Global expectations mediate local constraint: Evidence from concessive structures

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Abstract

Numerous studies have found facilitation for lexical processing in highly constraining contexts. However, less is known about cases in which immediately preceding (local) and broader (global) contextual constraint conflict. In two eye-tracking while reading experiments, local and global context were manipulated independently, creating a critical condition where local context biases towards a word that is incongruent with global context. Global context consisted of a clause introduced by a concessive marker generating broad expectations about upcoming material (Xiang & Kuperberg, 2015). Experiment 1 compared high- and low-predictability critical words, whereas Experiment 2 held the critical word constant and manipulated the preceding verb to impose different levels of local constraint. Facilitation from local context was reduced when it was incongruent with global context, supporting models in which information from global and local context is rapidly integrated during early lexical processing over models that would initially prioritize only local or only global context.

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Introduction

During incremental sentence processing, comprehenders must rapidly integrate words into a representation as it unfolds, incorporating information from immediately preceding words, in addition to broader linguistic context and real-world knowledge. Contextual information that highly constrains the upcoming input has been shown to facilitate both early and anticipatory processes of language comprehension (e.g., Altmann & Kamide, 1999; Federmeier, 2007; Kamide, 2008; Kamide et al., 2003; Laszlo & Federmeier, 2009; Staub, 2015). Facilitation for predictable words has been found not only in the presence of highly constraining local contexts, i.e., the word(s) directly preceding the critical word, but also from global contextual constraint, as in material in a previous clause or sentence (e.g., Chow & Chen, 2020; Fitzsimmons & Drieghe, 2013; Hess et al., 1995, among many others).

However, these expectations may be mediated by the connectives and markers that impose discourse relations between global and local contexts. For example, Xiang & Kuperberg (2015) found that the presence of a concessive marker *even so* (2) ameliorates the processing penalty associated with a highly unpredictable word (*celebrated*) given the global context provided in a previous sentence (1), suggesting that comprehenders rapidly use a concessive marker to revise their expectations about what is likely to appear in the following sentence.

(1) Elizabeth failed her exam. She went home and celebrated.

(2) Elizabeth failed her exam. Even so, she went home and celebrated.

In this paper, we further investigate the idea that lexical predictions may be revised in light of information presented in concessive clauses appearing before a target word. In two eye-tracking

studies, we explicitly manipulate the compatibility between global and local contexts on a lexical target given high and low levels of local constraint. Following Hess et al. (1995), we outline three broad ways in which contextual information might constrain lexical processing, focusing in particular on "hybrid" models in which both global and local context play active roles during early stages of sentence processing. To address situations in which expectations generated by global and local context conflict, we present three ways of further developing a hybrid account: a *local first* account, in which only local context affects the earliest stages of lexical processing, a *global dominant* account, in which information from global context may completely override local constraint, and a *dual source* account, in which both local and global context conspire together to mutually constrain expectations about upcoming words. We then provide a brief overview of the interpretation of concessive clauses, arguing that concessive structures provide a unique and valuable testing ground for the study of contextual effects on lexical processing.

Contextual effects on lexical processing

Previous research demonstrates that context biasing towards a word form facilitates lexical processing when that word is encountered (e.g., Ehrlich & Rayner, 1981; Morris, 1994; Rayner & Well, 1996) and disrupts processing when the combination is implausible or anomalous (e.g., Rayner et al., 2004). Various mechanisms have been proposed, including prediction, pre-activation, and post-lexical integration, among others (see DeLong et al., 2005, 2014; Kutas et al., 2011; Staub, 2015, for review). Sufficiently biasing context may even result in misperceiving a word as the expected word, if it is a highly frequent orthographic neighbor (e.g., Gregg & Inhoff, 2016; Pollatsek et al., 1999; Slattery, 2009, but see also Harris et al., 2021) or a transposed letter neighbor (Johnson, 2009). In these studies, contextual constraint is typically

specified as prior sentential information within the same clause as the critical word. Yet, information beyond the immediately preceding clause also influences the reading process (Bransford & Johnson, 1972), as comprehenders use their knowledge of the world and the prior discourse to link clauses together to form a coherent narrative structure. While comprehenders may delay making certain kinds of inferences, they appear to adjust rapidly to contexts that establish fictional (Filik & Leuthold, 2008; Nieuwland & Van Berkum, 2006) and counterfactual (Ferguson et al., 2008; Ferguson & Sanford, 2008; Nieuwland & Martin, 2012) scenarios, as discussed in more detail below.

As contextual information comes in a variety of forms, it is possible that each type of contextual constraint might have a qualitatively unique kind of impact on lexical processing in terms of the strength or the time course of the effect. Although contextual information has been categorized in many ways in prior literature, here we operationalize local constraint as the words constituting a syntactic frame preceding a particular word within the same clause. Global constraint is characterized here as any information that precedes the clause containing the target word.

We first discuss three broad classes of models from the literature that have been proposed to account for the effect of contextual constraint on lexical processing, *local-only, global-only,* and *hybrid* models, before expanding on the third approach. In a local-only model, contextual information is construed in terms of content local to the target word, such as a set of words (*The barber trimmed*) immediately preceding the target word or phrase (*the mustache*). These models tend to explain the effect of local context on lexical processing via low-level interlexical spreading activation from immediately preceding semantically related content words (*barber,*

trim) to the target (*mustache*). On these accounts, word recognition processes are isolated from those that trade in information from the broader discourse.

While local-only models easily account for phenomena such as semantic priming in word lists (e.g., Meyer & Schvaneveldt, 1976), their explanation of early effects of broader context on word recognition and lexical access poses a greater challenge. For example, Duffy et al. (1989) found that subjects were faster to name the final target word (*mustache*) of a sentence only when the target was biased by the preceding subject and verb (*The barber trimmed the mustache*), but not by the subject (*The woman trimmed the mustache*) or the verb (*The barber saw the mustache*) alone. They proposed that content words are stored in a temporary buffer which lexically prime the target word via automatic spreading-activation between semantic associates. As facilitatory priming was observed regardless of the syntactic position of the related words, they argued that the advantage reflects the combined activation of individual content words summed together within the buffer (e.g., Foss & Ross, 1983; Stanovich & West, 1983). In a local-only account, priming acts solely within the lexicon, rather than at a larger sentence or discourse level of representation.

However, biasing contextual information may also be provided by the broader, global discourse. This information may be conveyed through, for example, discourse topics and real-world knowledge. In global-only models, the influence of local context on word recognition and lexical access is attributed to the ease with which a given word may be integrated into an ongoing discourse representation. An early example comes from a phoneme monitoring task conducted by Foss & Speer (1991), in which the degree of response facilitation depended more on global context than on immediately local context. They interpreted these results as evidence that discourse integration plays the central role in contextual bias, as opposed to interlexical

spreading activation (see also Foss & Ross, 1983). In another global-only approach, Hess et al. (1995) conducted a cross-modal naming task and found that local contextual bias sped naming times only when global context was also congruent with the local context. They concluded that local context had no influence on lexical access beyond what it contributed to the ongoing discourse.

Hybrid models propose that information from both kinds of contextual environments influence lexical and post-lexical processes in either staged or interactive architectures. In staged variants, different sources of contextual information feed distinct processing routines that operate independently from each other (e.g., Posner & Snyder, 1975; Kintsch & Mross, 1985; Schustack et al., 1987; Till et al., 1988; . In the first stage, automatic interlexical spreading activation facilitates lexical access, operating independently of global context. In the second stage, information from global context guides sense selection and facilitates post-lexical integration of the word into the broader context. For example, in Schwanenflugel & White's (1991) weakly interactive model, global and local context jointly constrain upcoming words via semantic features. Low constraint contexts generate only a few general features consistent with many words, each providing some degree of facilitation. In contrast, high constraint contexts generate a large number of semantic features, serving to restrict the number of compatible words. Global context interacts with local context by mutually constraining upcoming words through the combination of semantic features; a highly compatible intersection of features was predicted to increase lexical facilitation over and above any effects derived from either source alone, whereas an incongruent combination might weaken the impact of features derived from a local source.

Morris (1994) corroborated Duffy et al.'s (1989) naming results in an eye-tracking study, finding shorter gaze durations on the target word for sentences with a combination of semantic

associates than those with a single related word. However, this effect was greater when the agent of the highly constraining verb (*trimmed*) was compatible with the target (*The gardener talked as the barber trimmed the mustache after lunch*) compared to when it was not (*The gardener talked to the barber and trimmed the mustache after lunch*). She concluded that facilitation of lexical processing arises both from interlexical priming and through sentential or message-level representations.

Hoeks et al. (2004) addressed a similar issue in an electrophysiological (EEG) study investigating how thematic fit and contextual constraint would affect the N400, an event-related potential (ERP) whose morphology increases in response to unexpected content, among other factors (Kutas & Hillyard, 1980; see Kutas & Federmeier, 2011, for review). They found an increased N400 excursion when the target word provided a poor thematic fit for the sentence, an effect which was further increased by strongly constraining message-level context. Although Morris (1994) and Hoeks et al. (2004) provide convincing evidence from distinct paradigms that the thematic relations providing sentential meanings interact with sentence constraint, their studies do not clearly resolve how more global sources of constraint might affect the use of local constraint in lexical processing. In another study, van Berkum et al. (2005) test the role of global context in generating predictions by creating two-sentence mini-stories in which the first sentence provides specific bias for which noun should follow an indefinite article in the second sentence. To ensure that constraint originated primarily from the broader context, the local context imposed very little constraint on the critical word. Participants were able to generate specific predictions about noun continuations based on prior sentence context, measured as an increased N400 when a gender-marked adjective following the indefinite article mismatched

with the gender of the predicted noun. However, the study was not designed to address how global and local context might interact.

In order to address this architectural issue more directly, the present paper considers three ways in which different kinds of hybrid models may make use of global and local contextual information during lexical processing. All three maintain that information from both global and local context is used in processing, but differ in which type of information is privileged in cases of contextual clash. For example, in (3), the local context (*flew a*) highly suggests the target word (*kite*), while the global context biases against the target word, as kite-flying is difficult without wind.

(3) When it wasn't windy outside, Alan flew a kite in the park.

We distinguish (i) hybrid models in which one source of contextual information strongly restricts which lexical candidates are available for later processes from (ii) hybrid models that draw on multiple sources of contextual information simultaneously. First, we introduce a *local first* hybrid account, in which local contextual fit is prioritized during the word recognition process and global contextual fit is deferred, possibly until post-lexical integration, as in staged hybrid models (Posner & Snyder, 1975; Schustack et al., 1987). This account predicts that encountering a likely word in a constraining local context confers an advantage in lexical processing, regardless of the word's compatibility with global context. From here on, we will refer to this facilitation as a *local compatibility* effect. Second, we consider a *global dominant* hybrid account, in which the global context winnows out incompatible continuations before local context further constrains the set of likely upcoming words. A case in which a word is

compatible with the local context, but clashes with the global context, would result in an immediate penalty during the word recognition process, referred to here as a *global incongruency* penalty. Finally, there is a *dual source* hybrid account, in which information from both global and local context is immediately used to mutually constrain the set of likely upcoming words. Neither local nor global context is privileged as a function of the architecture; they might feed separate processes that terminate at different times to produce a cascading effect, or they might interact to simultaneously constrain expectations about upcoming word forms. Regardless, a local compatibility facilitation would then occur only if the incoming word were compatible with both local and global context, a facilitatory effect which we call here a *full-context compatibility* effect.

We have limited our discussion to descriptions of how constraining information from global and local context might conceptually influence lexical processing, without committing to a specific implementation. The accounts above are compatible with an architecture that weighs constraint from global and local context differently, as well as one in which these processes are accessed at different time courses during processing. One particularly fruitful area of research concerning the interplay between global and local context is in the processing of counterfactual conditionals and fictional contexts, in which a word and its local context must be interpreted within an alternate or non-actual situation presented in the global context.

Counterfactual and fictional contexts

To assess the effects of global context on lexical processing, several previous studies have employed structures referencing an alternative reality, such as counterfactual conditional statements. These constructions allow researchers to identify the point at which comprehenders

use reasoning consistent with the counterfactual world rather than relying on their knowledge of the actual world.

In an EEG study, Ferguson et al. (2008) presented participants with counterfactual sentences such as *If cats were not carnivores, families could feed their cats a bowl of fish/carrots*... to examine how quickly knowledge from the counterfactual world, in which cats wouldn't eat fish, would be incorporated into the processing of the target word (*fish* or *carrots*). According to a local first hybrid account, *fish* would be easier to integrate than *carrots*. In contrast, under a global dominant or dual source hybrid account, *carrots* would be easier to integrate, as the language processor would take the full counterfactual context into consideration when generating lexical predictions. They found a smaller N400 effect for the real word compatible continuation (*fish*) compared to the contextually compatible continuation (*carrots*). The reduced N400 effect would seem to suggest that only real-world knowledge is taken into account at first, in line with local first account. However, results from other studies suggest information from global context is immediately available. Nieuwland & Martin (2012) presented participants with highly constraining counterfactual contexts, such as *If NASA had not developed its Apollo Project, the first country to land on the moon would have been America/Russia surely*, with *America* corresponding to real world knowledge and *Russia* to the counterfactual world. Here, counterfactual-false sentences (*America*) resulted in an increased N400 effect, arguing against a model that would delay input from global context.

Relatedly, fictional contexts have been shown to decrease implausibility penalties. Nieuwland & Van Berkum (2006) presented participants with fictional contexts in which inanimate objects behaved as animate beings, such as peanuts that dance and sing. Later in the text, the inanimate object was paired with a predicate that was either contextually appropriate but

inconsistent with real world knowledge (in this case, *was in love*), or consistent with real world knowledge, but not appropriate in this particular context (*was salted*). The contextually inappropriate predicates resulted in larger N400s, supporting either a global dominant or a dual source hybrid account, in which information from preceding context is immediately available for early stages of processing. Similarly, Filik (2008) placed otherwise anomalous statements (e.g. *The cat picked up the chainsaw*) into fictional contexts (in this case, the context of the "Tom and Jerry" cartoon) and found diminished N400s at the target word (*chainsaw*). Their results, too, supported a model in which broader contextual information is incorporated immediately during relatively early stages of lexical processing.

While the fictional contexts addressed here provide a richer global context compared to single counterfactual sentences, which could explain differences across experiments, most evidence across both stimulus types reveals that global information may be prioritized during lexical processing. However, the studies outlined above were not designed to test whether conflicting local context would disrupt the prioritization of global context, and do not, in our terminology, tease apart the difference between global dominant and dual source hybrid accounts. We employ a structure other than fictional and counterfactual contexts to do just that, namely, the concessive structure.

Concessive structures

Concessive structures provide a unique lens for studying how global and local constraint guide the integration of contextual expectation in sentence processing. Concessive clauses are often introduced by discourse markers, such as *although* and *even so*, triggering the inference that a real-world expectation should be cancelled or suspended. As noted by Xiang & Kuperberg

(2015), concessive structures are particularly useful in psycholinguistic research as they not only require that the comprehender calculate pragmatic assumptions that are often left implicit, but may also prime the comprehender to anticipate a reversal of expectations.

While concessive structures may take a number of shapes given the flexibility of clause order, we concentrate on bi-clausal concessive structures such as (4), in which a subordinate concessive clause is introduced by a concessive marker (*Although it was mid-December*) and is then followed by the matrix clause (*Mary was wearing shorts*). The concessive marker indicates that an unspecified expectation typically associated with the concessive clause does not hold, e.g., that people don't wear shorts in cold weather. The matrix clause then provides specific evidence against one such expectation (*denial of expectation*, Lagerwerf, 1998; Lakoff, 1971).

A concessive structure may be pragmatically infelicitous (indicated by a '#' mark) in one of two ways. One possible source of infelicity stems from a failure to address any readily accessible expectation altogether, as in (5). The continuation in (5) intuitively does not address a readily accessible expectation about Mary's behavior in cold weather, and reads as a non-sequitur. Infelicity may also arise when a readily accessible expectation is addressed, but is not reversed or denied (6). The continuation in (6) alludes to the same expectation that (4) relies on, an expectation about temperature-sensitive attire that depends on a further assumption that December is cold, but does not reverse any typical expectations about attire in cold weather, making it pragmatically infelicitous given real-world knowledge. Both (5) and (6) could be accommodated, however, given the right supporting context, e.g. that the speaker in (5) has some idiosyncratic belief that glasses-wearing is determined by the temperature or the month.

(4) Although it was mid-December, Mary was wearing shorts.

(5) # Although it was mid-December, Mary was wearing glasses.

(6) # Although it was mid-December, Mary was wearing gloves.

The concessive clause itself does not indicate which expectation will be denied. For concreteness, we assume that the content of a concessive clause A passively associates with situations C that typically co-occur in a meaningful way through a defeasible or non-monotonic inference, informed by real-world knowledge of A and C. Similar notions have been explored in generating discourse schemas (Bower et al., 1979; Schank & Abelson, 1977, but see also Alba & Hasher, 1983) or situations in implicit focus (e.g., Garrod & Sanford, 1988). For example, a situation occurring in mid-December (A) might be implicitly associated with many expectations, including cold or snowy weather, requiring warm attire, the availability of cider donuts, and so forth[1]. For convenience, we refer to the set of defeasible expectations associated with a clause A as EXPECT(A), and assume that a concessive marker triggers a conventional implicature or presupposition that some proposition C from EXPECT(A) is or will be incompatible with an assertion in the discourse (e.g. Lagerwerf, 1998). We remain agnostic about how information might be added to and organized within EXPECT(A).

In terms of incremental processing, an important function of a concessive clause is to signal that something unexpected will be asserted in the matrix clause. However, it is not the case that any otherwise-unexpected continuation becomes more expected. The range of felicitous continuations is pragmatically constrained by the real-world expectations in EXPECT(A), which are in some way relevant and informative to the present discourse (Blakemore, 2002; Winter &

[1] The particular set of expectations depend on the individual or the particular context; for example, the mentioned expectations for December are based on higher latitudes in the Northern hemisphere, but expectations for December weather would differ drastically depending on geographical location.

Rimon, 1994). The concessive marker thus provides an ideal case for the study of contextual constraint and the extent to which comprehenders may rank or evaluate potential continuations based on the expectations specific to the concessive clause.

(7) a. *Concessive clause:* Although it was mid-December, …

i. *Assertion:* It is mid-December

ii. *Real-world knowledge:* Generate EXPECT("It is was mid-December")

iii. *Conventional implicature:* Some situation from (ii) will be incompatible with upcoming information.

b. *Matrix clause:* Mary was wearing shorts.

i. *Assertion*: Mary was wearing shorts.

ii. *Possible updates to scenario*: It was probably not cold out; Mary doesn't mind being cold, etc.

The concessive marker furthermore provides a unique environment in which to study the incremental modulation of predictions as different sources of information become available. Our study employs concessive structures over counterfactual or fictional contexts for reasons similar to those articulated by Xiang & Kuperberg (2015); concessive discourse markers tightly constrain potential continuations by triggering an expectation that some relevant aspect of the reported situation deviates from how the world usually works, given the content of the concessive clause. In addition, concessive constructions allow for the manipulation of a broader global concessive context independent of the manipulation of context immediately local to a particular word in the matrix clause. In (7), multiple sources of information might be used to

predict the word *shorts*. Information from the global context indicates that surprising or unexpected information will eventually follow, whereas the matrix clause provides a local context (*Mary was wearing*) that constrains the continuation to a wearable object.

Xiang & Kuperberg (2015) predicted that the presence of a concessive discourse marker increases the strength and specificity of predictions generated. They compared pairs of sentences without any concessive marker (8a-b) to sentences containing *even so* (8c-d), measuring ERP responses at a target word (*celebrated*).

(8) a. *Coherent:* Elizabeth aced her exam. She went home and celebrated.

b. *Incoherent:* Elizabeth failed her exam. She went home and celebrated.

c. *Even-so–Coherent:* Elizabeth failed her exam. Even so, she went home and celebrated.

d. *Even-so–Incoherent:* Elizabeth aced her exam. Even so, she went home and celebrated.

An N400 effect on the target word was observed in incoherent contexts (8b, d), and was increased when the target was preceded by a concessive (8d) compared to when it was not (8b). This interaction suggests that comprehenders either engaged more actively in predictive processes or were more committed to their predictions if they had encountered the concessive *even so*. The results clearly indicate that information carried by the concessive marker in fact strongly influenced the generation of predictions during lexical processing. However, as with previous studies with counterfactual and fictional contexts, their study was not designed to identify whether global or local information, if either, hold a privileged status in early stages of processing.

To address this question, our study placed the concessive marker in a preceding subordinate concessive clause, signaling an upcoming reversal of expectations. Concessive clauses provided global context that was either congruent or incongruent with a later target word (*goal*), which was itself highly predictable in the locally constraining context of the matrix clause (*scored a* __). Like many others, we operationalized predictability and contextual constraint through the probability of word completion to a sentence fragment in a cloze task (Taylor, 1953). The same lexical content, except for a negation or negative marker, was used in concessive clause for congruent and incongruent contexts; see Table 1.

TABLE 1 ABOUT HERE

In addition to the global context, local sentence constraint was manipulated by comparing high (*goal*) and low (*deal*) cloze probability target object noun words (Experiment 1), or by manipulating the preceding verb with the same target object noun word to produce high and cloze probability combinations (Experiment 2). This design allowed us to evaluate the three conceptual possibilities outlined above. The local first account would predict only a *local compatibility* effect for highly constraining local contexts, regardless of the compatibility of global context. The global dominant account would predict only an overall effect of *global (in)congruency*, with no change in reading to match the change in local constraint level. Finally, the dual source account would predict an interaction wherein facilitation depends on both *local compatibility* and *global congruency*, i.e., facilitation from *full-context compatibility.*

As we explored the processing of concessive clauses in the eye movement record, the effects we predicted depended on a specific interpretation of eye movement measures. In reading studies, the predictability of a word given its context is often reflected in a number of early reading measures, including first fixation durations and first pass reading times on the word (Staub, 2015 for review). Readers also skip highly predictable words more often than unexpected words, and, when fixated, these highly predictable words receive shorter first fixation durations and first pass reading times (Ehrlich & Rayner, 1981; Rayner et al., 2012; Rayner & Well, 1996). The effect of highly predictable words has been found to depend on valid access to parafoveal preview (Balota et al., 1985; Juhasz et al., 2008; Schotter et al., 2015; White et al., 2005), i.e., outside the fovea. It is therefore also possible that readers are faster to progress to a predictable word from the previous region compared to less predictable words, though such *parafovea-on-fovea* effects are debated within models of reading (Kennedy, 1998; Kennedy & Pynte, 2005; Schotter et al., 2012). If global or local constraint facilitates lexical access during reading, we expected the effect to appear in any or all these measures. Measures indicating that a word or region was re-fixated (such as go past and second pass times) are assumed to involve post-lexical processing, such as ease of integration or reparsing (though see Clifton et al., 2007 and others for caution in assigning specific cognitive processes with early vs. late measures in reading). We therefore restrict predictions about early lexical processing to earlier measures of reading. We also anticipate that global discourse congruence influences measures of re-reading as well, but any findings in these measures cannot be solely attributed to early lexical processing, the focus of this paper. We will address the role of integration and other post-lexical processes in the General Discussion.

Experiment 1

Experiment 1 was designed to disentangle the three hybrid models by using (i) a global concessive context that provides a global bias towards or against events described in the matrix clause and (ii) the extent to which a target object noun fits the local contextual constraint provided by the matrix clause. A global dominant hybrid account predicts a penalty for object nouns that are incompatible with the concessive clause. A local first hybrid account predicts an advantage for object nouns that can be predicted from the local context. A dual source hybrid account predicts that the advantage for locally compatible object nouns will be moderated by the global context supplied by the concessive clause at the early stages of lexical processing. A dual source hybrid account would also allow for separable effects of local and global context at different points in the eye movement profile.

Participants

Forty-eight self-reported native speakers of English from the University of California Los Angeles participated for one course credit in sessions lasting between 30 and 45 minutes. Participants were recruited through the UCLA Psychology Subject Pool. Participants had normal or corrected-to-normal vision.

Materials

Thirty quartets were constructed such that a High or Low local constraint, operationalized as high or low cloze probability, word appeared in local context (*…she scored a…*). Low local constraint words were still semantically compatible with the local context. Concessive structures provided the global context, either Congruent with the High local constraint word (*Although the*

soccer player hadn't practiced recently…) or Incongruent with it (*Although the soccer player had practiced recently …)*. An example item can be found in Table 2. In most items, the lexical content of the global context region differed only in terms of negation. As negation may increase processing difficulty (e.g., Wason, 1961; Clark & Chase, 1972; Carpenter & Just, 1975), half of the items contained negation in the Congruent context while the remaining half contained negation in the Incongruent context. To diversify the items, roughly one third of the items contained negative morphology (*popular* vs. *unpopular*) or lexical contrasts (*loved* vs. *hated*) instead of sentential negation.

To norm the materials, a separate set of 46 native English-speaking undergraduate students were recruited through the UCLA Psychology Subject Pool to complete an online cloze task hosted on IbexFarm (http://spellout.net/ibexfarm/). Participants were presented with the complete context that would precede the High or Low constraint word and asked to provide a natural-sounding one-word continuation for the fragment provided. From the original 30 quartets, 20 items were selected such that the High local constraint word was highly probable (M = 0.88) in the Congruent context and moderately probable in Incongruent contexts (M= 0.52). The Low local constraint word was not very likely in either Congruent (M = 0.01) or Incongruent (M = 0.05) contexts.

TABLE 2 ABOUT HERE

The High and Low local constraint words were matched on frequency, length, orthographic neighborhood size, and other lexical characteristics known to affect reading prior to norming using the English Lexicon Project (Balota et al., 2007). The lexical characteristics for

the final set of items did not differ significantly between the High and Low local constraint words, listed in Table 3.

TABLE 3 ABOUT HERE

Predictions

As mentioned above, the explicit predictions of each model considered here depend on the interpretation of eye movement measures as reflective of the time course of processing. The models differ in what sources of information take priority during early lexical processing, and therefore primarily make predictions about early measures of reading on the target or critical word (*goal/deal*), such as first fixation durations, first pass times, and skipping rates. In addition, readers of English take in word level information from up to 14 characters to the right of a fixation (Rayner et al., 2012). We reasoned that early effects might also manifest in the region prior to the critical word (the local context), even though issues of whether material in parafoveal preview generally influence processing within foveal vision is currently unresolved.

To begin a review of the predictions of the three hybrid accounts, the *local first* model predicts that early eye movement measures would depend solely on local constraint. In other words, the local first model predicts a main effect of local context in early measures, so that words in High constraint contexts would be read faster than words in Low constraint contexts, with no effect of congruency with global context, and no interaction between global and local context, at least not in early reading measures on target words, i.e., an effect of *local context compatibility*. In contrast, the *global dominant* account predicts that only items congruent with global constraint receive contextual support, resulting in reduced fixation durations on the critical word. In all, the global dominant approach predicts a main effect of *global congruency,*

no main effect of *local compatibility,* and no interaction. Finally, the *dual source* account predicts that local context accounts constrains upcoming lexical continuations, resulting in a main effect of *local compatibility* for highly probable target words. However, it also predicts that local constraint additionally interacts with global congruency, so that a critical word in the High local constraint condition is read faster than those in the Low local constraint region when following Congruent global context, an effect described as facilitation from *full-context compatibility*.

Procedure

The items were counterbalanced such that per session participants only saw one condition of each item and saw an equal number of items in each condition. The experimental sentences were presented among 54 sentences from unrelated experiments as well as 20 fillers, for a total of 94 items per experimental session. Items were presented in an individually randomized order. Half of the items were followed by comprehension questions, as in (9). Participants responded using the left and right triggers on a game controller.

(9) What game occurred over the weekend?

The opening game The closing game

Items were presented using the UMass presentational software EyeTrack (https://blogs.umass.edu/eyelab/software/) on a 23-inch LCD screen in a private, sound-isolated room. Eye movement data were recorded using an SR EyeLink 1000 Plus eye tracker on a Lenovo desktop running Windows 7, with all unnecessary software turned off and no connection

to the Internet. The tracker was mounted to the table 55cm away from the monitor with approximately 2 characters subtending 1 degree of visual angle. The sampling rate was 1000 Hz. The items were presented in a black 11pt fixed-width proportion Monaco font on a light gray background. Participants were prompted to take a break halfway through the experiment, and as needed, and were instructed to blink in between trials. Three-point calibration was conducted at the start of each experiment and following breaks.

Data were cleared of blinks and major track losses using software from the University of Massachusetts, Amherst (https://blogs.umass.edu/eyelab/software/), for less than 3% data loss in the final dataset. Participants were excluded and replaced if they had more than five blinks in the critical region across all experimental items, or more than two blinks in the critical region in any given condition. All participants scored above 80% correct on relevant comprehension questions, with an overall average score of 91%, as well as an average score of 99% on non-experimental filler items. Any fixations under 40ms within one character of another fixation were merged with the nearest fixation. Any other fixations under 80 ms or over 1200 ms were removed.

Data analysis

Six standard eye movement measures were reported in this analysis. They include *first fixation duration*, the duration of the first fixation on a region; *first pass times*, the sum of all fixations on a region before exiting the region to the left or the right; *go past times*, the sum of all fixations on a region and regressions to previous regions before exiting the region to the right; *second pass times*, the sum of fixations on a region after a later region has been fixated; *regressions in*, the proportion of regressions into a region; and *regressions out*, the proportion of regressions made out of a region. *Skipping rates*, the proportion of trials in which there are no initial fixations on a

region, were analyzed when theoretically motivated, namely for the critical word region. The first four measures listed were analyzed using linear mixed effects regression models. Regressions in and out, as well as skipping rates, are binomially distributed, and were therefore analyzed using generalized linear mixed effects (*link logit*) models. All models were constructed via the lme4 package (Bates & Maechler, 2009) in R (R Core Development Team, 2017).

After the data-processing described in the previous section, outlier removal was conducted separately for each measure. For reading measures which are typically normally distributed, the data were winsorized (Dixon, 1960; Tukey, 1962), a process in which all data points beyond the top and bottom 5th percentile were transformed to the 5th and 95th percentile values respectively. This process allows for the preservation rather than removal of outliers (see also Sturt et al., 1999; Van Dyke & McElree, 2011, for examples of eye tracking studies with similar outlier removal procedures). No outlier removal or transformation was performed on measures that do not typically follow a normal distribution: go past, second pass, or regression data. Means and standard errors for all measures are provided in Table 4.

TABLE 4 ABOUT HERE

Linear mixed effects models were computed with global context, critical word, and their interaction as fixed-effect factors. The factors were sum-coded, so that Congruent context and the Low local constraint conditions were treated as the statistical baselines. A top-down model-fitting strategy was implemented to determine the most parsimonious random effect structure for the data. Maximal random effect structures with by-subject and by-items random slopes and intercepts were initially fit to the data. If these models failed to converge, models with less

complex random effect structures were fit by successively removing the random effect terms that had little to no explanatory value in a principal components analysis of the estimated covariance matrices (Bates et al., 2015; Matuschek et al., 2017). Models were successively simplified until a model with the most complex random effect structure converged. These models were then compared to a model specified with by-subject and by-items random intercepts. The random intercept models accounted for as much variance as the most complex models that converged, and are reported here for the relevant measures and regions.[2] Further, they produced qualitatively identical results to more complex versions in nearly all cases. Despite the recommendation to favor maximal models (Barr et al., 2013), models that do not converge lead to uninterpretability, in which case parsimonious random-effect structures are preferred (Bates et al., 2015; Matuschek et al., 2017). Fixed-effects were not reduced through model-fitting.

The *emmeans* (Lenth, 2020) package was used to explore interactions between factors within each model, and are reported in square brackets within the text. The Low and High local constraint words were compared at each level of Contextual support from the concessive clause, with Tukey corrections applied to control for multiple comparisons. Given the theoretical importance of the interactions at the critical region, comparisons on this region were computed regardless of whether the interaction was significant in the mixed-effects regression model. The

[2] A reviewer suggested presenting a power analysis for the studies, given the failure to fit models with complex random effect structures. Doing so requires estimating the degrees of freedom, which is not trivial in linear mixed effects models as the parameter estimates are calculated from the residual maximum likelihood, and not from observed and expected mean squares used in power analyses for ANOVAs (Pinheiro & Bates, 2006). We addressed power in two ways. We first conducted post-hoc power analyses with G*Power 3.1 using estimates based on the F-distribution of first fixation times, assuming the standard significance level ($\alpha = 0.05$) and a small-to-medium effect size (Cohen's $F = 0.25$). We conducted the test for a within-factors repeated measures 2x2 MANOVA. For Experiment 1 ($N = 48$), the power was calculated to be 0.80. For Experiment 2 ($N = 52$), the power was 0.84. As repeated measures designs complicate power calculations (Brysbaert & Stevens, 2018; Judd et al., 2017), we also estimated power using the method described in Judd et al. (2017). The power for Experiment 1 was calculated at 0.96, whereas the power for Experiment 2 was 0.98. However, observed (post-hoc) power calculations are often perceived as flawed or misleading when reasoning about non-significant results (e.g., Hoenig & Heisey, 2001). Finally, the two experiments essentially replicated each other, suggesting that the findings are robust.

effect size of each contrast was calculated as Cohen's *d* (Cohen, 1988), also obtained from *emmeans*.

The presentation of results is organized in terms of the theoretical mechanisms and their predictions. We limit our attention to specific regions of interest in order to reduce the number of comparisons and minimize Type II error (von der Malsburg & Angele, 2017). Measures that reflect the initial or first encounter of text in a region are presented first in Table 5. These include first fixation duration, first pass time, go past time, and regressions out on the critical region and the spillover region. Measures implicated in re-reading are presented next in Table 6: regression in and second pass times on the concessive clause, the local context, and the critical region. All significant effects for measures examined are reported. Skipping rates were only analyzed on the critical region, and are therefore not included in the tables reporting all measures. Any significant results in skipping rates are reported in the prose. All *p* values reported for linear mixed effects models are estimates from the package lmerTest (Kuznetsova et al., 2017).

Results

First encounter reading

Critical word

In first fixations, High local constraint words (M = 210 ms, *SE* = 3) were read faster than Low local constraint words (*M* = 222 ms, *SE* = 3), $t = -2.64$, $p < .05$, in keeping with the findings that readers spend less time on more predictable words; see the left panel of Figure 1. There was no effect of global context for this measure, nor an interaction between factors. However, planned pairwise comparisons of the estimated marginal means of the model revealed a differential effect of context on local constraint, shown in the left panel of Figure 2, in a pattern consistent with a

dual source account. In Congruent global contexts, High local constraint words were read 15ms faster than Low local constraint words [Cohen's d = .29, $ß$= 14.39, SE = 6.12, t = 2.35, p < .05], but the 8ms difference in Incongruent global contexts was not significant, t = 1.36, p = .17.

In first pass times, there was a trend for faster High local constraint (M = 219 ms, SE = 4) compared to Low local constraint (M = 228 ms, SE = 228) words, t = -1.84, p = .07, in a pattern similar to first fixation durations on this region. While we did not observe an effect of context or an interaction between factors, planned pairwise comparisons of the marginal means showed a trend towards a differential effect of context on local constraint. High local constraint words elicited a 13ms shorter first pass time compared to Low local constraint words [Cohen's d = .22, $ß$ = 12.40, SE = 7.02, t = 1.771, p = .07] in Congruent global contexts, but only a 6 ms difference in Incongruent global contexts, t < 1.

Analysis of go past times and regressions out each revealed a cost for Incongruent global contexts. As shown in Figure 3, it took readers longer to go past the critical region in sentences with Incongruent global contexts (M = 370 ms, SE = 23) compared to those with Congruent global contexts (M = 291 ms, SE = 11), t = 2.94, p < .001. No evidence for an effect of Local constraint or an interaction was observed. Incongruent global contexts also elicited more regressions out of the critical region (M = 27%, SE = 3) compared to Congruent global context (M = 18%, SE = 2), t = 2.66, p < .05. There was also a trend towards an interaction in regression out measures, z = -1.95, p = .05. Analysis of the marginal means found that the trend was due to 11% more regressions out of regions containing Low local constraint words than High local constraint words in Incongruent global contexts [Cohen's d = .54, $ß$ = 0.58, SE = 0.17, z = -1.88, p = .06], but there was no evidence for any difference between levels of local constraint in Congruent global contexts, z < 1.

Measures of initial reading on the critical region support the prediction that words which are more highly compatible with the local constraint of the matrix clause are less taxing to process than words less compatible with local constraint (*local compatibility*). In support of the dual source account, this advantage was moderated by the global context; words that were compatible with the local context were provided with an additional advantage when they were also supported by the concessive clause (*full-context compatibility*). Crucially, these findings were observed on the earliest measures of processing on a word: first fixation durations and first pass times. However, the evidence for an interaction was indirect and appeared only in planned comparisons of the region.

As readers may also have access to highly predictable words in parafoveal preview, we conducted additional analyses to determine whether they had initiated lexical processing prior to entering the critical region. Readers skipped High local constraint words (M = 44%, SE = 2) more often than Low local constraint words (M = 35%, SE = 2), β = 0.23, SE = 0.072, t = 3.155, $p < .001$, but there was no evidence of an effect of global context or an interaction between factors, z's < 1. We further reasoned that if readers sometimes accessed a High local constraint word from the local context region via parafoveal preview, they might have cancelled a forward saccade into the critical region, dwelling in preceding regions for longer periods of time. Analysis of go past times indicated that readers were faster to progress past the local context region when the critical region contained a High local constraint (M = 679 ms, SE = 17) compared to a Low local constraint (M = 718 ms, SE = 21) word, β = 6.47, SE = 31.03, t = 2.46, $p < .05$. Readers were slower to progress past the local context region following Incongruent global contexts (M = 712 ms, SE = 21) compared to Congruent global contexts (M = 685 ms, SE = 18), β = 69.76, SE = 30.92, t = 2.26, $p < .05$. More importantly, there was an interaction

between conditions, β = -85.41, *SE* = 43.68, t = -1.96, $p < .05$, showing an 82 ms advantage for High local constraint words over Low local constraint words in Congruent global contexts [Cohen's d = .23, β = 76.47, *SE* = 31.00, t = 2.46, $p < .05$], but a non-significant 4 ms penalty in Incongruent global contexts, $t < 1$.

Spillover region

No effects in first fixation duration or first pass times were observed in the spillover region. However, in go past times, there was an interaction between factors, t = 2.23, $p < .05$. Analysis of the marginal means revealed a significant 105 ms go past time advantage for High local constraint over Low local constraint words in Congruent global contexts [Cohen's d = .22, β = 99.50, *SE* = 44.60, t = 2.23, $p < .05$], but no significant difference in Incongruent global contexts (diff = 45ms). There was no effect of global context or local constraint outside of the interaction. No effects were observed for the regressions out measure.

TABLE 5 ABOUT HERE

Measures of re-reading

Concessive clause

The analysis of re-reading measures included regressions in and second pass reading times on the concessive clause, the local context region, and the critical region containing the High or Low local constraint word. Effects of global and local context, as well as their interaction, were observed in the percentage of regressions made into the concessive clause. Incongruent global

contexts elicited more regressions into the concessive clause (M = 51%, *SE* = 2) compared to Congruent global contexts (*M* = 27%, *SE* =2), $z = 7.94$, $p < .001$. There were also fewer regressions into the concessive clause in sentences containing High local constraint (*M* = 37%, *SE* = 2) compared to Low local constraint (M = 42%, *SE* = 2) words, $z = -2.23$, $p < .05$. In addition, global context and local constraint were found to interact, $z = 2.41$, $p < .05$. Analysis of the marginal means indicated that in Congruent global contexts, readers made fewer regressions into the concessive clause in sentences with High local constraint compared to Low local constraint (diff = 12%) words [Cohen's $d = .70$, $\beta = 2.02$, $SE = 0.46$, $t = 3.09$, $p < .05$]. Incongruent global contexts elicited a non-significant 1% difference between word types, $t < 1$. No effects were observed in second pass reading measures.

Local context region

In general, Incongruent global contexts elicited more regressions into the local context region (*M* = 34%, *SE* = 2) than Congruent global contexts (*M* = 25%, *SE* = 2) did, $z = 3.13$, $p < .001$. There was also a trend for fewer regressions into this region in sentences with High local constraint words (*M* = 27%, *SE* = 2) compared to Low local constraint words (*M* = 32%, *SE* = 2), $z = -1.78$, $p = .07$. There was no evidence that the factors interacted. In addition, readers spent longer re-reading the local context in sentences with Incongruent global contexts (*M* = 306 ms, *SE* = 20) compared to Congruent global contexts (*M* = 138 ms, *SE* = 14), $t = 7.39$, $p < .001$. No other effects were observed on this region.

Critical word

No effects were observed for regressions into the critical region. However, Incongruent global contexts elicited longer second pass times in the critical region (M = 56 ms, SE = 6) compared to Congruent global contexts (M = 96ms, SE = 7), t = 4.65, p < .001. There was a trend towards faster second pass times on High local constraint (M = 68 ms, SE = 6) over Low local constraint (M = 83 ms, SE = 7) words, t = -1.72, p = 0.09. Finally, the factors interacted, t = 2.19, p < .05, so that in Congruent global contexts, High local constraint words were read 34ms faster than Low local constraint words [Cohen's d = .13, β = -33.60, SE = 12.20, t = -2.762, p < .01], and there was only a non-significant 4ms difference between word types in Incongruent contexts, t < 1. No other effects were observed.

TABLE 6 ABOUT HERE

FIGURES 1-4 ABOUT HERE

Discussion

The results present clear evidence for a local compatibility advantage for measures indexing early eye-movement processes, namely first fixation duration and first pass measures, consistent with findings from previous studies on the effect of predictability on word recognition and lexical access during reading. Later measures presented evidence for a global incongruency penalty, in that go past times and regressions out both revealed a cost on the critical region for Incongruent global contexts. While evidence for an interaction for early measures between factors was not evident in the regression model, planned pairwise comparisons of the marginal means indicated that High local constraint words were advantaged over Low local constraint words in Congruent global contexts, but not Incongruent ones. The suggestion that readers might have accessed the critical word in parafoveal preview was supported by an interaction in go past

times in the local context region, indicating that readers were faster to progress forward into the critical region when both local and global context supported the word in that region. The results strongly support the predictions of the dual source account, in which both global and local context work together in the earliest stages of word identification.

Effects observed in first encounter reading often persisted into measures of re-reading. Sentences with locally compatible words reduced the percentage of regressions into the concessive clause and the local context region, but not the critical region. Evidence for a global incongruency cost was observed in regressions into the concessive clause and the local context, though not the critical region. Readers tended to spend longer re-reading the local context when following Incongruent global contexts. In addition, High local constraint words showed an advantage in second pass re-reading of the critical region when presented in sentences with Congruent global contexts. This interaction is again compatible with the dual source account, assuming that the difference in second pass times indexes a post-lexical integration advantage for words that are suitable with both local and global contexts.

It is worth noting, however, that the crucial evidence for an early interactive advantage for High local constraint words in Congruent global contexts emerged primarily from the region preceding the critical word. If correct, the pattern suggests that information from the global context may influence the degree to which the critical word could be accessed in advance, supporting parafoveal-on-foveal effects. While this pattern of results clearly favors the *dual source* account, a similar pattern on the critical word itself did not reach significance in the full linear regression model, despite differential effects of global context on local constraint in planned comparisons of first pass durations and first pass times.

The lack of an interaction on the critical word in Experiment 1 may be due to differences between word forms in the High and Low local constraint conditions. While differences between High and Low local constraint words were carefully controlled across a number of lexical characteristics, intrinsic differences between lexical items may have introduced noise that obscured the interaction in the full regression model. The change in lexical items in the critical region may have also affected the global congruency of Low local constraint conditions. As noted in the Introduction, a felicitous continuation of a concessive clause must not only be unexpected given the propositional content of the concessive clause, but also relevant to the broader discourse question that it raises in combination with the concessive marker. Continuations that are seemingly irrelevant given world knowledge might require additional accommodation about the particular event or event participants. It is therefore possible that the Low local constraint continuations may have differed in their relevance to the concessive clause, introducing a further potential source of noise. A post-hoc analysis that identified and excluded a small number of items for which this may have been an issue did not yield qualitatively different results, however. Even so, potential differences between lexical characteristics or discourse relevance in our items may have obscured the predicted effect on the critical word.

As the results and design of Experiment 1 present a need for a follow-up study, a second eye-tracking experiment was conducted to further address the role of global context in early lexical processing in which material in the critical region was held constant. Local constraint level was manipulated by adjusting the strength of bias in the phrase directly preceding the critical word, rather than manipulating the word in the critical region itself. This design change also creates a context in which the Low local constraint critical word should not differ in overall relevance to the concessive clause.

Experiment 2

Participants

Fifty-two self-reported native speakers of English from the University of California Los Angeles participated for one course credit in sessions lasting between 30 and 45 minutes. As before participants were recruited through the UCLA Psychology Subject Pool. Participants had normal or corrected-to-normal vision. No subject participated in the previous experiment.

Materials

The items from Experiment 1 were modified to manipulate the local context as well as global context. The concessive structures provided the global context, biasing towards the High local constraint word from Experiment 1 (Congruent: *Although the soccer player hadn't practiced recently ...)* or specifically against it (Incongruent: *Although the soccer player had practiced recently ...)*. The local context either contained high local constraint (High: *she scored a*…) or low local constraint (Low: *she prevented a*…). In contrast to Experiment 1, the critical word was held constant (*goal*). As with Experiment 1, global contexts differed only in the presence or absence of negation, and items were constructed so that half of the items had negation in the Congruent global context and half in the Incongruent global context. Any uses of lexicalized negation (*popular* vs. *unpopular*; *loved* vs. *hated*) were removed and replaced with sentential negation (*not*) to match the rest of the items. Twelve additional items were constructed following these specifications. A sample item is shown in Table 7.

The resulting set of thirty-two potential items were normed in an online cloze task, using the same hosting site, instructions, and subject pool as the norming task for Experiment 1. Two

variants of the cloze task were conducted. In both versions, participants were shown a fragment of the experimental sentences. In the first iteration, 36 participants were show the full context preceding the critical word, including both global and local contexts (*Although the soccer player hadn't practiced recently, she scored a…*). In the second iteration, 44 distinct participants were shown only the local context preceding the critical word (*She scored a…*), for a total of two conditions per item. In each experiment, items were counterbalanced and randomly interspersed with distractor filler items. A final set of 20 items were selected such that the critical word was highly probable in the Congruent-High (M = 0.92) and the Incongruent-High (M = 0.80) condition, but much less probable in the Congruent-Low (M = 0.44) and Incongruent-Low (M = 0.35) condition based on the first cloze task. The critical word was provided more often in High local constraint contexts (M = 0.68) compared to Low local constraint contexts (M = 0.07) in the second cloze task. Simple two-alternative forced-choice comprehension questions were presented after half of the sentences, as before.

TABLE 7 ABOUT HERE

The experimental items were presented with 72 other sentences from unrelated experiments and the same 20 non-experimental filler sentences shown in Experiment 1, for a total of 112 items.

Predictions

Predictions were identical to the predictions of Experiment 1. As before, the *local first* model predicts only a main effect of local constraint in early eye movement measures on or directly preceding the critical word, or *local compatibility* facilitation. The *global dominant* account

again predicts a main effect of *global congruency*, in which Congruent conditions would be read faster than Incongruent conditions. These predictions contrast with those of the *dual source* account, which predicts an interaction, in which the High local constraint condition would be read faster than the Low local constraint condition in congruent global context. As the critical word is held constant across all conditions, we predicted that any effects actually present at this point would not be obscured by other sources of noise.

Procedure

The presentation and procedure for Experiment 2 was the same as described for Experiment 1. Data were cleared of blinks and major track losses, using the same exclusion criteria as in Experiment 1, for less than 3% data loss. All participants scored above 80% correct on relevant comprehension questions, with an average score of 87%, and an average score of 97% on non-experimental filler items.

Results

The same measures and methods for analysis were used in Experiment 2 as in Experiment 1. All significant results are reported for the regions of interest. Means and standard errors for all measures are provided in Table 8. Models corresponding to first encounter reading are provided in Table 9. Models corresponding to re-reading are given in Table 10. Skipping rates on the critical word are reported in the prose.

TABLE 8 ABOUT HERE

Measures of first encounter reading

Critical word

On the critical region, High local constraint elicited shorter first fixation durations (M = 210 ms, SE = 3) than Low local constraint (M = 224 ms, SE = 3), t = -3.83, $p < .001$, in support of a local compatibility facilitation. As shown in the right panel of Figure 1, the effect was moderated by an interaction, in which the advantage was greater for High local constraint in Congruent global contexts (diff = 23 ms) compared to Incongruent global contexts (diff = 5 ms), t = 2.28, $p < .05$. Analysis of the marginal means confirmed this interpretation of the interaction; High local constraint showed an advantage over Low local constraint in Congruent global contexts [Cohen's d = .48, β = 22.49, SE = 5.18, t = 4.34, p < .001], but not Incongruent global contexts [Cohen's d = .12, β = 5.67, SE = 5.24, t = 1.08, p = 0.28].

First pass measures showed a pattern similar to first fixation durations. High local constraint elicited shorter first pass times (M = 216 ms, SE = 3) than Low local constraint (M = 236 ms, SE = 3), t = -4.69, $p < .001$. There was a trend towards an interaction between factors, t = 1.88, p = .06, showing a 30 ms advantage for High local constraint over Low local constraint in Congruent global contexts [Cohen's d = .51, β = 28.80, SE = 6.18, t = 4.67, $p < .001$], and a smaller 12 ms difference in Incongruent global contexts [Cohen's d = .22, β = 12.30, SE = 6.25, t = 1.98, $p < .05$]. No effects were observed on go past or regressions out measures.

The interaction in early eye movement measures predicted by the dual source account was observed directly on the critical word. To parallel the analysis in Experiment 1, we also examined skipping rates on the critical word, as well as go past times on the local constraint

region. No effects were found on either measure. Overall, the results strongly support the central idea that the advantage for High local contextual constraint is increased by Congruent global context (*full-context compatibility*). As the interaction manifested at slightly different locations within the eye movement record in the two experiments, the differences are most likely due to lexical characteristics of the words in the critical region.

Spillover region

In the spillover region, High local constraint elicited faster first fixation durations and first pass times compared to Low local constraint. In first fixation durations, there was a 7 ms advantage for High local constraint, $t = -2.13$, $p < .05$. In first pass times, there was a 25ms for High local constraint, $t = -2.45$, $p < .05$. In addition, Incongruent global contexts elicited longer go past times ($M = 686$, $SE = 29$) than Congruent global contexts ($M = 585$, $SE = 20$) did, $t = 3.13$, $p < .001$; see the right panel of Figure 3. No effects were observed for go past times or regressions out.

TABLE 9 ABOUT HERE

Measures of re-reading

Concessive clause

In the concessive clause region, Incongruent global contexts elicited more regressions into the concessive clause ($M = 49\%$, $SE = 2$) than Congruent global contexts ($M = 27\%$, $SE = 2$), $z =$

7.56, $p < .001$. Incongruent global contexts also elicited longer second pass times ($M = 736$ ms, $SE = 41$) than Congruent global contexts ($M = 267$ ms, $SE = 22$) did, $t = 11.18$, $p < .001$. The results support the predicted global incongruency penalty, also observed in Experiment 1.

Local context region

As with the previous region, Incongruent global contexts elicited more regressions into the concessive clause ($M = 33\%$, $SE = 2$) than Congruent global contexts ($M = 26\%$, $SE = 2$) did, $z = 2.51$, $p < .05$. Incongruent global contexts also elicited longer second pass times ($M = 298$ ms, $SE = 19$) than Congruent global contexts ($M = 151$ ms, $SE = 13$) did, $t = 7.04$, $p < .001$. The pattern is consistent again with a global incongruency penalty.

In support of a local compatibility facilitation, readers regressed into the Local constraint region less often in High local constraint ($M = 27\%$, $SE = 2$) than in Low local constraint ($M = 32\%$, $SE = 2$) conditions, $z = -2.07$, $p < .05$. They also spent less time re-reading this region in High local constraint conditions ($M = 194$ ms, $SE = 15$) than in Low local constraint ($M = 255$ ms, $SE = 18$) conditions, $t = -2.99$, $p < .01$. No other effects were observed in this region.

Critical word

As with the prior two regions, readers were more likely to regress into the critical region in Incongruent ($M = 19\%$, $SE = 2$) compared to Congruent ($M = 14\%$, $SE = 2$) global contexts, $z = 2.25$, $p < .05$. In addition, Incongruent global contexts elicited longer second pass times ($M = 98$ ms, $SE = 7$) than Congruent global contexts ($M = 53$ ms, $SE = 6$), $t = 5.31$, $p < .001$. They were

also faster in High (M = 66 ms, SE = 6) than Low local constraint (M = 85 ms, SE = 7), t = -2.32, $p < .05$, suggesting that locally constraining contexts continued to facilitate processing in later measures.

TABLE 10 ABOUT HERE

Discussion

The results of Experiment 2 replicated the basic findings of Experiment 1. An early advantage for high local constraint appeared in early eye movement measures in the critical region, while a penalty for global incongruency emerged in the spillover region and in rereading measures across regions. The trend towards an interaction in first fixation durations on the critical region in the previous experiment was found to be significant in Experiment 2, suggesting that differences in lexical characteristics or discourse relevance may have added variance that obscured detection of a similar effect in Experiment 1. First fixation durations showed that facilitation from high local constraint depended on congruency with global context, consistent with the prediction of *full-context compatibility*. This pattern of results supports the dual source account, in which both local and global context narrow down the potential likely continuations and influence early stages of lexical processing.

General Discussion

The effect of global context on the degree of facilitation from local constraint was explored in two eye tracking while reading studies. Structures with minimally different concessive clauses were employed to manipulate what global discourse expectations were available to the reader. In Experiment 1, we manipulated local constraint by comparing high cloze words with low cloze words in a given local context. In Experiment 2, we manipulated the level of constraint of the

local context by altering the local context itself while holding the critical word constant. In both experiments, we found evidence for an early *local compatibility* effect, manifesting as an advantage for continuations compatible with the current clause prior to or immediately at the critical word in first pass reading times. In addition, we found a penalty for global contexts that were incongruent with the local context and the critical word, beginning in the spillover region and persisting throughout later re-reading measures. The pattern was interpreted as evidence for a cost for *global incongruency*. Finally, we also found an interaction between factors, showing that the facilitation for constraining local context was hindered by incompatible global context, interpreted as evidence for a *full-context compatibility* effect. The interaction appeared early in the reading profile in both experiments. In Experiment 1, the interaction manifested in go past times on the region before the critical word, suggesting that the effect manifested in parafoveal preview. While the interaction was not significant on the critical word itself, the marginal means of first fixation durations on the critical word revealed an advantage for high cloze words in Congruent but not Incongruent contexts. In Experiment 2, where the critical word was held constant, the interaction was realized in first fixation durations directly on the critical word. A similar trend was observed in first pass times on this region.

We argued that the timing of these interactions is highly compatible with a *dual source account* of early lexical processing, outlined in the Introduction, in which neither global nor local information overrides the other during lexical processing. Instead, global context serves to constrain the effect of local context on predictability, even at the earliest stages of lexical processing. However, many open questions remain regarding the mechanisms that would produce these results. In what follows, we briefly discuss the extent to which past literature supports the idea that information from broader context can constrain early lexical processing.

We first relate our central findings to what is already known about local processes of lexical prediction, and then broaden the discussion to how the two sources of contextual information constrain incremental processing.

Lexical processing and prediction

While we have mainly discussed the *local compatibility* effect in terms of an advantage for encountering contextually compatible words during early stages of lexical processing, the notion of predictability may also be crucial in accounting for the processes described here. Indeed, local constraint was operationalized in terms of the cloze probability of the critical word. As mentioned, a wide body of literature has indicated that highly predictable words are associated with faster reading times and are more likely to be skipped during first pass reading. The predictability effect is sometimes attributed to increased pre-activation of a set of likely upcoming lexical items or lexical features (e.g., Frisson et al., 2017; Roland et al., 2012; Schwanenflugel & LaCount, 1988), and studies on predictability often manipulate a single word or phrase in the local context that results in greater predictability of a target word. The effects of local and global bias towards a target word appear to be relatively similar. For example, Fitzsimmons & Drieghe (2013) show that a constraining adjective (*hairy*) preceding a target word (*spider*) provides the same degree of facilitation as a preceding constraining clause (*afraid of creepy crawlers*) compared to neutral contexts. Given this background, it is unsurprising that the present study should find facilitation based on constraining local context. It seems that regardless of global context, constraining local context provides some degree of pre-activation for high-probability words. Such localized effects can be accounted for in numerous frameworks,

including those in which processing difficulty is proportional to the probability of a word given the sentence up to that point (Hale, 2001; Levy, 2008).

Our results raise the possibility that the source of lexical predictability extends beyond local constraint. The overall findings are compatible with any model of lexical prediction that incorporates information from the broader discourse prior to integration; a few specific avenues are discussed in the next two subsections.

Post-lexical processing and integration

A penalty for global contexts that were incongruent with the critical word was observed primarily in re-reading measures, such as longer second pass times and regressions into the global context regions. The fact that globally incompatible context exerted a persistent effect in later eye movement measures suggests that the concessive clause played a crucial role in determining whether the critical word is compatible with the expectations of the sentence encountered so far. One interpretation of this pattern is that incompatibility with a concessive context hinders the process of integrating the matrix clause continuation into the event representation of the full sentence. While the effects of low-level lexical processing on eye movements have been well-studied, the exact mapping of higher level processes, such as the integration of a word into its context, onto eye movements is less established (though see, e.g., Reichle et al., 2009 for a computational implementation of integrative processes).

The global context we consider is a unique one, in that concessive clauses trigger a specific kind of expectation. We discuss what the incremental process of forming those expectations might be in light of our results, using the example in (10), repeated here from (7) for convenience.

(10) Although it was mid-December, Mary was wearing shorts.

We have assumed that two crucial operations are engaged to process the concessive clause. The processor must compute EXPECT(A), defined as a set of defeasible inferences that are likely given the state of affairs in described in clause A, from the concessive clause. In this example, EXPECT(A) would correspond to the associations generated from a situation describing mid-December that are relevant and appropriate for the speaker or author to mention in the discourse. In addition, a conventional implicature is triggered by the concessive marker *although*, indicating that upcoming information will be incongruent with some situation contained in EXPECT(A), while still being relevant to the expectations formed from the concessive clause.

Xiang & Kuperberg (2015) outline a mechanism intended to capture how a concessive marker influences expectations about upcoming events. Adopting a generative hierarchical framework, they propose that concessive markers like *even so* influence the mental representation of sequences of events and the relationships between those events. High-level beliefs about likely sequences of events then influence the probability distribution over a number of likely events. In this framework, incoming material serves as feedback to revise those beliefs, in turn causing a reallocation of probability across potentially likely events. In other words, beliefs about the relevant defeasible inference may then influence the probability distribution across likely upcoming events such that the most probable events are those which are still relevant but incongruent with the defeasible inference. If the relevant defeasible inferences triggered in (10) were something like *Mary was wearing warm clothes,* then the most probable

events incongruent with that inference could be *Mary was wearing shorts, Mary was wearing sandals, Mary wasn't wearing a jacket,* and so forth.

One complexity unaddressed so far is the organization of inferences within EXPECT(A). Given the incremental nature of language processing, we find it unlikely that the contents of EXPECT(A) would be computed once, at the end of the concessive clause, and then remain fixed. Instead, we suspect the contents of EXPECT(A) may be dynamically reranked or revised as the matrix clause is processed to highlight the most relevant defeasible inference or set of inferences at any given point. This procedure might require a monitoring and feedback process of its own, as in Xiang & Kuperberg (2015). Between revising expectations based on EXPECT(A) and revising expectations about the defeasible inference itself from the combination of the concessive with the consequent clause, the process of incrementally generating predictions in a concessive structure is far from trivial, possibly recruiting more complex processes of event reasoning than those involved in predicting a word in a highly constraining local context.

Our experiments were not designed to investigate the intermediate processes that would be required to generate predictions in concessive contexts. Nonetheless, we think that these issues pose interesting questions to the field. As the dual source account predicts that information generated from the concessive clause also constrains word candidates that are evoked by local context in early lexical processing, we next briefly discuss how information from the concessive clause might be integrated with local constraint during lexical processing.

Interaction of local and global context localized at the target word

In the previous section, we reviewed a mechanism by which a concessive context could influence the perceived likelihood of various events. However, several possibilities regarding the

interplay between global and local context in generating lexical-level predictions remain. The framework proposed in Xiang & Kuperberg (2015), and further articulated in Kuperberg (2016), incorporates predictions along different levels of event representations, ranging from high level beliefs about sequences of events, to information about events themselves, and finally to the level of lexical items or features. Predictions at higher levels of event representations propagate downwards so that a prediction at the event sequence level influences not only the probability distribution across events, but also the distribution over specific lexical items or features. Continuous application of these processes would result in an incremental attunement between the interpretation of low-level information and higher-order expectations.

The fact that the interaction we find occurs in early eye movement measures on the target word suggests that frequent, incremental updates revise predictions throughout each level of event representation. Recent research further supports the idea that revision processes are initiated quickly. For example, Arkhipova et al. (2019) show that concessive markers in mono-clausal structures elicited a reduced N400 effect on words that semantically cohered with prior sentences in the context. As the effect was observed even when the concessive marker appeared immediately before the target word, the expectation reversal process appears to be initiated immediately.

Outside the realm of concessive discourse markers, Chow & Chen (2020) show that noun classifiers in Mandarin Chinese are used by comprehenders to refine lexical predictions when the classifier, which directly precedes the noun, clashes with the most likely possible continuation. In an ERP study in Italian, Husband & Bovolenta (2020) manipulated the local context through the predictability of a noun given its adjective preceding it, placed in global contexts that were either congruent or incongruent with the gender of the article for the expected noun. If

comprehenders form expectations for particular nouns from global context, it is reasonable that they would also predict the noun's specific gender. Encountering an article whose gender is incongruent with that expectation would provide an early cue that the prediction has failed. The N400 effect associated with violating the expectations of the local context was reduced when the global context was incompatible with the locally predicted noun. Whatever lexical predictions that might have been generated by adjective appeared to have been muted by global context. These studies, and others, indicate that predications made on the basis of local constraint appear to be delimited by information from global context. In general, these findings are broadly compatible with a dual source account, in which both local and global context conspire to delimit which words or lexical features are pre-activated for early lexical processing.

Altogether, this research suggests that likely upcoming lexical items may be pre-activated to greater or lesser extents depending on whether they address the expectations evoked by the concessive clause, how canonically they address those expectation, and how expected or compatible they are with local context.

Extending beyond concessive contexts

Our study was not designed to arbitrate between specific sentence processing architectures. In concessive contexts, the complex reasoning about the contents of EXPECT(A) should be available, in some form, at relatively early points in lexical processing, even if it only becomes most prominent during a post-lexical integration of the target word into the sentence context at large. These general conclusions are not expected to be unique to concessive contexts, however, and a similar pattern of results would be predicted whenever demands from global and local context

may come into conflict, and particularly in contexts that require complex reasoning about situations or relationships between events.

Counterfactuals provide an informative counterpoint to concessive structures. Counterfactuals have been said to present a dual meaning, conveying both the factual state of affairs along with a suppositional but factually false state of affairs (Kulakova & Nieuwland, 2016). For example, the statement *If I had wings, I would be able to fly*, conveys both the true statement that the speaker does not have wings and is unable to fly and the false supposition entertaining a world in which the speaker has wings and can fly. The dual meaning of counterfactuals may be compared to the computation of EXPECT(A) in the processing of concessive structures. Concessives differ from counterfactuals in that they predicate situations within the real world, and so do not elicit counterfactual reasoning about a false state of affairs, potentially engaging a distinct kind of reasoning about events or situations from the global context.

In addition, the degree of constraint from the global context is likely to determine the kinds of predictions comprehenders make. Differences between contextual constraint may explain different results reported in previous studies on counterfactuals. Ferguson et al. (2008) find a smaller N400 for the continuation (*fish*) compatible with the real world compared to the continuation (*carrots*) compatible with their counterfactual context *(If cats weren't carnivores, families could feed their cats a bowl of…*), which would not be expected on the basis of our results. However, the counterfactual context is not highly constraining, as there are many continuations besides *carrots* that would be equally compatible with the counterfactual clause, e.g., *broccoli, spinach, green beans*, etc. In contrast, Nieuwland & Martin (2012) used counterfactuals based on highly constrained historical events, and found immediate effects of the

global, counter-to-history contexts. In their materials, only one continuation was highly salient. For example, the sample item offers a supposition regarding the first country to send a man to the moon. Historical knowledge yields just two possibilities: America, the true-to-history continuation, and Russia, a well-established competitor during the space race. Thus, one explanation for the differences between studies is the extent to which the context compelled comprehenders to make specific predictions about the counterfactual world. In the moon-landing example, there is one clear alternative, whereas the realm of possibilities for vegetarian cat food is far less constrained. This possibility is supported by a noted difference in experimental modalities. Köhne & Demberg (2013), for example, find that the concessive marker *nevertheless* leads to rapid prediction generation in a visual world paradigm with clearly illustrated alternatives, but do not find similar evidence in reading, where their materials were arguably less constrained.

In the Xiang & Kuperberg framework, less constrained contexts could lead to a flatter probability distribution across possible continuations, resulting in a less informative context and a weaker impact on lexical processing. This proposal is in line with the ERP finding in Lau et al. (2013) that the N400 amplitude is more sensitive to semantic relatedness in word-pairs in experimental contexts where semantic relatedness can more reliably be used as an indicator of properties of the upcoming word. Lau et al. (2013) manipulated the reliability of semantic similarity by altering the proportion of semantically related pairs, ultimately suggesting that participants may be more likely to engage in predictive processing in contexts where their predictions are more likely to be accurate. It may be the case that less-constrained global contexts behave in a similar fashion, encouraging weaker predictions or less active predictive processing. Given a wide array of equally likely options, potential continuations may be activated

in advance, but not to a degree that would provide facilitation above real-world-consistent continuations. In contrast, if one highly likely continuation emerges, this may result in a stronger prediction, outweighing any strictly local or real-world constraint.

This general idea is compatible with the results of Ferguson et al. (2010). Importing Ferguson et al.'s (2008) materials into a visual world paradigm, they presented visual displays containing only two edible objects, e.g., fish and carrots, among distractor images. Participants very quickly looked to the item congruent with overall context, demonstrating that constraining the scope of possible continuations in an experimental setting does indeed facilitate the incorporation of global context into generating local predictions.

Another point of reconciliation between our study and the original Ferguson et al. (2008) study may be the overall constraint of the global and local contexts *combined*. As discussed previously, predictions made on the basis of global context are likely to be refined incrementally as more of the local context is encountered. It may be that *carrots* was a less expected continuation than another option such as *vegetables*, and this prediction error led to a process that not only inhibited the originally predicted word, but also interfered in incorporating global context into the revised prediction (Kulakova & Nieuwland, 2016). Like Nieuwland & Martin (2012), the concessive contexts explored here may have elicited a stronger commitment to the most likely situation or constrained set of situations in the global, concessive clause, and were further refined during processing of the local context.

Taken together, our findings suggest that in order to detect a large effect of global context on early lexical processing, the global context must be sufficiently constraining such that one likely continuation emerges, motivating a stronger commitment to that particular continuation. The presence of concessive markers, too, might strengthen the commitment to any given

prediction, seen in the comparison between sentences with and without concessive markers in Xiang & Kuperberg (2015). While many questions about the particular role of concessive contexts remain, we think that the experiments presented here contribute a novel point of entry into the ways that broader discourse context may impact lexical processing and prediction.

Conclusion

In two eye movement studies on concessive constructions, we find that information from a broader concessive context immediately influences online predictions about upcoming material, impacting early stages of lexical processing when global and local contexts are at odds. By manipulating global and local contexts independently of one another, our studies specifically target the timing in which information from the broader discourse becomes available. The findings support a *dual source* account of processing in which both global and local context narrow down probable continuations during early lexical processing. Our experiments indicate that global context can mediate expectations generated by local constraint at the earliest points in incremental processing. In general, we hope to have shown that the study of concessive structures is a fruitful one, providing a unique avenue to probe how varying levels of predictability from global and local context impact lower-level lexical processing.

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Tables

Table 1. Manipulation of contextual support for target word in concessive clause.

Context	**Content**	*Congruent context*	*Incongruent context*
Global context	Concessive clause	Although the soccer player hadn't practiced recently, …	Although the soccer player had practiced recently, …
	Relevant expectation from concessive clause	When an athlete doesn't practice, they don't score points.	When an athlete practices, they score points.
Local context	Matrix clause	she scored a …	she scored a …
	High local constraint	goal	goal
	Low local constraint	deal	deal

Table 2. Sample item from Experiment 1. Each cell represents a region used for analysis.

Conditions		**Regions**				
Global congruency	*Local constraint*	*Global context*	*Local context*	*Critical*	*Spillover*	*Final*
Congruent	*High*	Although the soccer player	she scored a	goal	at the opening game	over the weekend.
	Low	hadn't practiced recently,	she scored a	deal	at the opening game	over the weekend.
Incongruent	*High*	Although the soccer player	she scored a	goal	at the opening game	over the weekend.
	Low	had practiced recently,	she scored a	deal	at the opening game	over the weekend.

Table 3. Means and standard errors in parentheses for lexical-level characteristics.

	Local constraint	
Lexical Characteristic	High	Low
Length	4.95 (0.35)	5.25 (0.33)
Frequency: Log HAL	9.12 (0.33)	9.29 (0.38)
Frequency: Log SUBTLEX	3.14 (0.14)	3.16 (0.16)
Orthographic Neighborhood	6.95 (1.27)	7.90 (1.56)
Orthographic Levenstein Distance	1.80 (0.12)	1.77 (0.13)
Phonological Neighborhood	18.65 (3.26)	18.25 (3.64)
Number of Syllables	1.35 (0.13)	1.50 (0.15)
Number of Morphemes	1.40 (0.11)	1.30 (0.11)

Table 4. Experiment 1: Means and standard errors in milliseconds of eye-tracking measures.

Local Constraint	**Global Context**	**Concessive**	**Local**	**Critical Word**	**Spillover**	**Final**
	First fixation duration					
Low	Congruent	212 (3)	241 (5)	221 (5)	229 (4)	231 (4)
	Incongruent	213 (3)	237 (5)	223 (4)	230 (4)	230 (5)
High	Congruent	217 (3)	230 (4)	206 (4)	232 (4)	240 (5)
	Incongruent	210 (3)	241 (5)	215 (4)	235 (4)	239 (5)
	First pass times					
Low	Congruent	1316 (24)	602 (18)	229 (5)	419 (11)	426 (15)
	Incongruent	1302 (25)	561 (20)	227 (5)	461 (15)	425 (14)
High	Congruent	1365 (24)	575 (16)	216 (5)	429 (12)	407 (14)
	Incongruent	1291 (27)	576 (19)	221 (5)	467 (15)	454 (17)
	Go past times					
Low	Congruent	--	726 (29)	288 (14)	637 (38)	1460 (75)
	Incongruent	--	710 (32)	404 (35)	614 (30)	1857 (104)
High	Congruent	--	644 (21)	294 (16)	532 (26)	1206 (64)
	Incongruent	--	714 (26)	328 (29)	659 (41)	2118 (103)
	Regressions out					
Low	Congruent	--	11% (2)	16% (3)	14% (2)	50% (3)
	Incongruent	--	13% (2)	32% (4)	15% (2)	57% (3)
High	Congruent	--	6% (2)	20% (4)	12% (2)	41% (3)
	Incongruent	--	13% (2)	21% (4)	14% (2)	65% (3)
	Regressions in					
Low	Congruent	33% (3)	26% (3)	18% (3)	30% (3)	--
	Incongruent	51% (3)	39% (3)	18% (3)	25% (3)	--
High	Congruent	21% (3)	24% (3)	18% (3)	22% (3)	--
	Incongruent	52% (3)	29% (3)	23% (3)	31% (3)	--
	Second pass time					
Low	Congruent	267 (34)	155 (23)	73 (10)	165 (19)	--
	Incongruent	600 (55)	313 (29)	94 (10)	185 (19)	--
High	Congruent	194 (28)	121 (16)	39 (6)	118 (15)	--
	Incongruent	644 (54)	299 (29)	98 (10)	239 (22)	--

Table 5. Experiment 1: Linear mixed effect models of first encounter reading measures.

Measure	**Parameter**	**Critical word**				**Spillover**			
		Estimate	Std. Error	t/z-value	p-estimate	Estimate	Std. Error	t/z-value	p-estimate
First fixation durations	(Intercept)	216.33	3.31	65.29	< .001	231.11	4.00	57.85	< .001
	Incongruent context	2.29	2.15	1.07	0.29	0.89	1.89	0.47	0.64
	High local constraint	-5.67	2.15	-2.64	< .05	1.83	1.89	0.97	0.33
	Incongruent context x High local constraint	1.53	2.15	0.71	0.48	0.27	1.89	0.14	0.89
First pass times	(Intercept)	223.58	3.86	57.89	< .001	439.34	20.99	20.93	< .001
	Incongruent context	0.08	2.46	0.03	0.97	19.72	5.43	3.63	< .001
	High local constraint	-4.53	2.46	-1.84	0.07	4.76	5.42	0.88	0.38
	Incongruent context x High local constraint	1.68	2.47	0.68	0.50	-3.40	5.43	-0.63	0.53
Go past times	(Intercept)	328.52	13.62	24.12	< .001	605.89	43.49	13.93	< .001
	Incongruent context	37.58	12.78	2.94	< .001	26.37	15.71	1.68	0.09
	High local constraint	-17.36	12.78	-1.36	0.17	-14.79	15.69	-0.94	0.35
	Incongruent context x High local constraint	-20.17	12.78	-1.58	0.12	34.96	15.70	2.23	< .05
Regressions out	(Intercept)	-1.38	0.16	-8.60	< .001	-2.15	0.21	-10.25	< .001
	Incongruent context	0.29	0.11	2.66	< .05	0.06	0.10	0.56	0.58
	High local constraint	-0.06	0.11	-0.54	0.59	-0.10	0.10	-0.99	0.32
	Incongruent context x High local constraint	-0.21	0.11	-1.95	0.05	0.04	0.10	0.37	0.71

Table 6. Experiment 1: Linear mixed effect models of re-reading measures

Measure	**Parameter**	**Concessive clause**				**Local context**				**Critical word**			
		Estimate	Std. Error	t/z-value	p-estimate	Estimate	Std. Error	t/z-value	p-estimate	Estimate	Std. Error	t/z-value	p-estimate
Regressions in	(Intercept)	-0.55	0.15	-3.62	< .001	-0.99	0.14	-7.13	< .001	-1.62	0.20	-7.93	< .001
	Incongruent context	0.61	0.08	7.94	< .001	0.24	0.08	3.13	< .001	0.09	0.10	0.85	0.40
	High local constraint	-0.17	0.08	-2.23	< .05	-0.14	0.08	-1.78	0.07	0.12	0.10	1.16	0.25
	Incongruent context x High local constraint	0.18	0.08	2.41	< .05	-0.10	0.08	-1.25	0.21	0.08	0.10	0.81	0.42
Second pass times	(Intercept)	426.15	47.19	9.03	< .001	222.03	27.51	8.07	< .001	75.69	9.17	8.25	< .001
	Incongruent context	194.41	20.16	9.64	< .001	83.70	11.33	7.39	< .001	19.98	4.30	4.65	< .001
	High local constraint	-8.38	20.16	-0.42	0.68	-11.30	11.33	-1.00	0.32	-7.37	4.30	-1.72	0.09
	Incongruent context x High local constraint	28.79	20.16	1.43	0.15	5.30	11.33	0.47	0.64	9.43	4.30	2.19	< .05

Table 7. Sample item from Experiment 2. Each cell represents a region used for analysis.

Context		**Regions**				
Global congruency	*Local constraint*	*Global context*	*Local context*	*Critical*	*Spillover*	*Final*
Congruent	*High*	Although the soccer player hadn't practiced recently,	she scored a	goal	at the opening game	over the weekend.
	Low		she prevented a	goal	at the opening game	over the weekend.
Incongruent	*High*	Although the soccer player had practiced recently,	she scored a	goal	at the opening game	over the weekend.
	Low		she prevented a	goal	at the opening game	over the weekend.

Table 8. Experiment 2: Means and standard errors of eye-tracking measures.

Local Constraint	**Global Context**	**Concessive**	**Local**	**Critical Word**	**Spillover**	**Final**
		First fixation durations				
Low	Congruent	207 (3)	223 (3)	230 (4)	229 (4)	221 (4)
	Incongruent	206 (3)	229 (3)	218 (4)	231 (4)	236 (5)
High	Congruent	207 (3)	233 (4)	207 (4)	226 (3)	232 (5)
	Incongruent	212 (3)	245 (4)	213 (4)	221 (4)	244 (5)
		First pass times				
Low	Congruent	1300 (22)	496 (16)	240 (5)	470 (13)	451 (17)
	Incongruent	1278 (24)	494 (14)	233 (5)	483 (13)	443 (15)
High	Congruent	1277 (20)	472 (11)	210 (4)	441 (12)	431 (16)
	Incongruent	1235 (22)	511 (14)	221 (5)	463 (13)	424 (13)
		Go past times				
Low	Congruent	--	561 (23)	296 (13)	626 (32)	1517 (79)
	Incongruent	--	578 (23)	318 (20)	688 (37)	2313 (119)
High	Congruent	--	555 (21)	275 (16)	545 (24)	1436 (69)
	Incongruent	--	603 (30)	302 (18)	684 (44)	2197 (104)
		Regressions out				
Low	Congruent	--	5% (1)	16% (3)	11% (2)	43% (3)
	Incongruent	--	6% (1)	17% (3)	15% (2)	59% (3)
High	Congruent	--	7% (2)	18% (3)	8% (2)	43% (3)
	Incongruent	--	6% (1)	17% (3)	13% (2)	59% (3)
		Regressions in				
Low	Congruent	27% (3)	30% (3)	16% (3)	24% (3)	--
	Incongruent	48% (3)	35% (3)	19% (3)	29% (3)	--
High	Congruent	27% (3)	23% (3)	12% (2)	25% (3)	--
	Incongruent	50% (3)	31% (3)	20% (3)	31% (3)	--
		Second pass times				
Low	Congruent	264 (31)	175 (20)	60 (9)	158 (18)	--
	Incongruent	742 (58)	334 (29)	110 (11)	259 (22)	--
High	Congruent	271 (31)	126 (15)	45 (7)	142 (18)	--
	Incongruent	730 (58)	262 (24)	86 (9)	235 (20)	--

Table 9. Experiment 2: Linear mixed effect models of first encounter reading measures.

Measure	**Parameter**	**Critical word**				**Spillover**			
		Estimate	Std. Error	t/z-value	p-estimate	Estimate	Std. Error	t/z-value	p-estimate
First fixation durations	(Intercept)	215.91	4.07	53.07	<.001	227.04	3.49	65.02	<.001
	Incongruent context	-1.50	1.84	-0.81	0.42	-0.87	1.65	-0.53	0.60
	High local constraint	-7.04	1.84	-3.83	<.001	-3.51	1.65	-2.13	< .05
	Incongruent context x High local constraint	4.20	1.84	2.28	< .05	-2.09	1.65	-1.27	0.20
First pass times	(Intercept)	224.09	4.97	45.06	<.001	463.07	24.50	18.90	<.001
	Incongruent context	0.88	2.19	0.40	0.69	8.35	5.06	1.65	0.10
	High local constraint	-10.29	2.19	-4.69	<.001	-12.37	5.05	-2.45	< .05
	Incongruent context x High local constraint	4.13	2.19	1.88	0.06	2.60	5.05	0.51	0.61
Go past times	(Intercept)	293.89	14.79	19.87	<.001	635.18	43.22	14.70	<.001
	Incongruent context	11.72	8.10	1.45	0.15	50.98	16.27	3.13	<.001
	High local constraint	-10.72	8.09	-1.32	0.19	-21.38	16.26	-1.31	0.19
	Incongruent context x High local constraint	0.79	8.10	0.10	0.92	19.74	16.26	1.21	0.22
Regressions out	(Intercept)	-1.71	0.16	-10.87	<.001	-2.34	0.21	-11.03	< .05
	Incongruent context	-0.01	0.10	-0.07	0.94	0.03	0.17	0.17	0.86
	High local constraint	0.05	0.10	0.48	0.63	-0.16	0.10	-1.56	0.12
	Incongruent context x High local constraint	-0.02	0.10	-0.24	0.81	0.05	0.10	0.52	0.61

Table 10. Experiment 2: Linear mixed effect models of re-reading measures.

Measure	Parameter	Concessive clause				Local context				Critical word			
		Estimate	Std. Error	t/z-value	p-estimate	Estimate	Std. Error	t/z-value	p-estimate	Estimate	Std. Error	t/z-value	p-estimate
Regressions in	(Intercept)	-0.62	0.17	-3.77	< .001	-1.03	0.17	-6.05	< .001	-1.87	0.20	-9.12	< .001
	Incongruent context	0.57	0.07	7.56	< .001	0.19	0.07	2.51	< .05	0.23	0.10	2.25	< .05
	High local constraint	0.02	0.07	0.31	0.76	-0.15	0.07	-2.07	< .05	-0.09	0.10	-0.89	0.37
	Incongruent context x High local constraint	0.04	0.07	0.50	0.61	0.05	0.07	0.61	0.54	0.12	0.10	1.18	0.24
Second pass times	(Intercept)	503.17	54.53	9.23	< .001	224.51	25.22	8.90	< .001	75.11	9.78	7.68	< .001
	Incongruent context	234.04	20.93	11.18	< .001	73.44	10.44	7.03	< .001	22.86	4.31	5.31	< .001
	High local constraint	-2.27	20.93	-0.11	0.91	-31.18	10.44	-2.99	< .001	-9.96	4.30	-2.31	< .05
	Incongruent context x High local constraint	-4.86	20.92	-0.23	0.82	-5.77	10.44	-0.55	0.58	-2.63	4.30	-0.61	0.54

Figures

Figure 1. Local compatibility advantage in Experiment 1 (left panel) and 2 (right panel) shown in first fixation durations (ms) on critical word.

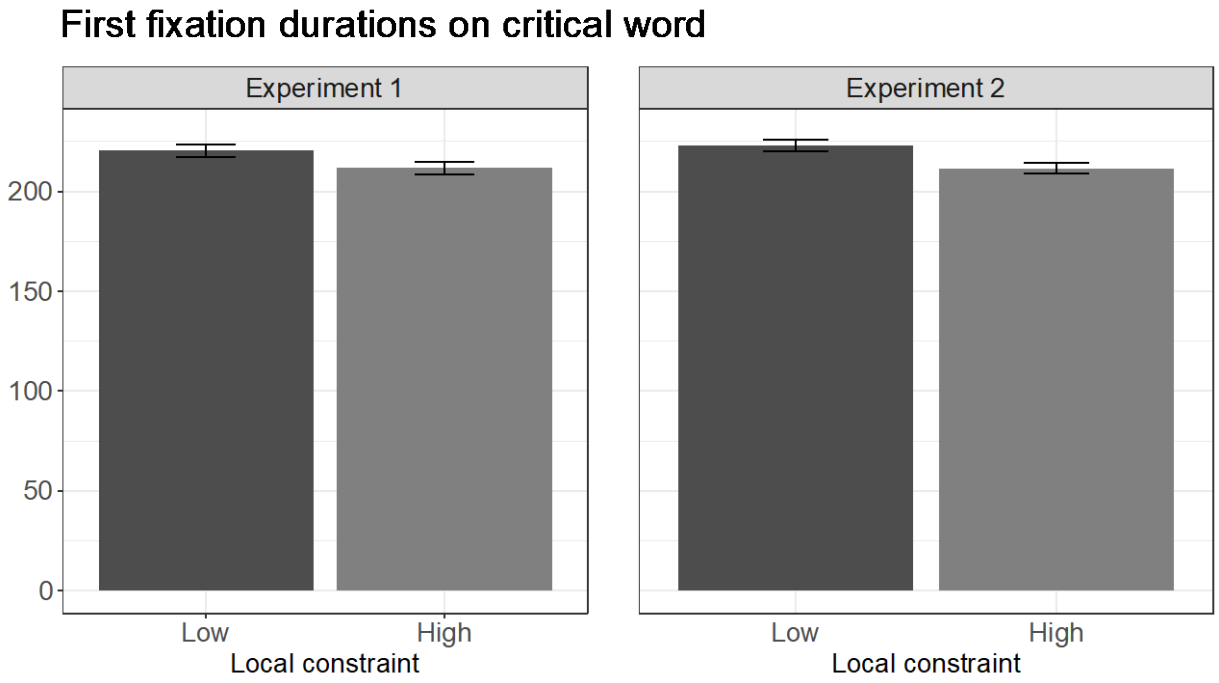


Figure 2. First fixation duration (ms) on critical word in Experiment 1 (left panel) and 2 (right panel).

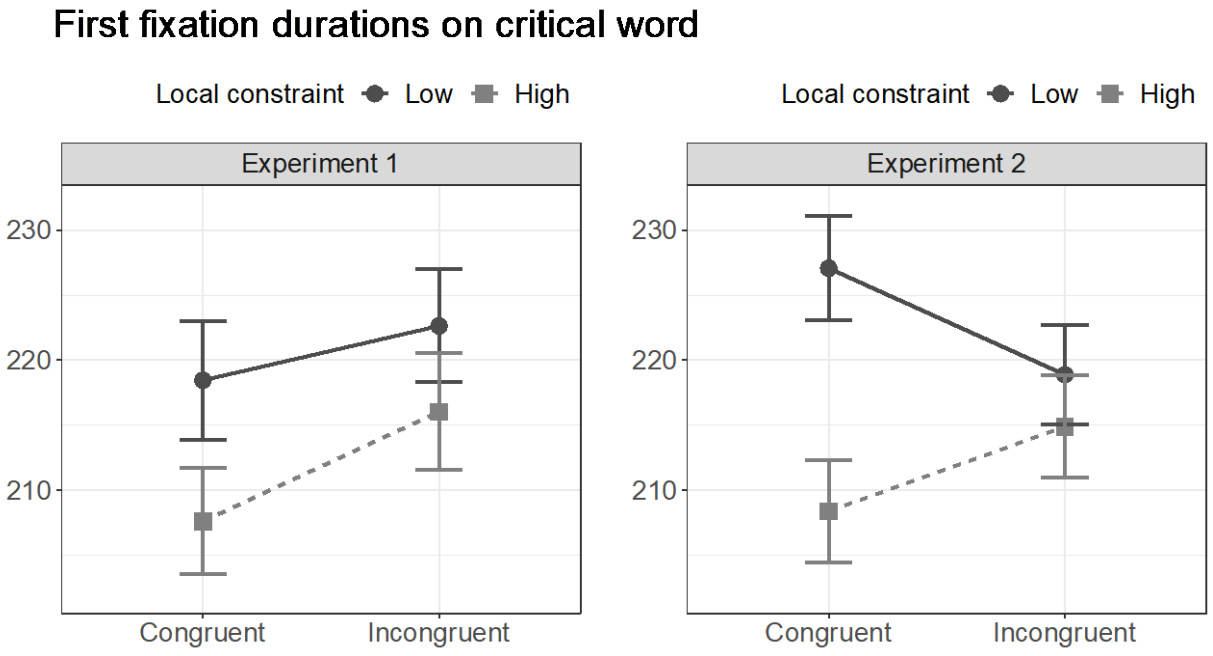


Figure 3. Global incompatibility penalty in Experiment 1 (left panel) and 2 (right panel) shown in go past times (ms) on spillover region.

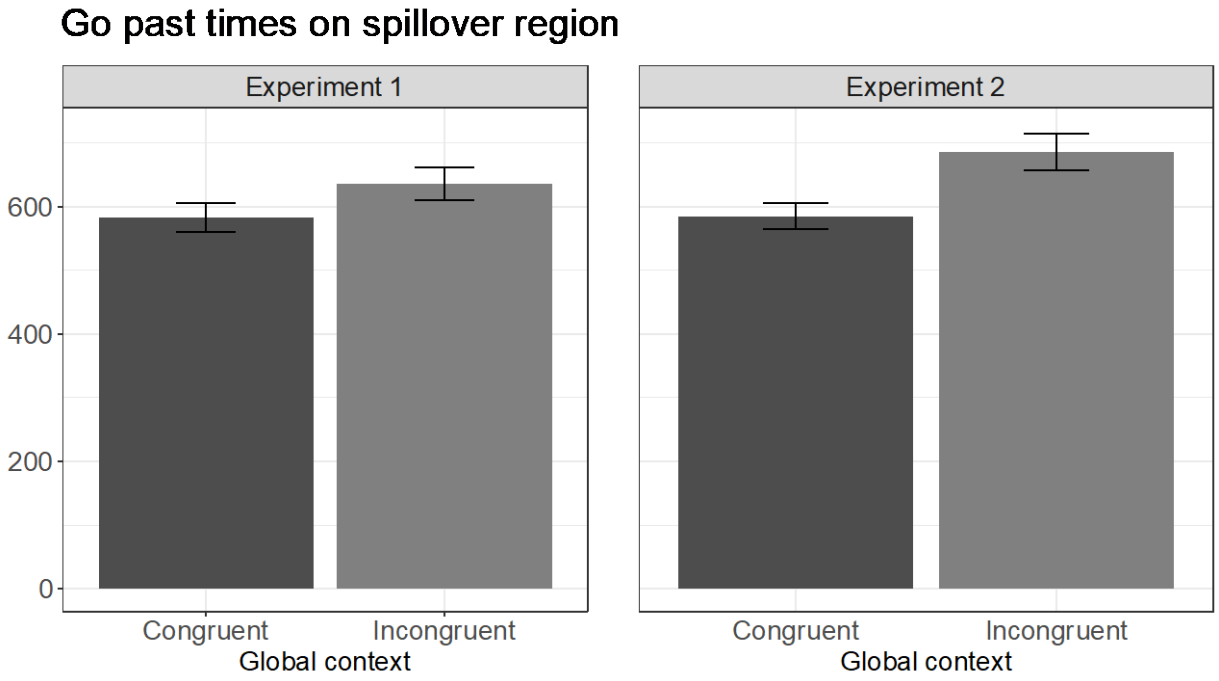
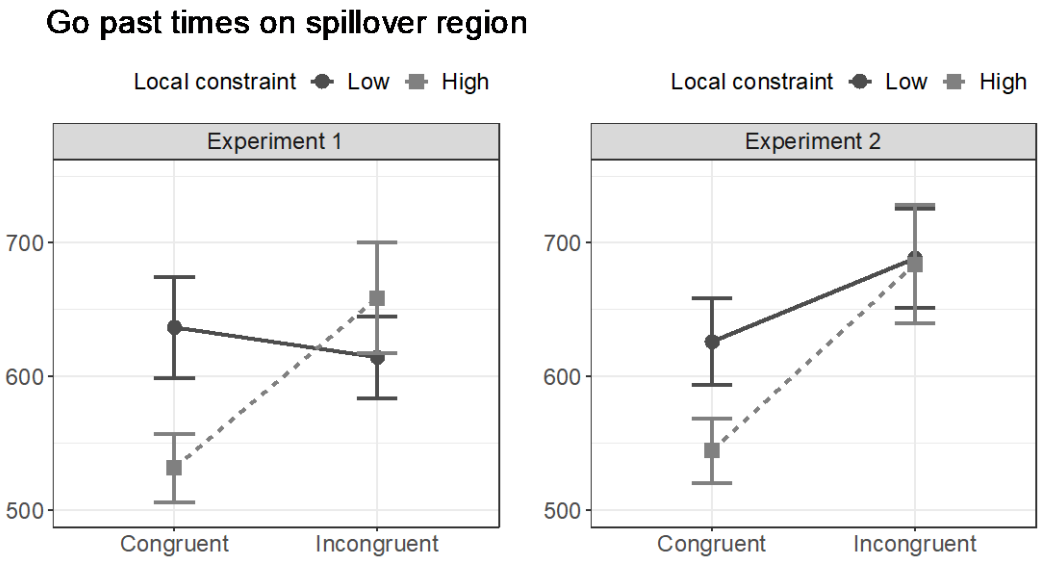


Figure 4. Go past times (ms) on spillover region in Experiment 1 (left panel) and 2 (right panel).



Experiment 1 items

Materials

The 20 quartets presented in the study are provided below. Regions are separated by a '/' sign. Critical words are printed in italics. Conditions consist of Global congruent (a,b), Global incongruent (c,d), High local constraint (a,c), and Low local constraint (b,d). Comprehension questions in caps were presented after half the sentences.

1

a. Even though it wasn't a windy day, / Arnold flew his / *kite* / in the park / by his house.
b. Even though it wasn't a windy day, / Arnold flew his / *plane* / in the park / by his house.
c. Even though it was a windy day, / Arnold flew his / *kite* / in the park / by his house.
d. Even though it was a windy day, / Arnold flew his / *plane* / in the park by his house.

2

a. Despite not being afraid of the dark, / Brianna switched on the / *lights* / before going / to bed every night.
b. Despite not being afraid of the dark, / Brianna switched on the / *radio* / before going / to bed every night.
c. Despite being afraid of the dark, / Brianna switched on the / *lights* / before going / to bed every night.
d. Despite being afraid of the dark, / Brianna switched on the / *radio* / before going / to bed every night.

WAS BRIANNA FRIGHTENED BY COMPLETE DARKNESS?
YES NO

3

a. Even though it wasn't Cara's birthday, / she baked a / *cake* / for her guests / and their friends.
b. Even though it wasn't Cara's birthday, / she baked a / *pizza* / for her guests / and their friends.
c. Even though it was Cara's birthday, / she baked a / *cake* / for her guests / and their friends.
d. Even though it was Cara's birthday, / she baked a / *pizza* / for her guests / and their friends.

4

a. Even though he trusted everyone at the gym, / Dan kept his clothes in a / *locker* / so that no one / would take them.

b. Even though he trusted everyone at the gym, / Dan kept his clothes in a / *closet* / so that no one / would take them.
c. Even though he didn't trust everyone at the gym, / Dan kept his clothes in a / *locker* / so that no one / would take them.
d. Even though he didn't trust everyone at the gym, / Dan kept his clothes in a / *closet* / so that no one / would take them.

DID DAN TRUST MANY PEOPLE AT THE GYM?
YES NO

5

a. Despite going to the beach every day, / Ellie's shoes never filled with / *sand* / and everyone else / was jealous.
b. Despite going to the beach every day, / Ellie's shoes never filled with / *rocks* / and everyone else / was jealous.
c. Despite not going to the beach every day, / Ellie's shoes never filled with / *sand* / and everyone else / was jealous.
d. Despite not going to the beach every day, / Ellie's shoes never filled with / *rocks* / and everyone else / was jealous.

6

a. Although it wasn't very cold out, / Frank zipped up his / *jacket* / while he was out / on a walk.
b. Although it wasn't very cold out, / Frank zipped up his / *pocket* / while he was out / on a walk.
c. Although it was very cold out, / Frank zipped up his / *jacket* / while he was out / on a walk.
d. Although it was very cold out, / Frank zipped up his / *pocket* / while he was out / on a walk.

WHAT WAS THE WEATHER LIKE?
VERY COLD NOT VERY COLD

7

a. Though the soccer player hadn't practiced recently, / she scored a / *goal* / at the opening game / over the weekend.
b. Though the soccer player hadn't practiced recently, / she scored a / *deal* / at the opening game / over the weekend.
c. Though the soccer player had been practicing recently, / she scored a / *goal* / at the opening game / over the weekend.
d. Though the soccer player had been practicing recently, / she scored a / *deal* / at the opening game / over the weekend.

8

a. Though the student studied for weeks before the exam, / she received a bad / *grade* / from the teacher / of her chemistry class.
b. Though the student studied for weeks before the exam, / she received a bad / *note* / from the teacher / of her chemistry class.
c. Though the student didn't study before the exam, / she received a bad / *grade* / from the teacher / of her chemistry class.
d. Though the student didn't study before the exam, / she received a bad / *note* / from the teacher / of her chemistry class.

9

a. Although he lived in a safe neighborhood, / Harry locked his / *door* / if he left the house / late at night.
b. Although he lived in a safe neighborhood, / Harry locked his / *safe* / if he left the house / late at night.
c. Although he didn't live in a safe neighborhood, / Harry locked his / *door* / if he left the house / late at night.
d. Although he didn't live in a safe neighborhood, / Harry locked his / *safe* / if he left the house / late at night.

HOW COULD HARRY'S NEIGHBORHOOD BE DESCRIBED?
PEACEFUL DANGEROUS

10

a. Even though he disapproved of violence, / Isaac carried a / *gun* / in his pocket / very discretely.
b. Even though he disapproved of violence, / Isaac carried a / *camera* / in his pocket / very discretely.
c. Even though he approved of violence, / Isaac carried a / *gun* / in his pocket / very discretely.
d. Even though he approved of violence, / Isaac carried a / *camera* / in his pocket / very discretely.

11

a. Even though the city didn't have good public transportation, / Jen always took the / *bus* / to the office / in the morning.
b. Even though the city didn't have good public transportation, / Jen always took the / *car* / to the office / in the morning.
c. Even though the city had good public transportation, / Jen always took the / *bus* / to the office / in the morning.

d. Even though the city had good public transportation, / Jen always took the / *car* / to the office / in the morning.

DID THE CITY HAVE GOOD PUBLIC TRANSPORTATION?
YES NO

12

a. Even though Kate didn't like desert plants, / she planted a / *cactus* / that would require / little maintenance.
b. Even though Kate didn't like desert plants, / she planted a / *bush* / that would require / little maintenance.
c. Even though Kate liked desert plants, / she planted a / *cactus* / that would require / little maintenance.
d. Even though Kate liked desert plants, / she planted a / *bush* / that would require / little maintenance.

HOW DIFFICULT WAS IT FOR KATE TO CARE FOR HER PLANT?
DIFFICULT NOT VERY DIFFICULT

13

a. Though he was considered unpopular, / Lewis was elected as / *president* / of the student body / at the university.
b. Though he was considered unpopular, / Lewis was elected as / *speaker* / of the student body / at the university.
c. Though he was considered popular, / Lewis was elected as / *president* / of the student body / at the university.
d. Though he was considered popular, / Lewis was elected as / *speaker* / of the student body / at the university.

WHERE DID LEWIS HOLD AN ELECTED POSITION?
IN LOCAL GOVERNMENT AT THE UNIVERSITY

14

a. Although Maria hated going to musicals, / she sang some / *songs* / from the newest show / on Broadway.
b. Although Maria hated going to musicals, / she sang some / *tunes* / from the newest show / on Broadway.
c. Although Maria loved going to musicals, / she sang some / *songs* / from the newest show / on Broadway.
d. Although Maria loved going to musicals, / she sang some / *tunes* / from the newest show / on Broadway.

15

a. Even though she hated all forms of exercise, / Nora went to the / *gym* / every other day / during the week.
b. Even though she hated all forms of exercise, / Nora went to the / *pool* / every other day / during the week.
c. Even though she enjoyed all forms of exercise, / Nora went to the / *gym* / every other day / during the week.
d. Even though she enjoyed all forms of exercise, / Nora went to the / *pool* / every other day / during the week.

HOW OFTEN DID NORA EXERCISE?
EVERY OTHER DAY ONCE A WEEK

16

a. Although Owen preferred mustard on hot dogs, / he asked for / *ketchup* / from the server / at the restaurant.
b. Although Owen preferred mustard on hot dogs, / he asked for / *cheese* / from the server / at the restaurant.
c. Although Owen disliked mustard on hot dogs, / he asked for / *ketchup* / from the server / at the restaurant.
d. Although Owen disliked mustard on hot dogs, / he asked for / *cheese* / from the server / at the restaurant.

17

a. Even though red noses and wigs scared her, / Rita liked the / *clown* / that performed / during the town fair.
b. Even though red noses and wigs scared her, / Rita liked the / *comedian* / that performed / during the town fair.
c. Even though red noses and wigs didn't scare her, / Rita liked the / *clown* / that performed / during the town fair.
d. Even though red noses and wigs didn't scare her, / Rita liked the / *comedian* / that performed / during the town fair.

DID RITA ENJOY THE PERFORMANCE?
YES NO

18

a. Despite not celebrating Easter, / Sean decorated Easter / *eggs* / with another family / that he knew.

b. Despite not celebrating Easter, / Sean decorated Easter / *cakes* / with another family / that he knew.
c. Despite celebrating Easter, / Sean decorated Easter / *eggs* / with another family / that he knew.
d. Despite celebrating Easter, / Sean decorated Easter / *cakes* / with another family / that she knew.

19

a. Though Tom didn't need glasses to see, / he strained his / *eyes* / when turning / to look far away.
b. Though Tom didn't need glasses to see, / he strained his / *neck* / when turning / to look far away.
c. Though Tom needed glasses to see, / he strained his / *eyes* / when turning / to look far away.
d. Though Tom needed glasses to see, / he strained his / *neck* / when turning / to look far away.

20

a. Although he generally hated playing in the snow, / Vincent built a / *snowman* / with his niece / over the weekend.
b. Although he generally hated playing in the snow, / Vincent built a / *dollhouse* / with his niece / over the weekend.
c. Although he generally loved playing in the snow, / Vincent built a / *snowman* / with his niece / over the weekend.
d. Although he generally loved playing in the snow, / Vincent built a / *dollhouse* / with his niece / over the weekend.

WHO DID VINCENT PLAY WITH?
HIS NIECE HIS DAUGHTER

Experiment 2 Items

The 20 quartets presented in the study are provided below. Regions are separated by a '/' sign. Critical words are printed in italics. Conditions consist of Global congruent (a,b), Global incongruent (c,d), High local constraint (a,c), and Low local constraint (b,d). Comprehension questions in caps were presented after half the sentences.

1

a. Even though it wasn't a windy day, / Allen flew a / *kite* / in the park / by his house.
b. Even though it wasn't a windy day, / Allen bought a / *kite* / in the park / by his house.
c. Even though it was a windy day, / Allen flew a / *kite* / in the park / by his house.
d. Even though it was a windy day, / Allen bought a / *kite* / in the park / by his house.

WAS THE PARK VERY FAR FROM ALLEN'S HOUSE?
YES NO

2

a. Despite not being afraid of the dark, / Brianna switched on the / *lights* / before going to bed / every night.
b. Despite not being afraid of the dark, / Brianna turned on the / *lights* / before going to bed / every night.
c. Despite being afraid of the dark, / Brianna switched on the / *lights* / before going to bed / every night.
d. Despite being afraid of the dark, / Brianna turned on the / *lights* / before going to bed / every night.

WAS BRIANNA FRIGHTENED BY COMPLETE DARKNESS?
YES NO

3

a. Though the soccer player hadn't practiced recently, / she scored a / *goal* / at the opening game / over the weekend.
b. Though the soccer player hadn't practiced recently, / she prevented a / *goal* / at the opening game / over the weekend.
c. Though the soccer player had been practicing recently, / she scored a / *goal* / at the opening game / over the weekend.
d. Though the soccer player had been practicing recently, / she prevented a / *goal* / at the opening game / over the weekend.

WHAT GAME OCCURRED OVER THE WEEKEND?
THE OPENING GAME THE CLOSING GAME

4

a. Despite usually having an expressionless face, / Nina pursed her / *lips* / when her classmate / spoke out of turn.
b. Despite usually having an expressionless face, / Nina tightened her / *lips* / when her classmate / spoke out of turn.
c. Despite not usually having an expressionless face, / Nina pursed her / *lips* / when her classmate / spoke out of turn.

d. Despite not usually having an expressionless face, / Nina tightened her / *lips* / when her classmate / spoke out of turn.

HOW DOES NINA MOST LIKELY FEEL TOWARDS HER CLASSMATE?
ANNOYED AMUSED

5

a. Although he lived in a safe neighborhood, / Harry bolted his / *door* / if he left the house / late at night.
b. Although he lived in a safe neighborhood, / Harry locked his / *door* / if he left the house / late at night.
c. Although he didn't live in a safe neighborhood, / Harry bolted his / *door* / if he left the house / late at night.
d. Although he didn't live in a safe neighborhood, / Harry locked his / *door* / if he left the house / late at night.

HOW WOULD HARRY'S NEIGHBORHOOD MOST LIKELY BE DESCRIBED?
DANGEROUS PEACEFUL

6

a. Even though he didn't approve of violence, / Isaac loaded his / *gun* / that he always / kept near him.
b. Even though he didn't approve of violence, / Isaac lifted his / *gun* / that he always / kept near him.
c. Even though he approved of violence, / Isaac loaded his / *gun* / that he always / kept near him.
d. Even though he approved of violence, / Isaac lifted his / *gun* / that he always / kept near him.

7

a. Even though she didn't enjoy physical activity, / Nora exercised at the / *gym* / every other day / during the week.
b. Even though she didn't enjoy physical activity, / Nora visited the / *gym* / every other day / during the week.
c. Even though she enjoyed physical activity, / Nora exercised at the / *gym* / every other day / during the week.
d. Even though she enjoyed physical activity, / Nora visited the / *gym* / every other day / during the week.

HOW OFTEN DID NORA GO TO THE GYM?
FIVE DAYS A WEEK EVERY OTHER DAY

8

a. Though Tom didn't need glasses to see, / he squinted his / *eyes* / when hunting / for his keys in the dark.
b. Though Tom didn't need glasses to see, / he strained his / *eyes* / when hunting / for his keys in the dark.
c. Though Tom needed glasses to see, / he squinted his / *eyes* / when hunting / for his keys in the dark.
d. Though Tom needed glasses to see, / he strained his / *eyes* / when hunting / for his keys in the dark.

HOW WOULD YOU DESCRIBE TOM'S EYESIGHT GENERALLY?
GOOD POOR

9

a. Even though Jennifer was a cautious driver, / she fastened her / *seatbelt* / when going on trips / in her jeep.
b. Even though Jennifer was a cautious driver, / she wore her / *seatbelt* / when going on trips / in her jeep.
c. Even though Jennifer wasn't a cautious driver, / she fastened her / *seatbelt* / when going on trips / in her jeep.
d. Even though Jennifer wasn't a cautious driver, / she wore her / *seatbelt* / when going on trips / in her jeep.

WAS JENNIFER A CAREFUL DRIVER?
YES NO

10

a. Although Craig liked having a messy room, / he mopped the / *floor* / whenever guests / were coming over.
b. Although Craig liked having a messy room, / he cleaned the / *floor* / whenever guests / were coming over.
c. Although Craig didn't like having a messy room, / he mopped the / *floor* / whenever guests / were coming over.
d. Although Craig didn't like having a messy room, / he cleaned the / *floor* / whenever guests / were coming over.

HOW DID CRAIG LIKE TO KEEP HIS ROOM?
DISORGANIZED TIDY

11

a. Despite fearing most animals, / Fred milked a / *cow* / while visiting a farm / in the country.
b. Despite fearing most animals, / Fred pet a / *cow* / while visiting a farm / in the country.
c. Despite not fearing most animals, / Fred milked a / *cow* / while visiting a farm / in the country.
d. Despite not fearing most animals, / Fred pet a / *cow* / while visiting a farm / in the country.

12

a. Although Vernon usually had a disheveled appearance, / he brushed his / *hair* / before his meeting / with his boss.
b. Although Vernon usually had a disheveled appearance, / he washed his / *hair* / before his meeting / with his boss.
c. Although Vernon usually didn't have a disheveled appearance, / he brushed his / *hair* / before his meeting / with his boss.
d. Although Vernon usually didn't have a disheveled appearance, / he washed his / *hair* / before his meeting / with his boss.

13

a. Even though Melissa usually forgot to clean, / she unclogged the / *toilet* / in the bathroom / every week.
b. Even though Melissa usually forgot to clean, / she cleared the / *toilet* / in the bathroom / every week.
c. Even though Melissa usually didn't forget to clean, / she unclogged the / *toilet* / in the bathroom / every week.
d. Even though Melissa usually didn't forget to clean, / she cleared the / *toilet* / in the bathroom / every week.

14

a. Despite being afraid of public performances, / Liam recited a / *poem* / in front of his class/ at the talent show.
b. Despite being afraid of public performances, / Liam performed a / *poem* / in front of his class/ at the talent show.
c. Despite not being afraid of public performances, / Liam recited a / *poem* / in front of his class/ at the talent show.
d. Despite not being afraid of public performances, / Liam performed a / *poem* / in front of his class/ at the talent show.

HOW WOULD LIAM PROBABLY FEEL BEFORE PERFORMING?
AT EASE NERVOUS

15

a. Despite not liking yardwork, / Michael raked up the / *leaves* / in his neighbor's yard / for extra cash.
b. Despite not liking yardwork, / Michael picked up the / *leaves* / in his neighbor's yard / for extra cash.
c. Despite liking yardwork, / Michael raked up the / *leaves* / in his neighbor's yard / for extra cash.
d. Despite liking yardwork, / Michael cleared up the / *leaves* / in his neighbor's yard / for extra cash.

16

a. Even though his wife liked facial hair, / Ben trimmed his / *beard* / before taking pictures / for his passport.
b. Even though his wife liked facial hair, / Ben tidied his / *beard* / before taking pictures / for his passport.
c. Even though his wife didn't like facial hair, / Ben trimmed his / *beard* / before taking pictures / for his passport.
d. Even though his wife didn't like facial hair, / he tidied his / *beard* / before taking pictures / for his passport.

17

a. Though Maria was usually relaxed about hygiene, / she bandaged the / *wound* / she got / while skateboarding.
b. Though Maria was usually relaxed about hygiene, / she rinsed the / *wound* / she got / while skateboarding.
c. Though Maria wasn't usually relaxed about hygiene, / she bandaged the / *wound* / she got / while skateboarding.
d. Though Maria wasn't usually relaxed about hygiene, / she rinsed the / *wound* / she got / while skateboarding.

18

a. Although Fred was feeling quite warm, / he ignited a / *fire* / in the pit / in his backyard.
b. Although Fred was feeling quite warm, / he started a / *fire* / in the pit / in his backyard.
c. Although Fred wasn't feeling that warm, / he ignited a / *fire* / in the pit / in his backyard.
d. Although Fred wasn't feeling that warm, / he started a / *fire* / in the pit / in his backyard.

19

a. Though Casper was generally short on cash, / he donated a lot of / *money* / to a fundraiser / for his friend.
b. Though Casper was generally short on cash, / he offered a lot of / *money* / to a fundraiser / for his friend.

c. Though Casper wasn't generally short on cash, / he donated a lot of / *money* / to a fundraiser / for his friend.
d. Though Casper wasn't generally short on cash, / he offered a lot of / *money* / to a fundraiser / for his friend.

20

a. Even though Peter didn't expect to find buried treasure, / he dug a / *hole* / in the sand / at the local beach.
b. Even though Peter didn't expect to find buried treasure, / he guarded a / *hole* / in the sand / at the local beach.
c. Even though Peter expected to find buried treasure, / he dug a / *hole* / in the sand / at the local beach.
d. Even though Peter expected to find buried treasure, / he guarded a / *hole* / in the sand / at the local beach.