*Lexical representations are malleable for about one second: Evidence for the non-automaticity of perceptual recalibration*

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The focus of the Samuel 2016 paper is to explore the dependency of perceptual recalibration on lexical processing. This paper seeks to address two questions: 1) must a listener be paying attention to a talker’s speech production to adjust their expectation of how that talker speaks, and 2) how long attention must be directed at the talker’s speech for this cognitive process to take place. To achieve this, Dr. Samuel developed a paradigm where participants were instructed to attend to one of two simulated talkers[[1]](#footnote-1) in a set of 5 experiments. In each experiment, the 1st talker is a female talker who produces speech with a phonetically shifted s/sh, and always begins speaking before the 2nd male talker. Participants were instructed to complete a task that was relevant to only one of the two talkers, effectively diverting the participants’ attention to one of the two verbal streams. Participants then completed a lexical decision task for the s/sh sound production of both talkers to examine if their expectations for the female talker’s speech changed to reflect the atypical pronunciations presented during the first task.

In this review, we will continue to focus on Experiment 1a and Experiment 1b of this study. Both experiments followed the same general structure described above, with a female talker beginning to speak during each trial and a male talker interrupting after 200ms (SOA = 200ms). During exposure, the female talker produces an atypical s/sh pronunciation, while the male does not exhibit atypical production. In Experiment 1a, participants were instructed to perform a lexical recognition task for the male talker’s speech. In Experiment 1b, a different set of participants were instructed to perform a syllable counting task for the female talker’s speech. Participants then completed a lexical decision task where they categorized s/sh production for both talkers. In Experiment 1a where the task was performed for the male talker, participants did not adapt their expectations to the atypical production of the female talker. However, in Experiment 1b where the task was performed for the female talker, participants did appear to adjust their categorization of s/sh sounds to reflect the atypical production of the female talker.

The results of Experiment 1 provide evidence that attentional resources are necessary for speech perception adaptation: When attention is directed towards the talker with the ambiguous shift, the listener adapts. When attention is directed away from this talker, there is no evidence of perceptual adaptation. Experiment 1 is important in establishing the reliability of subsequent experiments that probe the window of lexical malleability by asserting that redirecting attentional resources will interrupt speech perception adaptation.

This study builds off paradigms previously well established in the field to explore the question of the necessity of attentional resources in perceptual recalibration. Prior studies have explored dual-talker audio and the talker-specific property of s/sh perception. The exposure tasks presented in Experiment 1—2-AFC lexical recognition tasks in Experiment 1a and the 3-AFC syllable counting task in Experiment 1b—have also been used as labeling tasks for perceptual recalibration studies. The 2-AFC lexical decision task used to measure participant’s perceptual recalibration after the task in both experiments is a standard form of measurement in this field as well. Each experiment is sufficiently powered, and all participants were naive subjects to this series of experiments.

While earlier studies also investigated the necessity of attentional resources in other dual-task paradigms, this study offers a novel interpretation of earlier conclusions. Additionally, the results of Samuel 2016 contradict that of earlier studies on the subject and support this interpretation. Previous studies have found evidence of adaptation in dual-task paradigms, suggesting that perceptual recalibration to speech occurs automatically regardless of extrinsic cognitive load. Dr. Samuel argues in this paper that the reason other papers have suggested this may be due to the types of cognitive resources that the secondary task they implemented required; **the secondary tasks in prior studies did not tax the same cognitive resources as those needed for speech perception adaptation**, and therefore showed no evidence of the attention functioning as a mediator for perceptual recalibration. This novel proposal is well supported by the findings of Experiment 1, which was the first study to implement a secondary task that would directly compete for the cognitive resources involved in speech perception adaptation: a second talker. Following experiments in this study were therefore able to build on these results to constrain the cognitive process of perceptual adaptation.

While not the main focus of this review, the logic behind Experiments 2-5 were well-informed by the results of Experiment 1. The goal of these later studies was to substantiate the implications of Experiment 1: that the manipulation was functioning as theorized (Experiments 4 and Experiment 5) and the nature of the tasks (Experiment 3). However, I feel that the structure of the study became too broad in the last 3 experiments; the exploration began to diverge into many directions without fully developing the logic behind each individually or what their results might suggest outside of the context of this study.

Furthermore, I am left curious about the inconsistency of the task in Experiment 1b compared to that of Experiment 1a, and the other following experiments as well. No other experiment implemented a syllable-counting task, and all but Experiment 3 consistently utilized lexical recognition tasks during exposure. Even in Experiment 3, where the male voice was replaced with an environmental sound, the experiment followed a 2-AFC design and required the participant to consider the origin of the sound. The only task where the participants’ attention was directed towards the female (ambiguous) talker was in the syllable counting task. This presents the potential issue that Experiment 1a may not be directly comparable with Experiment 1b because, as later suggested by Experiment 5, lexical access (and potentially semantic information) is processed before the perceptual recalibration process. In contrast, the 3-AFC syllable counting task focused on syntactic information from the female talker’s speech and therefore may have occupied different cognitive resources and highlighted the importance of the production itself.

Another potential pitfall of this paper is the usage of a Stimulus Onset Asynchrony (SOA). The SOA between the female talker and the male talker likely aids the participants in separating the two competing verbal streams, but leaves room for variations in theories of cognitive mechanisms. For instance, participants were instructed to perform their task for the second, male talker in Experiment 1a and Experiments 2-5. The male talker, who lacks an ambiguous pronunciation for the listener to track, is always presented second and the participants’ attention is **redirected** to the second talker from the first talker. While this addresses Dr. Samuel’s secondary interest of how long the cognitive process of perceptual recalibration takes to be completed (as investigated in Experiments 2, 4, and 5), it assumes that directing attention to a verbal stream is equivalent to *shifting* attention to an alternative verbal stream based on prior instruction, which may not be the case.

The order of presentation between the two voices was not counterbalanced, nor could it be counterbalanced by the nature of Dr. Samuel’s design: unlike the lexical processing window, the perceptual recalibration window begins either at the presentation of the ambiguous sound or at the end of the entire word, as suggested by Experiment 5. If the latter (and potentially the former, depending on the SOA length), the participants may still be able to adapt their perception to the second talker due to a lack of obstruction at the end of the second word. There are also a handful of other related potential shortcomings of this study: the gender was never counterbalanced with relation to the talker order or with the ambiguous production of s/sh (atypical s/sh pronunciation was always produced by the female talker, who also always began speaking first).

Still, this study does adequately support a critical finding—that speech perception adaptation is not an automatic process—that rejected the accepted theory at the time in the field. This paper also began to investigate the qualities of this process (i.e., what types of secondary tasks tax the same cognitive resources as speech, see *Exp. 3*; Where does this window begin, see *Exp. 4*; and is this process different than initial lexical access, see *Exp. 5*), though it does so in a more exploratory fashion and does not delve deep into the associated features. Further research is necessary to gain a better understanding of what it means for speech perception adaptation to be a non-automatic cognitive process, but this paper is the first to suggest that perceptual adaptation is not automatic and to introduce these potential areas of study.

References

Samuel, A. G. (2016). Lexical representations are malleable for about one second: Evidence for the non-automaticity of perceptual recalibration. *Cognitive Psychology*, 88, 88–114.<https://doi.org/10.1016/j.cogpsych.2016.06.007>

1. *In experiment 3, the second talker was replaced with an environmental sound* [↑](#footnote-ref-1)