Not Everyone Has an Inner Voice: Behavioral Consequences of Anendophasia

Johanne S. K. Nedergaard (nedergaard@cc.au.dk)
Department of Linguistics, Cognitive Science and Semiotics, Aarhus University
8000 Aarhus C, Denmark

Gary Lupyan (lupyan@wisc.edu)
Department of Psychology, University of Wisconsin-Madison
Madison, WI 53706 USA

Abstract

It is commonly assumed that inner speech – the experience of thought as occurring in a natural language – is both universal and ubiquitous. Recent evidence, however, suggests that similar to other phenomenal experiences like visual imagery, the experience of inner speech varies between people, ranging from constant to non-existent. We propose a name for a lack of the experience of inner speech – anendophasia – and report four studies examining some of its behavioral consequences. We found that people who report low levels of inner speech have lower performance on a verbal working memory task and have more difficulty performing rhyme judgments based on images. Task switching performance, previously linked to endogenous verbal cueing, was unaffected by differences in inner speech. Studies of anendophasia, together with aphantasia, synesthesia, and differences in autobiographical memory are providing glimpses into what may be a large space of hitherto unexplored differences in people's phenomenal experience.

Keywords: inner speech; phenomenology; individual differences; categorization; task switching; memory

Introduction

Everyone, it is often said, has an inner voice, and most of our waking hours are claimed to be filled with inner speech: 'Daily, human beings are engaged in a form of inner dialogue, which enables them to high-level cognition, including self-control, self-attention and self-regulation.': Chella & Pipitone, 2020, p. 287; 'We all hear a voice inside our brain, commonly called "inner voice", "inner speech" or referred to as "verbal thoughts"' (Perrone-Bertolotti et al., 2014, p. 22). Most people do report experiencing inner speech (Alderson-Day et al., 2018; Heavey & Hurlburt, 2008; Morin et al., 2018) and because we often assume that our experiences mirror those of others, the majority experience comes to be viewed as universal (Lupyan et al., 2023).

The assumption that everyone has an inner voice has served as a stepping stone for research into the functions of inner speech – if everyone has it, it must be important. Speculations have ranged from the idea that natural language constitutes (at least some types of) thought (Bermúdez, 2007; Carruthers, 2002; Clark, 1998; Frankish, 2018; Gauker, 2011; Morin, 2018) to investigations of connections between inner speech and specific processes such as cognitive control (Alderson-Day & Fernyhough, 2015; Cragg & Nation, 2010; Emerson & Miyake, 2003; Morin et al., 2018).

But not everyone experiences inner speech. This is attested by personal narratives such as 'What it's like living without an inner voice' (Soloducha, 2020); 'People With No Internal Monologue Explain What It's Like In Their Head' (Felton, 2020), as well as more systematic investigations both targeting variation in inner speech (Alderson-Day et al., 2018; Brinthaupt et al., 2009; Hurlburt et al., 2013) and auditory imagery, which has sometimes been used as a proxy for inner speech (Dawes et al., 2020; Hinwar & Lambert, 2021).

While these data challenge the assumption that inner speech is universal, a natural question is *do such differences in subjectively assessed phenomenology predict differences in objectively assessed behavior?* Both positive and negative findings are informative. A *positive* finding helps us understand the extent to which people's cognition may be differentially guided by language. For example, in group studies it has been found that interfering with people's ability to name images (using both noninvasive neural stimulation and verbal interference) disrupts categorization (Lupyan, 2009; Lupyan et al., 2012; Perry & Lupyan, 2014, 2017). This has been taken as evidence that typical categorization is augmented by language (Lupyan, 2012). Although this may be true for a typical group of participants, it is possible that language may not be recruited by all people in the same way. Finding that there is *no* relationship between reported inner speech and behavior can mean one of several things. First, it could indicate that the measure of inner speech is invalid. Perhaps people have different theories about how to respond to questions concerning their inner experiences and rather than capturing actual inner experiences, people's responses merely tell us how these people think one *ought* to respond to such questions (Schwitzgebel, 2011). Assuming the measures are valid, negative findings could mean that differences in inner speech have no bearing on the task in question. If language is augmenting people's performance, this is unrelated to consciously experienced inner speech. Lastly, it is possible that people without inner speech may not differ in gross measures like accuracy or speed, but rely on different processes or strategies. Learning this is of immense interest

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because it helps uncover otherwise hidden variation in task performance (see also Keogh et al., 2021).

The Present Study

We recruited participants differing in subjectively reported inner speech and tested them on four behavioral tasks on which performance may vary as a function of inner speech based on prior theoretical claims. The first is a **rhyme judgment task**: participants see pairs of images and need to indicate whether their names rhyme or not. We reasoned that although participants with low inner speech would have no trouble naming the objects, a lesser reliance on inner speech would make it harder to compare the names in memory – necessary for making a rhyme judgment (Geva et al., 2011; Langland-Hassan et al., 2015). Just as visual imagery has been predicted (and sometimes found) to be linked to visual memory, we tested whether inner speech predicted **memory for verbal material**. We focused on memory for sets of words that were either phonologically similar and orthographically different or orthographically similar and phonologically different. Less inner speech was predicted to be associated with poorer overall memory for verbal material, but to the extent that phonological similarity creates memory confusion (Baddeley, 1966; Murray, 1968), less inner speech may be associated with a reduced phonological similarity effect. There is robust evidence that inner speech is often recruited for behavioral control when participants have to **switch between different tasks** (Baddeley et al., 2001; Emerson & Miyake, 2003; Miyake et al., 2004). For example, when asked to switch between adding and subtracting numbers, participants show a selective impairment if they undergo articulatory suppression, but no such impairment is found if the cues are exogenously provided (e.g., a symbol or color cue is used to inform participants whether they should add or subtract) (see Nedergaard et al., 2022, for a systematic review of verbal interference effects). We reasoned that people who do not habitually use inner speech might be selectively impaired when they have to rely on self-generated cues. On the other hand, it is possible that they have learned to rely on other strategies in which case no difference would be found. Our fourth and last task involves examining **category effects in perception**. There is considerable evidence that language induces more categorical representations from basic perception onward (e.g., Forder & Lupyan, 2019; Perry & Lupyan, 2014; Winawer et al., 2007). In a study examining the effects of conceptual categories, Lupyan et al. (2010) showed that controlling for visual differences, people's ability to tell whether two stimuli were physically the same was affected by the categorical status of those stimuli. For example, it took longer to distinguish two cats than an equally visually similar cat and dog. We wondered whether such category effects, insofar as they may be in part induced by feedback from verbal labels, may be reduced in people with less inner speech.

Methods

Participants

We recruited participants online who had previously completed the Internal Representations Questionnaire (Roebuck & Lupyan, 2020) as part of unrelated studies, contacting participants with verbal factor scores < 3.5 (bottom 16%-ile) or > 4.25 (top 40%-ile) on the Verbal factor of the questionnaire which is largely centered on propensity to experience and rely on inner speech. For example, one item with a high loading on the Verbal factor was 'I think about problems in my mind in the form of a conversation with myself'. One item with a high loading on the Visual factor was 'I often enjoy the use of mental pictures to reminisce'. The percentile cut-offs were asymmetric because it was more difficult to recruit participants reporting low levels of inner speech, and because the distribution in verbal scores on the IRQ is negatively skewed. Recruiting for example the top and bottom quartiles would have resulted in a "low inner speech" group who had moderate amounts of self-stated inner speech. We received ethical approval from the University of Wisconsin-Madison. Ten participants were excluded for responding randomly, missing at least one experiment, or clearly not complying with task instructions. Our final sample included 47 participants with relatively high verbal factor scores on the IRQ and 46 participants with low verbal factor scores. The two groups were balanced in terms of age, gender, education level, dyslexia, and first language.

Method: Rhyme Judgments

Materials and Procedure We constructed a set of rhyme pairs with 20 orthographic pairs (e.g., "sock" and "clock") and 20 non-orthographic pairs (e.g., "drawer" and "door"). The images were selected from the MultiPic database (Duñabeitia et al., 2018) and from Rossion and Pourtois (2004). On each trial, participants saw two images of items presented simultaneously and were asked to judge whether the names of the items rhymed or not. Participants completed 60 rhyme judgments in randomized order (20 orthographic rhymes, 20 non-orthographic rhymes, and 20 no-rhyme control trials). There was a 5000 ms response deadline.

Method: Verbal Working Memory

Materials and Procedure We used word sets from Baddeley (1966). One set contained words that were phonologically, but not orthographically similar ("bought", "sort", "taut", "caught", and "wart"). Another contained words that were orthographically, but not phonologically similar ("rough", "cough", "through", "dough", "bough"). The third contained words that were both phonologically and orthographically dissimilar ("plea", "friend", "sleigh", "row", "board"). On a given trial, participants saw five words in random order from one of the sets presented sequentially in writing and were then asked to reproduce them. Participants performed 24 trials in total with eight trials from each of the three word sets. The order of both set type and words within a trial were

randomized. There was no limit to how long participants could spend on reproducing the words on a given trial.

Method: Task Switching

Materials and Procedure On each block, participants were shown 30 randomly selected integers between 13 and 96 and asked to add or subtract 3 from each. All participants completed five blocks beginning with blocked addition or blocked subtraction, followed by (in a counterbalanced order) a block where problems alternated between addition and subtraction with the operation marked by color (red/blue), marked with a symbol (+/-), or not marked. The unmarked block required participants to remember which operation they had just done.

Method: Same/different Judgments

Materials and Procedure This experiment used three black silhouettes of cats and three black silhouettes of dogs. Participants completed two blocked conditions in the experiment: making physical identity judgments (same means physically identical) and making category judgments (same means same category). We are only interested in the physical identity judgments here. Participants completed 200 total trials and received feedback after incorrect responses ('incorrect' in red font).

Data Analysis

All analyses were conducted in R (v. 4.1.3). Participants and items (where appropriate) were modeled as random intercepts; random slopes were included for within-subject factors unless it prevented convergence. All predictors were centered. Reaction times were log-transformed to yield a more normal distribution. Accuracies were modeled using logistic regression. For ease of interpretation, the figures show the two inner speech groups as distinct but all the statistical models use verbal score (average score on the verbal representation items on the Internal Representations Questionnaire) as a continuous predictor. Error bars on all figures represent 95% confidence intervals around the mean (adjusted for repeated measures).

Results

Rhyme Judgments and Inner Speech

Participants took longer to make rhyme judgments on no-rhyme trials (M = 1981 ms) compared with orthographic trials (M = 1730 ms) (β = 0.12; SE = 0.04; t = 2.98; p = .005). Non-orthographic trials (M = 1821 ms) did not differ significantly from orthographic trials (β = 0.04; SE = 0.04; t = 1.11; p = .272). Trials where the presented images had higher name agreement were also faster (β = -0.04; SE = 0.02; t = -2.25; p = .029). Reported inner speech had no effect on speed of rhyme judgments (β = -0.01; SE = 0.02; t = -0.63; p = .534), and there were no interactions between rhyme type and verbal score (both p > .298). Verbal score and name agreement also did not interact (p > .975).

Participants were more accurate on no-rhyme judgments (M = 95.7%) than on orthographic rhyme judgments (M = 87.5%) (β = 1.30; SE = 0.29; z = 4.49; p < .001) and less accurate on non-orthographic rhyme judgments (M = 79.5%) than on orthographic rhyme judgments (β = -0.58; SE = 0.26; z = -2.18; p = .029). A higher verbal score was associated with a higher likelihood of responding accurately (β = 0.31; SE = 0.12; z = 2.58; p = .010). Trials with images with higher name agreement were not significantly easier (p < .139). There was no significant interaction between rhyme type and verbal score (both p > .311) or between verbal score and name agreement (p = .324). See Figure 1.

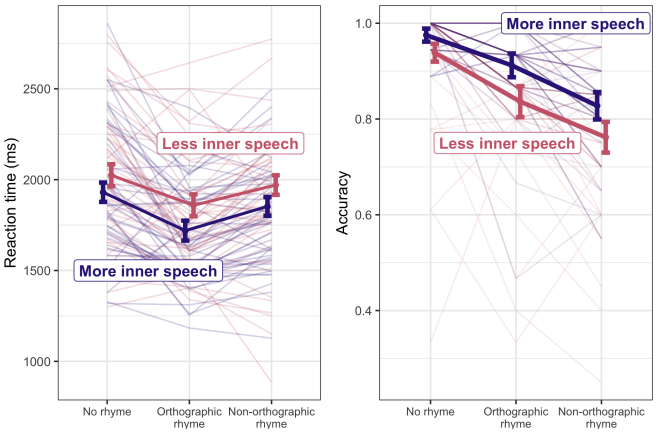

Figure 1: Reaction time (left) and accuracy (right) across groups by rhyme type.

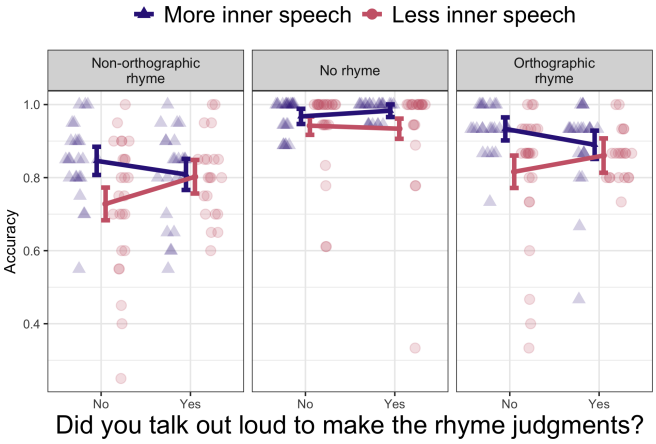

Figure 2: Accuracy by whether participants indicated that they had talked out loud to make the rhyme judgments.

Strategies for Rhyme Judgments

There was no significant difference between how many participants with more inner speech (23 out of 47) and how many participants with less inner speech (21 out of 46) reported that they had said the words out loud ($\chi^2(1) = 0.01$, p = .913). Nevertheless, the effect of doing so was interestingly different for the two groups as can be seen in Figure 2. Saying the words out loud diminished the accuracy

advantage associated with a higher verbal score for non-orthographic rhymes (β = -0.72; SE = 0.28; z = -2.53; p = .012) and orthographic rhymes (β = -0.69; SE = 0.31; z = -2.25; p = .024) compared with no-rhyme trials. This suggests that this was the strategy that participants with more inner speech used covertly.

Verbal Working Memory and Inner Speech

Participants remembered phonologically similar words significantly worse (M = 3.22) than orthographically-similar words (M = 3.62) (β = -0.72; SE = 0.08; t = -8.84; p < .001) which were in turn remembered worse than the dissimilar words (M = 3.94) (β = -0.33; SE = 0.08; t = -3.98; p < .001). Collapsing across the three types of word lists, greater inner speech was associated with better performance (β = 0.27; SE = 0.10; t = 2.60; p = .011). This effect remained significant if we disregarded the order in which participants responded, counting only whether they recalled the correct words (β = 0.19; SE = 0.08; t = 2.57; p = .012). There were no interactions between inner speech and type of word list (phonological similarity set versus dissimilar set: β = -0.04; SE = 0.08; t = -0.45; p = .19; orthographic similarity set versus dissimilar set: β = -0.11; SE = 0.08; t = -1.32; p = .190), although numerically, the difference was smallest for orthographically-similar words (see Figure 3).

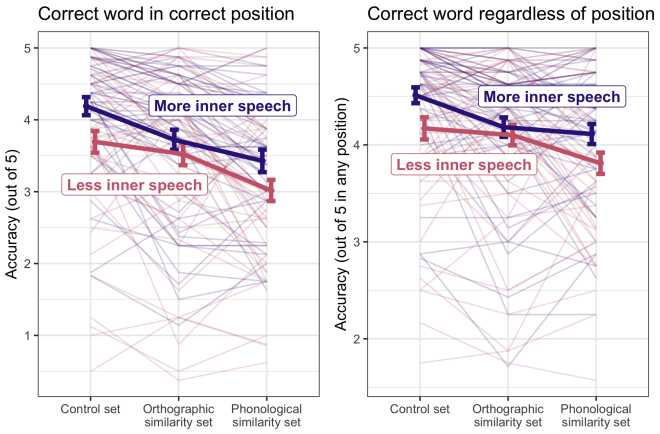

Figure 3: Score on the verbal working memory task by word set.

Strategies for Verbal Working Memory

There was no difference in reported talk-out-loud strategy between the group with more inner speech (10 out of 47) and the group with less inner speech (13 out of 46) ($\chi^2(1) = 0.29$, p = .589). Nevertheless, the effect of doing so was interestingly different for the two groups as can be seen in Figure 4. The difference between the two groups' memory performance disappeared when they reported that they said the words out loud to help them remember. Participants reporting more inner speech remembered the words better, but this effect was canceled out when participants reported talking out loud to solve the task (interaction effect: β = -0.50; SE = 0.23; t = -2.19; p = .031).

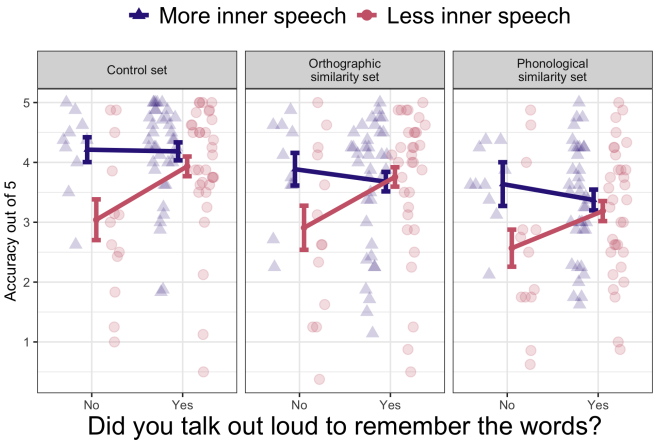

Figure 4: Verbal working memory performance by whether participants reported talking out loud to help them remember or not.

Inner speech and task switching

Participants responded less accurately[1] in the symbol-cued switch condition (M = 97.2%), in the color-cued switch condition (M = 95.4%), and in the uncued switch condition (M = 93.9%) compared with the blocked addition condition (M = 98.1%) (addition versus symbol-cue: β = -0.42; SE = 0.18; z = -2.32; p = .020; addition versus color-cue: β = -0.97; SE = 0.17; z = -5.84; p < .001; addition versus uncued: β = -1.27; SE = 0.16; z = -7.92; p < .001). Accuracy did not differ between blocked subtraction (M = 97.7%) and blocked addition (p = .239). Greater inner speech was not associated with different accuracy (p = .547) and there were no interaction effects between inner speech and block-type (all p > .075).

Participants responded faster in the blocked addition condition (M = 2300 ms) compared with the subtraction condition (M = 2550 ms) (β = 0.09; SE = 0.01; t = -8.41; p < .001), the symbol-cued switch condition (M = 2601 ms) (β = 0.12; SE = 0.01; t = 9.69; p < .001), the color-cued switch condition (M = 2778 ms) (β = 0.19; SE = 0.02; t = 12.23; p < .001), and the uncued switch condition (M = 2694 ms) (β = 0.15; SE = 0.02; t = 9.39; p < .001). More reported inner speech did not predict reaction times (p = .810), and there were no interaction effects (all p > .516). See Figure 5.

[1] We recalculated the accuracy measure so that any trial in the three switch conditions where participants in fact switched between adding and subtracting counted as correct (as long as the arithmetic was also correct). We did this to prevent a failure to switch once resulting in the remaining trials counting as incorrect.

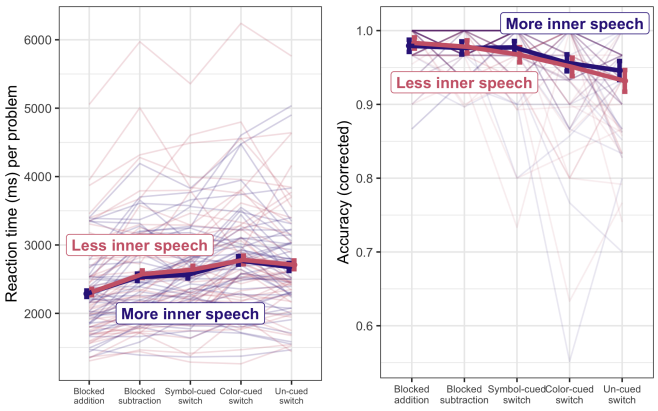

Figure 5: Reaction time and accuracy across conditions in the task switching experiment.

Inner Speech and Categorical Effects on Visual Discrimination

To the extent that inner speech is associated with more robust and/or rapid spontaneous categorization, we should find that it should be associated with a greater category effect, i.e., a relatively faster *different* response on between-category trials (cat-dog) and/or a relatively slower *different* response on within-category trials (cat_1 vs. cat_2). Across all correct trials, more inner speech was associated with numerically faster responses, but this difference was not statistically significant ($p = .09$). On the critical *different*-response trials, within-category trials were associated with significantly slower reaction times ($M = 923$ ms) than between-category trials ($M = 843$ ms) ($\beta = -0.08$; $SE = 0.01$; $t = -7.71$; $p < .001$), replicating the earlier result of Lupyan, Thompson-Schill, and Swingley (2010). However, inner speech was not associated with a differently sized category effect (interaction effect: $p = .954$), see Figure 6.

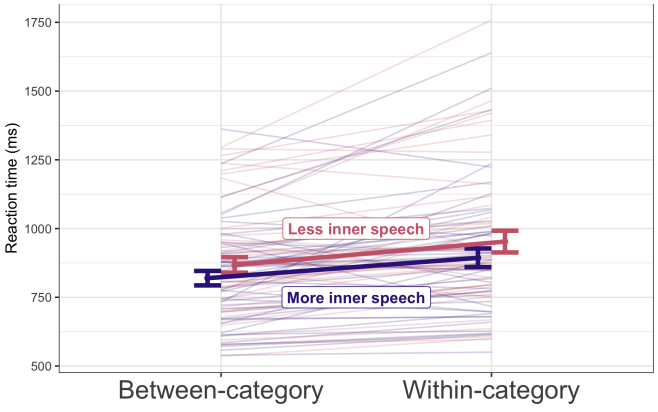

Figure 6: Reaction time on *different* trials either because the two silhouettes were from different categories or different images from the same category.

General Discussion

Participants who report experiencing less inner speech (our sample targeted those at < 16%ile of the verbal score on the IRQ) differed in performance on several behavioral tasks. They had a harder time judging whether the names of two images rhymed. The lack of an inner speech by nameability interaction makes it more likely that the effect stemmed from comparing phonological representations in memory rather than naming the images themselves. The same participants also had poorer verbal working memory regardless of the material. There was no indication of a weaker (or stronger) phonological similarity effect as a function of inner speech. Interestingly, in both the rhyming experiment and the verbal working memory experiment, performance differences between the two groups disappeared when participants reported talking out loud to solve the problems, suggesting a kind of compensatory mechanism. Inner speech differences did not predict performance in task switching. Everyone was equally worse on uncued-switch trials. Participants reported using a variety of self-cueing strategies. It is conceivable that despite this null finding, articulatory suppression would have a larger effect on the participants with more inner speech. Lastly, categorical effects on perceptual discrimination were similar for the two groups suggesting either the categorical effects in such tasks are not language-based, or that the speeded nature of such tasks makes the use of inner speech unlikely.

Anendophasia: A Lack of Inner Speech

When investigating unusual human experiences, it helps to have a label. For example, the coining of "aphantasia" to the lack of visual imagery (Zeman et al., 2010) is both helpful for research – providing a useful keyword – and for self-identification; its introduction led to the creation of an online community with over 50,000 members (r/aphantasia).

We would therefore like to propose a name for the phenomenon of a lack of inner speech: **anendophasia**: *an* (lack) + endo (inner) + phasia (speech). This term was developed in consultation with individuals who identify as lacking inner speech and has the benefit of including the familiar Greek root *phasia* (aphasia, paraphasia, etc.). Furthermore, "endophasia" has precedent in being used to refer to inner speech (Bergounioux, 2001; Loevenbruck et al., 2018). The term also avoids subsuming inner speech under "aphantasia" (Monzel et al., 2022) because inner speech is both auditory and articulatory in nature (whether it is better termed "inner hearing" or "inner speaking" is subject to debate) and because the linguistic properties of inner speech are not reducible to phonological properties. For these reasons, we also do not believe the previously proposed term "anauralia" is appropriate (Hinwar & Lambert, 2021).

Relations to Visual Imagery, Auditory Imagery and "Unsymbolized" Thought

Contrary to the popular belief that one is either a "verbal" or "visual" thinker (see Pashler et al., 2008 for critical review), verbal imagery and visual imagery are in fact positively correlated (Roebuck & Lupyan, 2020). Although not the focus of the current work, our results are consistent with earlier reports of three "orientations" that all have moderate

positive correlations: verbal, object/static imagery, and spatial/dynamic imagery (Blazhenkova & Kozhevnikov, 2009; Roebuck & Lupyan, 2020) suggesting a common imagery factor. Can anendophasia therefore be thought of as a lack of auditory imagery? We think not. First, many who lack inner speech report experiencing being able to hear music in their mind's ear (although they also report significantly fewer instances of "earworms"). Second, inner speech involves both auditory and articulatory-motor imagery. Second, although inner speech is often experienced as having phonological features – one of the reasons people often perceive it as speech (Langland-Hassan, 2018) – it also involves an articulatory-motor dimension (Geva, 2018; Perrone-Bertolotti et al., 2014). Paradoxically, some people also claim to experience "wordless" inner speech akin to a series of tip of the tongue states (Hurlburt et al., 2013).

When asked to reflect on what form their thoughts take, people who score low on both inner speech and visual imagery claim that they "think in concepts". What it means to "think in concepts" without relying on language is not clear. Beyond informal self-reports, the existence of such non-verbal and non-perceptual phenomenal experiences is supported by Descriptive Experience Sampling (DES) (Heavey & Hurlburt, 2008; Hurlburt & Akhter, 2006). When participants are probed at random times and asked to report on their mental states, ~22% of the time their reports are consistent with what Hurlburt has called "unsymbolized thinking". In such episodes, people feel that they think 'a particular, definite thought without awareness of that thought being conveyed as words, images, or any other symbols' (Heavey & Hurlburt, 2008, p. 802). Unsymbolized thinking is a slippery construct that tends to be defined in terms of what it is not. For example, Hurlburt and Akhter (2008) say that it is experienced as being 'a thinking, not a feeling, not an intention, not an intimation, not a kinesthetic event, not a bodily event' (p. 1366). A telling example is a participant wondering if her friend will arrive in a car or pickup truck, but not experiencing any words or images. The question is a single undifferentiated whole.

It is possible that unsymbolized thinking is subserved by the same verbal and perceptual processes, but with weak or absent conscious imagery (Vicente & Martínez-Manrique, 2016). Alternatively, it may correspond to a genuinely different form of experience in which people entertain more abstract conceptual representations which are less accessible to people with higher levels of inner speech and imagery.

What Have We Learned About Anendophasia?

People's self-reports cannot always be taken at face value (Heavey & Hurlburt, 2008; Hurlburt, 2011; Hurlburt et al., 2013). But when people report that their experience rarely takes a verbal format, they are not just confabulating. This is evident both in the consistency of their subjective responses (Roebuck & Lupyan, 2020), and, as we report here, there are some clear behavioral correlates.

We did find evidence that using other strategies than internal verbalization could reduce the performance differences between our two groups. This was clearest when we examined whether participants reported talking out loud to solve the problems or not. In both the verbal working memory experiment and in the rhyme judgment experiment, performance differences disappeared when participants reported talking out loud. This suggests that participants without anendophasia were already using verbalization strategies internally. One particularly interesting example comes from orthographically similar words in the verbal working memory experiment ("rough", "cough", "through", "dough", "bough"). Many participants with anendophasia reported a strategy of remembering just the first letters of the words once they were familiar with the set, thus reducing the load on verbal working memory. This is likely to be the reason why there was reduced difference in performance between the two groups for this word set. Another interesting case is the finding that the two groups did not differ in either reaction time or performance on the task switching experiment. This suggests that while the inner voice can be used as a behavioral self-cue, other and equally effective strategies may be available.

Limitations

One limitation of our work is its reliance on wholly subjective questions for measuring inner speech. Considering that our focus is on differences in phenomenology, this is appropriate. At the same time, there is reason to be skeptical of people's assessments of their inner experiences. People can be wrong about what they think they experience (Hurlburt & Schwitzgebel, 2011). It would be therefore helpful to supplement subjective assessments with objective ones of the sort becoming possible for differences in visual imagery (Kay et al., 2022). Another limitation is the remaining possibility that differences we ascribe to inner speech come from something else such as differences in conscientiousness. We believe this is unlikely since we saw examples of specific conditions where there were no differences between the two groups (e.g., no-rhyme pairs, orthographically similar words, and all conditions in the task switching experiment). Lastly, while the term "anendophasia" connotes *lack* of inner speech, many of the participants in our "low inner speech" group reported having *some* inner speech. Screening a larger group to identify people who do not endorse having *any* inner speech would help us see if the cognitive consequences of having less inner speech are continuous with having none.

Conclusion

Not everyone experiences inner speech. We proposed a name for a lack of inner speech: anendophasia. People who experience less inner speech were worse at making rhyme judgments in response to images and remembering a list of words. Task switching performance was not, however, either slower or less accurate. Taken together, our experiments suggest that there are real behavioral consequences of experiencing less or more inner speech, and that these differences may often be masked because people with anendophasia use alternative strategies.

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