Elaboration over a discourse facilitates retrieval in sentence processing

Melissa Troyer[1*], Philip Hofmeister[2], Marta Kutas[1]

[1]University of California, San Diego, USA, [2]Brown University, USA

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3 **Melissa Troyer[1]*, Philip Hofmeister[2], Marta Kutas[1,3]**

4 [1]Department of Cognitive Science, UCSD, La Jolla, CA, USA
5 [2]Department of Cognitive, Linguistic, and Psychological Sciences, Brown University, Providence, RI, USA
6 [3]Department of Neurosciences, UCSD, La Jolla, CA, USA

7 *** Correspondence:** Melissa Troyer, Department of Cognitive Science, 9500 Gilman Dr., La Jolla, CA, 92093,
8 USA. mtroyer@ucsd.edu

11

12 ## Abstract

13 Language comprehension requires access to stored knowledge and the ability to combine knowledge
14 in new, meaningful ways. Previous work has shown that processing linguistically more complex
15 expressions (*'Texas cattle rancher'* vs. *'rancher'*) leads to slow-downs in reading during initial
16 processing, possibly reflecting effort in combining information. Conversely, when this information
17 must subsequently be retrieved (as in filler-gap constructions), processing is *facilitated* for more
18 complex expressions, possibly because more semantic cues are available during retrieval. To follow
19 up on this hypothesis, we tested whether information distributed across a short discourse can
20 similarly provide effective cues for retrieval. Participants read texts introducing two referents (e.g.,
21 two senators), one of whom was described in greater detail than the other (e.g., '*The Democrat had*
22 *voted for one of the senators, and the Republican had voted for the other, a man from Ohio who was*
23 *running for president*'). The final sentence (e.g., '*The senator who the {Republican / Democrat} had*
24 *voted for…*') contained a relative clause picking out either the Many-Cue referent (with
25 '*Republican*') or the One-Cue referent (with '*Democrat*'). We predicted facilitated retrieval (faster
26 reading times) for the Many-Cue condition at the verb region ('*had voted for*'), where readers could
27 understand that '*The senator*' is the object of the verb. As predicted, this pattern was observed at the
28 retrieval region and continued throughout the rest of the sentence. Participants also completed the
29 Author/Magazine Recognition Tests (ART/MRT; Stanovich & West, 1989), providing a proxy for
30 world knowledge. Since higher ART/MRT scores may index (a) greater experience accessing
31 relevant knowledge and/or (b) richer/more highly-structured representations in semantic memory, we
32 predicted it would be positively associated with effects of elaboration on retrieval. We did not
33 observe the predicted interaction between ART/MRT scores and Cue condition at the retrieval
34 region, though ART/MRT interacted with Cue condition in other locations in the sentence. In sum,
35 we found that providing more elaborative information over the course of a text can facilitate retrieval
36 for referents, consistent with a framework in which referential elaboration over a discourse and not
37 just local linguistic information directly impacts information retrieval during sentence processing.

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39

40   ## 1.   Introduction

41   Real-world knowledge is activated rapidly and richly in language comprehension (e.g., Kutas &
42   Federmeier, 2000; DeLong et al., 2005; Metusalem et al., 2012). Knowledge about events, actions,
43   and entities in the world can rapidly affect people's expectations about upcoming linguistic
44   information (e.g., Kamide et al., 2003; DeLong et al., 2005; Borovsky et al., 2012). What's more,
45   real-world knowledge use during language comprehension is dynamic, and new information can
46   update, amend, or contradict prior information.

47   The ability to access this continually updated information depends on a number of factors,
48   including the linguistic context. For instance, Bransford and Johnson (1972) provided participants
49   with labeled and unlabeled versions of prose passages. One passage described an activity in which
50   people typically arrange things into groups, go to the appropriate facilities, and perform a routine
51   where a mistake may be rather expensive. Participants who initially received a label (e.g., *washing*
52   *clothes*) had better memory for the passages. Similar effects have been observed when people are
53   asked to remember information that has been causally linked (e.g., (1) someone needing change
54   because (2) they need to do their laundry) compared to unrelated information (Smith et al., 1978; see
55   also Bradshaw & Anderson, 1982). These findings, among others, demonstrate how language
56   comprehension is fundamentally linked to the supporting knowledge structures, or schema, that are
57   available to the comprehender (Radvansky & Zacks, 1991).

58   In addition to affecting offline processes like explicit memory, the availability of related
59   linguistic information in a sentence (e.g., the number of adjectives modifying a noun) appears to
60   affect online sentence processing (Hofmeister, 2011; Hofmeister & Vasishth, 2014). Modifying a
61   referent's description with a likely attribute description (e.g., a _ruthless_ dictator) leads to faster
62   reading times at words that trigger retrieval of this discourse referent, compared to a referring
63   expression with no modifiers. However, modification with attributes that are unlikely based on real-
64   world knowledge (e.g., a _lovable_ dictator) does not lead to the same facilitation, compared to the
65   baseline condition (Hofmeister, 2011). In short, re-accessing previously encoded content appears to
66   be influenced by the ability to access and use prior world knowledge in both online and offline
67   language tasks.

68   Here, we test whether providing more (vs. less) information about referents across a discourse
69   similarly can increase the ease of language comprehension when these referents are subsequently
70   referred to. In previous work on the role of elaboration in sentence processing (Hofmeister, 2011;
71   Hofmeister & Vasishth, 2014), the syntactic constructions used to investigate elaboration and
72   retrieval were limited to pre-nominal modification and filler-gap dependencies that linked elements
73   within a sentence. A natural question is whether the effects observed in such environments are
74   specific to that particular combination of encoding and retrieval conditions, or whether elaboration
75   can facilitate online language comprehension more generally. This work therefore examines the
76   generality of conceptual elaboration effects in language processing.

77   Given variability in knowledge due to individual experience, it is likely that individuals also
78   differ from one another in their ability to access and use any particular knowledge structure. If the
79   performance profiles described above depend significantly on the availability of existing knowledge
80   structures, then individual profiles ought to vary as a function of their experience accessing relevant
81   knowledge or the availability of richer or highly structured representations in memory. Before
82   outlining the current experiment, we briefly describe work underscoring the importance of world
83   knowledge for guiding online language comprehension.

84   When understanding sentences, people seem to anticipate upcoming information based on the
85   relationship between current linguistic information and prior world knowledge (e.g., Tanenhaus et

86   al., 1995; Kamide et al., 2003; Borovsky et al., 2012). For instance, if a listener hears '*The pirate*
87   *chases the…*', it is reasonable for her to expect that the sentence will continue with something that a
88   pirate (the agent) might chase (the action verb), such as a ship. Visual world eye-tracking paradigms,
89   in which participants listen to spoken language while looking at images of items on a computer
90   screen, have shown that both children and adults are sensitive to this type of information and use it to
91   anticipate upcoming linguistic content (e.g., Kamide et al., 2003; Borovsky et al., 2012, 2013; Troyer
92   & Borovsky, 2015).

93   In addition to eye-tracking paradigms, event-related brain potential (ERP) experiments support the
94   role of real-world knowledge in guiding language comprehension. For instance, the N400 ERP
95   component, whose amplitude is modulated by the semantic fit of meaningful input with prior context
96   (Kutas & Hillyard, 1980, 1984; Kutas & Federmeier, 2000; see Kutas & Federmeier, 2011, for a
97   recent review), is sensitive not only to fit of (or expectations about) semantic information but also to
98   incoming information as it relates to individuals' real-world knowledge (Hagoort et al., 2004;
99   Nieuwland & Van Berkum, 2006; Hald et al., 2007; Filik & Leuthold, 2013). For instance, Hagoort
100   and colleagues (2004) presented participants with sentences drawing upon world knowledge, such as
101   the fact that the color of Dutch trains is yellow. They found reduced N400 amplitude to words like
102   '*yellow*' in the sentence '*Dutch trains are <u>yellow</u> and very crowded*' compared to sentences like
103   '*Dutch trains are <u>sour</u> and very crowded*' (where '*sour*' is semantically inconsistent) and '*Dutch*
104   *trains are <u>white</u> and very crowded*' (where '*white*' is semantically consistent but inconsistent with
105   world knowledge about Dutch trains). These findings support the notion that experienced-based
106   world knowledge (Dutch trains are yellow) affects language comprehension with the same time
107   course as (and possibly via similar mechanisms to) semantic information (trains cannot be sour).

108   Furthermore, Metusalem and colleagues (2012) showed that rich information about events in the
109   world is available during language comprehension. In their study, people read short scenarios about
110   events—for example, a football game: '*Jeremy is a great athlete despite being prone to injury.*
111   *During his last high school football game, he was knocked unconscious twice. That still didn't keep*
112   *him from scoring the winning {TOUCHDOWN / HELMET / LICENSE} with only seconds*
113   *remaining.*' Unsurprisingly, N400 amplitude was reduced to predictable words fitting both with
114   event-related information and with the semantics of the sentence (like '*touchdown*') compared to
115   anomalous words (like '*license*'). Critically, N400 amplitude was intermediate to words which were
116   not plausible continuations of the sentence but which were event-related (e.g., '*helmet*', which is
117   situationally related to football). These findings suggest that a rich landscape of knowledge can be
118   rapidly activated during language comprehension, likely contributing to the flexibility of language
119   comprehension.

120   Participants in the Metusalem et al. study also completed two tasks called the Author and
121   Magazine Recognition Tests (ART and MRT, respectively), which require participants to select the
122   authors and magazines that they recognize from lists containing both real and false examples
123   (Stanovich & West, 1989). These tests provide an estimate of print experience, and the authors
124   suggested that, by proxy, higher performance on the ART/MRT could reflect richer world
125   knowledge. Indeed, performance on the ART/MRT predicts measures of declarative knowledge,
126   including tests of cultural literacy recognition (rs = .53-.72; West & Stanovich, 1991; Stanovich et
127   al., 1995); tests about history and literature knowledge (rs = .59-.62; Stanovich & Cunningham,
128   1992); a range of tests about cultural and practical knowledge (rs = .53-.85, Stanovich &
129   Cunningham, 1993); and, in children, the General Information subtest of the Peabody Individual
130   Achievement Test (using a modified Title Recognition Test for Children; r = .43; Cunningham &
131   Stanovich, 1991). If prior world knowledge influences access to event-related information, then
132   N400 amplitude might vary with performance on the ART/MRT. The authors found that scoring
133   higher on the ART and MRT was associated with a greater numerical reduction in N400 amplitude

134 for implausible, yet event-related, continuations (e.g., '*helmet,*' in the example above), compared to
135 participants who scored lower on the ART/MRT. However, the authors were unable to draw strong
136 conclusions about the relationship between the N400 and scores on the ART/MRT, partly due to the
137 number of participants (N = 30), which is relatively low for examining individual differences.

138   In combination with prior world knowledge, new information—for example, information
139 encountered in the current discourse—can be exploited rapidly to aid future language processing. For
140 example, Nieuwland and Van Berkum (2006) presented participants with short texts in which they
141 ascribed human-like properties (e.g., the ability to fall in love) to typically inanimate objects (e.g.,
142 peanuts). In their experiments, the N400 was sensitive to these newly-learned features, suggesting
143 that people easily updated their mental models of the discourse to include these properties.

144   The current work investigates how variability in the amount of recently encountered information,
145 providing elaboration of a referent, affects subsequent access. This work extends recent findings
146 from self-paced reading studies that suggest that longer or more semantically complex linguistic
147 representations of referents can facilitate subsequent access to those referents (Hofmeister, 2011;
148 Hofmeister & Vasishth, 2014). For instance, Hofmeister (2011) asked participants to read (word-by-
149 word) sentences in which a critical noun was described by zero, one, or two adjectives (low, mid, and
150 high complexity conditions, respectively). Participants might read, '*It was a (famous (deaf)) sculptor
151 that the aristocrats at the gallery ridiculed during the exclusive art show.*' At a subsequent critical
152 verb (e.g., '*ridiculed*'), the critical noun had to be understood as the grammatical object of the verb.
153 In order to access this information, participants must somehow retrieve information about the initial
154 noun (e.g., '*sculptor*'). Hofmeister reported decreased reading times during (or in some cases,
155 immediately following) the critical verb for items in the highest-complexity condition (i.e., where
156 critical nouns were preceded by two adjectives) compared to the other conditions. In similar
157 experiments, such findings also were observed for nouns which were semantically richer/more
158 specific (e.g., '*soldier*') compared to less rich/less specific (e.g., '*person*'). Hofmeister interpreted
159 these results as showing that additional semantic (and possibly syntactic) features of a linguistic
160 representation led to facilitated retrieval of the information later in the sentence.

161   Studies like those of Hofmeister and colleagues have primarily focused on pre-nominal
162 descriptors ('*Texas cattle rancher*') or differences in the semantic specificity/richness of a single
163 word ('*soldier*' vs. '*person*') but have not explored the roles of other types of descriptions across a
164 discourse. Pre-nominal adjectives are likely to change the processing of an upcoming noun for
165 multiple reasons. First, in an information-theoretic sense, pre-nominal modification can lower the
166 entropy of (or uncertainty about) the upcoming noun. Second, modifiers might be predictive of the
167 noun for other reasons such as semantic relatedness (consider the relationship between the three
168 words '*Texas,*' '*cattle,*' and '*rancher,*' for example). And finally, pre-nominal modification entails a
169 specific type of syntactic relationship between modifiers and the noun, with the entire bundle of
170 linguistic information [modifier(s) + noun] constituting a phrasal unit.

171   In the current study, we investigate how complex descriptions impact the subsequent retrieval of
172 information about referents in language comprehension across sentence boundaries. We vary the
173 additional linguistic information not in adjectival modifiers directly preceding the noun, but using
174 post-nominal modification across multiple sentences in a short discourse. We predicted that
175 providing higher-complexity descriptions about referents would make it easier for participants to
176 process subsequent language referring to those referents compared to referents with linguistically
177 simpler descriptions. Such a finding would indicate that conceptual complexity, above and beyond
178 the phrasal unit, can influence retrieval in real-time language comprehension.

179   We also asked participants to complete a simple test designed to assess print exposure, which has
180 been used as a proxy for real-world knowledge (e.g., Metusalem et al., 2012). We predicted that

181   participants with greater world knowledge would be able to more effectively make use of additional
182   information—possibly due to richer networks of conceptual representations and/or more effective
183   access to relevant conceptual information. We therefore predicted these participants would be more
184   likely to show effects of linguistic complexity at subsequent retrieval sites.

2.   Methods

2.1   Participants

187   A total of 101 participants, ages 18-29 (M = 20.7, 77 women) took part in the experiment.
188   Participants were excluded from analysis if their overall accuracy on comprehension questions was
189   less than 70%. This resulted in the exclusion of 9 participants, for a total of 92 participants in the
190   final dataset. Participants were students at UCSD who reported that they were native English
191   speakers. They received partial class credit for participation. All participants provided informed
192   consent for the study, which was approved by the University of California, San Diego Institutional
193   Review Board.

2.2   Design and materials

195   The materials for the study were 24 experimental items and 36 filler items of similar length and
196   syntactic complexity. The majority of our materials were created by modifying materials from
197   Fedorenko et al. (2012). A full listing of the experimental and filler items can be found in the
198   Appendix. Each item consisted of a short text of three sentences. All items began with two sentences,
199   which were presented and read (self-paced) as whole sentences. The third sentence was presented
200   word-by-word, using a moving-window self-paced reading paradigm (Just et al., 1982). Filler items
201   were constructed to be similar to experimental items in length and content.

202   For experimental items, the first sentence always introduced four individuals, two of whom were
203   referred to using the same noun (e.g., '*senator*', in the example below). The second sentence always
204   described relationships between the first two individuals (e.g., the two senators) and the second two
205   (e.g., the Democrat and the Republican), with one of the first two individuals being described in more
206   detail more than the other. In the third and final sentence, the second noun was varied to
207   unambiguously pick out a referent for its object. In the example below, for instance, '*The senator
208   who the Republican had voted for*' would refer to the senator from Ohio who was running for
209   president (the Many-Cue condition), while '*The senator who the Democrat had voted for*' would
210   refer to the other senator (the One-Cue condition).

(1)   Sentence 1:   Two senators were arguing with a Democrat and a Republican after a big debate.

       Sentence 2:   The Democrat had voted for one of the senators, and the Republican had voted
                      for the other, a man from Ohio who was running for president.
       Sentence 3:   The senator who the {Republican / Democrat} had voted for was picking a fight
                      about health care reform.

211   As described above, Cue condition refers to the presence or absence of additional descriptive
212   information in the second sentence. To mitigate any effect of recency of information on reading
213   times, we also created a second version of the materials in which the Many-Cue item came earlier
214   than the One-Cue item. For example, in the second version of the example shown in (1), the second
215   sentence would read, '*The Democrat had voted for one of the senators, a man from Ohio who was
216   running for president, and the Republican had voted for the other*.' The factor Mention Order refers
217   to whether the critical item (i.e., the object of the relative clause in Sentence 3) was mentioned

218   relatively early or relatively late in the second sentence. In the example above (1), the information is
219   Early for the One-Cue condition (i.e., '*The Democrat had voted for one of the senators*') but Late for
220   the Many-Cue condition (i.e., '*The Republican had voted for one of the senators*'). The design was
221   therefore a 2 x 2: Cue condition (Many-Cue, One-Cue) and Mention Order (Early, Late). This
222   resulted in four lists, randomized across participants according to a Latin-square design such that no
223   participant saw the same exact order of experimental and filler items.

224   Finally, each text was followed by a comprehension question, which participants answered with
225   *yes* or *no* by key press. Across the experiment, comprehension questions queried each of the three
226   sentences in a text so that a third focused on Sentence 1, a third on Sentence 2, and a third on
227   Sentence 3. Half of the sentences were answered correctly with *no* and half with *yes*. For the example
228   above in (1), the comprehension question asked about the first sentence and was correctly answered
229   with *yes*: *Were the senators arguing before a big debate?* Similarly, filler questions asked about
230   either the first, second, or third sentence, in equal proportions. Half of each set were correctly
231   answered with yes, and half with no.

2.3   Author and Magazine Recognition Tests

233   Prior to testing, participants also completed an updated version of the Author Recognition Test
234   (ART) and the Magazine Recognition Test (MRT) (Stanovich & West, 1989). These tasks were
235   designed to provide a simple yet powerful way to estimate print experience and, by proxy, world
236   knowledge. Previous work has found correlations in the range of r = .5-.8 between ART/MRT and
237   many measures of declarative/cultural knowledge (West & Stanovich, 1991; Stanovich et al., 1995;
238   Stanovich & Cunningham, 1992, 1993; Cunningham & Stanovich, 1991); in addition, both tests
239   correlate (rs = .3-.4) with measures of reading comprehension, and the ART also correlates with
240   measures of orthographic and phonological processing (Stanovich & West, 1989). Participants were
241   given a printed list of 80 potential author names (ART) and 80 potential magazine titles (MRT;
242   presented separately) and were asked to put a check mark next to the ones they knew to be true
243   authors/magazines. In actuality, only half were real authors/magazines. Participants were asked to
244   avoid guessing because some of the names on the lists were not actual authors/magazines. Scores for
245   these tasks were calculated by summing the number of hits (correct items checked) minus the number
246   of false alarms (checked items which were incorrect). The scores for both tasks were computed
247   separately but combined (summed) for analyses.

2.4   Procedure

249   We used Linger (version 2.88) by Doug Rohde to collect self-paced reading data. For this part of the
250   experiment, participants were instructed that they would be reading short texts made up of three
251   sentences and that they should read the sentences for content, as there would be comprehension
252   questions following each text. They were provided with examples and familiarized with the task
253   before they began, including practice on two items very similar to those used in the study, preceded
254   by a few simpler examples of word-by-word self-paced reading.

255   Accuracy was computed on the fly and in aggregate in subsequent analyses. If participants
256   responded incorrectly, a warning flashed on the screen to encourage them to try harder to answer
257   correctly on subsequent questions. Participants were given a break halfway through the experiment
258   and instructed to take short breaks as needed in between items.

259   Following testing, participants completed an exit questionnaire including questions about the ease
260   of the experiment. The experiment was typically completed in under an hour.

261   **2.5   Analysis**

262   Although the final sentence of each text was presented word by word, five regions were created, the
263   last four of which were analyzed (an example is demarcated below). Region 1 always consisted of a
264   noun phrase (two words); region 2 was the start of the relative clause (three words); region 3 was the
265   verb phrase of the relative clause (1-3 words); region 4 was the matrix verb phrase region (2-5
266   words); and region 5 was a final region including direct objects, adverbials, or prepositional phrases
267   (2-7 words).

268   (2)   The senator / who the Republican / had voted for / was picking a fight / about health care
269   reform.

270   For the primary analyses, we first identified any trial containing single-word responses that were less
271   than 100 ms or greater than 5000 ms and removed these trials from subsequent analysis, affecting
272   less than 1% of the data. Next, for each trial, RTs for words within a region were averaged. These
273   averaged RTs were then log-transformed, and data points falling more or less than 2.5 SDs from the
274   mean (by region and condition) were eliminated, affecting ~2.5% of the data.

275   Statistical analyses used linear mixed-effects models (Baayen, 2008) incorporating random
276   effects for both items and subjects as well as fixed effects of Cue condition, Mention Order, and
277   Spillover (log RT of the preceding region) as fixed effects, unless otherwise indicated. In addition,
278   we included by-subjects and by-items random slopes for Cue condition, as this was our primary
279   independent variable of interest. All analyses were performed in the statistical programming
280   environment R.

281   **3.   Results**

282   **3.1   Self-paced reading**

283   Mean log reading times by region are shown in Figure 1, and full model estimates and statistics are
284   provided in Table 1.

285   At the second region (which is the point at which the noun phrase '*The senator*' begins to be
286   disambiguated), we observed no main effect of Cue condition or Mention Order, but there was a
287   significant interaction of the two (β = -.011, SE = .005, t = -2.055, p < .05). Visual inspection
288   revealed this interaction appeared to be driven by slower reading times for conditions from Version 1
289   (Many-Late, One-Early) compared to Version 2 (Many-Early, One-Late) (see above for an example
290   of Version 1 vs. Version 2 of the materials). A follow-up analysis with Version (V1, V2) as fixed
291   effects and Subject and Item as random effects indicated this was the case, with a significant
292   difference between the two (β = -.011, SE = .005, t = -2.04, p < .05).

293   Region 3 was the retrieval region where we predicted a main effect of Cue condition. Here, we
294   observed the predicted main effect of Cue condition, with faster reading times in the Many-Cue
295   compared to the One-Cue condition (β = .019, SE = .008, t = 2.394, p < .05). In addition, we also
296   observed a marginal effect of Mention Order, with relatively Late information leading to faster
297   reading times compared to Early information (p = .07) as well as a marginal interaction of Cue and
298   Mention Order (p = .09).

299   The effect of Cue condition persisted into both Regions 4 ($\beta = .016$, SE = .006, $t = 2.632$, p < .05)
300   and 5 ($\beta = .026$, SE = .006, $t = 4.074$, p < .001). No significant main effects or interactions with
301   Mention Order were observed in either region, though there was a marginal interaction between Cue
302   and Order in region 4 (p = .05).

303   Table 1. Full model estimates and statistics for reading times from the final sentence. Statistically
304   significant predictors (p < .05) are in bold.

Region	Effect	Estimate	Std. Error	t-value	p-value
Region 2	**(Intercept)**	**5.693**	**0.023**	**247.15**	**0.000**
	Cue condition	0.000	0.007	-0.059	0.953
	Mention Order	-0.003	0.005	-0.656	0.512
	Cue x Order	**-0.011**	**0.005**	**-2.055**	**0.040**
Region 3	**(Intercept)**	**5.834**	**0.026**	**222.01**	**0.000**
	Cue condition	**0.019**	**0.008**	**2.394**	**0.025**
	Mention Order	0.014	0.008	1.794	0.073
	Cue x Order	-0.013	0.008	-1.680	0.093
Region 4	**(Intercept)**	**5.786**	**0.022**	**264.604**	**0.000**
	Cue condition	**0.016**	**0.006**	**2.632**	**0.015**
	Mention Order	0.005	0.005	0.899	0.369
	Cue x Order	-0.011	0.005	-1.953	0.051
Region 5	**(Intercept)**	**5.916**	**0.025**	**238.968**	**0.000**
	Cue condition	**0.026**	**0.006**	**4.074**	**0.000**
	Mention Order	0.008	0.005	1.639	0.101
	Cue x Order	-0.003	0.005	-0.544	0.586

305

3.2   ART/MRT scores

307   Scores on the ART and MRT were calculated separately and then summed to create a single
308   composite score. For the ART, scores ranged from -5 (one participant checked more incorrect items
309   than correct items, leading to the negative score) to 25, with a mean of 7.28 (SD = 3.87). Scores for
310   the MRT ranged from 1 to 20, with a mean of 7.97 (SD = 3.83). The two tasks were positively
311   correlated (r = .415, p < .0001). When combined by summation, the mean composite score was 15.25
312   (SD = 6.47).

3.3   Comprehension question accuracies

314   Comprehension questions were included primarily to encourage participants to read the texts
315   carefully. Comprehension question accuracy was 88.32% (*SD* = 6.14%) for filler materials. Analyses
316   using mixed-effects logistic regression (with Cue condition and Mention Order as fixed effects and
317   Subject and Item as random effects) revealed that accuracy did not differ as a function of Cue
318   condition or Mention Order, with a mean of 79.35% (*SD* = 14.80%) for the Many-Cue condition and
319   a mean of 77.26% (*SD* = 13.82%) for the One-Cue condition. We therefore observed that our
320   manipulation of interest, Cue condition, had no measurable effect on offline comprehension
321   accuracies.

322   Accuracies were also analyzed by the type of question, that is, whether the question asked about
323   the first, second, or third sentence. Mixed-effects logistic regression with question type (first, second,
324   third sentence) as a fixed effect and Subjects and Items as random effects revealed that questions
325   about the second sentence (*M* = 70.92%, *SD* = 20.89%) were answered less accurately than questions
326   about the final sentence (*M* = 84.51%, *SD* = 13.54%; β = -0.46, *SE* = 0.17, z = -2.75, p < .01), though
327   the difference between questions about the first sentence (*M* = 79.48%, *SD* = 14.30%) and second
328   sentence did not reach significance (p = .14). This pattern likely reflects the fact that the second
329   sentence was the most complex/longest of the three sentences.

3.4   Relationship between reading times and ART/MRT

331   We predicted that individuals scoring higher on the ART/MRT, and who are therefore likely to have
332   greater world knowledge, would show the greatest effects of Cue condition during the retrieval
333   region. However, adding the continuous ART/MRT composite scores as a predictor did not indicate
334   any effect of ART/MRT on reading times during region 3 nor was there any interaction with Cue or
335   Mention Order (all ps > .16).

336   However, ART/MRT scores interacted with Cue condition at an un-predicted location, in Region
337   2 (β = -.002, SE = .001, t = -2.247, p < .05). To follow up on this interaction, we used both group
338   comparisons based on a median split as well as a correlational analyses. Numerically, individuals
339   scoring higher on the ART/MRT had faster reading times for the One- (*M* = 5.66 log ms, *SD* = .31)
340   compared to the Many-Cue condition (*M* = 5.69 log ms, *SD* = .33), but individuals scoring lower on
341   the ART/MRT had the opposite numeric pattern (One-Cue, *M* = 5.72 log ms, *SD* = .31; Many-Cue, *M*
342   = 5.70, *SD* = .31). Mixed-effects models performed separately over each group with Cue as a fixed
343   effect and subject and item as random effects indicated that these were only trends (ps = .09, .11,
344   respectively). However, a correlational analysis of ART/MRT scores and differences between One-
345   Cue minus Many-Cue RTs was significant, r = -.216, p < .05. We had no specific predictions for any
346   effect of Cue at this region nor any interactions with ART/MRT (but see discussion).

347   In addition, ART/MRT scores interacted with Cue condition in Region 4 (β = -.002, SE = .001, t
348   = -2.172, p < .05). We again inspected both group differences and correlations between ART/MRT
349   and reading time differences. For the higher-scoring group, there was little difference based on Cue
350   condition (One-Cue, M = 5.80 log ms, SD = .33; Many-Cue, M = 5.79 log ms, SD = .34; difference
351   n.s.). However, a mixed-effects model (see above) revealed a difference between the One-Cue (M =
352   5.81 log ms, SD = .32) and Many-Cue (M = 5.76, log ms, SD = .29) conditions for the group scoring
353   lower on the ART/MRT (β = .027, SE = .008, t = 3.537, p < .001). The correlation between
354   ART/MRT scores and differences between One-Cue minus Many-Cue RTs was significant (r = -
355   .283, p < .01), indicating that lower scores were associated with larger differences between
356   conditions. Although this pattern occurred at Region 4, a region subsequent to the critical retrieval
357   region in our experiment (Region 3), it is possible the interaction between ART/MRT and Cue
358   condition at this region relates to continued retrieval processes. We further discuss this possibility in
359   the discussion.

360   There were no other interactions with ART/MRT at any other region in this analysis.

361   4.   Discussion

362   4.1   Summary of findings
363   This study had two primary aims. The first was to test whether a greater amount of linguistic
364   elaboration about a referent over a short discourse could facilitate subsequent access to that
365   information during online language processing. If so, the second was to test whether this facilitation
366   was greater for those with more world knowledge (determined using scores from the Author and
367   Magazine Recognition Tests as a proxy) would lead to increased facilitation based on elaboration.

368   Supporting our hypothesis that elaborative information would provide more cues to retrieval, we
369   found reduced reading times at a critical retrieval site when the referent had previously been
370   described in more detail, albeit not more so for those with greater world knowledge. This work
371   provides a novel contribution by suggesting that elaboration can affect retrieval-related processes in
372   cross-sentential dependencies. These findings demonstrate the generality of elaboration effects in
373   sentence processing (Hofmeister, 2011; Hofmeister & Vasishth, 2014).

374   It is particularly noteworthy that various formal syntactic theories treat anaphoric dependencies as
375   fundamentally different than filler-gap dependencies. For instance, in transformational theories of
376   syntax, filler-gap dependencies are licensed via cyclic movement of the filler, leaving behind a trace,
377   whereas no such process applies to anaphoric dependencies (co-indexing provides the necessary
378   connection) (e.g., Chomsky, 1995, among many others). More importantly, the retrieval conditions in
379   filler-gap dependencies are quite different from those in the current study. In filler-gap dependencies,
380   the retrieval target is necessarily within the same sentence, which may limit the retrieval search
381   space, relative to that for anaphoric dependencies. Further, the onset of a filler-gap dependency
382   signals that the target information must be restored in the near future. That is, once a filler is
383   encountered, a process is initiated that necessarily ends with retrieval; hence, it is predictable that the
384   filler information will be needed again. Up to that point, the parser is actively engaged in searching
385   for the first available integration point (Frazier & Clifton, 1989; Frazier & d'Arcais, 1989; Clifton &
386   Frazier, 1989). This contrasts with anaphoric dependencies where there is no guarantee that a referent
387   will ever be mentioned again—as was the case for the elaborative information presented in our short
388   texts. In sum, anaphoric dependencies do not come with the same set of expectations or retrieval cues
389   that accompany filler-gap dependencies. Thus, demonstrating that elaboration effects nevertheless

390 arise in cross-sentential dependencies suggests that they are not contingent upon any of the
391 idiosyncrasies of filler-gap dependencies.

392   We did not observe the predicted interaction between ART/MRT and Cue condition at Region 3.
393 However, two unpredicted related results were the interactions between ART/MRT scores and Cue
394 condition on reading times at Regions 2 and 4. In Region 2 ('*The senator / **who the Democrat /**...*'),
395 participants may begin to anticipate the upcoming object of the relative clause, though there is still
396 ambiguity with respect to which referent will be mentioned. We tentatively speculate that differences
397 in language experience / world knowledge (as indexed by ART/MRT scores) may affect the
398 individual's sensitivity to this ambiguity (or ability to predict an upcoming referent), possibly
399 resulting in the observed interaction.

400   We initially hypothesized that having greater world knowledge (and higher scores on the
401 ART/MRT, by proxy), would associate with greater ease of access for meaningful cues to retrieval.
402 We therefore predicted greater facilitation in retrieval (at Region 3) for the Many-Cue condition, or
403 possibly in a subsequent region, for those with greater world knowledge. However, the interaction
404 between Cue and ART/MRT scores which we observed at Region 4 did not support our hypothesis;
405 rather, individuals with lower ART/MRT scores drove effects of Cue condition in this region, with
406 lower reading times associated with the Many-Cue compared to the One-Cue condition. One
407 possibility is that for our materials, having more information benefited those with less language
408 experience / less knowledge *more*, meaning that the group scoring lower on ART/MRT was able to
409 benefit from the additional information in the Many-Cue condition while the higher-scoring group
410 showed less of a difference between conditions. Future work using more tightly controlled stimuli
411 (e.g., with identical numbers of words in each region, with identical syntax, etc.) might shed more
412 light on the nature of these individual differences.

413   Overall, we interpret our findings as evidence that having more information about a referent is
414 beneficial during retrieval and perhaps during subsequent comprehension, as the sentence progresses
415 and information accumulates.

4.2   The role of elaboration in online sentence processing

417 Work by Hofmeister and colleagues (Hofmeister, 2011; Hofmeister & Vasishth, 2014) has shown
418 that under many circumstances, elaborative information, typically in the form of adjectives preceding
419 a noun, increases processing times at the point of encoding (at the noun) but facilitates processing
420 times at a subsequent dependency. This finding holds for words which are more elaborated in the
421 sense that they are semantically richer (e.g., '*soldier*' is richer than '*person*'), but it does not hold
422 when adjectives preceding a noun are atypical descriptors (e.g., '*ruthless military dictator*' is typical
423 but '*lovable military dictator*' is not). Here, we add to this literature by showing that elaborative
424 information presented across multiple sentences, and not just locally (at the point of modifying a
425 noun, for example), can facilitate subsequent access to or retrieval of that information.

426   What may account for the benefit of retrieving representations that have relatively many features
427 associated with them, even across discourse boundaries? On one hand, such effects are surprising
428 since it would seem to imply that more content must be retrieved. On the other, these effects align
429 naturally with several non-mutually-exclusive hypotheses about the nature of memory retrieval in
430 language processing. For instance, in the cue-based retrieval model of Lewis & Vasishth (2005), the
431 efficacy of retrieval for some item in memory is driven partly by its retrieval history, i.e., how many
432 times an item has been restored and how recently. Modifying a word or phrase that has been encoded
433 in the past reactivates that item, leading to an increase in its activation. This reactivation process can

434 even arguably offset any effects of time-based decay, giving rise to so-called anti-locality effects
435 (Vasishth & Lewis 2006). From this point of view, the increased ease of retrieval observed in regions
436 3 to 5 is ascribable to a boosted level of activation of the target either prior to retrieval, or possibly
437 during retrieval, as relevant cues spread activation to other cues (see Hofmeister, 2011). A separate,
438 though not mutually exclusive, view suggests that adding semantic features to a discourse referent
439 typically gives rise to a conceptually unique representation in the current discourse context. The
440 advantage of this elaboration is manifested at the retrieval region, as the broader memory literature
441 demonstrates a robust memory advantage for targets with contextually unique features (Moscovitch
442 and Craik, 1976; Fisher & Craik, 1977; Jacoby & Craik, 1979; Hunt & Worthen, 2006, Gallo et al,
443 2008). In essence, adding details about a person or event increases the likelihood that this entity bears
444 conceptual features that no other memory item (or very few others) shares, reducing the chance for
445 similarity-based interference at retrieval. Both of these views capture the observed effects in our
446 experiment without adjudicating between them.

447   In conclusion, the present findings are novel in showing that when (potentially) relevant semantic
448 information is associated with a concept, it may directly impact its retrieval, even when the
449 elaborative information is distributed across a discourse, and not just or at all in the local (within-
450 sentence) linguistic context (as in Hofmeister, 2011; Hofmeister & Vasishth, 2014). Relatedly, one
451 recent study found that when participants read longer descriptions (e.g., *'The actor who was*
452 *frustrated and visibly upset'* vs. *'The actress'*), they were more likely to refer back to them with a
453 pronoun, a finding the authors attributed to enhanced prominence of the referent due to the
454 elaboration (Karimi et al., 2014). When concepts are more elaborated, subsequent processing
455 advantages may occur because (a) there are more semantic features available and/or (b) those
456 features lead to increased activation levels of the concept. Our findings suggest that variability in the
457 elaboration of referents may have relatively long-term consequences for their processing across the
458 subsequent discourse.

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609

610 **6.   Figure Legends**

611

612 **Figure 1 Log average word reading times by region for sentence 3.** Errors bars represent by-
613 subject standard errors of the mean. There was a main effect of Cue condition at regions 3-5 (Many-
614 Cue > One-Cue; * = p < .05; ** = p < .001). See Table 1 for full model statistics.

615

7.   Appendix

A. Experimental Sentences

Shown here is version 1, one-cue; version 1, many-cue, and version 2 (both Cue conditions) can be deduced following the schema provided in the text.

1. Two senators were arguing with a Democrat and a Republican after a big debate.
The Democrat had voted for one of the senators, and the Republican had voted for the other, a man from Ohio who was running for president.
The senator who the Democrat had voted for was picking a fight about health care reform.

2. Two musicians were talking to an interviewer and a newscaster during a radio talk show.
The interviewer had dated one of the musicians, and the newscaster had dated the other, a guitarist who also sang with a gospel group.
The musician who the interviewer had dated was answering most of the questions.

3. Two cashiers were discussing recent events with a customer and a supervisor at the grocery store.
The customer joked with one of the cashiers, and the supervisor joked with the other, a mother of two who often picked up extra shifts.
The cashier who the customer joked with was getting off work in two hours.

4. Two scientists were going over a new protocol with a technician and an intern in the lab.
The technician questioned one of the scientists, and the intern questioned the other, a UCLA graduate who was the head of the lab.
The scientist who the technician questioned was going to a conference in Philadelphia.

5. Two actors were having a conversation with a screenwriter and a director during the filming of a movie.
The screenwriter corrected one of the actors, and the director corrected the other, an Academy Award winner who often starred in period dramas.
The actor who the screenwriter corrected was planning to appear in his first Broadway role.

6. Two lawyers got along very well with a secretary and an accountant in their office in a big firm.
The secretary greeted one of the lawyers, and the accountant greeted the other, a new partner in the firm who was originally from the south.
The lawyer who the secretary greeted was running late that morning.

7. Two pediatricians often went over various medications with a cardiologist and a nurse on staff.
The cardiologist phoned one of the pediatricians, and the nurse phoned the other, an oncologist who specialized in leukemia.
The pediatrician who the cardiologist phoned was on call on Christmas Day.

8. Two neurologists worked together with a professor and a resident at the medical center on campus.
The professor gave advice to one of the neurologists, and the resident gave advice to the other, a newcomer who had gone to school in New York.
The neurologist who the professor gave advice to usually worked with epilepsy patients.

663 9. Two writers were quibbling about the point of a book with a critic and a publisher at a public
664 event.
665 The critic annoyed one of the writers, and the publisher annoyed the other, a staff member at the New
666 York Times who wrote Op-Ed pieces.
667 The writer who the critic annoyed had recently started to teach college writing.
668
669 10. Two teachers were talking about lesson plans with a student and the principal in the school office.
670 The student really liked one of the teachers, and the principal really liked the other, a Civil war buff
671 who taught social studies.
672 The teacher who the student really liked was teaching eighth graders that year.
673
674 11. Two politicians were disagreeing with a journalist and a photographer after an interview.
675 The journalist criticized one of the politicians, and the photographer criticized the other, a Green
676 Party member who supported gun control.
677 The politician who the journalist criticized was becoming popular with young voters.
678
679 12. Two inventors displayed new technology to a researcher and an organizer at a convention.
680 The researcher praised one of the inventors, and the organizer praised the other, an employee of
681 Caltech who was interested in robotics.
682 The inventor who the researcher praised was writing a book on artificial intelligence.
683
684 13. Two congressmen squabbled about the national election with a governor and a moderator after
685 the panel discussion.
686 The governor antagonized one of the congressmen, and the moderator antagonized the other, a Texan
687 who lived on a ranch.
688 The congressman who the governor antagonized often voted in the minority of his party.
689
690 14. Two ambassadors were planning a trip with an interpreter and a reporter for later in the month.
691 The interpreter contacted one of the ambassadors, and the reporter contacted the other, a speaker of
692 five languages who often worked abroad.
693 The ambassador who the interpreter contacted was traveling constantly for the next three months.
694
695 15. Two managers were examining the company's books with a programmer and an administrator
696 after work.
697 The programmer interrogated one of the managers, and the administrator interrogated the other, a
698 hard worker who often stayed for late hours.
699 The manager who the programmer interrogated was coming up for a big promotion.
700
701 16. Two historians were discussing an article with an anthropologist and a geographer in a group
702 meeting.
703 The anthropologist challenged one of the historians, and the geographer challenged the other, an
704 expert on Ancient Greece who studied papyrus.
705 The historian who the anthropologist challenged was going to Athens later that month.
706
707 17. Two counselors were chatting about teaching methods with a librarian and an aide at the high
708 school.
709 The librarian offended one of the counselors, and the aide offended the other, an alum of the school
710 who also worked at an after-school program.
711 The counselor who the librarian offended was starting to think about a change in careers.

712
713   18. Two sopranos were practicing their duet with a conductor and an accompanist before chorus
714   rehearsal.
715   The conductor approached one of the sopranos, and the accompanist approached the other, a high
716   school senior who was applying to Stanford.
717   The soprano who the conductor approached almost always got a solo in each performance.
718
719   19. Two engineers were chatting about a project with a mathematician and a physicist at a meeting.
720   The mathematician interrupted one of the engineers, and the physicist interrupted the other, a car buff
721   who also loved to ride motorcycles.
722   The engineer who the mathematician interrupted was describing a new project for the company.
723
724   20. Two artists met up at a museum with a docent and a curator before a new exhibit.
725   The docent addressed one of the artists, and the curator addressed the other, a painter who also taught
726   art at a local college.
727   The artist who the docent addressed was visiting the museum for the first time.
728
729   21. Two gymnasts were working out with a wrestler and a coach at the school gym.
730   The wrestler watched one of the gymnasts, and the coach watched the other, a national competitor
731   who performed best on balance beam.
732   The gymnast who the wrestler watched was graduating at the top of her class.
733
734   22. Two caterers were talking about food with chef and a server before a big event.
735   The chef spoke to one of the caterers, and the server spoke to the other, an entrepreneur who was
736   noted for her pastries.
737   The caterer who the chef spoke to was planning the menu for a wedding later in the week.
738
739   23. Two carpenters were working near each other with a bricklayer and a foreman at a construction
740   site.
741   The bricklayer yelled to one of the carpenters, and the foreman yelled to the other, a specialist in
742   restoration who had decades of experience.
743   The carpenter who the bricklayer yelled to was going to retire within the next year.
744
745   24. Two attorneys were talking shop with a client and a judge in the courtroom.
746   The client argued with one of the attorneys, and the judge argued with the other, a highly paid
747   prosecutor who won nearly all her cases.
748   The attorney who the client argued with primarily handled criminal cases.
749
750   **B. Filler Sentences**
751   1. A model, a makeup artist, and two hairdressers discussed possible hairstyles during a photo shoot.
752   The model liked her hair straight; however, the makeup artist and the hairdressers wanted her hair to
753   be curly.
754   The model got paid ten thousand dollars for every photo shoot but was stubborn and hard to work
755   with.
756
757   2. A lifeguard, a swimmer and two surfers became good friends over the summer.
758   The lifeguard began dating the swimmer, and the surfers both envied them.
759   After a few weeks they broke up, and the surfers were secretly glad.

760
761 3. A higher school, his sister, and two cousins watched a movie together in a movie theater.
762 The high schooler threw popcorn at his sister and then one of the cousins hit the boy for
763 misbehaving.
764 All four family members were kicked out of the movie theater.
765
766 4. A singer, a ballerina, and two violinists performed together during a concert.
767 One of the violinists accompanied the singer and then the ballerina joined in with a beautiful piece.
768 The singer was dating the ballerina, and they had been going out for two months.
769
770 5. A cheerleader, her father, and two injured players sat together at the basketball game.
771 The father disliked one of the injured players because he was dating his daughter.
772 In fact, the cheerleader's father disliked all of his daughter's boyfriends.
773
774 6. A tightrope walker, a clown, and two acrobats were bowing to the audience at the circus.
775 The clown opened the circus with an introductory act, and then the tightrope walker and the acrobats
776 ended the show with an amazing finale.
777 When the tightrope walker was little, he did not want to be in the circus.
778
779 7. A chauffeur, a beauty queen and two PR reps sat in a limousine together.
780 The beauty queen and the chauffeur exchanged private looks while the PR reps both talked on their
781 phones.
782 The beauty queen and the chauffeur were planning to elope together.
783
784 8. A sports psychologist, a snowboarder, and two instructors met after the big competition.
785 The sports psychologist gave a lecture and then the instructors showed a video of the snowboarder's
786 race.
787 The snowboarder had won a bronze medal last year, and this year, he aspired to win the gold.
788
789 9. A cartoonist, a filmmaker and two producers expressed interest in producing a movie together.
790 The cartoonist and the filmmaker wanted to make a movie for young children; however, the
791 producers wanted to make an R-rated movie.
792 Most of the filmmaker's movies are total failures on opening weekend.
793
794 10. A ski instructor, a teenager, and two young twins skied down the bunny slope together during a
795 ski lesson.
796 The ski instructor and the teenager finished the course quickly; however, the twins fell down twice
797 before the finish line.
798 It was the twins' first time skiing ever, and the last time the teenager had skied he broke his arm.
799
800 11. A chemist, a neuroscientist, and two biologists conducted several experiments.
801 The chemist and the neuroscientist came up with a new hypothesis, but the biologists offered an
802 alternative account.
803 The chemist and the neuroscientist had recently won a Nobel prize for some important discoveries.
804
805 12. A drummer, a bassist, and two vocalists listened carefully while a song was playing.
806 The vocalists decided to change the lyrics after the drummer complained about the song's message.
807 The vocalists are no longer talking to the drummer, and the band might break up.
808

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809   13. Two members of the marching band, a football player, and his girlfriend were going to dinner
810   before prom.
811   The football player waited while his girlfriend and the others finished getting ready.
812   The football player's girlfriend got her dress at a thrift shop, so it cost very little.
813
814   14. Two actresses, a comedian, and a dog had a scene together in a play.
815   The comedian taught the dog tricks while the actresses watched.
816   The comedian has become very popular and all of his performances are sold out for the next two
817   months.
818
819   15. Two supermodels, a businessman, and his wife drank red wine together on a yacht.
820   The businessman flirted with the supermodels while the wife rolled her eyes.
821   The businessman had dated five different models in the last month, and his wife was thinking of
822   divorcing him.
823
824   16. Two parents, a daughter, and a son walked around together at the zoo.
825   The daughter stopped to buy some ice cream while the parents and the son looked at the lions.
826   The daughter loves to go to the zoo and has a season pass.
827
828   17. Two celebrities, a runway model and a rock star held a pre-party together before the big gala.
829   The celebrities talked to the rock star and then the rock star danced with the runway model.
830   The model just divorced her husband and is now dating the rock star.
831
832   18. Two CEOs, a strategist, and a trustee argued during a board meeting.
833   The trustee and the strategist agreed upon a solution but the CEOs preferred their own ideas.
834   The trustee had donated ten million dollars to the company, so he was unhappy when his opinion was
835   not taken into consideration.
836
837   19. Two midfielders, a goalie, and a fullback made dessert together before the team dinner.
838   The goalie and the fullback baked a cake and then the midfielders decorated the cake with icing.
839   The whole team really cared about the soccer coach, and the cake was for his birthday.
840
841   20. Two chaperones, a freshman, and a senior class officer were having an argument at the school
842   dance.
843   The chaperones were yelling at the senior class officer because she had been dancing inappropriately.
844   The chaperones yelled at most of the students at the dance and were known for being very strict.
845
846   21. Two bridesmaids, a groom, and a bride celebrated at the reception after a wedding.
847   The bride and groom danced while the bridesmaids looked on.
848   There was a rumor that the groom had cheated on the bride with one of the bridesmaids.
849
850   22. Two hall monitors, a janitor, and a police officer patrolled the hallways of the high school
851   between classes.
852   The hall monitors asked the janitor to clean up after a food fight and then informed the police officer
853   of the incident.
854   It took the janitor two hours to clean up the mess, and no one could identify the students involved in
855   the food fight.
856

857   23. Two environmentalists, a zoologist and a philanthropist worked on a plan for saving the
858   endangered African elephants.
859   After the environmentalists and the zoologist described the worsening situation, the philanthropist
860   wrote a check for 23 million dollars.
861   The environmentalists and the zoologist have been working together for many years.
862
863   24. Two waitresses, a bouncer, and a DJ conversed during their break.
864   The bouncer playfully teased the waitresses, and then the DJ warned the bouncer about his
865   inappropriate behavior.
866   The bouncer was known to be obnoxious, and the DJ didn't much care for him.
867
868   25. A city councilman, a treasurer, and an orator gathered together for a meeting.
869   The councilman and the treasurer wanted to improve their public speaking skills, so the orator was
870   giving them advice.
871   The councilman's speeches improved significantly after meeting with the orator.
872
873   26. A queen, a princess and a prince prepared for the grand arrival of the king.
874   The queen applied make-up while the princess and the prince checked up on the festive meal.
875   The queen had spent the entire day primping for the arrival of the king.
876
877   27. A shark, a seal and an animal feeder were in the same tank together at the aquarium.
878   The shark attacked the seal while the animal feeder tried to distract it with shark food.
879   The shark bit the animal feeder on the leg, and he decided to sue the aquarium.
880
881   28. A fugitive, an undercover cop, and a schoolgirl were in the same train car.
882   The cop tackled the fugitive, and then the schoolgirl screamed.
883   The fugitive managed to escape, but the cop eventually caught up with him.
884
885   29. A farmer, a banker, and a mayor had a meeting on a farm.
886   The farmer talked to the banker while the mayor surveyed the farm.
887   The mayor wants to buy the farm and turn it into a community park, and she hopes to start
888   construction this month.
889
890   30. A preacher, an assistant pastor, and an organist led praise worship during the service on Sunday.
891   The preacher said the prayer, and then the assistant pastor gave a reading.
892   The assistant pastor and the organist got married last month in the same church.
893
894   31. A golf pro, a novice player, and a caddy were on the golf course.
895   The golf pro demonstrated how to putt, and the novice imitated him.
896   The caddy thought that the golf pro was very patient, and the novice was really enjoying the lesson.
897
898   32. A university president, a campus police chief, and a dean spoke to the incoming class at
899   orientation.
900   The chief's speech was sobering, but the other two speeches were more uplifting.
901   The university president is retiring this year, and the university has already found a replacement.
902
903   33. A rapper, his agent, and a dancer were going over the contract for a new music video.
904   The rapper talked to the agent while the dancer looked over the information about her salary.
905   The rapper had worked with the agent before, so he was confident that the contract was fair.

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906
907   34. A physician assistant, a surgeon, and a patient discussed several treatment options in the
908   emergency room.
909   The physician assistant and the surgeon recommended a surgery; however, the patient remained
910   skeptical.
911   The physician assistant and the surgeon have been at the same hospital for nearly ten years and often
912   work together.
913
914   35. A concierge, a pianist, and a flutist were engaged in an argument in the hotel lobby.
915   The pianist and the flutist stated they had made room reservations; however, the concierge claimed
916   that they had not.
917   Later, the concierge was fired for being so rude because the pianist and the flutist complained to the
918   manager about the horrible guest service.
919
920   36. A nanny, a dog walker, and a pickpocket were sitting in the same area at the park.
921   The dog walker punched the pickpocket after he stole the nanny's wallet.
922   The pickpocket got away, and the dog walker never found out whether he was ever arrested.

Figure 1.JPEG