, our
results demonstrate that this is not always the case,
but depends on which analyses are available to the pars-
er, and whether one is much more strongly preferred
than the others. Instead, the present results are most
readily accommodated by a theoretical account requiring
that the alternative syntactic analyses of an ambiguity
are constructed in parallel, and that referential
factors, such as the processing of contrastive focus,
can influence which analysis is selected. Constraint-satisf-
faction theory (e.g., MacDonald, 1994; MacDonald
et al., 1994; Tanenhaus & Trueswell, 1995) is the best
known of these accounts, but other theories also allow
for the parallel construction and evaluation of alterna-
tive syntactic analyses (e.g., Unrestricted Race theory:
Van Gompel & Pickering, 2001; Van Gompel, Pickering,
Pearson, & Liversedge, 2005). Constraint-satisfaction
theory differs from the other accounts by requiring that
the rival analyses of an ambiguity compete for adoption,
with various sources of linguistic and non-linguistic
information imposing constraints that support one or
other of the possible analyses.

Constraint-satisfaction theory can accommodate the
present results by requiring that there are strong syntac-
tic constraints supporting the construction of an active
transitive analysis of an ambiguity, whenever it is avail-
able. Referential factors will also impose constraints on
ambiguity resolution. Thus, whereas only and a which-
context supports a relative clause analysis of the ambi-
guity, only and either a who- or a whether-context does
not. To explain the Experiment 1 results, the theory
would require that syntactic constraints supporting the
transitive analysis over-ride referential processing pref-
ferences, causing readers initially to adopt this analysis
of the ambiguity irrespective of the interrogative con-
text. Having adopted the transitive analysis, readers
must reanalyze it if subsequently proves to be deficient.

The theory can account for the Experiment 2 results
by requiring that, with the transitive analysis ruled out,
syntactic constraints supporting either the intransitive or
relative clause analyses are much weaker, and more equally balanced; and that under these conditions, refer-
ential factors influence the competition between them.
Thus, using only and a which-context to create an expec-
tation for modifying information biases the processor
into adopting the relative clause analysis of the ambigu-
y, thereby avoiding difficulty at disambiguation. By
contrast, only and a whether-context does not require
modifying information. Consequently, readers are less
likely to adopt this analysis, and to incur a processing
cost at syntactic disambiguation.

More problematic for advocates of the Constraint-
satisfaction theory was our finding that off-line sentence
completions were not predictive of on-line parsing pref-
ences. Its proponents (e.g., Spivey & Tanenhaus, 1998;
Spivey-Knowlton & Sedivy, 1995) often use sentence
completion data to estimate the relative strength of con-
straints favoring the alternative analyses of an ambiguity
at particular points in a sentence. However, we found
that although sentence completions were informative
about the effectiveness of only and an interrogative con-
text in causing readers to anticipate modifying informa-
tion, they were not necessarily informative about whether this affected the initial parsing of the ambiguity.
Thus, in Experiment 1, the sentence completion data
indicated that only and which more strongly predisposed
readers to adopting the relative clause analysis of the
ambiguity than did only and who. However, this affected
semantic integration rather than parsing decisions, since
both ambiguous and unambiguous relative clause sen-
tences were easier to integrate with which- than who-con-
texts. In Experiment 2, the sentence completions
indicated that only with a which-context were reliably
more likely to predispose readers to adopting the relative
clause analysis of the ambiguity than only with a
whether-context. However, in this case the relative pref-
ence did affect parsing decisions, with readers having
difficulty in processing the ambiguity in whether-con-
texts, but not in which-contexts. Thus, although sentence
completions may be informative about contextual influ-
ences on completion preferences, it is not always the case
that these preferences reflect initial parsing decisions.
We note that several other researchers have found a mis-
mash between sentence completion data and on-line
reading times (Clifton, Kennison, & Albrecht, 1997; Liv-
ersedge, Paterson, et al., 1998, 1998; Liversedge et al.,
2002; Murray & Liversedge, 1994; Paterson et al.,
1999; Pickering, Traxler, & Crocker, 2000; Van Gompel
& Pickering, 2001). Although such findings do not con-
stitute evidence against Constraint-satisfaction theory
per se, they do suggest that sentence completion meth-
oodology does not provide a reliable index of on-line
parsing decisions.

We attributed the different pattern of results in
Experiments 1 and 2 to post-verbal information affecting
the availability of a transitive analysis prior to syntactic
disambiguation. However, other explanations are possi-
ble. One such explanation might be that the ambiguous
verbs used in Experiment 1 were more biased towards a
transitive analysis of the ambiguity than those in Exper-
iment 2, and that the differing transitivity biases were
responsible for our effects. In other words, readers might
have had more processing difficulty when attempting to
overcome a strong transitivity bias in Experiment 1 than
a weak transitivity bias in Experiment 2. Alternatively, it
may have been harder for readers to assign a relative
clause analysis to the ambiguity for sentences in Exper-
iment 1 than in Experiment 2, irrespective of the avail-
ability of a transitive analysis. Assigning a relative
clause analysis in Experiment 1 involved goal extraction,
whereas it involved theme extraction for the sentences in
Experiment 2. Relative clause analyses involving some
forms of extraction are more difficult to process than others (e.g., Gibson, 1998; Gibson & Hsiao, 2005).

Therefore, it may be that extraction from a goal position was hard in Experiment 1 while extraction from a theme position was easy in Experiment 2. Future research could clarify this issue.

At least one other piece of evidence is consistent with our account. MacDonald (1994) also explored the effect of post-verbal evidence for a transitive analysis of an ambiguity by varying the first word that followed an ambiguous verb so that it either was or was not consistent with a transitive analysis. For example, including the preposition in in the sentence The dictator fought in the coup was hated immediately rules out the possibility of a transitive analysis of fought. However, if the word just is included after the verb, as in The dictator fought just after dawn was hated, it prolongs the possibility of a transitive analysis (e.g., the sentence could continue as just one soldier). Readers had more difficulty in processing sentences when the possibility of a transitive analysis was prolonged than when it was short-lived. The effect cannot be attributed to any transitivity biases associated with individual verbs, since both forms of the sentence included the same ambiguous verb. Furthermore, it cannot be attributed to differences in the processing of different relative clause types, since the sentences ultimately were disambiguated as the same type of relative clause construction. Instead, the effect appears to be due to the post-verbal information (i.e., in or just) either ruling out or prolonging the possibility of a transitive analysis of the ambiguity.

Finally, like Sedivy (2002), we used materials in which contrastive focus and context either did or did not create an expectation for a relative clause, but the propositional content of the relative clause did not uniquely specify a referent in the prior discourse context. In this respect, our manipulation was not of the type often is used when testing the Referential theory (e.g., Altmann & Steedman, 1988), since this theory stipulates that readers prefer to adopt the relative clause analysis of an ambiguity when the propositional content of this analysis uniquely identifies a discourse referent.

Neither Sedivy nor Ni et al. (1996) included the same stipulation in their account of the influence of contrastive focus on parsing. Nevertheless, our results suggest that Sedivy was correct in supposing that a combination of context and contrastive focus would bias readers into anticipating relative clause information, regardless of whether it uniquely identified a discourse referent. However, we also found that the contextual manipulation did not impinge on initial parsing decisions for the temporarily transitive ambiguity investigated in Experiment 1. It is yet to be determined whether further strengthening the contextual manipulation by additionally requiring that the relative clause does uniquely identify a discourse referent will be sufficient to over-ride the preference for a transitive analysis of a relative clause ambiguity.

In conclusion, our studies contribute to resolving the controversy concerning the influence of contrastive focus on the parsing of relative clause ambiguities (Clifton et al., 2000; Liversedge et al., 2002; Ni et al., 1996; Patterson et al., 1999; Sedivy, 2002), by showing that syntactic processing preferences modulate the influence of contrastive focus on parsing decisions. The results suggest that when there is a strongly preferred syntactic analysis, it will be adopted regardless of the influence of contrastive focus. However, if the parser is selecting between relatively dispreferred analyses, then under these conditions, the choice may be influenced by the processing demands associated with the computation of contrastive focus. We have suggested that these results are consistent with a processor that integrates multiple sources of information, including referential factors, when resolving syntactic ambiguities.

Uncited reference

Pearlmutter and MacDonald (1995).

Appendix A

Sentence materials used in Experiment 1. Contexts were interrogatives formed from a which- or who-phrase, and followed by either an ambiguous reduced or an unambiguous unreduced relative clause sentence.

1. Harry wondered [which actors/who] received an apology. Only actors [who were] refused an audition received an apology within the week.
2. Liz wondered [which actresses/who] gave a curtsy. Only actresses [who were] passed a bouquet gave a curtsy immediately.
3. Tom wondered [which builders/who] fitted a kitchen. Only builders [who were] paid a deposit fitted a kitchen within the week.
4. Bronwen wondered [which children/who] ate an egg. Only children [who were] passed a spoon ate an egg straightaway.
5. Phil wondered [which clerks/who] wanted a job. Only clerks [who were] issued a work permit wanted a job before the summer.
6. Alice wondered [which directors/who] sent a reply. Only directors [who were] faxed a message sent a reply the next day.
7. Jeremy wondered [which editors/who] contacted a lawyer. Only editors [who were] served a writ contacted a lawyer straightaway.
8. Caroline wondered [which executives/who] found a confidential file. Only executives [who were] typed a letter found a confidential file later that day.
9. John wondered [which farmers/who] ploughed a field. Only farmers [who were] sold a tractor ploughed a field that afternoon.
10. Sally wondered [which footballers/who] scored a goal. Only footballers [who were] offered an orange scored a goal straightaway.

11. Peter wondered [which foreigners/who] drank a coffee. Only foreigners [who were] bought a hamburger drank a coffee at the same time.

12. Louise wondered [which gamblers/who] placed a bet. Only gamblers [who were] lent a tenner placed a bet the next day.

13. Keith wondered [which nurses/who] insulted a patient. Only nurses [who were] bought a present insulted a patient today.

14. Nicky wondered [which girls/who] solved an equation. Only girls [who were] sold a calculator solved an equation the same afternoon.

15. Bernard wondered [which thugs/who] surrendered a weapon. Only thugs [who were] granted an amnesty surrendered a weapon straightaway.

16. Gillian wondered [which wives/who] developed a rash. Only wives [who were] knitted a scarf developed a rash within a week.

17. Terry wondered [which inspectors/who] wore a disguise. Only inspectors [who were] assigned a case wore a disguise the next day.

18. Hayley wondered [which journalists/who] wrote a novel. Only journalists [who were] asked a favour wrote a novel that year.

19. Mike wondered [which policemen/who] caught a criminal. Only policemen [who were] sent a bribe caught a criminal immediately.

20. Rita wondered [which lecturers/who] got a promotion. Only lecturers [who were] awarded a fellowship got a promotion within the year.


22. Gloria wondered [which politicians/who] gave an answer. Only politicians [who were] asked a question gave an answer straightaway.

23. George wondered [which reviewers/who] wrote an article. Only reviewers [who were] sent a book wrote an article within the week.

24. Nicola wondered [which salesman/who] bought a car. Only salesmen [who were] paid a commission bought a car the next day.

25. Reg wondered [which schoolboys/who] wrote an essay. Only schoolboys [who were] lent a book wrote an essay the next day.

26. Fiona wondered [which spectators/who] made a complaint. Only spectators [who were] told a joke made a complaint that evening.

27. Barry wondered [which stockbrokers/who] called a relative. Only stockbrokers [who were] made an offer called a relative within the hour.

28. Lorna wondered [which suspects/who] signed a confession. Only suspects [who were] refused a lawyer signed a confession within the hour.

29. Geoff wondered [which teenagers/who] invited a juggler. Only teenagers [who were] allowed a party invited a juggler straightaway.

30. Rachel wondered [which toddlers/who] lost a rattle. Only toddlers [who were] peeled a banana lost a rattle under the sofa.

31. Josh wondered [which tradesmen/who] bought a drink. Only tradesmen [who were] offered a job bought a drink straightaway.

32. Debbie wondered [which visitors/who] bought a gift. Only visitors [who were] told a story bought a gift when they arrived.

33. Jake wondered [which widows/who] married a toyboy. Only widows [who were] left a fortune married a toyboy that same year.

34. Louisa wondered [which women/who] phoned a salesman. Only women [who were] delivered a catalogue phoned a salesman the same day.

35. Stan wondered [which workers/who] smoked a cigarette. Only workers [who were] allowed a tea-break smoked a cigarette that morning.

36. Jade wondered [which youths/who] bought a jacket. Only youths [who were] posted a cheque bought a jacket yesterday.
1635 11. Robert wondered [which politicians/whether the politicians] or the public celebrated. Only politicians [who were] cheered in the houses of parliament celebrated at home if they had won the vote.

1636 12. Hayley wondered [which musicians/whether the musicians or the singers] impressed the manager. Only musicians [who were] tutored in the studio impressed the manager if they had played well.

1637 13. Steve wondered [which teachers/whether the teachers or the students] worried. Only teachers [who were] interviewed in the common room worried all day if they had been threatened with redundancy.

1638 14. Stella wondered [which women/whether the women or the men] purchased a portrait. Only women [who were] painted in the studio purchased a portrait later if they were impressed.

1639 15. Geoff wondered [which teachers/whether the teachers or the headmaster] thanked the guest speaker. Only teachers [who were] assisted in the fete thanked the guest speaker afterwards if they had enjoyed the speech.

1640 16. Lorna wondered [which doctors/whether the doctors or the chemists] relaxed that afternoon. Only doctors [who were] studied in the laboratory relaxed that afternoon if they had completed the experiment.

1641 17. Chris wondered [which students/whether the students or the lecturers] became drunk. Only students [who were] served in the wine bar became drunk that evening if they had finished their shift.

1642 18. Claire wondered [which postgraduates/whether the postgraduates or the research assistants] continued their duties. Only postgraduates [who were] instructed in the college continued their duties if they had time.

1643 19. Richard wondered [which footballers/whether the footballers or the cricketers] triumphed in a game. Only footballers [who were] coached in the stadium triumphed in a game if they had been training.

1644 20. Rachel wondered [which gymnasts/whether the gymnasts or the dancers] improved their routine. Only gymnasts [who were] directed in the gymnasium improved their routine if they had practised.

1645 21. Tom wondered [which pensioners/whether the pensioners or the housewives] drank in the pub. Only pensioners [who were] helped in the charity shop drank in the pub if they had found a bargain.

1646 22. Rebecca wondered [which postgraduates/whether the postgraduates or the undergraduates] succeeded in their exams. Only postgraduates [who were] taught in the summer school succeeded in their exams if they had revised.

1647 23. Phil wondered [which mechanics/whether the mechanics or the students] became qualified engineers. Only mechanics [who were] trained in the workshop became qualified engineers if they had worked hard.

1648 24. Alison wondered [which visitors/whether the visitors or the caterers] complimented the host. Only visitors [who were] entertained in the bar complimented the host if they had stayed over.

1649 25. George wondered [which mountaineers/whether the mountaineers or the ramblers] succeeded in the climb. Only mountaineers [who were] trained in the Peaks succeeded in the climb if they had taken their time.

1650 26. Caroline wondered [which artists/whether the artists or the musicians] enjoyed the lessons. Only artists [who were] taught in the college enjoyed the lessons if they had made new friends.

1651 27. Keith wondered [which gangsters/whether the gangsters or the thugs] joined the rival gang. Only gangsters [who were] fought in the alleyway joined the rival gang if they had lost the battle.

1652 28. Sue wondered [which mercenaries/whether the mercenaries or the snipers] concealed themselves during the day. Only mercenaries [who were] hunted in the mountains concealed themselves during the day if they had been afraid.

1653 29. Gary wondered [which managers/whether the managers or the directors] expected a wage rise. Only managers [who were] telephoned in the day expected a wage rise if they had met their targets.

1654 30. Julia wondered [which youths/whether the youths or the adults] visited a psychiatrist. Only youths [who were] bullied in the playground visited a psychiatrist if they were depressed.

1655 31. Tony wondered [which fighter pilots/whether the fighter pilots or the soldiers] parachuted into the desert. Only fighter pilots [who were] attacked in the day parachuted into the desert if they had been shot.

1656 32. Helen wondered [which spies/whether the spies or the terrorists] threatened the manager. Only spies [who were] filmed in the seedy motel threatened the manager on their way out.

References


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