Prosodic Focus Marking for Phonological Reasons: The Case of Homophones?

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Introduction

Previous studies on when and how production reductions occur in English:

1. Wheeldon and Monsell (1992):
   - Found a reduction of duration after homophone and repetition primes.
   - Possible due to the prior production of a word's phonological code which affects the ease with which a word form-once-retrieved is encoded and articulated.
2. Jacobs et al. (2015):
   - Priming with pure repetitions leads to more reduction than priming with homophones.
   - Auditory stimuli are sufficient for repetition reduction.

Since these findings did not bring up any discussion in prosodic effects, it led us to investigate the roles that focus marking play when a prominence shift happens within sentences.

Previous studies on prominence shift:

Hamlaoui et al. (2018):
- Due to a shift in focus marking from one word to another, particularly in two sentences consisting of the same antecedent appearing in the same syntactic position.
- Prosodic marking of the focus is realized through an enhanced prominence (reflected in higher pitch, intensity, and longer duration), as the already-given information is realized through a reduced prominence (reflected in lower pitch, intensity, and shorter duration).

Two main parts of this project:

1. To investigate two research questions:
   a. What kinds of repetition could result in a prominence shift?
   b. Does the syntactic position of the repeating word influence prominence shift?
2. To develop scripts to automate data analysis.

Methodology

Two production experiments were conducted online:
- Sentence-final target words & sentence-initial target words
- Participants were recruited via Prolific with compensation, without knowing the topics of the study.
- During each trial: a line of planned production shows up on the screen, with 4 images illustrating the sentence.
- Participants were asked to read the sentence as loud and as naturally as possible.
- Two factors were manipulated: type of word (identical/homophone) & syntactic position (same/different position).
- In each item set: 6 conditions with the same target word, 4 test conditions and 2 control conditions

Sample item sets:

		Same syntactic position	Different syntactic position
Identical antecedent	**Initial target**	On the left, the hare is bigger than the fox, and on the right, the hare is bigger than the glove	On the left, the fox is bigger than the hare, and on the right, the hare is bigger than the glove
	Final target	On the left, the ball is bigger than the doe, and on the right, the house is bigger than the doe	On the left, the doe is bigger than the car, and on the right, the house is bigger than the doe.
Homophone antecedent	**Initial target**	On the left, the hare is bigger than the fox, and on the right, the hair is bigger than the glove	On the left, the fox is bigger than the hare, and on the right, the hair is bigger than the glove
	Final target	On the left, the ball is bigger than the doe, and on the right, the house is bigger than the dough	On the left, the doe is bigger than the car, and on the right, the house is bigger than the dough
Control 1: completely different	**Initial target**	On the left, the book is bigger than the fox, and on the right, the hare is bigger than the glove.	
	Final target	On the left, the ball is bigger than the car, and on the right, the house is bigger than the doe	
Control 2: completely identical	**Initial target**	On the left, the hare is bigger than the glove, and on the right, the hare is bigger than the glove	
	Final target	On the left, the house is bigger than the doe, and on the right, the house is bigger than the doe	

Table 1: Sample experiment item sets

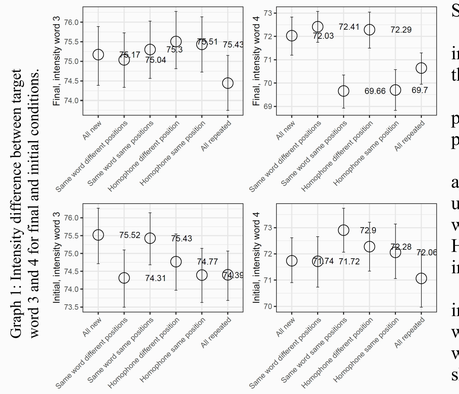
Each item set was designed to contain 4 target words. Among 24 item sets, 12 sets used homophones with different spelling, and 12 sets used homophones with the same spelling but different meanings.

In total, 52 North American English speakers took part in the study, including 39 females, 12 males, and 1 non-binary.

Data Analysis

An annotating script was developed for annotating the collected data. This Python script made it easier to annotated Textgrid files. It only takes as input an spreadsheet. Users can change parameters to add desired tiers for later data analysis.

Image 1: Output Textgrid file if all parameters are set to "yes." Parameters include annotating: interval of interest (IOI), vowels in IOI, stressed vowels in IOI, zone of interest, syllables in IOI.



Graph 1: Intensity difference between target word 3 and 4 for final and initial conditions.

Some key findings are as follow:

1. There was an **asymmetry** between the intensity pattern of target-final conditions and that of target-initial conditions.
2. The **most salient** prominence shift took place in which **homophone** target words were place **sentence-finally**.
3. For target-final conditions, words that appeared in the **same syntactic position** underwent more salient prominence shift than words appeared in different syntactic positions. However, the same effect did not apply to target-initial conditions.
4. For target-initial conditions, the largest intensity difference occurred in the condition in which all information was new and no words were repeated. We could say that prominence shift does not occur if final focus is unavailable.

Discussions and Conclusion

What Jacobs et al.'s work missed:
- Repetition reduction was solely related to auditory feedback.
- The understanding of how homophones interacted with the production was unclear.
- Only target-initial stimuli were constructed. (Example: "The pie shrinks. The pi flashes.")

Our project:
- Filled the gap and provided a new account for the reduction effect: the focus account.
- Should not perceive an asymmetry in the results between target-final and target-initial conditions if only repeated words spoken aloud led to repetition reduction in target word durations.
- Target-initial conditions: just a natural intensity reduction produced by the utter as their utterance approached to its end.
- Set the target words to be sentence-final and the most prominent reductions occurred with homophone target words. (Example: "on the left, the ball is bigger than the doe, and on the right, the house is bigger than the dough.")

Our research questions can now be addressed:

1. Both homophones and identical antecedents can result in a prominence shift.
2. Syntactic position indeed affects the production of a prominence shift. Target words in the same syntactic position showcase more salient prominence shift.

In conclusion:

Our study provided a focus account for prominence shift. It first addresses that both pure phonological form and semantic meaning would cause production reduction. Then, it indicates that syntactic position plays a role in how placing of a prosodic focus meets people's prediction: a final focus is the proper focus that people expect the occurrence of a given antecedent. In general, repetition does not have a ubiquitous effect in prominence shift. A prominence shift is most likely to occur when there is a final focus with the proper phonological or semantic cue.

Going Forward

The next steps will be:

1. Despite of all the acoustic measurements collected by the scripts, We also manually annotated the audio data for two rounds to determine if we perceive a prominence shift. However, there were too many confounds with human-annotated results. Among three acoustic measurements (pitch, intensity, and duration), intensity was selected to be analyzed as the final result because it indicated the most obvious prominence shift. It led us to question: what should be considered to be the universal and principle acoustic cue when we are trying to determine if a prominence shift happens? In the future, we hope to develop a model which could help dive deeply into this topic. Further statistical analysis should be conducted by using random forest or linear regression.

2. The annotating script still runs locally on the terminal. We hope to integrate the local script to the server, and to build a standardized data-collecting and data-annotation pipeline. We also hope to build a user-friendly online platform that enables people interested in linguistics to conduct their experiments and analyze data by themselves at ease.

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