Testing the mental simulation view of inner speech

M2 research internship (2025-2026)

Laboratoire Parole et Langage (CNRS UMR 7309) (Aix-en-Provence)

Scientific context

The ability to mentally produce speech or "inner speech" is a cornerstone of human cognition. It is involved in a plethora of activities such as reading, planning, or remembering [for reviews, see 1, 2]. Despite the ubiquity of this inner voice, the cognitive and neural mechanisms leading to this subjective experience remain poorly known. One prominent perspective is that the sensory content of inner speech would correspond to the predicted sensory consequences of inhibited motor commands (issued by pairs of internal forward and inverse models, respectively) [e.g., 3, 4, 5, 6].

The study conducted by [7] provided one of the few pieces of experimental evidence suggesting that inner speech indeed involves a mental simulation of speech motor commands, as evidenced by sensory attenuation of the concomitant (and congruent) perception of external speech sounds during inner speech. Although being widely cited in the inner speech literature, one major limitation of this study is that it did not assess inner speech (contrary to what the title of the paper suggests), but rather what is commonly referred to as silent speech, which is the mouthed but silent production of speech (i.e., speech produced with visible articulatory movements, but without phonation). Inner speech, on the other hand, does not involve visible articulatory movements. In this project, we aim to replicate and extend the study of [7] with a larger sample of participants and, crucially, by adding a proper inner speech condition.

Objectives, methods, and expected outcomes

[7] developed an astute experimental paradigm to test whether the sensory attenuation effect characteristic of corollary discharge is observed during silent speech. This paradigm relied on a context perceptual effect, called the Mann effect [8], in which the perception of an ambiguous syllable on the /da/-/ga/ acoustic continuum can be influenced by the syllable that immediately precedes it (the context sound). The general finding is that when this ambiguous syllable is preceded by the context syllable /ar/, it is perceived more often as a /da/, whereas when it is preceded by a context syllable /al/, it is perceived more often as a /ga/. [7] asked participants to silently articulate a syllable that was concomitant and either congruent or incongruent with the context sound. The author reasoned that if corollary discharge is involved in silent speech and if silent speech is produced concomitantly (and in a congruent manner) with the context sound, this context sound should thus be attenuated, hence causing a reduction of the Mann effect (i.e., the context sound should have a weaker influence on the following categorisation task). In contrast, if the mouthed syllable is incongruent with the concomitant context sound, the Mann effect should be preserved (or at least, be less affected). [7] indeed observed that the Mann effect was reduced during silent speech, and to a greater extent when the silently produced syllable matched the context sound, thus corroborating the involvement of a corollary discharge during silent speech.

The results from [7] considerably impacted research on inner speech [e.g., 1, 9, 3, 10], working memory [e.g., 11, 12], or the general cognitive science's literature [e.g., 13, 14], taken as evidence for the involvement of the motor system during inner speech production. However, following work often missed that [7] used "enacted inner speech" (i.e., silent speech) rather than actual inner speech. The main objective of this preregistered direct replication is to test whether the reduction of the Mann effect observed by [7] is also present during *inner* speech (i.e., when no visible articulatory movement is produced). First, we will reproduce the silent speech condition of [7]. Then, we will use a similar task, but replacing silent speech by inner speech: we will instruct participants to produce a syllable mentally, without any articulatory movement. In further exploratory analyses, we will also assess to what extent low-level acoustic features of the participant's voice and its similarity to the acoustic features of the pre-recorded contextual sounds can predict the magnitude of these effects. If we replicate the effect found in [7] during both silent and inner speech, this will corroborate the involvement of corollary discharge in inner speech. In contrast, if no such effect is found in inner speech, this study will provide evidence against the involvement of corollary discharge in inner speech. Overall, results from this replication effort will provide crucial arguments for or against the conceptualisation of inner speech as the mental simulation of overt speech, and further refine our understanding of the characteristics of the corollary discharge. A preregistered version of our protocol (in-principle accepted as a Stage-1 registered report) is available as a preprint at https://osf.io/preprints/psyarxiv/abps9.

Profile and missions

We are seeking a motivated Master's student with a background in psychology, psycholinguistics, or cognitive neuroscience to join our research project. The internship will involve the following tasks: i) understanding the research question through a review of the literature on inner speech, ii) collecting the behavioural data, iii) extending existing code to perform group-level statistical analyses, and iv) interpreting the results and writing a final report (Master's thesis).

The ideal candidate is fluent in English (to interact with the English-speaking participants) and demonstrates good programming skills (R or Python). Applications should include a short motivation letter, a CV, M1 transcripts, and the names of two referees.

Lab and supervision

The internship will take in place in the Laboratoire Parole et Language (LPL, CNRS UMR 7309) located in Aix-en-Provence (on-site work is expected), under the supervision of:

Dr. Ladislas Nalborczyk (CNRS, LPL)
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References

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