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Short Communication

Suggestion overrides automatic audiovisual integration

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ABSTRACT

Cognitive scientists routinely distinguish between controlled and automatic mental processes. Through learning, practice, and exposure, controlled processes can become automatic; however, whether automatic processes can become deautomatized – recuperated under the purview of control – remains unclear. Here we show that a suggestion derails a deeply ingrained process involving involuntary audiovisual integration. We compared the performance of highly versus less hypnotically suggestible individuals (HSIs versus LSIs) in a classic McGurk paradigm – a perceptual illusion task demonstrating the influence of visual facial movements on auditory speech percepts. Following a posthypnotic suggestion to prioritize auditory input, HSIs but not LSIs manifested fewer illusory auditory perceptions and correctly identified more auditory percepts. Our findings demonstrate that a suggestion deautomatized a ballistic audiovisual process in HSIs. In addition to guiding our knowledge regarding theories and mechanisms of automaticity, the present findings pave the road to a more scientific understanding of top-down effects and multisensory integration.

1. Introduction

Mental processes fall along a spectrum from controlled (i.e., voluntary) to automatic (i.e., involuntary; Moors & De Houwer, 2006). Whereas controlled processes are slow, effortful, and demand attention – e.g., acquiring literacy for an analphabet – automatic processes are fast, effortless, and hardly require attention – e.g., understanding a simple sentence uttered in one's native tongue (Shiffrin & Schneider, 1977). Certain cognitive functions, such as reading, become automatic through practice (MacLeod & Dunbar, 1988). While multiple studies have addressed how controlled processes become automatic, few studies have investigated how people may regain control over automatic processes (Lifshitz, Aubert Bonn, Fischer, Kashem, & Raz, 2013). Here we show that persons who are compliant with hypnotic suggestions – HSIs – can deautomatize specific automatic processes involving audiovisual integration.

Most scientists consider word reading an automatic process for proficient readers. Relying on the gold standard of visual attention – the Stroop effect – many studies demonstrate that skilled readers seem unable to withhold accessing word meaning despite explicit instructions to attend to ink color only (MacLeod, 1992). HSIs, however, seem capable of reducing this automatic effect. For example, they can attenuate the Stroop effect following a suggestion to construe the experimental English words as meaningless symbols of a foreign language (Campbell, Blinderman, Lifshitz, & Raz, 2012; Casiglia et al., 2010; Parris, Dienes, & Hodgson, 2012; Raz & Campbell, 2011; Raz, Fan, & Posner, 2005; Raz, Kirsch, Pollard, & Nitkin-Kaner, 2006; Raz, Shapiro, Fan, & Posner, 2002). For some proficient readers, therefore, word reading may be more malleable than

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previously acknowledged (Besner, 2001; Dishon-Berkovits & Algom, 2000; Magalhães De Saldanha da Gama, Slama, Caspar, Gevers, & Cleeremans, 2013). But how generalizable is this novel ability of HSIs?

We used the classic McGurk effect – an auditory illusion crafted by presenting visual and auditory streams that are incongruent, demonstrating the influence of visual facial movements on auditory speech percepts (McGurk & Macdonald, 1976). So robust is the McGurk effect that people are unable to avoid the illusion even if they are aware of the audiovisual discrepancy (McGurk & Macdonald, 1976) and regardless of practice (Summerfield & McGrath, 1984). Behavioral and neuroimaging assays associate the McGurk effect with low-level, pre-attentive perceptual processing (Colin et al., 2002; Kislyuk, Möttönen, & Sams, 2008; Soto-Faraco, Navarra, & Alsius, 2004). Consequently, researchers consider the McGurk effect inexorable and largely immune to top-down influences. The McGurk effect, furthermore, is arguably more automatic than the Stroop effect because – evident in non-human primates (Ghazanfar & Logothetis, 2004) and beginning within the first few months of human life (Kushnerenko, Teinonen, Volein, & Csibra, 2008) – exposure to speech perception and audiovisual integration is likely more ingrained than processing visual word-forms (Lifshitz et al., 2013). We examined whether administering a posthypnotic suggestion (PHS) – a condition wherein a participant complies with a suggestion made during hypnosis after termination of the hypnotic experience – would reduce the interpretation of illusory speech and improve correct audio identifications in the McGurk context.

2. Materials and methods

Participants were right-handed, proficient English speakers who provided written informed consent and participated in exchange for financial compensation or course credit. We screened participants for suggestibility using both the Harvard Group Scale of Hypnotic Susceptibility, Form A (HGSHS-A; Shor & Orne, 1962) and the Hypnotic Susceptibility Scale, Form C (SHSS-C; Weitzenhoffer & Hilgard, 1962). HSIs comprised ten participants (five male; mean age = 33 years) – scoring 10–11 out of a possible 11 on the SHSS-C and top 5% of HGSHS-A; LSIs comprised ten participants (five male; mean age = 31 years) – scoring 0–1 of a possible 11 on the SHSS-C and bottom 5% of HGSHS-A. All participants were McGurk-naïve. The size of our sample is comparable to other published studies of HSIs, who comprise a small percentage of the population (Barnier & McConkey, 2004); we have shown that these studies generalize across larger samples (Lifshitz et al., 2013; Raz, Moreno-Iniguez, Martin, & Zhu, 2007).

Each McGurk session included a random order of 30 incongruent and 40 congruent trials. We ran participants on a standard McGurk paradigm under two conditions and in a counterbalanced fashion. We instructed participants to indicate the speech sound they heard in each trial as accurately as possible by circling their response on a multiple-choice list comprising four possible syllables. In one condition we provided participants with a PHS to view the auditory and visual components of the audiovisual stimuli as disparate information streams, exhorting them to prioritize the auditory input whilst crisply viewing the video; in the other condition we provided no suggestion. In addition, we provided a brief training and tested each participant on mute video (i.e., visual input only) and videoless audio (i.e., auditory input only) to ensure that they understood the instructions and demonstrated normal hearing and vision.

In the suggestion condition, the senior author (AR) administered a variation of the standard classical hypnotic induction (Weitzenhoffer & Hilgard, 1962). After about a 10-min induction, AR would administer the posthypnotic suggestion (see below) and leave the room to allow an experimenter (CD) to administer the McGurk task. At the end of the suggestion condition, AR came back into the room, canceled the suggestion, and verified that the participant was feeling well. Most participants had a vague memory of the task. The experimental suggestion was as follows:

> Use your mind, like you know very well how to do, to sharpen and enhance your hearing. That's right, your hearing ability will rival that of a hunting animal such as a wolf, or even better, an owl. Everything that you hear will be amplified, crisply audible, loud and clear. Your ears will feel more sensitive and more powerful, in the sense that you can easily hear every little sound and readily detect and discern even the most faint auditory nuance. In this regard, you will feel that your hearing is most dominant. It will be the most dominant sense, and you will quickly and accurately report what you're hearing regardless of any other sensory information or potential distractions. While your vision remains intact and unchanged, you will continue to see crisply and with normal focus. Your sense of hearing will be so acute however, that it will far surpass your other senses. Everything you experience will be auditory first, through a primary channel. What comes after is less important. You will be able to hear things for what they are, even if they are masked or camouflaged by other information. Let your ears guide you as you pay attention to the sounds that you are about to hear. Nothing is more important than what you are able to hear. If you are ever unsure of what's going on, your ears will guide you to the right answer. Everything else is secondary; primary is your power of super hearing.

Digital audiovisual stimuli comprised consonant–vowel syllables featuring the face of a female English narrator. Stimuli consisted of four conditions: muted video; audio + still image of the narrator; congruent audiovisual (CAV); and incongruent audiovisual (IAV). Mean stimulus duration was 2270 ms and mean syllable duration was 770 ms. Videos streamed at 30 frames per second (s) with sound sampled at 44.1 hertz (Hz) and filtered to reduce ambient noise. A black-screen display separated all stimuli; to alert participants to an oncoming trial, a red screen preceded each stimulus for 0.5 s. The experiment consisted of four sessions: a brief training; muted video, audiovisual, and audio + still image of the narrator. Training comprised seven trials to ascertain both comprehension and performance; muted video consisted of five repetitions of each video token, and audio + still image comprised three repetitions of each audio token. The main audiovisual task consisted of ten repetitions of each three IAV and four CAV stimuli. Stimuli were randomly presented throughout.

Sitting at a chinrest–headrest setup, participants viewed stimuli from a distance of 52 cm. The video of the narrator accompanied audio coming through two *Altec Lansing VS4221* loudspeakers at approximately 85 dB from the location of the screen. To ensure compliance, an experimenter monitored ocular stance and direction of gaze throughout.

3. Results

We investigated whether suggestion could reduce the McGurk illusion in 20 healthy volunteers utilizing an experimental design similar to that used in previous Stroop studies with PHS (Casiglia et al., 2010; Parris et al., 2012; Raz & Campbell, 2011; Raz et al., 2002, 2005, 2006). We calculated the proportion of both illusory and accurate auditory perceptions for each group – HSIs and LSIs – both with and without PHS (Fig. 1; for individual data see online Supplementary material). We analyzed these dependent variables as a function of *Suggestion* (Absent or Present), *Group* (HSIs or LSIs), *Experimental Order* (Suggestion-First or Suggestion-Second) and *Congruency* (CAV or IAV). Experimental order – whether participants experienced suggestion first or second – was not significant. Differences of least square means analysis revealed no significant effects among HSIs or LSIs for CAV stimuli; therefore, we focused the Suggestion∗Group analysis on the IAV trials. Mixed analysis of variance revealed a significant interaction between Suggestion and Group for the proportion of both total auditory illusions ($F(1,18) = 16.846$, $p < .001$; $\eta^2 = 0.483$) and correct auditory perceptions ($F(1,18) = 17.427$, $p < .001$; $\eta^2 = 0.492$). Following a PHS to construe the audio and video components of the audiovisual stimuli as separate information streams, HSIs, but not LSIs, fell for noticeably fewer illusory auditory perceptions ($t(9) = 5.093$, $p < .001$; $\eta^2 = 0.742$) and correctly identified more auditory percepts ($t(9) = -5.598$, $p < .001$; $\eta^2 = 0.777$).

4. Discussion

Our findings show that a specific PHS reduced the automaticity of the McGurk effect in a sample of HSIs. At least for these select individuals, therefore, even deeply ingrained mental operations – typically deemed involuntary – may be more governable than previously presumed. Neuroimaging accounts demonstrate that suggestion can impact visual perception at an early processing stage (McGeown et al., 2012; Raz et al., 2005). Moreover, variations in conscious awareness as well as in pre-stimulus brain states appear to influence the synthesis of auditory and visual information (Keil, Müller, Ihssen, & Weisz,

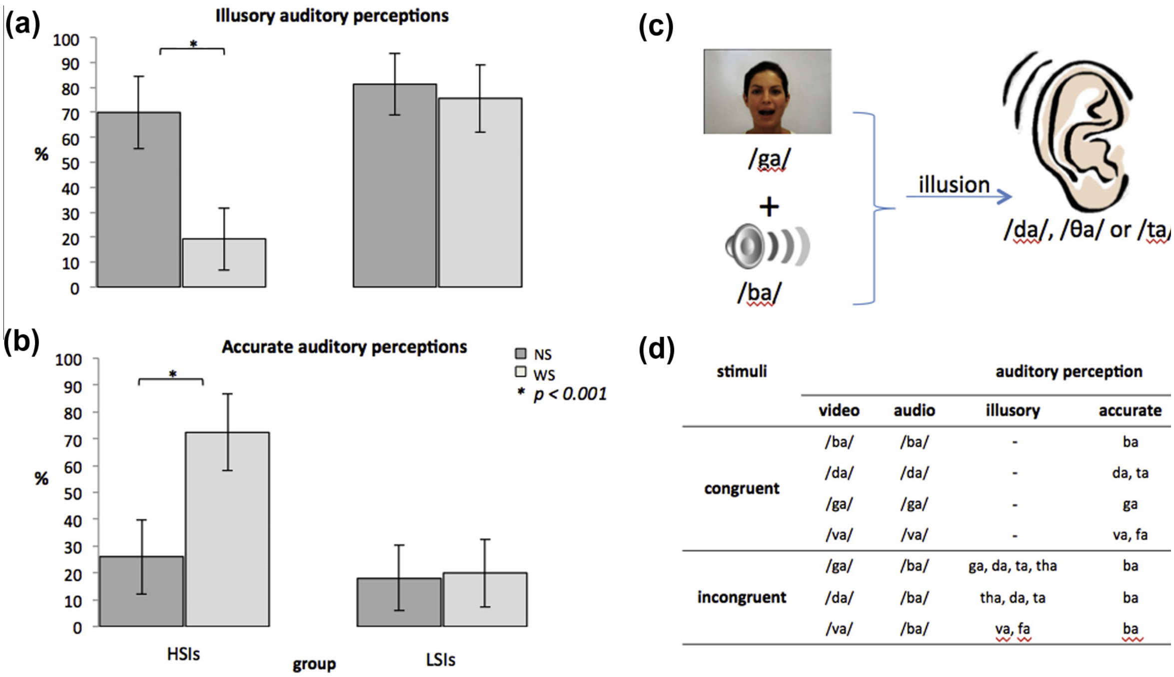

Fig. 1. McGurk task performance. (a and b) Percent illusory and accurate auditory perceptions on incongruent trials for highly hypnotically suggestible individuals (HSIs) and less hypnotically suggestible individuals (LSIs) with no suggestion (NS) and with suggestion (WS), including standard error. (c) Example from the McGurk paradigm used: video /ga/ dubbed with audio /ba/, producing illusory sound /da/, /θa/, or /ta/. (d) Video and audio stimuli presented to participants.

2012; Palmer & Ramsay, 2012). Thus, the suggestion to override the McGurk illusions may function through a top-down regulation of low-level sensory integration (Beauchamp, Nath, & Pasalar, 2010). In this regard, overriding automatic processes involving visual attention (Iani, Ricci, Baroni, & Rubichi, 2009; Iani, Ricci, Gherri, & Rubichi, 2006) seems to extend to automatic tasks involving multisensory integration (Terhune, Cardeña, & Lindgren, 2010).

Here we show that even strongly entrenched cross-modal perception – seldom amenable to behavioral interventions – can speedily return, without training, to the purview of cognitive control following a specific suggestion. Beyond demonstrating that control processes mold involuntary, pre-attentive cognition, this line of research bears important clinical implications. For example, such self-regulatory influence could contribute toward treating impulse-control disorders as well as disrupting maladaptive patterns of thought, emotion, and action. These top-down effects, originating from expectations, symbolic thoughts and other higher cortical functions, descend to interface with sensory bottom-up processes and likely represent a meaningful trajectory of mind–body regulation. We encourage independent replication of these results and hope to report neuroimaging data unraveling some of the underlying mechanisms before long.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.concog.2013.12.010.

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