

# Do Two Wrongs Make a Rhyme?

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## Abstract

In some cases, yes!

## 1 Introduction

It has been widely established that human thought, perception, and memory are susceptible to priming effects, which occur when a participant is shown a variable prior to completion of a task (Forbach et al. 1974; Antos 1979; Molden 2014; Pardilla-Delgado & Payne 2017). Of particular concern to this paper is semantic priming, where participants are primed with a semantically-related word prior to viewing the target object (Neely 1976; Naccache & Dehaene 2001). Studies involving semantic priming frequently adopt the lexical decision task to observe its effects on lexical processing (Shelton & Martin 1992; Draine & Greenwald 1998; others), though semantic priming has also been shown to affect non-lexical objects such as images (Sperber et al. 1979; Bannon 2022).

Importantly, the primary interest of many studies involving semantic priming is determining how priming facilitates processing of items in contexts where the future is unknown at the time of priming. For example, in a lexical decision task, participants are unaware of what words may appear in upcoming trials. However, very little research has investigated the role of priming in altering predicted outcomes – can priming affect your mental predictions after you have made them? To answer this question, we conducted a pilot experiment where participants determined the best continuation for a phonologically-constrained item within a rhyming context. We found that priming cannot override the prediction of the intended target, but it may affect decisions when the predicted intended target does not appear. These findings suggest semantic priming only applies to environments where prediction is difficult (or impossible), or in contexts where an expected outcome is subverted. The consequences of such a conclusion may have some interesting implications on the incremental processing literature and will be discussed in the final section of this paper.

## 2 Experiment

As mentioned previously, recent work in priming is mostly concerned with its effects on unpredictable futures. The goal of this experiment is to see how strong the effect of semantic priming (if any) is in an environment with a predictable outcome. The following subsections will outline my methods, predictions, and results.

All experimental items and materials can be found at the following Github link, which you can click:

<https://github.com/johnstarr-ling/LING4477-Final-Project>.<sup>1</sup>

### 2.1 Methods

In this section, I will describe the methodology used for the primary experiment.

#### 2.1.1 Design & Materials

To study how priming may or may not affect a predictable outcome, it is first necessary to establish a linguistic structure that directs the participant to a predictable, intended target. For the purposes of this experiment, we utilize *rhyming poetry*. Consider the following lines from a Shakespearean sonnet:

- (1) I love to hear her speak, yet well I *know*  
That music hath a far more pleasing sound;  
I grant I never saw a goddess *go*;  
My mistress, when she walks, treads on the ground.

In (1), we find a regular rhyming pattern involving *perfect rhymes*<sup>2</sup>, with italics and underlines indicating the pairs of rhyming words. Numerous studies have confirmed that perfect rhymes are predictable (Read et al. 2014; Lea et al. 2021; Knoop et al. 2021). As such, we assume that rhyming poetry with perfect rhymes serves as an acceptable linguistic device for investigating our research question.

Each experimental trial had the following structure (which is additionally outlined in Figure 1): participants were shown a rhyming lyric with the final perfect rhyme left blank. After seven seconds, the lyric would disappear and a word would take its place. Participants were then asked if the word could fill in the lyric, according to their intuitions. If the word could fill in the blank, participants were told to choose “Yes” to move on to the next experimental trial. If the word could *not* fill in the blank, participants

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<sup>1</sup>If any information is missing or the link is broken, please contact the author.

<sup>2</sup>Perfect rhymes are rhymes in stressed positions that match perfectly in syllable count, syllable nucleus, and syllable coda (Hanson 2003)

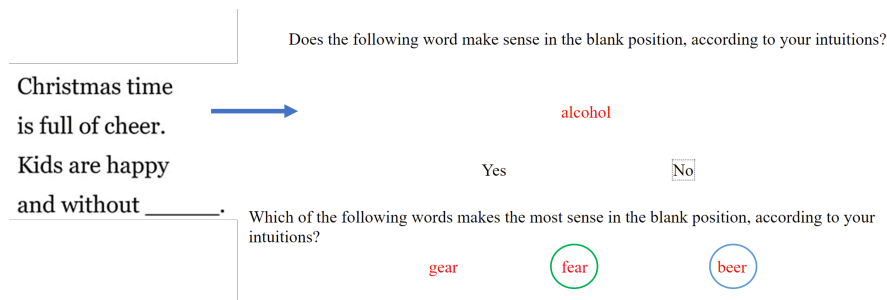


Figure 1: Sample stimulus for Experiment 1. The rhyming poem with the final rhyme left blank is shown on the left. After seven seconds, the screen on the right would appear; all information in the red box is hidden unless the participant chooses “No”. The green circle indicates the intended target, and the blue circle indicates the alternative target suggested by the prime.

were told to choose “No”, causing three additional words to appear on the screen. Participants were then instructed to choose a word from these three words to move on to the next experimental trial. The sequence following the participants decision to choose “No” is the main focus of this experiment.

12 experimental items gathered from a novel corpus of rhyming data (John’s Rhyme Subversion Corpus (JRS-C)) were used for this experiment. All experimental items had a rhyme scheme of either ABAB or ABCB, with the second and fourth lines always rhyming together in a perfect rhyme. To experimentally determine the influence of priming on established prediction, we use a non-rhyming semantic prime for a rhyming alternative of the intended target; this rhyming alternative will henceforth be referred to as the alternative target. For example, consider the example stimulus in Figure 1. The word “alcohol” is synonymous with “beer” and therefore serves as its semantic prime, and “beer” rhymes with the true intended target “fear”. However, “alcohol” does not rhyme with the intended target itself, and therefore should trigger the participant to say it is not a viable rhyming continuation of the lyric. All semantic primes in this study are synonyms of their respective alternative target and have no phonological similarity with their respective intended target.

The regions of interest for this study are the three words that appear when the participant selects “No”. This grouping of three words varies along the following two factors: 1) the presence of the intended target (+/-) and 2) the presence of the alternative target (+/-).

Therefore, participants were shown four possible conditions: 1) both the intended target and the alternative target 2) the intended target without the alternative target, 3) the alternative target without the intended target, and 4) neither the intended target nor the alternative target (control condition). Across conditions, filler rhyming words of identical syntactic category to the

|                      | + Intended Target | - Intended Target |
|----------------------|-------------------|-------------------|
| + Alternative Target | + AT, + IT (1)    | +AT, -IT (3)      |
| - Alternative Target | - AT, +IT (2)     | -AT, -IT (4)      |

Table 1: Paradigm of factors. Parentheses indicate experimental conditions.

intended target were added so that participants always had three possible words to choose from.

To control for the possible effects of semantic relatedness across words in our experimental items, we collected the cosine similarity of all possible pairings that could appear for each experimental item using pre-trained GLoVe word embeddings (Pennington et al. 2014). For each experimental item, the cosine similarity between the semantic prime and the alternative target was over 0.6 in all cases, suggesting great semantic association and relatedness. Additionally, the cosine similarity between the semantic prime and all other targets was less than 0.15, indicating that the semantic prime is unlikely to prime any target besides the alternative target. Such measures ensure that the semantic prime only primes the alternative target.

In addition to the 12 experimental items, participants were also presented 24 filler items for this experiment. Fillers were taken from the Chicago Rhyming Poetry Corpus (CRPC), a corpus of rhyming poems from the 16th-20th centuries (Sonderegger & Reddy 2012). All filler items had identical rhyme schemes to those of the experimental items. Within these 24 filler items, 12 filler items presented the intended target of the rhyme after the lyric disappeared, meaning participants should select “Yes”. The other 12 filler items did not present the intended target of the rhyme in this situation and instead showed an unrelated, non-rhyming word, meaning participants should select “No”; the intended rhyme was then presented alongside two other non-rhyming synonyms of the intended rhyme. This latter half of fillers was constructed to reduce the likelihood of participants becoming accustomed to experimental trials, which always do not display the intended rhyme as the priming word. In personal communication with some participants after they had taken the experiment, no participants appeared to extract the relevant variables of study for the experiment.

In total, participants saw 36 four-line lyrics (12 experimental, 24 filler) in a Latin-squared design. This experiment was conducted on the online research platform PC Ibex (Zehr & Schwarz 2018). Data demonstration link is provided here: <https://farm.pcibex.net/r/ZQKaDs/>

### 2.1.2 Participants

In total, 12 people participated in this experiment (mean age = 27). All participants were native speakers of English. Each participant was recruited by the author via personal communication and compensated with eternal

friendship and adoration. No participants were excluded.

## 2.2 Predictions

Three predictions are possible from this experiment, each with their own consequences:

**H0:**

A semantic prime cannot override prediction of the intended target and does not take precedence in contexts where the intended target is absent.

**H1:**

A semantic prime cannot override prediction of the intended target but does take precedence in contexts where the intended target is absent.

**H2:**

A semantic prime can override the prediction of the intended target and takes precedence in contexts where the intended target is absent.

From the above hypotheses, the following predictions ensue:

According to our null hypothesis, the semantic prime would have no effect on participants' decision. As such, we would expect the intended target to be chosen in conditions 1 and 2, and the alternative target to be chosen with a comparable acceptance rate to the two unrelated rhyming words in condition 3.

According to H1, the semantic prime would have not be able to override the predicted intended target, but would influence decision-making when the intended target was not present. Therefore, we would expect the intended target to be selected in conditions 1 and 2, and the alternative target to be chosen at a significantly higher acceptance rate than the two unrelated rhyming words in condition 3.

According to H2, we would expect participants to choose the alternative target in any situation where it appears. As such, we would expect the intended target to be selected in condition 2 alone, and the alternative target to be chosen at a significantly higher acceptance rate in conditions 1 and 3.

## 2.3 Results

The results of the experiment can be found in Figure 2; these results were processed using a variety of Python and R scripts, all of which are available on the previous Github link. Columns marked NULL indicate situations where participants selected "Yes" to the semantic prime, meaning they did not view the experimental condition for that item.

In both conditions 1(+alternative, +intended) and 2 (-alternative, +intended), we find that participants overwhelmingly select the the intended

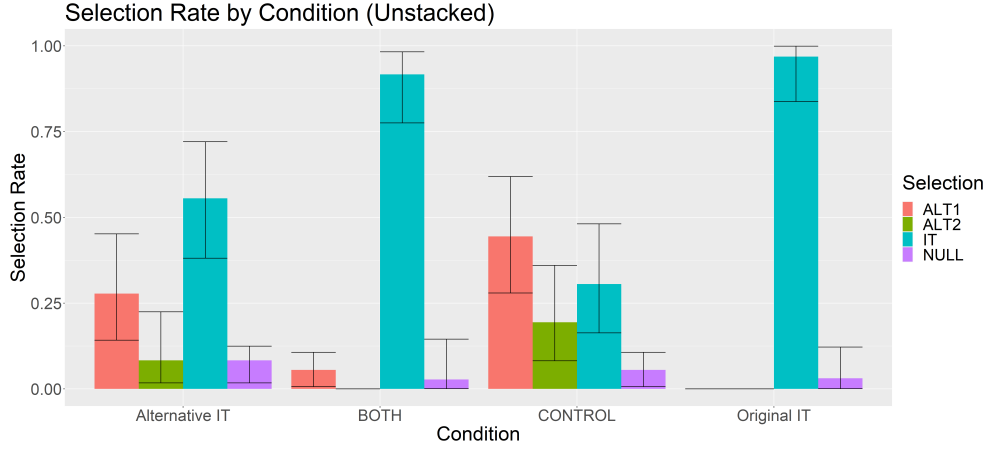


Figure 2: Results for Experiment 1. The blue bar in the Alternative IT condition corresponds with the alternative target, *not* with the original intended target.

target. As such, it appears that the semantic prime cannot override the predictions established, therefore rejecting H2. In condition 4 (-alternative, -intended), selection rates appear to be near random.

In condition 3 (+alternative, -intended), the blue bar for IT represents the alternative target; this is a result of how we coded our data. We find that the alternative target is selected more frequently than the other presented words in this condition. To test if the alternative target is selected at a significantly higher rate than the other presented words in condition 3, we conducted a pairwise comparison of proportions with Holm-adjusted  $p$ -values. We find that the selection rate of the alternative target and the second rhyming word (ALT2) were significantly different ( $p=0.0001$ ). We did not find a significant difference between the alternative target and the first rhyming word (ALT1) ( $p=0.07012$ ) or between the two rhyming words themselves ( $p=0.07012$ ). In this way, we partially reject H1, as we find a significantly higher acceptance rate for the alternative target for one of the two rhyming words in condition 3. It should be mentioned that the  $p$ -values for both the comparison between alternative target and the first rhyming word and the comparison between the two rhyming words themselves both near significance. Given more participants, we may be able to firmly accept or reject H1.

### 3 Discussion

In relation to our original hypotheses, we completely reject H2 and H0, and partially accept H1. As such, our findings suggest that semantic priming does not affect prediction when the expected outcome surfaces, though se-

mantic priming may allow affect decision-making when the intended target does not appear.

In its current iteration, this experiment suffers from a lack of analyses on response times. Such information may provide critical insight into how participants are processing our data. For example, consider the following two scenarios. First, it is possible that participants may spend more time processing their options in condition 1, even though participants are consistently accepting the intended target over the alternative target. Such a finding would suggest that there is a significant processing cost of rejecting the semantically-primed alternative target. Second, it is just as possible that participants spend no time rejecting the alternative target in the condition where both the alternative and intended targets appear. These results would run contrary to the previous hypothetical situation, providing an on-line correlate of the offline decisions that show how semantic priming has little effect on overriding predictable linguistic signals.

With the additional fact of response times, the results of this study may provide some interesting insight for the greater incremental processing literature. Consider the following garden-path sentence: “the horse raced past the barn fell”. While the incremental parsing literature remains inconclusive as to whether or not the human parser operates serially or in parallel, their general conclusion is the same – our linguistic system jumps to a conclusion prior to it actually being confirmed, meaning these garden path sentences are predicted to be complete, and then we must resolve this error retrospectively upon hearing additional information (Van Dyke & Lewis 2003; Tabor & Hutchins 2004; Cho et al. 2017). In this study, we move one step earlier. Rather than providing unexpected information after the lyric is complete to induce a garden-pathing effect, we provide unexpected information in the final position of a phonologically-regular context. An interesting question for future study is to see if the resolution process in these data are comparable to those of reading time data for garden path sentences.

## 4 Conclusion

Much of the previous work on semantic priming examines how priming affects unforeseen circumstances. In this pilot study, we study how semantic priming affects prediction in anticipated contexts. Broadly, we find that semantic priming cannot override the salient intended target, but it may affect lower-level semantic processing in an environment where expectations are subverted. Further study is needed to determine the strength of the effects.

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