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Investigating shared and distinct mechanisms in semantic and syntactic enrichment: A priming study

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Abstract

Aspectual verbs (e.g., *begin*) and intensional verbs (e.g., *want*) can both take entity-denoting NPs as a complement (*begin/want the book*) and acquire an implicit meaning (e.g., *reading*). Linguistic theory posits that such enriched implicit meanings can be acquired either by semantic enrichment with aspectual verbs or by syntactic enrichment with intensional verbs (Pykkänen, 2008). To investigate whether semantic and syntactic enrichment share enrichment operations, we conducted a structural priming study. Experiment 1 repeated the verb on prime and target trials and found evidence for enrichment priming for both verb types. Experiment 2 crossed the verb type and found no evidence for priming. These results suggest that enrichment operations are distinct for aspectual and intensional verbs. However, Experiment 3 repeated Experiment 1 without lexical boost and found no enrichment priming within the verb type. Thus, producing an enriched structure may not robustly activate enrichment structures, leaving open questions concerning shared mechanisms.

Key words: enrichment, complement coercion, priming, production

Introduction

Sentence meanings are sometimes expressed implicitly, when the implicit meanings need to be acquired from the context. For example, the sentence “*The student continued/wanted the book*” is likely to mean that the student continued/wanted to read/get the book, because reading is the typical action associated with a student and a book. These implicit meanings arise in cases of *enrichment*. Interestingly, the operations that underlie enrichment seem to go through distinct routes depending on the type of the verb (Pylkkänen, 2008). But are the mechanisms involved in enrichment shared across different types of verb despite some distinctions? We explored this question by testing whether enrichment operations for aspectual verbs (e.g., *continue*) and intensional verbs (e.g., *want*) can prime and be primed by each other in a structural priming study.

Aspectual verbs, including *begin*, *continue*, and *finish*, are typically used to modify the temporal information of a verb phrase or infinitival event. Intensional verbs, including *want*, *need* and *imagine*, normally take a clausal complement and express a mental state of their subject. However, both types of verbs are also acceptable with entity-denoting noun phrase complements. Although these cases appear to be simple transitive constructions, they differ from other transitives in that an implicit meaning is triggered. One hypothesis is that the entity-denoting complement of aspectual and intensional transitive constructions mismatches the selectional requirements of the verbs, triggering an enrichment operation that rescues these constructions and eliciting an implicit meaning.

While this broad framework applies to both aspectual and intensional verbs, the particular operations each uses to address the selectional mismatch appear to be different (Pylkkänen, 2008; Pylkkänen & McElree, 2006). Aspectual verbs resolve a selectional mismatch by a semantic type shifting enrichment operation. When comprehenders detect a mismatch between an aspectual verb and an entity-denoting complement noun, they coerce

the default interpretation of the noun as an entity into a different one by type shifting the noun's semantic type from an entity into an event (Jackendoff, 1997; McElree et al., 2001; Pustejovsky, 1995; Traxler et al., 2002, 2005). On the other hand, intensional verbs resolve a selectional mismatch by a syntactic enrichment operation that inserts a silent head. When comprehenders detect a mismatch between an intensional verb and an entity-denoting complement noun, they insert a silent verb into the syntactic representation (Delogu et al., 2010; Larson et al., 1997).

A critical distinction between the two types of enrichment lies in the involvement of syntax: semantic enrichment type-shifts the complement noun without affecting the syntactic structure of the sentence, while syntactic enrichment changes the underlying sentence structure. Pylkkänen (2008) demonstrates the difference between aspectual and intensional transitive constructions with several linguistic tests. She observes that aspectual verbs allow modification and event anaphor when the event is overtly presented as in (1), but modification and event anaphor in (2) are unable to target the implicit event meaning. Intensional verbs, however, permit modification and event anaphor to target the event, regardless of whether the event is explicit (3) or implicit (4).

- (1) a. Joe began reading the book page by page.
 b. Joe began reading the book, but it hurt his eyes.
- (2) a. #Joe began the book page by page.
 b. #Joe began the book, but it hurt his eyes.
- (3) a. Joe wants to get results quickly.
 b. Joe wants to get some horses, but his mother won't allow it.
- (4) a. Joe wants results quickly.
 b. Joe wants some horses, but his mother won't allow it.

Empirical evidence for the distinction between the semantic and syntactic enrichment comes from reading eye-tracking studies. Comprehending enriched sentences seems costly,

and many studies have found longer reading time for sentences involving enrichment (e.g., *The author began the book*) compared to control sentences (e.g., *The author wrote the book*) (McElree et al., 2001; Traxler et al., 2002). This cost has been argued to be associated with the additional type-shifting operation that is not required for unenriched sentences.

Interestingly, enrichment for aspectual and intensional verbs does not appear to incur processing cost under the same conditions. In Traxler et al. (2002), participants read sentences with an aspectual verb which was followed by an entity-denoting noun (e.g., *started the puzzle*) or an event-denoting noun (e.g., *started the fight*). Reading times for these sentences were compared with control sentences which contained a neutral verb instead of an aspectual verb (e.g., *saw the puzzle/fight*). When the complement noun denotes an event, there is no mismatch with the selectional requirements of the aspectual verb, so this construction should not trigger enrichment operations. In contrast, the complement noun that denotes an entity mismatches the verb's requirements, thus this should trigger enrichment operations.

Consistent with this hypothesis, Traxler et al. (2002) found longer reading times for sentences with the aspectual verb + entity noun construction than for their control sentences, but there was no reading time difference between sentences with the aspectual verb + event noun construction and their control sentences. Their findings suggest that enrichment operations for aspectual verbs are triggered when the complement noun does not denote an event.

However, this does not seem to apply for intensional verbs. Following evidence that intensional verbs also elicit costs for enrichment (Delogu et al., 2010), Husband and Politzer-Ahles (2016, in prep) replicated the findings of Traxler et al. (2002), but they additionally found reading time slow-down for intensional verbs irrespective of whether the complement noun denoted an entity or an event. Thus, not only an entity-denoting complement but also an event-denoting complement seem to elicit a processing cost with intensional verbs. This difference may indicate distinct mechanisms involved in semantic enrichment (for aspectual verbs) and syntactic enrichment (for intensional verbs).

Although both semantic and syntactic enrichment result in similar implicit meanings, the differences in their underlying structural and semantic representations suggest that less is shared than meets the eye. Because both types of enrichment are triggered by a detection of a mismatch and involve computation of implicit meaning using the context and the properties of the noun, some of the operations may be shared between semantic and syntactic enrichment. However, type-shifting for semantic enrichment and a silent verb insertion for syntactic enrichment are specific to each type of enrichment operation and may not involve the same mechanism. To evaluate whether there are shared or distinct mechanisms underlying semantic and syntactic enrichment, we turned to structural priming to investigate the process of constructing enriched structures (Bott & Chemla, 2015).

Raffray et al. (2014) used a structural priming paradigm to investigate the processes involved in producing enriched structures. Participants saw prime pictures describing an event (e.g., an author writing a book/a celebrity giving a speech) together with an incomplete sentence that induced participants to produce either a semantically enriched structure, an aspectual verb with an entity-denoting NP (e.g., *The author began the* – “book”), or one of two structures that do not require semantic enrichment: a complex aspectual + overt VP with an entity-denoting NP (e.g., *The author began writing the* – “book”) or an aspectual verb with an event-denoting NP (e.g., *The celebrity began the* – “speech”). Then they saw a target picture describing another event (e.g., a bricklayer building a wall) and an incomplete sentence that could be completed with either an entity-denoting NP, requiring a semantically enriched structure, or a verb + entity-denoting NP, which does not require semantic enrichment (e.g., *The bricklayer began* – “the wall” / “building the wall”). On each trial, participants were asked to read the given sentence fragment aloud and complete it appropriately. Participants were more likely to produce an enriched response following an enriched prime compared to both types of unenriched prime. Since this priming effect only occurred with enriched verb + entity-NP primes, but not with VP + entity-NPs or verb +

event-NPs, the priming effect for the enriched vs. unenriched NP are not simply a syntactic priming effect (NP Prime vs. VP Prime), and that enrichment operations can be primed independently.

We extended Raffray et al. (2014) and tested whether syntactic enrichment can be primed similarly, and whether the enrichment priming occurs symmetrically for semantic and syntactic enrichment. Our studies used written production by participants online. The procedure was analogous to Corley and Scheepers (2002), who used a written (typed) production task administered with an internet-based software and replicated the structural priming effects reported in Pickering and Branigan (1998). Experiment 1 examined priming within enrichment categories using the same verbs, extending Raffray, et al.'s design to include both aspectual and intensional verbs. Experiment 2 examined priming between enrichment categories, pairing aspectual primes with intensional targets and intensional primes with aspectual targets. Experiment 3 returned to Experiment 1 to investigate the role of lexical boost on priming within enrichment categories.

Experiment 1

Experiment 1 tested enrichment priming in aspectual verbs and intensional verbs to explore potential differences in constructing enriched structures by semantic type shift and syntactic insertion. We expected to replicate Raffray et al. (2014) and find enrichment priming effects in aspectual verbs. We also expected similar priming effects for intensional verbs, assuming that enrichment with intensional verbs can also prime themselves.

Methods

Participants

Sixty-four native English speakers (Mean age = 34 years, range = 21-66 years) were recruited on Amazon Mechanical Turk and paid \$3 to participate in a 20 minute study. They reported to have no language or neurological disorders.

Stimuli

We created 32 item sets. Each item consisted of two visual stimuli: a prime picture and a target picture. The pictures were taken from freely available online clipart websites and depicted an agent and an action. The action included *writing*, *reading*, *eating*, *drinking*, and *baking* amongst others. Each prime picture was paired with four types of sentence fragment, and each target picture was paired with two types of sentence fragment (cf. Figure 1). The full set of critical items are in Appendix.

Prime sentence fragments were constructed from two conditions: Prime type (NP Prime, VP Prime) and Verb type (Aspectual, Intensional). NP Primes were composed of a subject NP, an aspectual/intensional verb and *the* (e.g., *The mouse began/wanted the*), so it could be completed with an (enriched) entity-denoting noun (e.g., *cheese*) or an event-denoting noun (e.g., *eating*). VP Primes were composed of a subject NP, an aspectual/intensional verb, an infinitival verb and *the* (e.g., *The mouse began/wanted to eat the*). Since an infinitival verb was already given, VP Primes do not trigger an enriched structure. We used three aspectual verbs (*begin*, *finish*, and *start*) and six intensional verbs (*want*, *need*, *desire*, *fancy*, *imagine*, and *request*). These verbs were selected based on a pilot study, where 24 native English speakers completed a prime fragment (e.g., *The mouse began/wanted the* or *The mouse began/wanted to*) and a following target fragment ending with an aspectual or intensional verb (e.g., *The monkey began/wanted*). Only the verbs for which participants produced an enriched structure (e.g., *began/wanted* – “the apple”) on the target trial were included in the main experiment. The proportion of enriched responses for each verb was: *begin* = 15%, *finish* = 64%, *start* = 16%, *want* = 24%, *need* = 41%, *desire* = 24%, *fancy* = 69%, *imagine* = 37%, *request* = 36%. The mean proportion of enriched responses was 28% for aspectual verbs and 43% for intensional verbs.

The target sentence fragment always had the same sentence structure, a subject NP and the same aspectual or intensional verb as the paired prime sentence (e.g., *The woman*

began/wanted). Thus, the target fragment allowed completion with an enriched structure (e.g., *The woman began/wanted* – “the apple”) or with an unenriched structure (e.g., *The woman began/wanted* – “to eat the apple”).

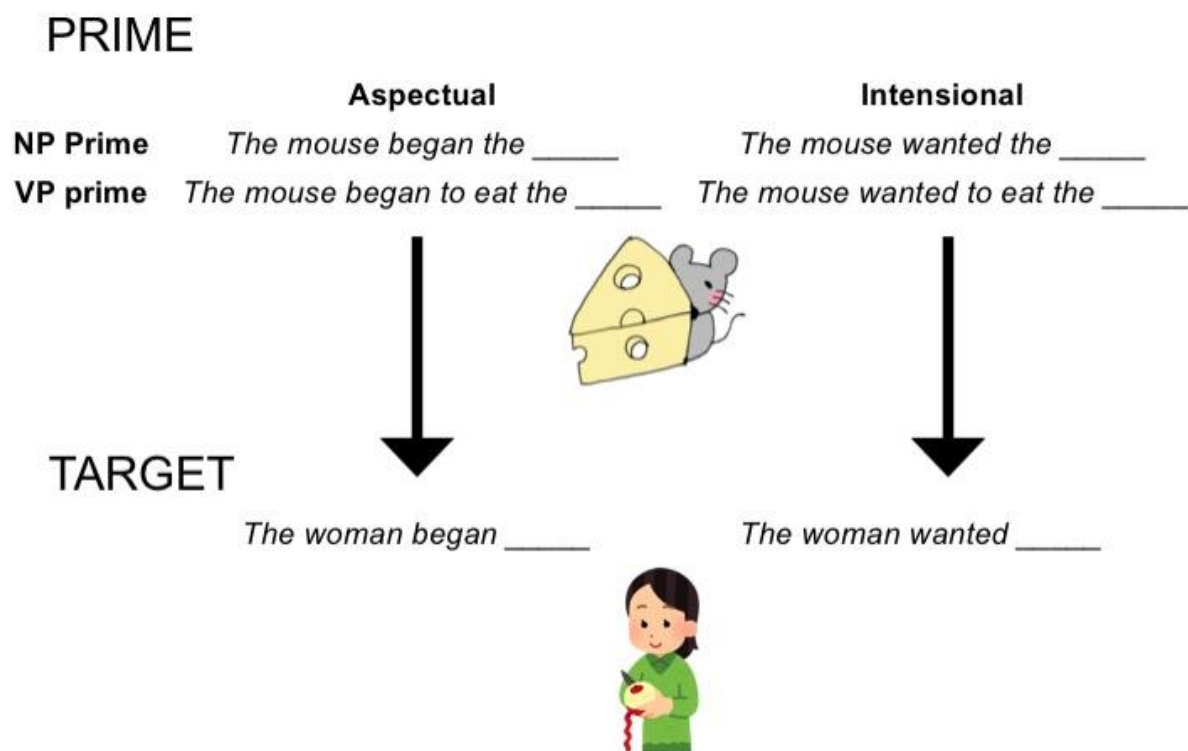


Figure 1. An example item for Experiment 1.

We additionally created 64 filler picture-sentence pairs. The filler sentence fragments did not contain any of the aspectual or intensional verbs used in the experimental items, and the sentence structure was varied across items. The filler pictures also depicted an action that was intended to be easy to describe (e.g., a pupil handing a book over a counter, for the sentence fragment *The pupil went to return* – “the book”).

Procedure

We created four experimental lists, counterbalanced so that participants saw only one version of each item per list. Each list contained the equal number of items per condition: eight items each for Aspectual NP Prime, Aspectual VP Prime, Intensional NP Prime and Intensional VP Prime, and 16 items each for Aspectual Target and Intensional Target. Items

were randomised for every participant, while keeping every prime trial followed by its paired target trial. The total of 128 trials were divided into four blocks, so that participants could take a short break between the blocks.

We conducted our experiment on TESTABLE (<https://www.testable.org>) – a platform that hosts online behavioural experiments. Participants used their laptop to take part in the experiment. Participants were instructed to set their browser to full screen and minimise possible distractions (e.g., TV, phone) during the experiment. For each trial, participants saw a picture and a sentence fragment. They were instructed to read the sentence fragment and complete it with a word or phrase that came to mind when they saw the picture, using as many words as needed. They were asked to type their response as quickly as possible and hit the Enter key when they finished typing. They were given two examples and four practice trials before the main experiment. The data was automatically saved on the TESTABLE cloud as participants completed the experiment.

Data coding

We coded responses to the primes as either Entity-denoting or Event-denoting, and responses to the targets as either Enriched or Unenriched. The NP Prime (e.g., *The mouse began the*) completed with an entity-denoting noun (e.g., *cheese*) was coded as Entity-denoting (NP Entity), while the same prime completed with an Event-denoting noun (e.g., *eating*) was coded as Event-denoting (NP Event). For the VP Prime (e.g., *The mouse began to eat the*), an Entity-denoting noun completion (e.g., *cheese*) was coded as Event-denoting (VP Event), because the event verb was present in the context. Thus, prime responses were categorised into three prime types as shown in Table 1.

Table 1. Response coding with examples.

Trial Type	Response Type	Example
Prime	NP Entity	The mouse began the – cheese The mouse wanted the – cheese
	NP Event	The mouse began the – eating The mouse wanted the – eating

	VP Event	The mouse began to eat the – cheese The mouse wanted to eat the – cheese
Target	Enriched	The woman began – the apple The woman wanted – the apple
	Unenriched	The woman began – to peel the apple The woman wanted – to eat the apple

Other responses that did not fit into any of those types were coded as NA. Those responses typically included completion with a different structure (e.g., *The repairman wanted the watch to be fixed*), with an adjective (e.g., *The artist desired quiet*) or a preposition (e.g., *The chef finished with the hot dog*), or with an abstract noun (e.g., *The woman began her day*). Ungrammatical responses (e.g., *The mouse began the to eat the cheese*) were also coded as NA. If the prime trial was coded as NA, the subsequent target was also coded as NA, but if only the target trial was coded as NA, we retained the data for the prime trial for analysis of the responses on prime trials. The coded data had 6% NA for the prime analysis, and 8% NA for the target analysis.

Analysis

We analysed our data using binomial generalised linear mixed models (GLMM) implemented in the *lme4* package (Bates et al., 2008) in R (R Development Core Team, 2015) with the maximum random structure justified by our design (Barr et al., 2013). The models we report all converged with a maximum random structure. For the prime responses, we tested whether the likelihood of producing an entity-denoting noun (i.e., enriched structure) over an event-denoting noun (i.e., unenriched structure) differed between aspectual and intensional verbs. For this analysis, we only included prime responses for the NP Prime, because an enriched structure could never be produced for the VP Prime. Our model evaluated Prime completion type (Entity vs. Event) as predicted by Verb type (Aspectual vs. Intensional); the R syntax: $\text{PrimeCompletion} \sim \text{VerbType} + (1 + \text{VerbType} \mid \text{Subject}) + (1 + \text{VerbType} \mid \text{Item})$.

For the target responses, we first ran a model testing an interaction of Prime completion type (NP Entity vs. NP Event + VP Event combined) by Verb type; the *lme4* syntax: $\text{TargetResponseType} \sim \text{VerbType} * \text{PrimeCompletionType} + (1 + \text{VerbType} * \text{PrimeCompletionType} | \text{Subject}) + (1 + \text{VerbType} * \text{PrimeCompletionType} | \text{Item})$. Since there were many NP Event responses for aspectual verbs but not for intensional verbs on prime trials, we conducted a follow-up analysis testing the effect of enriched vs. unenriched prime within the NP primes (i.e., NP Entity vs. NP Event) only for aspectual verbs (cf. Raffray et al., 2014). The *R* syntax: $\text{TargetResponseType} \sim \text{PrimeCompletionType} + (1 + \text{PrimeCompletionType} | \text{Subject}) + (1 + \text{PrimeCompletionType} | \text{Item})$. In all the models, the categorical variables were sum-coded (1 vs. -1).

We additionally computed Bayes factors for the predictor PrimeCompletionType in the target trial analysis by fitting generalised Bayesian mixed effects models using the *brms* package (Bürkner, 2018). We used priors from the *get_prior* function in the *brms* package. We fitted the models using a Bernoulli distribution and ran 4 chains per model, each for 10000. We compared the full model to a model excluding the predictor PrimeCompletionType. These models did not include an interaction of VerbType by PrimeCompletionType because the interaction was not significant and including the interaction did not improve the model fit.

Results

In NP Prime trials, participants were more likely to produce an entity-denoting noun for intensional verbs than for aspectual verbs (93% vs. 58%), $\beta = -1.7$, $SE = .36$, $z = -4.7$, $p < .001$. This suggests that people strongly preferred an entity-denoting noun to an event-denoting noun for intensional verbs, whereas they did not have such a strong preference for aspectual verbs.

The results for target trials are shown in Figure 2. On target trials, the model testing an interaction of Prime completion type (Entity vs. Event) by Verb type revealed significant

effects of Verb type, $\beta = 1.4$, $SE = .22$, $z = 6.4$, $p < .001$, and Prime completion type, $\beta = -.58$, $SE = .12$, $z = -4.7$, $p < .001$. The effect of Verb type indicates that participants were more likely to complete the target with an enriched response for intensional verbs than for aspectual verbs (57% vs. 25%). The effect of Prime completion type indicates that participants were more likely to complete the target with an enriched response when they completed the corresponding prime with an enriched vs. unenriched response (53% vs. 34%). The lack of a significant interaction of Verb type by Prime completion suggests that enrichment priming was similar for both verb types. Participants were more likely to produce an enriched over unenriched response after an entity-denoting prime completion than after an event-denoting prime completion (Aspectual verbs: 32% vs. 22%, Intensional verbs: 69% vs. 48%). The Bayes factor of 1916 for Prime completion type suggests extreme evidence in favour of the alternative hypothesis over the null hypothesis (cf. Lee & Wagenmakers, 2014). Thus, we found evidence for enrichment priming in both aspectual and intensional verbs. The model testing an effect of Prime completion type within NP primes in aspectual verbs did not find a significant effect of Prime completion type ($p = .4$). The Bayes factor of .59 for Prime completion type suggests moderate ($1/.59 \approx 1.7$ times more likely) evidence in favour of the null hypothesis over the alternative hypothesis.

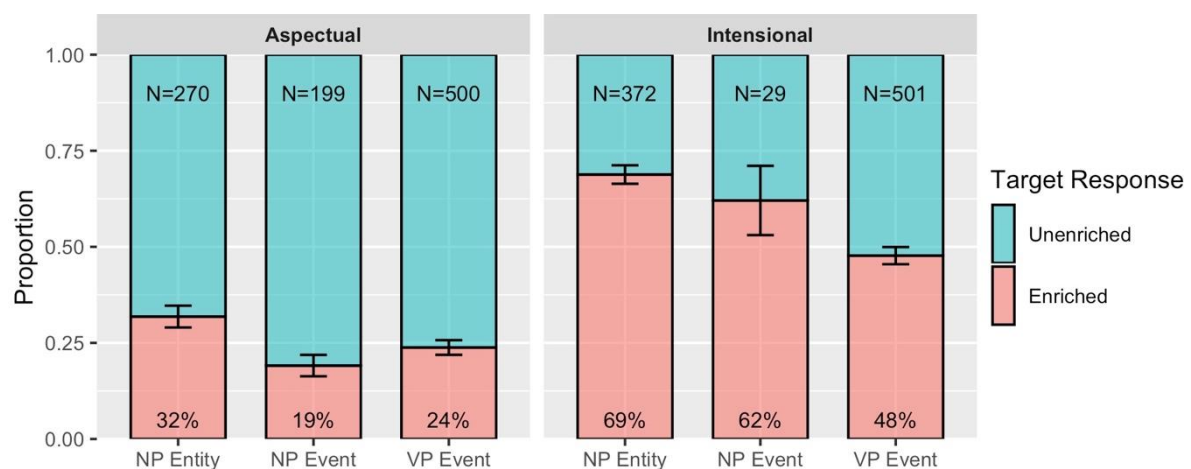


Figure 2. The proportion of Enriched (pink) and Unenriched (blue) responses for NP Entity, NP Event and VP Event primes for aspectual (left) and intensional (right) verbs in Experiment 1. The numbers at the top of each bar indicate the number of trials for each prime type, and the percentages at the bottom of each bar indicate the proportion of Enriched responses for each prime type. The error bars represent a standard error.

Discussion

The evidence for enrichment priming in both verb types suggests that both semantic and syntactic enrichment can be primed, extending Raffray et al. (2014)'s evidence for priming of semantic enrichment with aspectual verbs to syntactic enrichment with intensional verbs. This suggests that enrichment mechanisms can be priming, whether they require type shifting as in semantic enrichment or the insertion of a silent verb as in syntactic enrichment.

In Experiment 2, we tested whether the enrichment mechanisms primed for semantic enrichment can be extended to syntactic enrichment and vice versa. As we discussed in the Introduction, both types of enrichment are similar in that they are triggered by a detection of a mismatch between the verb's selectional restrictions and the noun, and that they involve a pragmatic inference to the implicit meaning. Thus, it is possible that these operations can be primed across the verb types. However, syntactic enrichment for intensional verbs alters the syntactic structure of the sentence, whereas syntax is unaffected in semantic enrichment for aspectual verbs. Given this distinction, we may not find priming across verb types. Alternatively, given that only the syntactic enrichment involves this additional syntactic operation, we may find asymmetric priming, where syntactic enrichment primes semantic enrichment, but semantic enrichment does not prime syntactic enrichment.

Experiment 2

Methods

Participants

Sixty-four native English speakers (Mean age = 34 years, range = 20-63 years) were recruited on Amazon Mechanical Turk and paid \$3 to participate in a 20 minute study. They reported no language or neurological disorders.

Stimuli

The stimuli were closely based on those in Experiment 1. The prime sentences with an intensional verb were followed by a target sentence with an aspectual verb, and the prime sentences with an aspectual verb were followed by a target sentence with an intensional verb. For example, the prime with an intensional verb “*The mouse wanted the*” or “*The mouse wanted to eat the*” was followed by the target with an aspectual verb “*The woman began*”. The full set of critical items are in Appendix.

Procedure, data coding and analysis

The procedure, data coding and analysis were all identical to Experiment 1. The coded data had 6% NA for the prime analysis, and 11% NA for the target analysis. As in Experiment 1, there were many NP Event responses for aspectual verbs but not for intensional verbs on prime trials. Thus, we compared responses following the NP Entity vs. NP Event prime only for intensional verbs (i.e., the prime contained an aspectual verb).

Results

Consistent with Experiment 1, the analysis on prime trials showed that participants were more likely to produce an entity-denoting noun for intensional verbs than for aspectual verbs (92% vs. 55%) in NP Prime trials, $\beta = -1.3$, $SE = .23$, $z = -5.4$, $p < .001$.

The results for target trials are shown in Figure 3. In target trials, the model testing an interaction of Prime completion type (Entity vs. Event) by Verb type revealed a significant

effect of Verb type, $\beta = 1.3$, $SE = .26$, $z = 5.1$, $p < .001$. Participants were more likely to complete the target with an enriched response when the target contained an intensional verb than when it contained an aspectual verb (57% vs. 25%). But unlike Experiment 1, neither the interaction of Prime completion type by Verb type nor the effect of Prime completion type was significant ($ps > .6$). The Bayes factor of .033 for Prime completion type suggests strong ($1/.033 \approx 30$ times more likely) evidence in favour of the null hypothesis over the alternative hypothesis. Following Experiment 1, we also compared Entity vs. Event prime completions within NP primes in intensional verbs (Note: the target contained an aspectual verb); this model did not find a significant effect of Prime completion type either ($p = .39$). The Bayes factor of .097 for Prime completion type suggests strong ($1/.097 \approx 10$ times more likely) evidence in favour of the null hypothesis over the alternative hypothesis. Thus, Experiment 2 did not find any evidence for enrichment priming for either of the verb type.

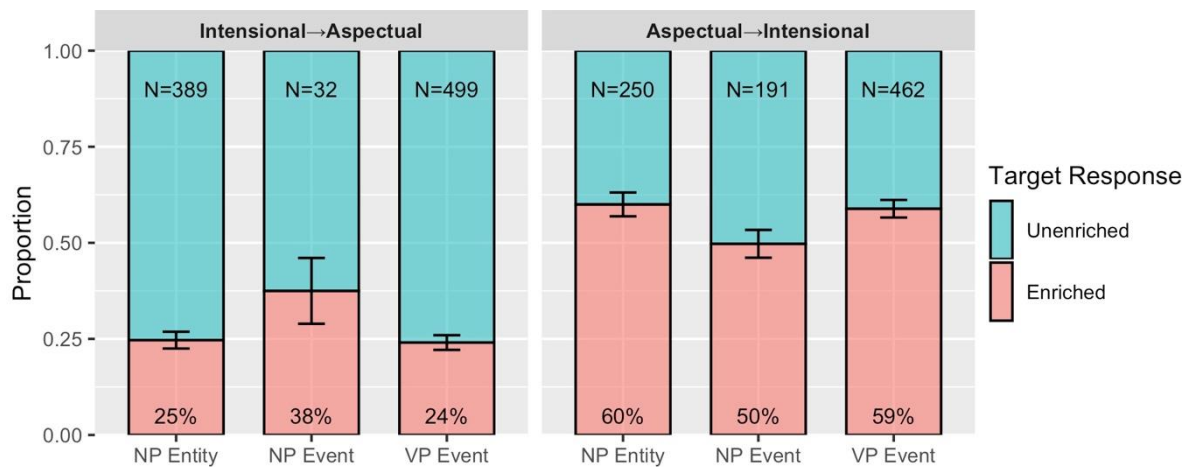


Figure 3. The proportion of Enriched (pink) and Unenriched (blue) responses for NP Entity, NP Event and VP Event primes for aspectual (left; primed by intensional) and intensional (right; primed by aspectual) verbs in Experiment 2. The numbers at the top of each bar indicate the number of trials for each prime type, and the percentages at the bottom of each bar indicate the proportion of Enriched responses for each prime type. The error bars represent a standard error.

Discussion

Experiment 2 did not find any enrichment priming effects. That is, completing a prime sentence with an enriched structure did not significantly affect the likelihood of completing a target sentence with an enriched structure. The lack of priming between aspectual and intensional verbs may suggest that semantic enrichment and syntactic enrichment do not share underlying mechanisms. However, the lack of priming effects in Experiment 2 could simply be due to a lack of lexical boost (e.g., Pickering & Branigan, 1998). The same aspectual/intensional verbs were repeated on prime and target trials in Experiment 1, but this could not be done in Experiment 2 since the two enrichment classes have different verbs. To explore to what extent the results in Experiment 2 result from a lack of lexical boost, Experiment 3 tested enrichment priming within aspectual and intensional verbs, but without lexical overlap.

Experiment 3

Methods

Participants

Sixty-two native English speakers (Mean age = 33 years, range = 20-54 years) were recruited on Amazon Mechanical Turk and paid \$3 to participate in a 20 minute study. They reported no language or neurological disorders.

Stimuli

The stimuli were closely based on those in Experiment 1. The prime and target sentences contained a different verb, but the verb belonged to the same verb type. For example, the target “*The woman wanted*” was preceded by the prime “*The mouse needed the*” or “*The mouse needed to eat the*”. The full set of critical items are in Appendix.

Procedure, data coding and analysis

The procedure, data coding and analysis were all identical to Experiment 1. The coded data had 9% NA for the prime analysis, and 14% NA for the target analysis.

Results

Consistent with Experiments 1 and 2, the analysis on prime trials showed that participants were more likely to produce an entity-denoting noun for intensional verbs than for aspectual verbs (81% vs. 54%) in NP Prime trials, $\beta = -.98$, $SE = .28$, $z = -3.6$, $p < .001$.

The results for target trials are shown in Figure 4. In target trials, the model testing an interaction of Prime completion type (Entity vs. Event) by Verb type only found a significant effect of Verb type, $\beta = 1.9$, $SE = .75$, $z = 2.5$, $p = .01$, suggesting that participants were more likely to complete the target with an enriched response for intensional verbs than for aspectual verbs (57% vs. 24%). Neither the interaction of Prime completion type by Verb type nor the effect of Prime completion type was significant ($ps > .4$). The Bayes factor of .051 for Prime completion suggests strong ($1/.051 \approx 19.6$ times more likely) evidence in favour of the null hypothesis over the alternative hypothesis.

The model comparing Entity vs. Event prime completions within NP primes in aspectual verbs did not find a significant effect of Prime completion type either ($p = .4$). The Bayes factor of .12 suggests moderate ($1/.12 \approx 8.3$ times more likely) evidence in favour of the null hypothesis over the alternative hypothesis. Thus, like in Experiment 2, Experiment 3 did not find any evidence for enrichment priming for either of the verb type.

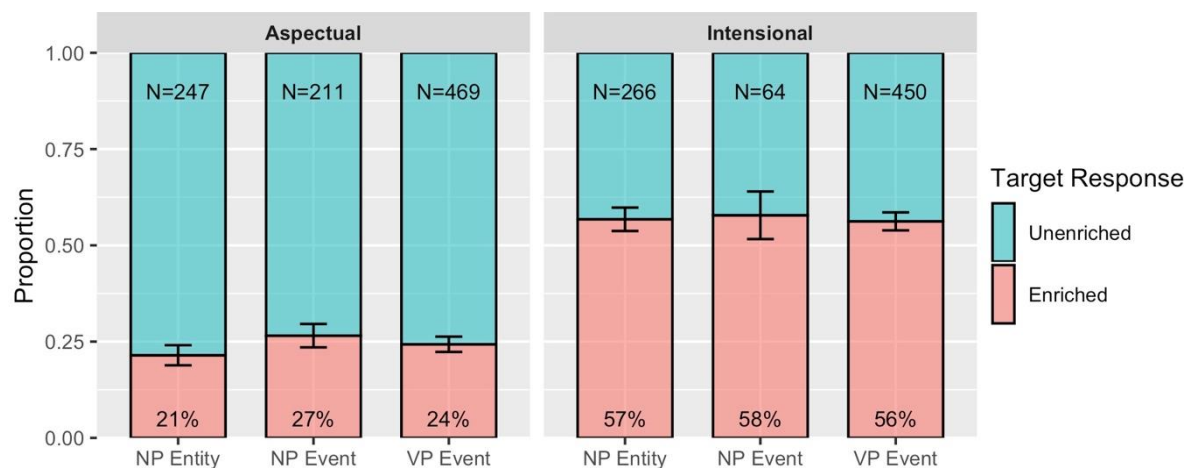


Figure 4. The proportion of Enriched (pink) and Unenriched (blue) responses for NP Entity, NP Event and VP Event primes for aspectual (left) and intensional (right) verbs in Experiment 3. The numbers at the top of each bar indicate the number of trials for each prime type, and the percentages at the bottom of each bar indicate the proportion of Enriched responses for each prime type. The error bars represent a standard error.

General discussion

We investigated whether the mechanisms of enrichment are shared between semantic and syntactic enrichment by testing whether the two types of enrichment can prime each other. At first glance, semantic enrichment and syntactic enrichment appear to share some mechanisms, but not all. Both types of enrichment are triggered by a detection of a mismatch between the selectional requirements of the verb and the complement noun. However, semantic enrichment resolves this mismatch by a type-shift, while syntactic enrichment adds syntactic structure by insertion of a silent verb. We conducted a series of written production experiments using structural priming to tap into this distinction in the process of constructing an enriched structure.

Experiment 1 found evidence for enrichment priming from aspectual verbs to aspectual verbs and from intensional verbs to intensional verbs. The Bayes factor suggested extreme evidence in favour of the alternative hypothesis over the null hypothesis, providing

strong evidence that both semantic and syntactic enrichment can be primed. Experiment 2 crossed the verb type and found no evidence for enrichment priming from intensional verbs to aspectual verbs or from aspectual verbs to intensional verbs. The Bayes factor suggested strong evidence in favour of the null hypothesis over the alternative hypothesis, thus, the robust priming effect obtained in Experiment 1 disappeared in Experiment 2. The lack of between verb type priming suggests that the mechanisms involved in semantic and syntactic enrichment might not be shared in either direction. However, Experiment 3 tested enrichment priming within verb type without lexical overlap and found no evidence for enrichment priming from aspectual verbs to aspectual verbs or from intensional verbs to intensional verbs. The Bayes factor again suggested strong evidence in favour of the null hypothesis over the alternative hypothesis. Thus, the lack of priming effects in Experiment 2 could simply be due to the lack of lexical boost. Taken together, our findings suggest that lexical boost is required to prime enrichment operations in both aspectual and intensional verbs.

These results have implications for our theories of enrichment mechanisms. The finding that enrichment priming requires lexical boost suggests that simply producing an enriched structure may not robustly activate another enriched structure. The locus of the priming in Experiment 1 may not be enrichment operation of type-shifting or verb insertion per se but may rather be sensitive to a component of a described event (e.g., the *beginning* or *wanting* an action). These components are still relatively abstract, as they do not inform comprehenders about the contentful action that must be inferred, but they are directly related to the lexical content of the sentence. Lexical content, therefore, may affect a comprehender's structural choices more robustly than enrichment operations. Alternatively, enrichment operations might have been activated, but such activation may be too weak to prime implicit constructions (vs. explicit syntactic structure) without the aid of lexical boost.

Since we found no evidence for enrichment priming within the verb type without a lexical boost, it is unclear whether the lack of enrichment priming across the verb type

indicates distinct mechanisms between semantic and syntactic enrichment or it is simply due to a lack of lexical boost. We do, however, find an interesting numeric trend in Experiment 2 suggesting that completing a prime with an aspectual verb with an NP Entity (i.e., enriched structure), participants were more likely to produce an enriched response on the intensional verb target trial compared to when completing the prime with an NP Event (i.e., unenriched response). This trend seems to be the opposite for the target with an aspectual verb; numerically, participants were less likely to produce an enriched response after completing a prime with an intensional verb with an NP Entity (vs. NP Event). These differences could indicate an asymmetric priming effect, with ~10% facilitation from semantic enrichment to syntactic enrichment and ~13% inhibition from syntactic enrichment to semantic enrichment. However, this pattern should be treated with caution because these differences were not statistically significant.

Raffray et al. (2014) used an oral production task and found evidence for priming for semantic enrichment. Their Experiment 3 compared semantic enrichment priming with and without a lexical boost and found priming only when the *coercing* aspectual verb (e.g., *began* in *The student began the book*) was repeated on the prime and target trials. These findings are consistent with our Experiments 1 and 3, suggesting that similar content or operations can be primed using an oral production task and a typing production task. Experimental 4 in Raffray et al. (2014) additionally found that the degree of priming was affected by the repetition of a *coerced* action (e.g., *read* in *The student began the book*), suggesting that the boost to the priming effect can arise also from repetition of a content that was not explicitly expressed. That is, the boost to priming is not only related to the repetition of an identical word, but also the overlap of the semantic content. However, given that there was no priming without a boost from overlapping information, the operations that produce an enriched structure may not be targeted by priming (though it might be possible to detect such representation using another method).

A notable difference between Raffray et al. and our study was that Raffray et al. found more overall enriched responses on target trials compared to our Experiment 1. Following an enriched prime, they found 57% enriched responses (Experiment 1), while we found only 32% enriched responses for aspectual verbs. It is not clear what exactly contributed to this difference, but one potential factor is the verbs used in these experiments. Raffray et al. used *begin*, *complete*, *continue*, *enjoy*, *finish*, *master*, *start*, and *try*, whereas we only used *begin*, *start* and *finish*. According to Katsika et al. (2012), aspectual verbs are inherently temporal, thus requiring an event-denoting complement, but the verb *enjoy*, as a psychological verb, may take an entity or an event as a complement, so the selectional restriction may not be represented in the mental lexicon. The verbs *master* and *try* are also classified as another, non-aspectual verb category. Consistent with this hypothesis, Katsika et al. (2012) found processing cost (i.e., longer reading times) for enriched (vs. unenriched) constructions with an aspectual verb but not for those with a psychological verb. If only aspectual verbs incur additional processing cost, people may be generally more likely to produce enriched constructions for non-aspectual verbs than for aspectual verbs. This might account for the overall higher rate of producing enriched constructions in Raffray et al.'s study (which used both aspectual and non-aspectual verbs) than in our study (which did not include psychological verbs or other non-aspectual category of verbs).

A consistent and robust finding in all our experiments was that participants produced more enriched responses for intensional verbs than for aspectual verbs on both prime and target trials. This difference seems to reflect a general preference for an enriched construction in intensional verbs than in aspectual verbs. This difference could also suggest that the enrichment operation is less costly for syntactic enrichment than for semantic enrichment. Semantic enrichment involves a semantic type shift – changing the default semantic type of the noun from entity-denoting to event-denoting. In contrast, syntactic enrichment changes the syntactic structure of the sentence by inserting a silent verb that entails the implicit event

representations. The semantic type shift, which is unique to semantic enrichment, might incur more processing cost than a silent verb insertion.

Alternatively or additionally, the difference might be due to general differences in verb types. When speakers produce a sentence with semantic enrichment (e.g., *The author began the book*), they are liable to have a specific event (e.g., writing) in mind, whereas this might not be the case when producing a sentence with syntactic enrichment (e.g., *The author wanted the book*). In the latter case, the silent verb is likely a light verb (akin to “have” or “get”), and these verbs may be less specific in terms of specifying the underlying event compared to verbs denoting a specific action. However, we note that enrichment is still required, as we discussed in the Introduction (cf. Pytkänen, 2008). In sentences with an intensional verb such as *Joe wants results quickly*, the adverb *quickly* can modify the implicit event (e.g., *get*), even if the specific action of getting is not specified. In contrast, an equivalent modification is not possible without a suitable embedded verb in sentences with a non-intensional verb such as *#Joe likes results quickly*. The modification ambiguity in *Joe wants results quickly* becomes possible because the silent verb is recovered, suggesting that intensional transitives require syntactic enrichment.

Somewhat related to the point above, a possible limitation of our study is that unenriched sentences may not always be the dominant interpretation of the enriched counterpart. This was notably the case for sentences with *imagine*, as in *The carpenter imagined building the house*. The sentence *The carpenter imagined the house* may be interpreted as the carpenter forming a mental image of the house rather than imagining the process of building the house¹. Thus, in production, some speakers may find *The carpenter imagined building the house* different from *The carpenter imagined the house*, and syntactic enrichment may not be required for these speakers. To address whether the inclusion of

¹ We thank an anonymous reviewer for pointing this out.

imagine affected our results, we re-analysed the target response data (see Supplementary file for details). These analyses showed that the results from all experiments did not depend on the items with *imagine*.

Conclusions

We found enrichment priming for aspectual and intensional verbs only when the prime and the target contained the same verb. The lack of priming without lexical boost suggests that enrichment constructions may not be robustly activated when producing (via typing) an enriched structure. The lack of priming across aspectual and intensional verb types could indicate distinct mechanisms for semantic and syntactic enrichment, but we cannot rule out the possibility of (partly) shared mechanisms because priming across the verb types by definition fails to have lexical boost.

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Data availability statement

The experiment setup files and R scripts for the analyses are available on the Open Science Framework (<https://osf.io/geuwq/>). The visual stimuli cannot be publicly shared as some of them are copyright-protected, but they are available from the first author upon request.

Appendix. Stimuli for Experiment 1

Item	Verb type	Prime	Prime fragment	Target fragment
1	Aspectual	VP	The author began to write the	The artist began
		NP	The author began the	The artist began
	Intensional	VP	The author desired to write the	The artist desired
		NP	The author desired the	The artist desired
2	Aspectual	VP	The scholar started to read the	The woman started

		NP	The scholar started the	The woman started
		VP	The scholar needed to read the	The woman needed
3	Aspectual	NP	The scholar needed the	The woman needed
		VP	The bartender finished making the	The baby finished
	Intensional	NP	The bartender finished the	The baby finished
		VP	The bartender fancied making the	The baby fancied
4	Aspectual	NP	The bartender fancied the	The baby fancied
		VP	The customer finished eating the	The girl finished
	Intensional	NP	The customer finished the	The girl finished
		VP	The customer fancied eating the	The girl fancied
5	Aspectual	NP	The customer fancied the	The girl fancied
		VP	The repairman began to fix the	The boy began
	Intensional	NP	The repairman began the	The boy began
		VP	The repairman wanted to fix the	The boy wanted
6	Aspectual	NP	The repairman wanted the	The boy wanted
		VP	The woman began drinking the	The cat began
	Intensional	NP	The woman began the	The cat began
		VP	The woman fancied drinking the	The cat fancied
7	Aspectual	NP	The woman fancied the	The cat fancied
		VP	The chef finished baking the	The child finished
	Intensional	NP	The chef finished the	The child finished
		VP	The chef fancied baking the	The child fancied
8	Aspectual	NP	The chef fancied the	The child fancied
		VP	The boy began playing the	The man began
	Intensional	NP	The boy began the	The man began
		VP	The boy fancied playing the	The man fancied
9	Aspectual	NP	The boy fancied the	The man fancied
		VP	The woman started to use the	The programmer started
	Intensional	NP	The woman started the	The programmer started
		VP	The woman needed to use the	The programmer needed
10	Aspectual	NP	The woman needed the	The programmer needed
		VP	The woman finished baking the	The man finished
	Intensional	NP	The woman finished the	The man finished
		VP	The woman fancied baking the	The man fancied
11	Aspectual	NP	The woman fancied the	The man fancied
		VP	The boy started riding the	The man started
	Intensional	NP	The boy started the	The man started
		VP	The boy fancied riding the	The man fancied
12	Aspectual	NP	The boy fancied the	The man fancied
		VP	The girl began reading the	The boy began
	Intensional	VP	The girl began the	The boy began
		VP	The girl fancied reading the	The boy fancied

13	Aspectual	NP	The girl fancied the	The boy fancied
		VP	The kids started to decorate the	The farmer started
	Intensional	NP	The kids started the	The farmer started
		VP	The kids wanted to decorate the	The farmer wanted
14	Aspectual	NP	The kids wanted the	The farmer wanted
		VP	The mechanic began to fix the	The woman began
	Intensional	NP	The mechanic began the	The woman began
		VP	The mechanic needed to fix the	The woman needed
15	Aspectual	NP	The mechanic needed the	The woman needed
		VP	The mouse began to eat the	The woman began
	Intensional	NP	The mouse began the	The woman began
		VP	The mouse wanted to eat the	The woman wanted
16	Aspectual	NP	The mouse wanted the	The woman wanted
		VP	The dog began to eat the	The woman began
	Intensional	NP	The dog began the	The woman began
		VP	The dog needed to eat the	The woman needed
17	Aspectual	NP	The dog needed the	The woman needed
		VP	The monkey began eating the	The man began
	Intensional	NP	The monkey began the	The man began
		VP	The monkey fancied eating the	The man fancied
18	Aspectual	NP	The monkey fancied the	The man fancied
		VP	The girl began to ride the	The man began
	Intensional	NP	The girl began the	The man began
		VP	The girl requested to ride the	The man requested
19	Aspectual	NP	The girl requested the	The man requested
		VP	The girl started to use the	The boy started
	Intensional	NP	The girl started the	The boy started
		VP	The girl wanted to use the	The boy wanted
20	Aspectual	NP	The girl wanted the	The boy wanted
		VP	The man started smoking the	The barista started
	Intensional	NP	The man started the	The barista started
		VP	The man fancied smoking the	The barista fancied
21	Aspectual	NP	The man fancied the	The barista fancied
		VP	The family began to have the	The kids began
	Intensional	NP	The family began the	The kids began
		VP	The family desired to have the	The kids desired
22	Aspectual	NP	The family desired the	The kids desired
		VP	The grandma finished knitting the	The woman finished
	Intensional	NP	The grandma finished the	The woman finished
		VP	The grandma fancied knitting the	The woman fancied
23	Aspectual	NP	The grandma fancied the	The woman fancied
		VP	The lady began eating the	The boy began

		NP	The lady began the	The boy began
		VP	The lady fancied eating the	The boy fancied
24	Aspectual	NP	The lady fancied the	The boy fancied
		VP	The woman began to wash the	The chef began
	Intensional	NP	The woman began the	The chef began
		VP	The woman needed to wash the	The chef needed
25	Aspectual	NP	The woman needed the	The chef needed
		VP	The carpenter finished building the	The tailor finished
	Intensional	NP	The carpenter finished the	The tailor finished
		VP	The carpenter imagined building the	The tailor imagined
26	Aspectual	NP	The carpenter imagined the	The tailor imagined
		VP	The architect began designing the	The designer began
	Intensional	NP	The architect began the	The designer began
		VP	The architect imagined designing the	The designer imagined
27	Aspectual	NP	The architect imagined the	The designer imagined
		VP	The woman finished replacing the	The boy finished
	Intensional	NP	The woman finished the	The boy finished
		VP	The woman fancied replacing the	The boy fancied
28	Aspectual	NP	The woman fancied the	The boy fancied
		VP	The man began making the	The man began
	Intensional	NP	The man began the	The man began
		VP	The man imagined making the	The man imagined
29	Aspectual	NP	The man imagined the	The man imagined
		VP	The novelist finished writing the	The sculptor finished
	Intensional	NP	The novelist finished the	The sculptor finished
		VP	The novelist imagined writing the	The sculptor imagined
30	Aspectual	NP	The novelist imagined the	The sculptor imagined
		VP	The boy began eating the	The girl began
	Intensional	NP	The boy began the	The girl began
		VP	The boy fancied eating the	The girl fancied
31	Aspectual	NP	The boy fancied the	The girl fancied
		VP	The runner finished drinking the	The chef finished
	Intensional	NP	The runner finished the	The chef finished
		VP	The runner fancied drinking the	The chef fancied
32	Aspectual	NP	The runner fancied the	The chef fancied
		VP	The boy began to eat the	The thief began
	Intensional	NP	The boy began the	The thief began
		VP	The boy wanted to eat the	The thief wanted
		NP	The boy wanted the	The thief wanted

Appendix. Stimuli for Experiment 2

Item	Verb type	Prime	Prime fragment	Target fragment
1	Aspectual	VP	The author began to write the	The artist desired
		NP	The author began the	The artist desired
	Intensional	VP	The author desired to write the	The artist began
		NP	The author desired the	The artist began
2	Aspectual	VP	The scholar started to read the	The woman needed
		NP	The scholar started the	The woman needed
	Intensional	VP	The scholar needed to read the	The woman started
		NP	The scholar needed the	The woman started
3	Aspectual	VP	The bartender finished making the	The baby fancied
		NP	The bartender finished the	The baby fancied
	Intensional	VP	The bartender fancied making the	The baby finished
		NP	The bartender fancied the	The baby finished
4	Aspectual	VP	The customer finished eating the	The girl fancied
		NP	The customer finished the	The girl fancied
	Intensional	VP	The customer fancied eating the	The girl finished
		NP	The customer fancied the	The girl finished
5	Aspectual	VP	The repairman began to fix the	The boy wanted
		NP	The repairman began the	The boy wanted
	Intensional	VP	The repairman wanted to fix the	The boy began
		NP	The repairman wanted the	The boy began
6	Aspectual	VP	The woman began drinking the	The cat fancied
		NP	The woman began the	The cat fancied
	Intensional	VP	The woman fancied drinking the	The cat began
		NP	The woman fancied the	The cat began
7	Aspectual	VP	The chef finished baking the	The child fancied
		NP	The chef finished the	The child fancied
	Intensional	VP	The chef fancied baking the	The child finished
		NP	The chef fancied the	The child finished
8	Aspectual	VP	The boy began playing the	The man fancied
		NP	The boy began the	The man fancied
	Intensional	VP	The boy fancied playing the	The man began
		NP	The boy fancied the	The man began
9	Aspectual	VP	The woman started to use the	The programmer needed
		NP	The woman started the	The programmer needed
	Intensional	VP	The woman needed to use the	The programmer started
		NP	The woman needed the	The programmer started
10	Aspectual	VP	The woman finished baking the	The man fancied
		NP	The woman finished the	The man fancied
	Intensional	VP	The woman fancied baking the	The man finished
		NP	The woman fancied the	The man finished
11	Aspectual	VP	The boy started riding the	The man fancied

		NP	The boy started the	The man fancied
		VP	The boy fancied riding the	The man started
12	Aspectual	NP	The boy fancied the	The man started
		VP	The girl began reading the	The boy fancied
	Intensional	NP	The girl began the	The boy fancied
		VP	The girl fancied reading the	The boy began
13	Aspectual	NP	The girl fancied the	The boy began
		VP	The kids started to decorate the	The farmer wanted
	Intensional	NP	The kids started the	The farmer wanted
		VP	The kids wanted to decorate the	The farmer started
14	Aspectual	NP	The kids wanted the	The farmer started
		VP	The mechanic began to fix the	The woman needed
	Intensional	NP	The mechanic began the	The woman needed
		VP	The mechanic needed to fix the	The woman began
15	Aspectual	NP	The mechanic needed the	The woman began
		VP	The mouse began to eat the	The woman wanted
	Intensional	NP	The mouse began the	The woman wanted
		VP	The mouse wanted to eat the	The woman began
16	Aspectual	NP	The mouse wanted the	The woman began
		VP	The dog began to eat the	The woman needed
	Intensional	NP	The dog began the	The woman needed
		VP	The dog needed to eat the	The woman began
17	Aspectual	NP	The dog needed the	The woman began
		VP	The monkey began eating the	The man fancied
	Intensional	NP	The monkey began the	The man fancied
		VP	The monkey fancied eating the	The man began
18	Aspectual	NP	The monkey fancied the	The man began
		VP	The girl began to ride the	The man requested
	Intensional	NP	The girl began the	The man requested
		VP	The girl requested to ride the	The man began
19	Aspectual	NP	The girl requested the	The man began
		VP	The girl started to use the	The boy wanted
	Intensional	NP	The girl started the	The boy wanted
		VP	The girl wanted to use the	The boy started
20	Aspectual	NP	The girl wanted the	The boy started
		VP	The man started smoking the	The barista fancied
	Intensional	NP	The man started the	The barista fancied
		VP	The man fancied smoking the	The barista started
21	Aspectual	NP	The man fancied the	The barista started
		VP	The family began to have the	The kids desired
	Intensional	VP	The family began the	The kids desired
		VP	The family desired to have the	The kids began

		NP	The family desired the	The kids began
22	Aspectual	VP	The grandma finished knitting the	The woman fancied
		NP	The grandma finished the	The woman fancied
	Intensional	VP	The grandma fancied knitting the	The woman finished
		NP	The grandma fancied the	The woman finished
23	Aspectual	VP	The lady began eating the	The boy fancied
		NP	The lady began the	The boy fancied
	Intensional	VP	The lady fancied eating the	The boy began
		NP	The lady fancied the	The boy began
24	Aspectual	VP	The woman began to wash the	The chef needed
		NP	The woman began the	The chef needed
	Intensional	VP	The woman needed to wash the	The chef began
		NP	The woman needed the	The chef began
25	Aspectual	VP	The carpenter finished building the	The tailor imagined
		NP	The carpenter finished the	The tailor imagined
	Intensional	VP	The carpenter imagined building the	The tailor finished
		NP	The carpenter imagined the	The tailor finished
26	Aspectual	VP	The architect began designing the	The designer imagined
		NP	The architect began the	The designer imagined
	Intensional	VP	The architect imagined designing the	The designer began
		NP	The architect imagined the	The designer began
27	Aspectual	VP	The woman finished replacing the	The boy fancied
		NP	The woman finished the	The boy fancied
	Intensional	VP	The woman fancied replacing the	The boy finished
		NP	The woman fancied the	The boy finished
28	Aspectual	VP	The man began making the	The man imagined
		NP	The man began the	The man imagined
	Intensional	VP	The man imagined making the	The man began
		NP	The man imagined the	The man began
29	Aspectual	VP	The novelist finished writing the	The sculptor imagined
		NP	The novelist finished the	The sculptor imagined
	Intensional	VP	The novelist imagined writing the	The sculptor finished
		NP	The novelist imagined the	The sculptor finished
30	Aspectual	VP	The boy began eating the	The girl fancied
		NP	The boy began the	The girl fancied
	Intensional	VP	The boy fancied eating the	The girl began
		NP	The boy fancied the	The girl began
31	Aspectual	VP	The runner finished drinking the	The chef fancied
		NP	The runner finished the	The chef fancied
	Intensional	VP	The runner fancied drinking the	The chef finished
		NP	The runner fancied the	The chef finished
32	Aspectual	VP	The boy began to eat the	The thief wanted

Intensional	NP	The boy began the	The thief wanted
	VP	The boy wanted to eat the	The thief began
	NP	The boy wanted the	The thief began

Appendix. Stimuli for Experiment 3

Item	Verb type	Prime	Prime fragment	Target fragment
1	Aspectual	VP	The author started to write the	The artist began
		NP	The author started the	The artist began
	Intensional	VP	The author wanted to write the	The artist desired
		NP	The author wanted the	The artist desired
2	Aspectual	VP	The scholar began to read the	The woman started
		NP	The scholar began the	The woman started
	Intensional	VP	The scholar requested to read the	The woman needed
		NP	The scholar requested the	The woman needed
3	Aspectual	VP	The bartender started making the	The baby finished
		NP	The bartender started the	The baby finished
	Intensional	VP	The bartender imagined making the	The baby fancied
		NP	The bartender imagined the	The baby fancied
4	Aspectual	VP	The customer began eating the	The girl finished
		NP	The customer began the	The girl finished
	Intensional	VP	The customer imagined eating the	The girl fancied
		NP	The customer imagined the	The girl fancied
5	Aspectual	VP	The repairman started to fix the	The boy began
		NP	The repairman started the	The boy began
	Intensional	VP	The repairman needed to fix the	The boy wanted
		NP	The repairman needed the	The boy wanted
6	Aspectual	VP	The woman finished drinking the	The cat began
		NP	The woman finished the	The cat began
	Intensional	VP	The woman imagined drinking the	The cat fancied
		NP	The woman imagined the	The cat fancied
7	Aspectual	VP	The chef began baking the	The child finished
		NP	The chef began the	The child finished
	Intensional	VP	The chef imagined baking the	The child fancied
		NP	The chef imagined the	The child fancied
8	Aspectual	VP	The boy finished playing the	The man began
		NP	The boy finished the	The man began
	Intensional	VP	The boy imagined playing the	The man fancied
		NP	The boy imagined the	The man fancied
9	Aspectual	VP	The woman began to use the	The hacker started
		NP	The woman began the	The hacker started
	Intensional	VP	The woman wanted to use the	The hacker needed

10	Aspectual	NP	The woman wanted the	The hacker needed
		VP	The woman began baking the	The man finished
	Intensional	NP	The woman began the	The man finished
		VP	The woman imagined baking the	The man fancied
11	Aspectual	NP	The woman imagined the	The man fancied
		VP	The boy began riding the	The man started
	Intensional	NP	The boy began the	The man started
		VP	The boy imagined riding the	The man fancied
12	Aspectual	NP	The boy imagined the	The man fancied
		VP	The girl started reading the	The boy began
	Intensional	NP	The girl started the	The boy began
		VP	The girl imagined reading the	The boy fancied
13	Aspectual	NP	The girl imagined the	The boy fancied
		VP	The kids began to decorate the	The farmer started
	Intensional	NP	The kids began the	The farmer started
		VP	The kids desired to decorate the	The farmer wanted
14	Aspectual	NP	The kids desired the	The farmer wanted
		VP	The mechanic started to fix the	The woman began
	Intensional	NP	The mechanic started the	The woman began
		VP	The mechanic wanted to fix the	The woman needed
15	Aspectual	NP	The mechanic wanted the	The woman needed
		VP	The mouse started eating the	The woman finished
	Intensional	NP	The mouse started the	The woman finished
		VP	The mouse needed to eat the	The woman wanted
16	Aspectual	NP	The mouse needed the	The woman wanted
		VP	The dog started to eat the	The woman began
	Intensional	NP	The dog started the	The woman began
		VP	The dog wanted to eat the	The woman needed
17	Aspectual	NP	The dog wanted the	The woman needed
		VP	The monkey finished eating the	The man began
	Intensional	NP	The monkey finished the	The man began
		VP	The monkey imagined eating the	The man fancied
18	Aspectual	NP	The monkey imagined the	The man fancied
		VP	The girl started to ride the	The man began
	Intensional	NP	The girl started the	The man began
		VP	The girl wanted to ride the	The man requested
19	Aspectual	NP	The girl wanted the	The man requested
		VP	The girl began to use the	The boy started
	Intensional	NP	The girl began the	The boy started
		VP	The girl needed to use the	The boy wanted
20	Aspectual	NP	The girl needed the	The boy wanted
		VP	The man finished smoking the	The barista started

		NP	The man finished the	The barista started
		VP	The man imagined smoking the	The barista fancied
21	Aspectual	NP	The man imagined the	The barista fancied
		VP	The family started to have the	The baker began
	Intensional	NP	The family started the	The baker began
		VP	The family wanted to have the	The baker desired
22	Aspectual	NP	The family wanted the	The baker desired
		VP	The grandma began knitting the	The woman finished
	Intensional	NP	The grandma began the	The woman finished
		VP	The grandma imagined knitting the	The woman fancied
23	Aspectual	NP	The grandma imagined the	The woman fancied
		VP	The lady finished eating the	The boy began
	Intensional	NP	The lady finished the	The boy began
		VP	The lady imagined eating the	The boy fancied
24	Aspectual	NP	The lady imagined the	The boy fancied
		VP	The woman started to wash the	The chef began
	Intensional	NP	The woman started the	The chef began
		VP	The woman wanted to wash the	The chef needed
25	Aspectual	NP	The woman wanted the	The chef needed
		VP	The carpenter began building the	The tailor finished
	Intensional	NP	The carpenter began the	The tailor finished
		VP	The carpenter fancied building the	The tailor imagined
26	Aspectual	NP	The carpenter fancied the	The tailor imagined
		VP	The architect started designing the	The designer began
	Intensional	NP	The architect started the	The designer began
		VP	The architect fancied designing the	The designer imagined
27	Aspectual	NP	The architect fancied the	The designer imagined
		VP	The woman began replacing the	The boy finished
	Intensional	NP	The woman began the	The boy finished
		VP	The woman imagined replacing the	The boy fancied
28	Aspectual	NP	The woman imagined the	The boy fancied
		VP	The man finished making the	The man began
	Intensional	NP	The man finished the	The man began
		VP	The man fancied making the	The man imagined
29	Aspectual	NP	The man fancied the	The man imagined
		VP	The novelist started writing the	The sculptor finished
	Intensional	NP	The novelist started the	The sculptor finished
		VP	The novelist fancied writing the	The sculptor imagined
30	Aspectual	NP	The novelist fancied the	The sculptor imagined
		VP	The boy finished eating the	The girl began
	Intensional	VP	The boy finished the	The girl began
		VP	The boy imagined eating the	The girl fancied

31	Aspectual	NP	The boy imagined the	The girl fancied
		VP	The runner began drinking the	The chef finished
	Intensional	NP	The runner began the	The chef finished
		VP	The runner imagined drinking the	The chef fancied
32	Aspectual	NP	The runner imagined the	The chef fancied
		VP	The boy started to eat the	The thief began
	Intensional	NP	The boy started the	The thief began
		VP	The boy needed to eat the	The thief wanted
		NP	The boy needed the	The thief wanted

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