

**Global and local influences on adjective-noun combination:**

**A limit on incrementality**

Steven Frisson

University of Massachusetts and University of Antwerp

Martin J. Pickering

University of Edinburgh

Brian McElree

New York University

Word count: 3996

## Abstract

An eye-tracking experiment examined the on-line interpretation of complex expressions like heavy smoker. Preceding contexts biased the interpretation either towards a subsective (someone who smokes a lot) or an intersective interpretation (a smoker who weighs a lot). Results indicate that the global context does not completely override local preferences for how the expression would be interpreted on its own. These results constrain the notion of incrementality in sentence comprehension and suggest that strict incrementality, in which each word is immediately and fully interpreted as soon as it is encountered, cannot be maintained. Alternative theories and comparisons to existing research in other domains are discussed.

Recent research has particularly emphasized the incremental nature of language comprehension. Since Marslen-Wilson (1973), evidence has accumulated that people generally semantically interpret sentence fragments as they are encountered (e.g., Altmann & Steedman, 1988; Garrod, Freudenthal, & Boyle, 1994; Traxler & Pickering, 1996). Recently, there have been some suggestions that interpretation is as incremental as it possibly could be, with people employing all available information to fix an interpretation for an expression as early as possible (Sedivy, Tanenhaus, Chambers, & Carlson, 1999). Additionally, other researchers have suggested that effects of global context can completely override local interpretations that may be incompatible with it (Hess, Foss, & Carroll, 1995).

Researchers have not precisely defined what limits there might be to incrementality. In this paper, we attempt to define these limits by proposing what we term strict incrementality. According to this position, people immediately interpret an expression in a way that is compatible with currently global context if they can, and do not subsequently consider alternatives unless the initial interpretation turns out to be implausible (or anomalous). A particularly clear test case concerns the interpretation of noun phrases such as the heavy smoker. In an otherwise neutral context, people are likely to combine the adjective and noun in such a way that the noun phrase is taken to denote a person who smokes heavily. Linguists refer to this as a subsective interpretation, because the adjective picks out a subset of the set denoted by the noun (Kamp & Partee, 1995). However, this local interpretation may not be plausible in all contexts. In a context like Because of all the fast food he consumes, the heavy smoker had to see a doctor, the noun phrase is likely to be interpreted as a heavy person who happens to be a smoker. This is an intersective interpretation, because it is a simple

intersection of the interpretation of the adjective and a noun (e.g., the heavy smoker means someone who is heavy and a smoker). Here, prior context supports the global “heavy-weighing” interpretation. More importantly, the context places a strong constraint on the likely interpretation of heavy as soon as heavy is encountered, and the interpretation remains plausible throughout the rest of the sentence. According to strict incrementality, people should adopt the global (heavy-weighing) interpretation at the adjective, and, moreover, should not consider the local (heavy-smoking) interpretation after processing the noun smoker.

Although strict incrementality may appear to be an extreme position, it is in accord with much of the experimental evidence since Marslen-Wilson (1973), who showed that some speech shadows could be affected by semantic context with 250msec of hearing a word. The more direct evidence for strict incrementality has come from “visual world” experiments, in which listeners’ eyes are monitored while they hear utterances and view scenes that may be compatible with those utterances. It is argued that the pattern of looks indicates how people are interpreting utterances as they hear them. For example, Sedivy, et al. (1999, Experiment 1; see also Eberhard, Spivey-Knowlton, Sedivy, & Tanenhaus, 1995) had participants respond to instructions like “Touch the plain red square,” when they were presented with an array containing different combinations of objects. When the array contained only one plain object, listeners tended to fixate that object soon after hearing plain. When it contained many plain objects but only one red one, they tended to fixate the appropriate object (i.e., the plain red one) soon after hearing red. When it contained more than one plain red object but only one plain red square, they fixated that object only after hearing square. Hence participants fixated the appropriate object as soon as disambiguation occurred. Sedivy et

al. (1999) argued that participants “actively consider all the referents that are compatible with the linguistic input at a particular point in time, continuously narrowing the set of possible referents until it is possible to identify a singleton set.” (p. 112). Importantly, the information is used as soon as it becomes available – although there is obviously a slight delay while the word is recognized and the eye movement is planned, there is no delay imposed for linguistic reasons. At the level of reference, then, visual world experiments provide some evidence for strict incrementality.

As Sedivy et al. (1999) noted, these experiments do not demonstrate how reference is determined for ambiguous words. In many cases, the meaning of different word forms appears only to be fixed by the following context, including some adjectives (red hair vs. red truck), prepositions (on the table vs. on Thursday), and verbs (John loved the Englishwoman vs. John loved the Viennese torte). In such cases, one account predicts that strict incrementality of reference would not occur (Clifton & Ferreira, 1989).

However, Sedivy et al. (1999) proposed an alternative hypothesis, whereby available information from the context can be used to pin down the meaning of a linguistic expression, with no principled limits on the degree of incrementality. To test this, they investigated whether visual context would fix the interpretation of an adjective like tall. Sedivy et al. asked participants to “pick up the tall glass ...” in a scene that contained a tall glass (target), a tall pitcher (competitor), a key (distracter), and either a short glass (contrast object) or a file folder (control). After hearing “the tall,” listeners in the control condition have no information to distinguish the target from the competitor (in neither case is it really necessary to add the adjective). But in the contrast condition, it would be particularly appropriate to say “the tall glass” to distinguish it from the short glass. For listeners to be sensitive to this information, they would have to interpret tall in

relation to the visual context. And this is what Sedivy et al. found: Listeners were more likely to fixate the tall glass immediately after hearing tall in the contrast versus the control condition. This suggests that interpretation of adjectives is incremental even when their meaning is ambiguous, at least when context supports a particular interpretation.

According to strict incrementality, context is used to determine interpretations at the earliest possible point. In Sedivy et al. (1999), this would mean that the disambiguated visual context (i.e., containing the small glass) would determine the interpretation of “the tall” at that point. However, Sedivy et al.’s findings do not license this strong conclusion. The fact that listeners considered the reference object more in the context with the contrast object than with the control does not mean that they fully disambiguated at this point, but only that they had begun the process of disambiguation.

Additionally, although immediate disambiguation may occur in the “visual world” context, one can legitimately question whether it necessarily occurs outside such contexts. The visual world provides information about the possible referents of words, but a linguistic context on its own often does not. It is therefore possible that interpretation is more incremental when it involves “linking” words to established referents in a visual context than when the linguistic context itself proposes the referents and places them in a mental model. So it is unclear whether strict incrementality holds for the processing of sentences like Because of all the fast food he consumes, the heavy smoker had to see a doctor. Do readers use the context to determine that heavy means “heavy -weighing” as soon as it is encountered, and never consider the “heavy -smoking” interpretation?

There is some relevant evidence from research concerned with global versus local influences on word recognition. One issue has been how local or global context affects the processing of unambiguous words. Hess et al. (1995) had participants name a critical word like poem in related or unrelated local contexts (e.g., the English major wrote the poem vs. the computer science major wrote the poem), which were combined with related or unrelated global contexts (e.g., when a computer science major wanted to express his love for a woman vs. when he was completing a computing project). They found that only global context had an immediate effect on naming times, thus suggesting that local relations are entirely overridden by global context. In contrast, Morris (1994) found that reading times on an unambiguous word were affected both by global context and by local context. There appears, therefore, to be disagreement about whether local context has an independent effect on lexical processing, or whether it can be entirely overridden by global factors.

Kambe, Rayner, and Duffy (2001) considered the processing of a biased ambiguous word (e.g., band, whose dominant meaning is “musical band” and subordinate meaning is “jewelry”). The subordinate bias effect is the finding that a word is harder to process than an unambiguous control if context supports the subordinate meaning (Duffy, Morris, & Rayner, 1988). An equivalent subordinate bias effect ensued whether global (sentence-external) or local (sentence-internal) context supported the subordinate meaning, suggesting that global context can influence local processing. However, when local context supported the subordinate meaning, global context had no further effect. For example, if local context disambiguated band as meaning “jewelry,” it was irrelevant whether global context was about weddings or rock concerts. This suggests some limits on the effects of global context.

Beyond this research, however, there has been little attempt to determine how local and global factors affect different aspects of comprehension. Additionally, in prior research there is considerable vagueness about where a division between local and global should be drawn, so there would be a benefit in considering cases of adjective-noun combination where, arguably, such a distinction can be precisely defined. To test whether strict incrementality holds generally in this domain, we contrasted sentences like the following:

1a. Because of all the fast food he consumes, the heavy smoker had to see a doctor.

(Global)

1b. Because he was so incredibly unhealthy, the heavy smoker had to see a doctor.

(Local)

1c. Because of all the fast food he consumes, the heavy teenager had to see a doctor.

(Global control)

Strict incrementality predicts that the context will assign the global (intersective, i.e., heavy-weighting) interpretation at heavy in (1a), as discussed above. If so, there is no need to consider the local, heavy-smoking interpretation, and hence processing disruption should not occur. If true, (1a) will not differ from (1c), where the global interpretation is adopted at the same point. In (1b), the context provides less clear evidence about the interpretation of heavy, but there is certainly no reason to assume that (1b) should be easier than (1a). In other words, there is no reason to assume difficulty with (1a). But if strict incrementality is wrong, readers will not fix an interpretation of heavy in (1a) or (1c). In (1c), there is no competing interpretation, hence no reason for difficulty. But in

(1a), the heavy-smoking interpretation should be activated, and hence there should be conflict between the global and local interpretations. Finally, no conflict should occur in (1b), because only the local interpretation is supported (i.e., the global context is consistent with the heavy-smoking interpretation).

Within the context of the local/global literature, strict incrementality contrasts with what we term a local-first account, in which the local interpretation is obtained even if it is incompatible with global context. Hence, the heavy smoker is initially interpreted as referring to smokers who smoke heavily even though the phrase follows the context Because of all the fast food he consumes. When the conflict between this interpretation and global context becomes apparent, the reader must select one of the possible interpretations (here, the global interpretation is likely adopted). Crucially, this account assumes that compositional processes can be ‘insulated,’ at least initially, from broader contextual effects. Strict incrementality is compatible with a global-first account, in which global context overrides the local context entirely, so that heavy smoker is immediately interpreted as referring to a smoker who weighs a lot following a context like Because of all the fast food he consumes .... This account therefore assumes no special status to local context, and, arguably, eschews any principled distinction between local and global context. Notice, however, that the global-first account makes a more radical prediction than required by strict incrementality, because strict incrementality only requires that people will adopt the global interpretation when the ambiguous word (e.g., heavy) precedes the expression that local disambiguates it (e.g., smoker).

## Experiment

Method

Participants. Thirty native British English speaking students from the University of Edinburgh were paid to participate. All had normal or corrected-to-normal vision.

Items. We constructed 24 sets of items like (4) above (see Appendix). To insure that our contexts strongly constrain the interpretation of the following adjectives, we asked 22 further participants to complete, in any way they liked, fragments like Because of all the fast food he consumes, the heavy ..., taken from the Global and Global Control conditions (1a and 1c). Participants completed 81.3% of the 528 responses with a response that two raters judged compatible with the global context (e.g., heavy was taken to mean heavy-weighing), with 15.7% being ambiguous, 1.1% being other responses (e.g., adjective interpreted as a noun), and only 1.9% of responses being compatible with the local interpretation. Hence, we can be confident that the contexts were strongly constraining. Additionally, cloze values for the particular nouns in the Global and Global Control conditions were very low, 1.9% and 0.4% respectively, so any difference between these conditions cannot be due to differences in the predictability of the nouns.

Procedure. We monitored the movements of participants' right eyes during reading using a Fourward Technologies Dual Purkinje Generation 6 eye-tracker (angular resolution: 10 min arc). Items were displayed on a VGA color screen 61 cm from participants' eyes (4 characters per degree of visual angle). Gaze location was monitored every millisecond, and the software sampled the tracker's output to determine the time and location of fixations. Participants were instructed to read at their normal rate for comprehension and were kept in place with a bite bar and head rest. Yes/no comprehension questions appeared on the screen after 50% of the trials.

After determining which line of the text was fixated, an automatic procedure pooled short contiguous fixations. This procedure assimilated all fixations shorter than 80 ms and within one character space of another fixation to that fixation. Fixations shorter than 80 ms and not within one character space to another fixation were excluded because we presume that readers hardly extract any information during such a short fixation (see Rayner & Pollatsek, 1989). Fixations longer than 1200 ms were also excluded since these were most probably due to tracker loss.

We defined four regions as follows: preceding context, the adjective, the noun, and a spill-over region (the following word or two words if less than 4 characters and not the last word of the first line)<sup>1</sup>. An example is in (5), with the regions indicated by slashes.

5. Because of all the fast food he consumes, the/ heavy/ smoker/ had to/ see a doctor.

We performed the following analyses. First fixation time is the initial fixation time in a region. First-pass time is the sum of all fixations occurring within a region before the first fixation outside the region. For single-word regions, this corresponds to gaze duration (Rayner & Duffy, 1986). Total time is the sum of all fixations within a region. Second-pass time is rereading times for a region after the eyes has moved out of that region to the right. Whereas first fixation and first-pass time measure fairly early processing, second-pass time and total time pay attention to the time spent re-reading, and are therefore sensitive to later aspects of processing. The reported means and ANOVAs for all measures except second-pass time are based on reading times excluding

trials upon which readers skipped a region on first pass. Analyses for which these excluded trials were included as zeroes produced nearly identical results.

-----  
 INSERT TABLE 1 ABOUT HERE  
 -----

## Results

We first excluded trials on which tracker loss occurred (0.7% of the trials), and trials when the reader skipped the first region or two consecutive regions on first-pass were also excluded (3.3% of the trials), as we assume that readers did not process the sentence adequately. Reading times over 3SD from the means were excluded from the analyses. Reading times are in Table 1.

Contrary to the strict incrementality account, reading times indicated that the presence of a local interpretation that was incompatible with the global interpretation caused processing difficulty. On the noun region, one-way ANOVAs revealed an effect on second-pass times on the noun region,  $F_1(2,58)=6.75$ ,  $p<.01$ ,  $F_2(2,46)=6.09$ ,  $p<.01$ , with means comparisons revealing that the Global condition was harder than both the Local condition,  $F_1(1,29)=11.27$ ,  $p<.01$ ,  $F_2(1,23)=14.23$ ,  $p<.001$  and the Global Control condition,  $F_1(1,29)=5.87$ ,  $p<.05$ ,  $F_2(1,23)=4.10$ ,  $p<.06$ .

The same pattern of results occurred on the spill-over region on the first fixation time and total-time measures. For first fixation times, ANOVAs revealed a main effect,  $F_1(2,58)=4.32$ ,  $p<.05$ ,  $F_2(2,46)=5.02$ ,  $p<.05$ . The Global condition was harder than the Local condition,  $F_1(1,29)=3.37$ ,  $p<.08$ ,  $F_2(1,22)=4.09$ ,  $p<.06$  and the Global Control

---

<sup>1</sup> Probability of fixation in the spill-over region was .85 for Local, .81 for Global, and .80 for Global Control.

condition,  $F_1(1,29)=8.83$ ,  $p<.01$ ,  $F_2(1,23)=6.41$ ,  $p<.05$ . The main effect for total times was also significant,  $F_1(2,58)=4.76$ ,  $p<.05$ ,  $F_2(2,46)=3.43$ ,  $p<.05$ . The Global condition was harder than the Local condition,  $F_1(1,29)=9.65$ ,  $p<.01$ ,  $F_2(1,23)=6.70$ ,  $p<.05$  and marginally harder than the Global Control condition,  $F_1(1,29)=3.88$ ,  $p<.06$ ,  $F_2(1,23)=3.00$ ,  $p<.1$ . (There also was a weak trend toward a main effect on first-pass,  $F_1(2,58)=1.00$ ,  $p>.1$ ,  $F_2(2,46)=2.74$ ,  $p<.08$ .)

### Discussion

The experiment demonstrated that a strongly biasing preceding context did not remove the strong preference to select the local interpretation: Participants had difficulty reading heavy smoker in a context that supported the ‘heavy -weighing’ interpretation, presumably because they were unable to ignore the local ‘heavy -smoking’ interpretation. In contrast, they had no difficulty reading heavy smoker in a context that was consistent with the ‘heavy -smoking’ interpretation, or with heavy teenager in the same context. It therefore appears that readers consider the local reading whether or not the global reading is congruent with this interpretation. Previous work suggests that global context does not entirely override local context in the process of lexical access and lexical ambiguity resolution (Kambe et al., 2001; Morris, 1994). Our results suggest that similar principles hold for the interpretation of complex expressions. Both findings suggest there are limits on effectiveness of global information when it conflicts with local information.

Furthermore, these results cast doubt on strict incrementality. Completion norms suggest that the context was strong enough to provide clear support for the global interpretation of the adjective (e.g., heavy). Therefore, if each word was assigned a

specific interpretation consistent with the global context at the earliest possible moment, people should have adopted the global interpretation for the noun phrase (in this case, heavy-weighing smoker). If so, there should have been no difficulty with the Global condition as compared to the Local and the Global Control conditions. To the contrary, the Global condition did disrupt readers. This means that readers did not fully commit to the global interpretation of the adjective at the earliest possible moment.

We propose that people retained some element of doubt about the interpretation of the adjective when it was first encountered, even though context was strong enough to disambiguate it. One variant of this proposal is that readers did not interpret the adjective initially (i.e., while processing the adjective itself), but rather delayed for at least one word until processing the head noun in order to determine whether the immediately following context was relevant. Such a possibility requires that people can maintain an underspecified interpretation that is compatible with more than one specific sense for short periods of time. Some studies support this assumption (Frazier, 1999; Frazier & Rayner, 1990; Frisson & Pickering, 1999, 2001; Pickering & Frisson, 2001) and, indeed, suggest that even a strong context need not lead to sense disambiguation.

A closely related variant proposes that people use global information to begin disambiguating the adjective toward a specific sense immediately, but do not normally complete this process before processing immediately following material. Accordingly, in the Global condition, readers begin favoring the ‘heavy -weighing’ interpretation of the heavy smoker when they encounter the adjective, but do not entirely excluded alternative interpretations of it. Upon reading the noun, they consider the alternative ‘heavy - smoking’ interpretation, and the ensuing competition leads to processing difficulty. This would not happen in the Global control condition, because there was no likely alternative

interpretation for the heavy teenager. In the Local condition, the context did not support the ‘heavy -weighing’ interpretation, so the alternative interpretation would be obtained without conflict.

Both variants are consistent with models that have been proposed for syntactic ambiguity resolution, where multiple constraints are brought to bear as soon as they become available but, crucially, interact over time (e.g., McRae, Spivey-Knowlton, & Tanenhaus, 1998). Our results could be compatible with a model in which readers ignore global information entirely until the head noun is encountered, but such a model would be incompatible with the visual-world experiments on adjective interpretation (Sedivy et al., 1999). However, the visual-world experiments provide evidence for when people begin to consider a particular interpretation (given the particular visual environment employed), but crucially do not demonstrate when people have fixed on a particular interpretation to the exclusion of others. Visual-world experiments may suggest no principled limit on incrementality, but reading-time experiments such as ours suggest that strict incrementality is untenable.

## REFERENCES

- Altmann, G. T. M., & Steedman, M. (1988). Interaction with context during human sentence processing. Cognition, *30*, 191-238.
- Clifton, C., Jr., & Ferreira, F. (1989). Parsing in context. Language and Cognitive Processes, *4*, SI77-SI104.
- Duffy, S. A., Morris, R. K., & Rayner, K. (1988). Lexical ambiguity and fixation times in reading. Journal of Memory and Language, *27*, 429-446.
- Eberhard, K M, Spivey-Knowlton, M.J., Sedivy J.C., & Tanenhaus, M.K. (1995). Eye movements as a window into real-time spoken language processing in natural contexts. Journal of Psycholinguistic Research, *24*, 409-436.
- Frazier, L. (1999). On sentence interpretation. Dordrecht: Kluwer Academic Publishers.
- Frazier, L. & Rayner, K. (1990). Taking on semantic commitments: Processing multiple meanings vs. multiple senses. Journal of Memory and Language, *29*, 181-200.
- Frisson, S., and Pickering, M.J. (1999). The processing of Metonymy: Evidence from eye movements. Journal of Experimental Psychology: Learning, Memory, and Cognition *25*, 1366-1383.
- Frisson, S., and Pickering, M.J. (2001). Figurative language processing in the Underspecification Model. Metaphor and Symbol, *16*, 149-171.
- Garrod, S., Freudenthal, S., & Boyle, E. (1994). The role of different types of anaphor in the on-line resolution of sentences in a discourse. Journal of Memory and Language, *33*, 39-68.

- Hess, D. J., Foss, D. J., & Carroll, P. (1995). Effects of global and local context on lexical processing during language comprehension. Journal of Experimental Psychology: General, 124, 62-92.
- Kambe, G., Rayner, K., & Duffy, S.A. (2001). Global context effects on processing lexically ambiguous words: Evidence from eye fixations. Memory & Cognition, 29, 363-372.
- Kamp, H. and Partee, B.H. (1995). Prototype theory and compositionality. Cognition, 57, 129-191.
- Marslen-Wilson, W.D. (1973). Linguistic structure and speech shadowing at very short latencies. Nature, 244, 522-523.
- McRae, K., Spivey-Knowlton, M. J., & Tanenhaus, M. K. (1998). Modeling the influence of thematic fit (and other constraints) in on-line sentence comprehension. Journal of Memory and Language, 38, 283- 312.
- Morris, R.K. (1994). Lexical and message level sentence context effects on fixation times in reading. Journal of Experimental Psychology: Learning, Memory & Cognition, 20, 92-103.
- Pickering, M.J., and Traxler, M.J. (1998). Plausibility and recovery from garden paths: an eye-tracking study. Journal of Experimental Psychology: Learning, Memory, and Cognition, 24, 940-961.
- Pickering, M.J., and Frisson, S. (2001). The semantic processing of verbs: Evidence from eye movements. Journal of Experimental Psychology: Learning, Memory, and Cognition, 27, 556-573.

- Rayner, K., and Duffy, S.A. (1986). Lexical complexity and fixation times in reading: effects of word frequency, verb complexity, and lexical ambiguity. Memory & Cognition, 14, 191-201.
- Rayner, K. and Pollatsek, A. (1989). The psychology of reading. Englewood Cliffs: Prentice Hall.
- Sedivy, J.C, Tanenhaus, M.K., Chambers, C.G., & Carlson, G.N. (1999). Achieving incremental semantic interpretation through contextual representation. Cognition, 71, 109-147.
- Traxler, M. J., & Pickering, M. J. (1996). Plausibility and the processing of unbounded dependencies: an eye-tracking study. Journal of Memory and Language, 35, 454-475.

## APPENDIX: EXPERIMENTAL ITEMS

Version a = intersective preceding context, subsective bias: Global

Version b = subsective preceding context, subsective bias: Local

Version c = intersective preceding context, no subsective bias: Global Control

The “/” marks delimit the regions of analysis. The final “/” mark also indicates the line break.

1.

a. Even though he had lifted weights for years, the/ strong/ applicant/ was not/ impressive.

b. Even though he had the right qualifications, the/ strong/ applicant/ was not/ impressive.

c. Even though he had lifted weights for years, the/ strong/ fireman/ was not/ impressive.

2.

a. In the 100m race at the office sports day, the/ fast/ typist/ beat/ all of her/ colleagues.

b. In the competition for the best employee, the/ fast/ typist/ beat/ all of her/ colleagues.

c. In the 100m race at the office sports day, the/ fast/ hurdler/ beat/ all of his/ colleagues.

3.

a. Because of all the fast food he consumes, the/ heavy/ smoker/ had to/ see a/ doctor.

b. Because he was so incredibly unhealthy, the/ heavy/ smoker/ had to/ see a/ doctor.

c. Because of all the fast food he consumes, the/ heavy/ teenager/ had to/ see a/ doctor.

4.

- a. In the paintball game between the publishers, the/ accurate/ translator/ won/ the prize.
- b. In the annual competition at the publishers, the/ accurate/ translator/ won/ the prize.
- c. In the paintball game between the publishers, the/ accurate/ apprentice/ won/ the prize.

5.

- a. At his 100th birthday party, my/ old/ friend/ received/ a silver watch./
- b. At our annual class reunion, my/ old/ friend/ received/ a silver watch./
- c. At his 100th birthday party, my/ old/ father/ received/ a silver watch./

6.

- a. During the sprinting session, the/ quick/ thinker/ outdid/ all of the others./
- b. During the testing session, the/ quick/ thinker/ outdid/ all of the others./
- c. During the sprinting session, the/ quick/ walker/ outdid/ all of the others./

7.

- a. Because he constantly complains, the/ difficult/ writer/ was not/ liked by/ many.
- b. Because he uses obscure references, the/ difficult/ writer/ was not/ liked by/ many.
- c. Because he constantly complains, the/ difficult/ convict/ was not/ liked by/ many.

8.

- a. Having taken a long steamy bath, the/ dirty/ politician/ retired/ to the/ living room.
- b. Having accepted yet another bribe, the/ dirty/ politician/ retired/ to the/ living room.
- c. Having taken a long steamy bath, the/ dirty/ youngster/ retired/ to the/ living room.

9.

a. Being prepared to follow any instructions, the/ flexible/ acrobat/ became/ very/

popular.

b. After performing such complicated manoeuvres, the/ flexible/ acrobat/ became/ very/

popular.

c. Being prepared to follow any instructions, the/ flexible manager/ became/ very/

popular.

10.

a. Because she wore an exquisite dress, the/ elegant/ ballerina/ was admired/ by/ many.

b. Making all movements seem effortless, the/ elegant/ ballerina/ was admired/ by/ many.

c. Because she wore an exquisite dress, the/ elegant/ princess/ was admired/ by/ many.

11.

a. Because he suffered from a wasting disease, the/ weak/ leader/ was continually/

ignored.

b. Because he couldn't control his own staff, the/ weak/ leader/ was continually/ ignored.

c. Because he suffered from a wasting disease, the/ weak/ infant/ was continually/

ignored.

12.

a. Because he has withstood physical assaults, the/ tough/ bargainer/ can endure/ most

things.

b. Because he is stubborn and strong-willed, the/ tough/ bargainer/ can endure/ most things.

c. Because he has withstood physical assaults, the/ tough/ champion/ can endure/ most things.

13.

a. After she spent the last of his money, the/ poor/ lecturer/ was told/ she had to/ leave.

b. After all of the parents complained, the/ poor/ lecturer/ was told/ she had to/ leave.

c. After she spent the last of his money, the/ poor/ tourist/ was told/ she had to/ leave.

14.

a. Because he respected every customer, the/ decent/ photographer/ was well/ liked.

b. Though he never received high acclaim, the/ decent/ photographer/ was well/ liked.

c. Because he respected every customer, the/ decent/ professional/ was well/ liked.

15.

a. Living at the other end of the world, the/ distant/ relative/ didn't/ get/ an invitation to the party.

b. Being only the cousin of my nephew, the/ distant/ relative/ didn't/ get/ an invitation to the party.

c. Living at the other end of the world, the/ distant/ comrade/ didn't/ get/ an invitation to the party.

16.

- a. Measuring less than five feet, the/ small/ investor/ nevertheless/ got things/ done his way.
- b. Having almost no money to spare, the/ small/ investor/ nevertheless/ got things/ done his way.
- c. Measuring less than five feet, the/ small/ employee/ nevertheless/ got things/ done his way.

17.

- a. Because he carried so much extra weight, the/ big/ banker/ already/ suffered/ three heart attacks.
- b. Because of the pressure of stock markets, the/ big/ banker/ already/ suffered/ three heart attacks.
- c. Because he carried so much extra weight, the/ big/ trucker/ already/ suffered/ three heart attacks.

18.

- a. Taking such a long time to find his belongings, the/ slow/ learner/ upset/ even/ the most cheerful people.
- b. Taking such a long time to understand anything, the/ slow/ learner/ upset/ even/ the most cheerful people.
- c. Taking such a long time to find his belongings, the/ slow/ climber/ upset/ even/ the most cheerful people.

19.

a. Because his explanation of maths were unclear, the/ Gaelic/ teacher/ was/ disliked by his students.

b. Because he had demanded perfect pronunciation, the/ Gaelic/ teacher/ was/ disliked by his students.

c. Because his explanation of maths were unclear, the/ Gaelic/ physicist/ was/ disliked by his students.

20.

a. Because the mid-day sun was too strong for him, the/ fair/ player/ decided/ he/ had had enough.

b. Because the opposition was fouling all the time, the/ fair/ player/ decided/ he/ had had enough.

c. Because the mid-day sun was too strong for him, the/ fair/ adult/ decided/ he/ had had enough.

21.

a. As the chairs at the fundraising dinner were fragile, the/ huge/ sponsor/ felt/ very uncomfortable.

b. As everyone else at the fundraising dinner was frugal, the/ huge/ sponsor/ felt/ very uncomfortable.

c. As the chairs at the fundraising dinner were fragile, the/ huge/ visitor/ felt/ very uncomfortable.

22.

- a. Because he was the best surgeon on the West Bank, the/ Palestinian/ expert/ was in/ great demand.
- b. Because he organised meetings about the West Bank, the/ Palestinian/ expert/ was in/ great demand.
- c. Because he was the best surgeon on the West Bank, the/ Palestinian/ fellow/ was in/ great demand.

23.

- a. Because the podium was fairly rickety, the/ enormous/ donor/ felt/ extremely/ nervous.
- b. Because the economy was fairly frail, the/ enormous/ donor/ felt/ extremely/ nervous.
- c. Because the podium was fairly rickety, the/ enormous/ youth/ felt/ extremely/ nervous.

24.

- a. Because the conference was held in America, the/ European/ specialist/ felt/ a/ little uncomfortable.
- b. Because the conference focused on America, the/ European/ specialist/ felt/ a/ little uncomfortable.
- c. Because the conference was held in America, the/ European/ cardiologist/ felt/ a/ little uncomfortable.

TABLE 1

Experiment: Means for First Fixation Times, First-Pass Times, Second-Pass Times, and Total Reading Times

	<i>Preceding context</i>	<i>Adjective</i>	<i>Noun</i>	<i>Spill-over region</i>
FIRST FIXATION				
Global	157	269	270	268
Local	150	268	264	255
Global Control	152	263	278	245
FIRST-PASS				
Global	1386	284	302	303
Local	1372	292	295	300
Global Control	1383	282	298	289
SECOND-PASS				
Global	224	43	55	36
Local	193	37	23	17
Global Control	177	41	32	23
TOTAL TIME				
Global	1590	331	356	360
Local	1547	324	328	319
Global Control	1561	310	338	332

Note. Reading times are in milliseconds.