Exploring the Automaticity Speech Perception and Adaptation

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Background

Spoken language is highly variable by nature. Talkers differ in how they produce speech sounds, even when they share similar language backgrounds. Still, listeners understand newly encountered talkers when hearing them speak for the first time. To overcome speech variation, the brain actively learns how talkers speak, and constructs expectations about how that talker will produce speech in the future. Though this process often occurs without the listener noticing, how automatic speech perception adaptation is remains unclear. In this experiment, we will limit the available attentional resources for speech perception by exposing a listener to two talkers speaking simultaneously. We will then test the effects of directing the listener's attention to one talker on the listener's ability to adapt to both talkers.

Hypothesis

We hypothesize that speech perception adaptation is contingent upon attention. If there are limits to the automaticity of speech perception, then we expect listeners will adapt their perceived categorical boundary to align better with the speech of the talker they are instructed to attend to compared to the unattended talker.

Predictions
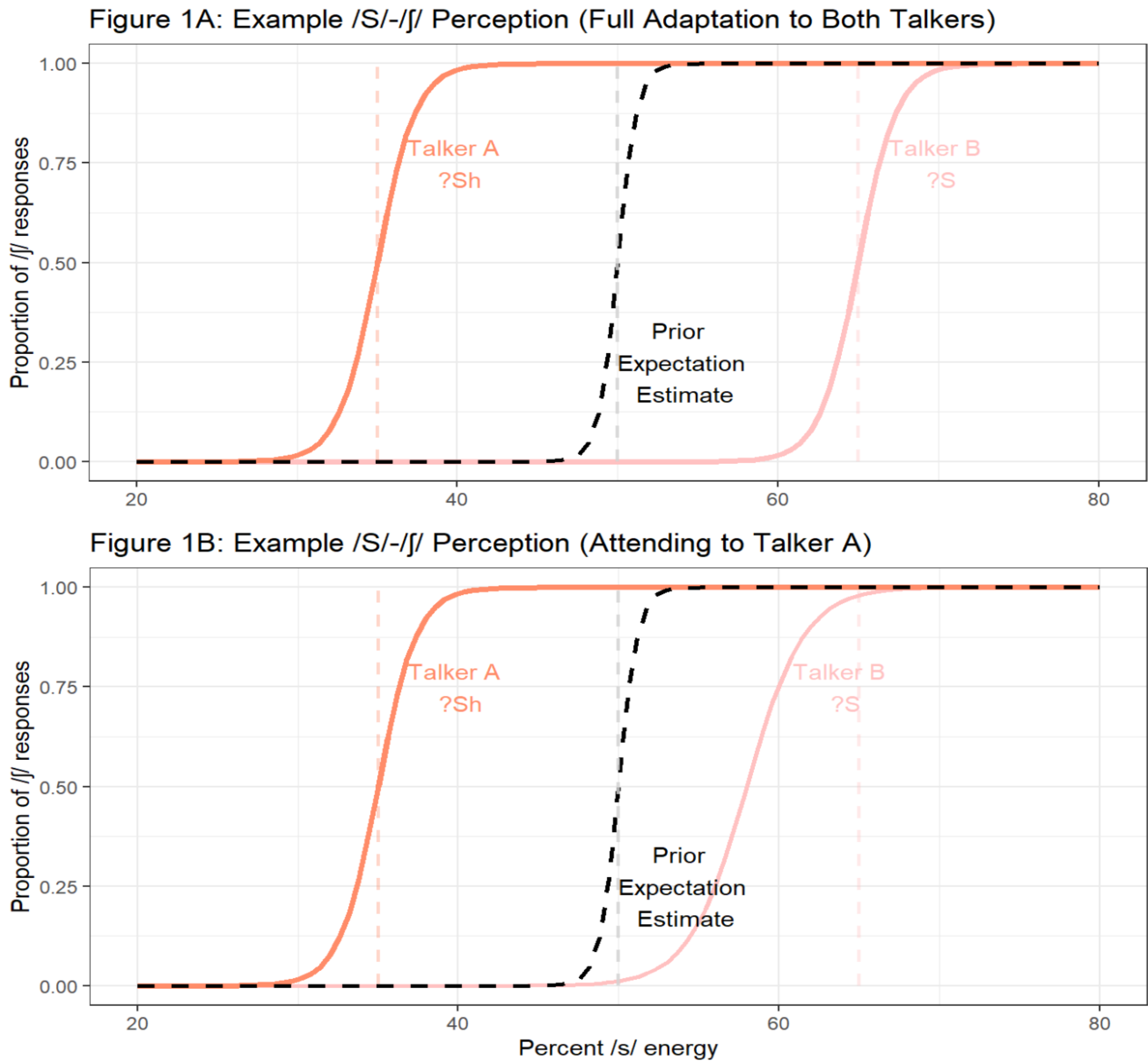
Figures 1A & 1B: Graphical representations of listeners responses to the asi-ashi test continuum during the Test Phase. As the percent of energy of /s/ in the recording increases, the more likely participants are to respond "ashi" (/∫/), rather than "asi" (/s/). If perceptual adaptation is dependent on attentional resources, we anticipate the listener will adjustment to the unattended talker will be constrained.

Implications

The results of this experiment begin to explore the role of attention in speech perception adaptation. A listener's perceptual boundary changing more to fit the attended talker's speech than the unattended talker's speech would suggest there are limits to the automaticity of speech perception and may also provide insight into how our brains allocate attentional resources under higher cognitive loads.

Design

In this study, we will be measuring listeners' perceptual adaptation to two simulated talkers' S-∫ production.

S-∫ sounds exist on a continuum, spanning from /s/ as in "Sock" to /sh/ as in "Shock." Earlier research suggests that listener adaptation to talker S-∫ production is **talker-specific.** This means that listeners adjust their perceived boundary between S-∫ for each talker regardless of other talkers the listener may also hear (Kraljic & Samuel, 2005). **This quality could allow us to simulate two distinct talkers with different S-∫ productions during the same experimental exposure** (Cummings & Theodore, 2022*).*

Critical Trials

Our critical stimuli are created from 40 recordings of S/∫ words, each **spoken typically (S, Sh)** and **accented (?S, ?Sh)** (Kraljic & Samuel, 2005).

All recordings were processed using Praat (Boersma, 2002) to simulate the words being **spoken by a male talker** and **a female talker** (Luthra et al., 2021).

These words were split in half to **create two sets of words representing two talkers**:10 unique S words and 10 unique ∫ words were allocated to each talker (*see below*).

Talker A			Talker B	
∫	**S**		**∫**	**S**
Ambition	Pregnancy		Initial	Parasite
Machinery	Democracy		Beneficial	Obscene
Brochure	Embassy		Neogtiate	Medicine
Official	Legacy		Commercial	Tennessee
Crucial	Reconcile		Parachute	Peninsula
Pediatrician	Personal		Efficient	Hallucinate
Flourishing	Eraser		Publisher	Arkansas
Reassure	Episode		Glacier	Compensate
Graduation	Literacy		Refreshing	Dinosaur
Vacation	Coliseum		Impatient	Rehersal

Figure 2: Lists of s and ∫ words that will be produced in Talker A's and Talker B's voice, respectively.

Each experiment will have a male and a female talker:
If Talker A is female, then Talker B is male.
If Talker A is male, then Talker B is female.

Exposure Phase

Talker A and Talker B recordings were paired to create Materials A and Materials B. Half of the participants will hear the words in Materials A with the simulated accent (?S, ?Sh), and the words in Materials B without the accent (S, Sh). The other half of the participants will hear the inverse, meaning Materials B will be accented and Materials A will not be *(See below).*

The word pairings shown horizontally across in Materials A & B were then spliced together to **create stereo audio files** where one talker is played in the left ear, and the other in the right ear. Like talker gender, ear assignment was counterbalanced across participants.

Filler Trials

Each experiment consists **of 80 total exposure trials**, including **20 critical** trials and **60 filler** trials. During filler trials, one talker will say a word and the other talker will say a nonword. Each talker has a 50% chance of saying a nonword.

Paradigm

Participants will be instructed to attend to either the female talker or the male talker. They will then perform a series of 2-option forced-choice lexical decision tasks, in which they hear a recording and then select on their screen if this talker said a word or a nonword (*see below*).

Figure 4: Static representation of how a participant will progress through a trial. Each trial will begin with the participant hearing an audio file and then selecting either "Word" or "Nonword".

Figure 3: Visual illustrating how the words spoken by Talker A and Talker B will be paired to produce two sets of materials.

Test Phase

After the Exposure Phase, participants will hear the asi-ashi test continuum across trials in each talker's voice. This continuum is used to gauge when listener's shift from perceiving a sound as "Sh" to "S" (*see left*). Each trial will only play a recording from a single voice at once. Participants will select if the audio they heard was "asi" or "ashi" for each trial, to produce results like the predictions, shown to the left.

Figure 5h: "S" and "Sh" sounds exist on a spectrum, where "asi" can be altered to sound like "ashi" by changing the percentage of /s/ energy.

References

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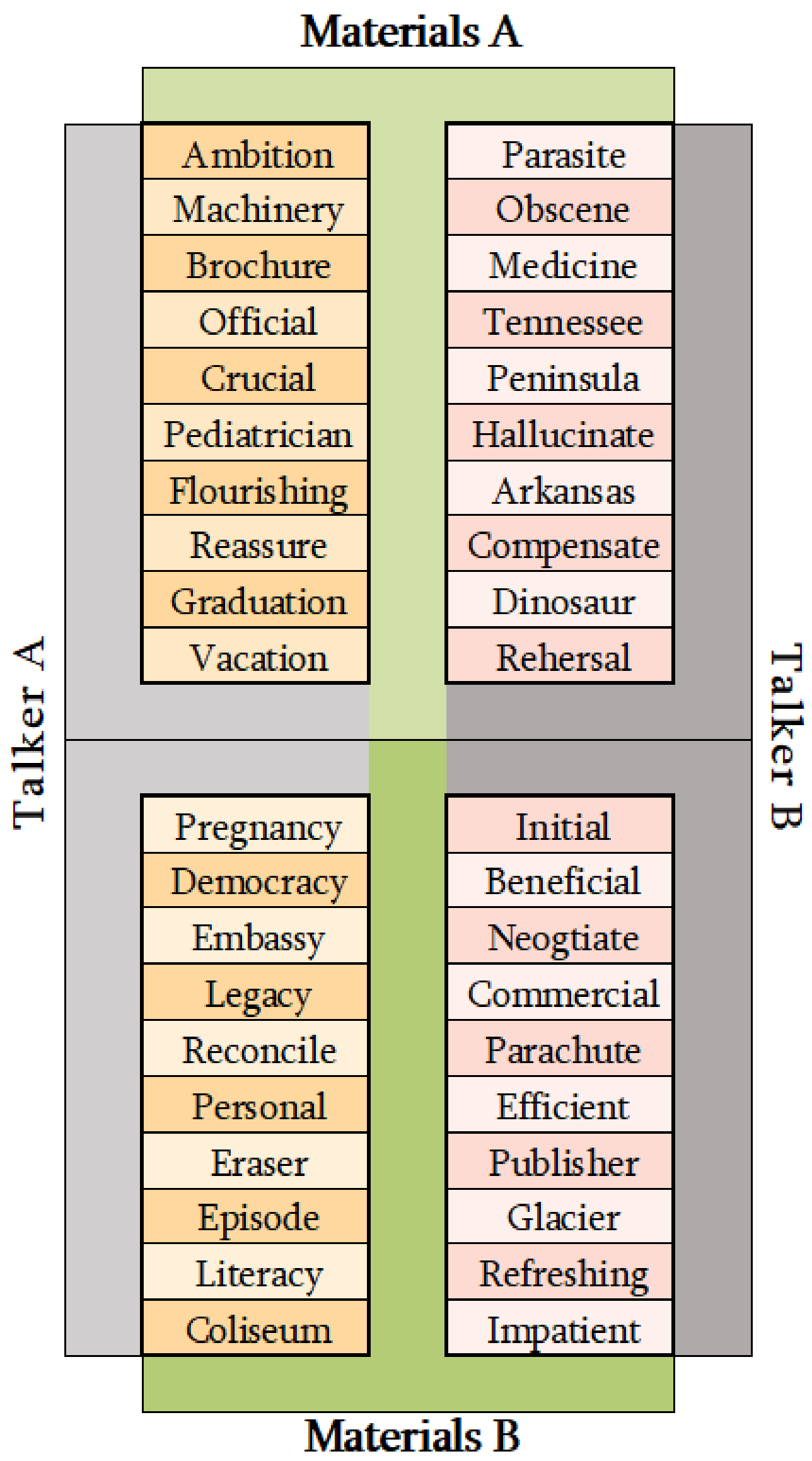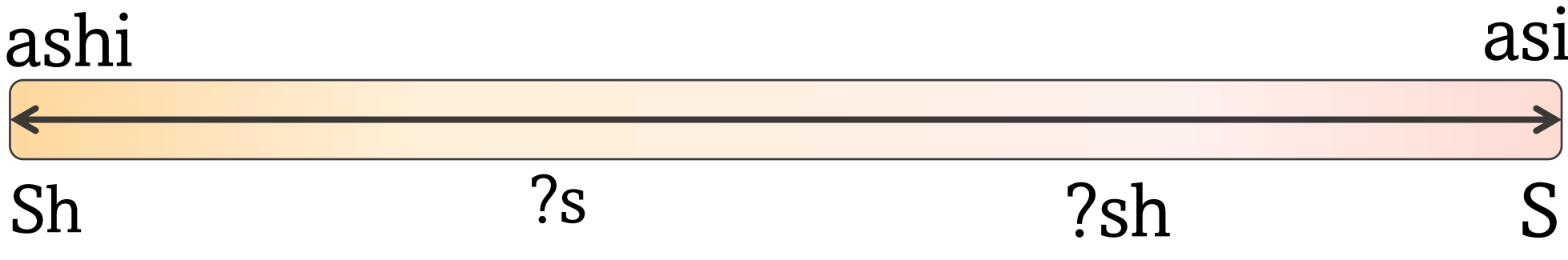
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