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The Unforeseen Consequences of Interacting With Non-Native Speakers

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Abstract

Sociolinguistic research shows that listeners' expectations of speakers influence their interpretation of the speech, yet this is often ignored in cognitive models of language comprehension. Here, we focus on the case of interactions between native and non-native speakers. Previous literature shows that listeners process the language of non-native speakers in less detail, because they expect them to have lower linguistic competence. We show that processing the language of non-native speakers increases lexical competition and access in general, not only of the non-native speaker's speech, and that this leads to poorer memory of one's own speech during the interaction. We further find that the degree to which people adjust their processing to non-native speakers is related to the degree to which they adjust their speech to them. We discuss implications for cognitive models of language processing and sociolinguistic research on attitudes.

Keywords: Non-native speakers; Lexical competition; Memory; Good-enough representations; Top-down expectations

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1. Introduction

When studying language processing, we often study how we understand a word such as *rose*. As cognitive scientists, we tend to ignore the vast sociolinguistic literature that shows that a rose referred to by any other speaker is not the same rose. That literature shows that the way we interpret what speakers say depends on their sex, age, race, geographical region, socioeconomic status, and so on (e.g., Babel & Russell, 2015; Drager, 2005, 2011; Johnson, Strand, & D'Imperio, 1999; Koops, Gentry, & Pantos, 2008; Niedzielski, 1999; Rubin, 1992; Staum Casasanto, 2008). Psychological evidence supports the notion that we spontaneously integrate information about the speaker and use it to interpret incoming speech (van Berkum; Hanulikova, Van Alphen, Van Goch, & Weber, 2012; Arnold, Kam, & Tanenhaus, 2007). Here we focus on the case of interactions between native (NS) and non-native speakers (NNS) and examine how sociolinguistic expectations influence the way we process language and, consequently, how they impact our recollection of the interaction.

Sociolinguistic research has shown that listeners might have negative attitudes towards NNS, and these can lead them to provide less feedback in interactions, problematize the speech of the NNS, and in general, not share the communicative burden (Lindemann, 2002; Lippi-Green, 1997). Independently of attitudes, listeners also expect NNS to have lower linguistic proficiency in their non-native language. Accordingly, listeners do not show the same neural response to grammatical errors if they are produced by NNS rather than NS (Hanulikova et al., 2012). Furthermore, listeners optimize language processing when listening to NNS by processing the less reliable linguistic input in less detail while increasing their reliance on reliable contextual information (Lev-Ari, 2015; Lev-Ari & Keysar, 2012). For example, listeners are less likely to notice semantic changes in story details when the story is told by an NNS rather than an NS, even though they are as capable of detecting the changes if warned to do so beforehand (Lev-Ari & Keysar, 2012). If people change the way they process language when they listen to NNS, such systematic adjustment might have consequences beyond the focal attempt to understand the speaker. It could influence the way individuals process language in general during and following interactions with NNS. In Experiment 1, we test whether listening to an NNS influences the process of lexical access. In Experiment 2, we test whether interacting with NNS leads people to represent their own speech in less detail during the interaction.

2. Experiment 1

This experiment tests whether the less-detailed processing of the language of NNS increases lexical competition by increasing the perceived conceptual similarity of lexical items. Less-detailed representations of words are more similar to one another than fully detailed representations, because they might lack details that differentiate the concepts. Lexical access, in turn, is sensitive to the semantic similarity of a word to its competitors, as word retrieval requires the inhibition of competitors, and the more so, the more similar the competitors are to the target word (Anderson, Bjork, & Bjork, 1994). Yet the degree to which words are perceived as similar varies with the task at hand. Focusing participants' attention on the similarity between words increases lexical competition, whereas focusing them on the differences between them reduces it (Smith & Hunt, 2000).

To test the influence of processing the language of NS versus NNS on lexical competition, participants listened to a recording of an NS or an NNS, and then performed a separate Retrieval-induced-Inhibition task. This task tests the degree to which words are inhibited due to recall of semantically similar words. We predicted that *earlier* processing of the language of an NNS would lead to less detailed processing, which would increase words' perceived similarity, and therefore increase their inhibition.

Retrieval-induced inhibition is not unique to words. It also occurs with non-linguistic stimuli, such as color and location (Ciranni & Shimamura, 1999). Yet our account (Lev-Ari, 2015) predicts that listening to NNS would influence linguistic processing in particular, not cognitive processing in general. Therefore, half of the participants performed a control non-linguistic version of the task, which included shapes and spatial arrangements instead of words.

2.1. Method

2.1.1. Participants

One-hundred-and-two native English speakers participated. Eight were excluded because they were either NNS ($N = 1$) or had participated in related experiments ($N = 7$).

2.1.2. Stimuli and design

2.1.2.1. Manipulation of speaker's native status: Participants were told that they would listen to a story by a previous participant, and then answer comprehension questions about it. The story was recorded in English by one native speaker of American English and one native speaker of Turkish. In order to reinforce expectations about the linguistic competence of the NNS, the recording started with a short dialogue in which the NNS speaker made a couple of grammatical errors. The story itself was fully grammatical and identical in both conditions. Next, participants performed a surprise memory task. They received a transcript of the story in which some of the words changed, and they tried to detect those changes.[1]

2.1.2.2. Linguistic retrieval-induced Inhibition task: We selected six words from each of three categories: animals, fruit, and occupations. All were common words (e.g., *lion*, *teacher*) and no two words in the same category started with the same letter (see Table 1a). None of the words appeared in the previous story task. We divided each category into two lists of three words and then created six versions for the practice phase by combining a list from one category with a list from another category. Therefore, a sixth of the participants practiced half of the animal words and half of the fruit words, another sixth of the participants practiced half of the animal words and half of the occupation words, and so on. Eighteen additional words, six from each category, served as fillers in the final recognition task.

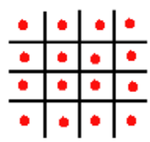
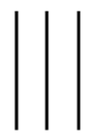
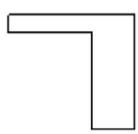
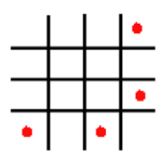
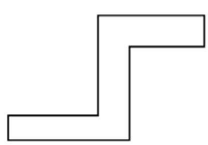
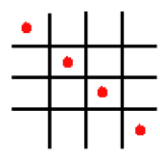
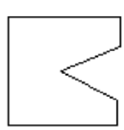
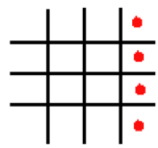
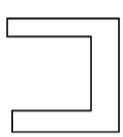
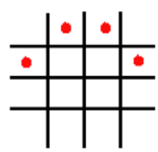
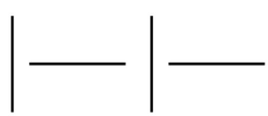
2.1.2.3. Non-linguistic retrieval-induced Inhibition task: We generated three spatial categories: □ (shapes),  (dots in a grid), and  (line arrays). For each spatial category, we generated four items. This task included fewer items than the linguistic one in order to equate difficulty across tasks. The items were hard to label to discourage a linguistic

Table 1
List of stimuli for the (a) linguistic and (b) non-linguistic tasks in Experiment 1

1a

Category	Animals	Fruit	Occupations
Category items	goat	banana	artist
	lion	cherry	engineer
	pig	lemon	nurse
	snake	peach	policeman
	tiger	strawberry	scientist
	whale	watermelon	teacher

1b

Category			
Category items			
			
			
			

strategy of encoding (see Table 1b). We divided each group of items into two subgroups and combined them to generate six versions for the practice stage in the same manner as in the linguistic Retrieval-induced Inhibition task. Twelve additional items, four from each category, served as fillers in the final recognition task.

2.2. Procedure

Participants performed the story task with either an NS or an NNS, and then performed either a linguistic or non-linguistic Retrieval-induced Inhibition task, in a fully crossed design.

The procedure of the Retrieval-induced Inhibition tasks was based on Veling and van Knippenberg (2004) and is illustrated in Figure 1. In the Memorization Phase, either 18 words or 12 spatial arrays appeared on the screen one at a time next to their category name (e.g., ANIMALS – tiger or ||||: \/\/\). The words and spatial items were blocked by category. The order of categories and the order of the items within each category were randomized. Each item appeared for 5 s with a 1-s interval between them.

Next, participants performed a cued recall task (Practice Phase). The cues were the category name followed by the first letter of the target word (e.g., ANIMALS – t), or the category symbol followed by the left-most part of the target shape (||||: \/). Participants wrote the responses in a booklet, with each response on a different page. Participants

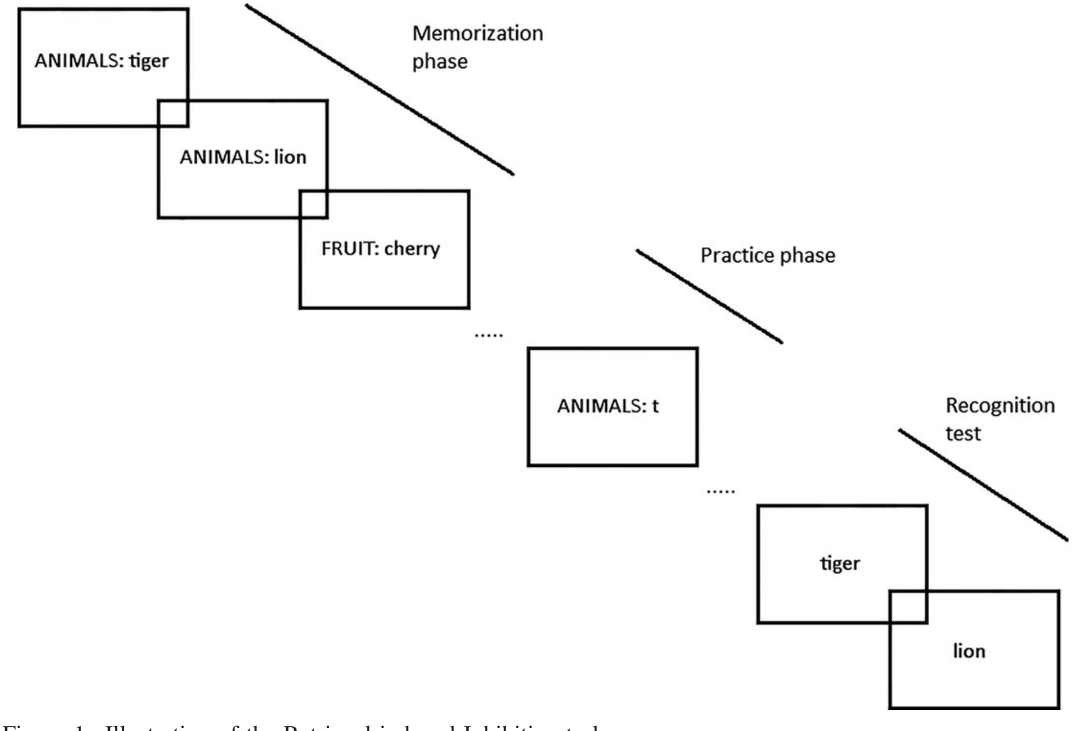


Figure 1. Illustration of the Retrieval-induced Inhibition task.

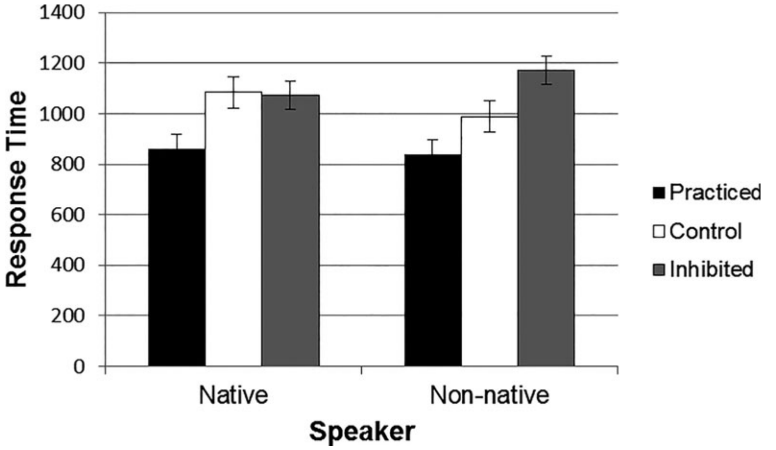


Figure 2. Response time (ms) in the linguistic inhibition task as dependent on speaker and item type.

only recalled 6 out of the 18 words or 4 out of the 12 spatial items—half of the items in two of the categories, and none of the items from the third category. Thus, a third of the items were practiced, a third of the items were not practiced but belonged to the practiced categories ("inhibited"), and a third of the items were not practiced and belonged to the non-practiced category ("control"). Participants recalled each of these items three times.

In the final Recognition Test, all learned items and fillers were presented one at a time in a random order in the center of the screen. Participants judged whether each item was on the study list by pressing one of two keys as quickly as possible. Accuracy and response time were measured.

2.3. Results and discussion

2.3.1. Linguistic retrieval-induced inhibition

We first tested whether participants exhibited greater linguistic inhibition if they previously listened to an NNS. RTs were truncated to 2.5 SDs away from the mean. Additionally, items that participants failed to recall during the retrieval practice session or practiced by error, even though the items were not among the ones to be practiced, were excluded from analysis (3.3%). We analyzed the data with a mixed model with Participants and Items as random variables, and Condition (Control, Inhibited, Practiced), Speaker (NS, NNS), and their interaction as fixed factors. The model included intercepts for the random variables and a slope for Condition for the Participants.[2]

As Fig. 2 shows, participants were faster to respond to the practiced items than to the control items ($\beta = -149$, $SE = 57$, $t = -2.62$), and this effect did not interact with Speaker ($\beta = -72$, $SE = 80$, $t < 1$). In contrast, only participants who previously listened to an NNS were significantly slower to respond to the inhibited than to the control items ($\beta = 183.65$, $SE = 55$, $t = 3.31$), as also reflected by a significant interaction with Speaker ($\beta = -195$, $SE = 78$, $t = -2.5$). These results support our hypothesis that listeners' adjustment to NNS influences lexical competition. When participants listened to the NNS tell the story, they shifted to a less-detailed manner of processing, which was carried over to the following inhibition task. This less-detailed manner of processing rendered the words more similar to one another, increasing competition, and consequently, inhibition.

It might seem puzzling that participants who listened to the NS showed no inhibition, but such inhibition is sometimes absent. In our case, lack of inhibition could have resulted from the surprise memory test in the story task that preceded the Retrieval-induced Inhibition task. It required participants to focus on subtle differences between words, and such focus on differences has been shown to eliminate Retrieval-induced Inhibition (Smith & Hunt, 2000). For our purposes, it is important that the inhibition was larger in the NNS compared to the NS condition.

2.3.2. Non-linguistic retrieval-induced inhibition

We next examined whether the effect of listening to NNS on inhibition is linguistic in nature. If our theory is correct, and the increase in inhibition is due to the lesser specification of words' features, then listening to NNS should not influence non-linguistic inhibition. Two participants were excluded because they failed to practice enough shapes in the practice phase to allow analysis of their data. As with the Linguistic Retrieval-induced Inhibition task, items that participants failed to recall during the practice phase were excluded from analysis (6%). In addition, participants occasionally wrongly recalled shapes that were the hybrid of two shapes. In these cases, the shapes incorporated into the hybrid items were excluded from analysis (2.3%).

In order to test whether participants exhibited different levels of inhibition depending on the speaker they listened to, we fit a mixed model with Participants and Items as random variables, and Condition (control, inhibited, practiced), Speaker (NS, NNS), and their interaction as fixed effects. The model included intercepts for the random variables and a slope for Condition for the Participants factor. Unlike the linguistic task, non-linguistic inhibition was not influenced by the native status of the speaker participants previously listened to. Specifically, participants were slower to respond to the inhibited items than to the control items ($\beta = 371$, $SE = 126$, $t = 2.95$), and this effect did not interact with Speaker ($t = -1.04$).

The results indicate that the enhanced inhibition in the NNS condition found in the linguistic task is specific to linguistic processing. The two tasks were identical in all but the nature of the memorized items, yet differences in inhibition only emerged in the linguistic version. Thus, listening to an NNS can influence lexical competition. Experiment 2 evaluates whether this altered manner of processing extends to the way people represent their own speech during interactions with NNS.

3. Experiment 2

Experiment 1 showed that listening to NNS can alter the way language is accessed and represented. During interactions with NNS, interlocutors process and represent other input as well, such as input from other interlocutors and their own utterances. The question then arises whether the processing adjustment is specific to what the NNS says or whether it extends to the processing of other interlocutors' speech and to one's own speech. If the adjustment is specific, it would require dynamic switching back and forth between two different manners of processing. Alternatively, once an interlocutor adjusts processing to an NNS, the same manner of processing might persist in processing other input, including own speech.

To test whether the adjustment to NNS extends to the processing and representation of own speech during interactions with NNS, we recorded participants' interactions with either an NS or an NNS confederate. We later tested participants' memory of the content they provided. If they process all speech in less detail, then they should be less likely to encode the semantic subtleties in their own speech when they interact with NNS. Consequently, they should have poorer memory of what they said than those who interacted with an NS.

3.1. Method

3.1.1. Participants

Seventy-three native English speakers participated for pay.

3.1.2. Stimuli and design

We constructed a story and generated a list of open-ended questions that required inference and did not have a single correct response. We also generated multiple plausible responses to each question and piloted them to ensure they all clearly differed in meaning. The final stimuli included a story that was 536 words long, 10 interview questions about the story, and an average of 16.5 responses per question.[3]

3.1.3. Procedure

Participants interacted with either an NS or an NNS confederate who was a native speaker of Mandarin in a reading comprehension task. First, participants read the story silently. Then, the experimenter handed the confederate a list of questions and told her that she should interview the participant. Participants were free to respond in their own words and at any length. The interview was audio recorded.

Next, the participant and confederate were told that each would perform some tasks individually. The confederate was led out of the room, and participants performed a filler-naming task. Following this task, participants received a surprise memory test of their interview responses. They were presented with the questions along with potential responses and were instructed to circle all the responses they provided. They could circle as many responses per question as they wished in order to best represent their original answer, and they also had the option of indicating that they did not provide any of the presented responses.

3.2. Results and discussion

The second author calculated participants' recognition of the responses they provided by comparing the responses they circled in the memory test with the responses they provided during the interview. A second coder, blind to condition, calculated recognition for a random selection of 10% of the questions. The two coders agreed on 97.8% of the responses. Disagreements were resolved by discussion, and when disagreements remained, the first author arbitrated. Participants' performance on each question was coded as 1 if the participants recognized all the responses they provided, and 0 otherwise. Participants' commission errors were coded as 1 for questions in which they circled at least one response that they never provided, and 0 otherwise.

One participant was excluded because his performance was more than 3 SD away from the mean. Another participant was excluded for circling an exaggerated number of responses—3.4 times the number of responses they provided compared with a ratio of 1.3 for the average participant. In order to test whether participants' representation of their own speech was poorer if they talked to an NNS, we modeled their success at recognizing their own responses, and their commission errors.[4]

In general, participants who interacted with an NS had better memory for their own responses: They correctly recognized more of their own responses and were less likely to falsely recognize a response as their own.

We first examined participants' success at recognizing the responses that they had provided. Participants were free to provide as many arguments as they wished in response to each interview question. On average, participants circled 1.33 responses per question (range: 0–7). Since the more responses one provides, the less likely they are to recognize all of them, we included in the model the number of responses participants provided (Provided Responses) as a correlate. The mixed model analysis, then, included Participants and Items as random variables, and Provided Responses and Interlocutor as fixed effects. We included intercepts for the random variables, a slope for Provided Responses for the Participants and Items variables, and a slope for Interlocutor for the Items variable. Results showed that participants were less likely to recognize all their responses the more responses they provided ($\beta = -1.33$, $SE = 0.2$, $z = -6.76$, $p < .001$). Importantly, participants were also more likely to recognize all their responses if their interlocutor was an NS rather than an NNS ($\beta = 0.56$, $SE = 0.25$, $z = 2.27$, $p < .03$). On average, participants correctly recognized all the responses they provided for each question 77% of the time if they interacted with an NS, but only 66% of the time if they interacted with an NNS. This pattern supports our hypothesis that the adjustment to NNS leads people to represent what they said in less detail.

We next tested whether participants who interacted with an NNS were more likely to wrongly identify a distractor as one of their original interview answers. The model included Participants and Items as random variables and Interlocutor as a fixed factor. The random structure included intercepts and a slope for Interlocutor for the Items variable. As predicted, participants who interacted with an NNS made more commission errors than those who interacted with a native speaker ($\beta = -0.56$, $SE = 0.28$, $z = -2.03$, $p < .05$). On average, participants who interacted with a native speaker made a commission error on 38% of the questions, whereas those who interacted with an NNS made a commission error on 52% of the questions.

This experiment focused on the effect of interacting with an NNS on memory for own speech. It is well documented that people accommodate their speech when they interact with NNS by simplifying their speech, avoiding local variants, widening their vowel space, slowing down their speech, and so forth (Barbu, Martin, & Chevrot, 2014; Biersack, Kempe, & Knapton, 2005; Long, 1983; Uther, Knoll, & Burnham, 2007). Since both speech and processing accommodation are thought to be driven by expectations regarding low linguistic competence of the interlocutor, we examined whether the degree of accommodation in speech predicted the degree of accommodation in processing. Because the study was not originally designed to evaluate this question, we did not have baseline recordings of the participants. As a result, we could not measure the degree to which they slowed down their speech for the NNS, but only their absolute speech rate. Given that participants were randomly assigned to interact with either an NS or an NNS, there is no reason to assume systematic differences in baseline speech rate. We measured participants' speech rate by calculating the number of syllables per second in their responses to the last question of the interview.

We correlated participants' speech rate with their success at recognizing their own speech (averaged across questions) and with their commission errors rate, separately for the NS and the NNS conditions. As Fig. 3 shows, the speech rate of the participants who interacted with an NNS positively correlated with their success at recognition ($r = 0.4$, $p < .02$). Those who accommodated more to the NNS by speaking more slowly also accommodated more in their processing, leading to poorer memory. In contrast, as predicted, speech rate was not related to recognition success for those who interacted with an NS, as speech rate in that case should not reflect accommodation ($r = -0.14$, n.s.). The difference between the correlation in the two samples was significant ($z = 2.3$, $p < .03$).

The rate of commission error did not correlate with speech rate for either group (rs<|0.1|, n.s.). It is hard to know why speech rate did not predict commission errors in the

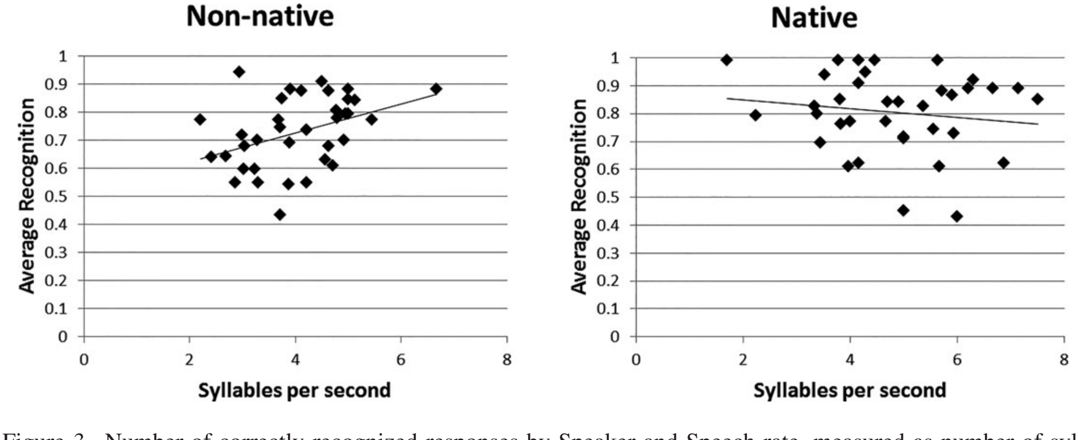


Figure 3. Number of correctly recognized responses by Speaker and Speech rate, measured as number of syllables per second in participants' last response.

NNS condition. It could be that commission errors require not only less-detailed representations but also filling-in of additional details, and this tendency does not relate to adjustment in speech. Alternatively, it could be that our paradigm was not sensitive enough to find this relationship.

Together, the results of this study demonstrate that expectations that NS have of NNS influence not only how they process the speech of the NNS, but also the way they process their own speech. Participants who interacted with an NNS were less able to recognize their own responses, suggesting that they represented what they themselves said in less detail. This might suggest that those who have the strongest expectations regarding NNS, or those who adjust the most to them, might have the least precise memories of their interactions with NNS.

4. General discussion

These studies demonstrate that processing non-native speech induces a general change in the manner of language processing. As part of listeners' adjustment to NNS, they process the language in less detail. Experiment 1 shows that such adjustment influences lexical access. Experiment 2 shows that it influences memory of own speech. Therefore, models of language processing should take into account the role that speaker identity and listeners' expectations of the speaker play in language processing. The results also suggest that sociolinguists and social psychologists studying impression formation of NNS and interactions between NS and NNS should take into account that people's memory of their interactions with NNS depends on their expectations of NNS, as these influence the manner in which they process language during the interaction. For example, interactants' feedback might be less nuanced if the representation is less detailed. Similarly, less detailed representation of the content of what non-native speakers say can influence the degree to which they would be individualized. Furthermore, while these experiments focus on the lexical-semantic level, similar effects are likely to be obtained at other linguistic levels. Indeed, Hanulikova et al. (2012) showed differences between the way NS and NNS speech is processed at the grammatical level. In sum, our studies demonstrate how the sociolinguistic variable of nativeness status affects psychological processing of what people say and how the conversation is remembered.

4.1. Cognitive load

Processing accented speech is harder than processing native speech (Munro & Derwing, 1995), suggesting that the findings of Experiment 2 could be explained with a cognitive load account. When participants listened to an NNS, the greater cognitive load involved in processing non-native language might have reduced their ability to encode their own speech in sufficient detail and thus reduced their ability to detect their own responses later on. Though the cognitive load account is plausible, there is no evidence that load has an effect on the level of detail of representations. In fact, previous research that examined whether cognitive load leads to less-detailed representations found no such influence (Sanford, Sanford, Filik, & Molle, 2005).

The results of Experiment 1 cannot be accounted for by cognitive load. In fact, a cognitive load account would make opposite predictions. In Experiment 1, participants who initially listened to an NNS later showed greater inhibition than those who first listened to the NS, even though the inhibition task did not involve processing of non-native speech at all. Furthermore, if processing language of an NNS had depleted participants' resources, then they would have been slower, and less able to perform inhibition. Yet participants in Experiment 1 had similar average response time in the two speaker conditions and, more important, they showed greater, not reduced inhibition after listening to an NNS. Lastly, load should have affected both the linguistic and the non-linguistic inhibition task, but the native status of the speaker only influenced performance on the linguistic version of the task. This shows that the influence is linguistic in nature and not due to any effect of cognitive resources.

The alternative account of depleted resources is also inconsistent with other studies regarding the impact of processing non-native language on performance. For example, the influence of the speaker's native status was found to be larger for participants with higher working memory (Lev-Ari, 2015). If a change in performance is due to depleted resources, those with the fewest resources should be most influenced (as long as everyone performs above chance). In contrast, if a change in performance is due to active and effortful adjustment, then such adjustment should be manifested more strongly by those who have sufficient cognitive resources to do so, as was found. In another study adjustment occurred when the expectations about the speaker's proficiency were relevant, but not otherwise (Lev-Ari & Keysar, 2012). If poorer memory is due to depleted resources, it should manifest independent of the relevance of the task.

4.2. Attitudes toward NNS

Research on attitudes highlights the importance of memory processes when people form impressions of others. In particular, people's expectations and goals influence what they attend to during processing, and these consequently influence what they remember of the person or the situation and their attitude toward them (e.g., Hamilton, 1989). In these studies we did not examine participants' memory of the NNS or their impression of them. Nevertheless, the results of Experiment 2 along with prior results show that people process the language of NNS in less detail and increase their reliance on top-down information to interpret and represent it. This suggests that merely expecting NNS to have lower linguistic competence can lead people to remember their interaction with them in less detail and in a manner that is more in line with their expectations. Future research could explore whether expectations of lower linguistic competence indeed lead to enhancement of prior stereotypes following interactions with NNS.

4.3. Conclusion

These studies show how processing non-native speech influences the manner in which language is processed and remembered, and that this modulation applies to all linguistic input in that situation, including one's own speech. They thus show how cognitive models of language processing can benefit from sociolinguistic literature on the importance of speaker identity when studying how language is processed and interpreted. This also suggests that studying how language is processed might contribute to our understanding of the attitudes that people develop toward NNS. While these studies focus on interactions with NNS, the underlying principle applies to other cases as well. Listeners hold expectations regarding language use of different people depending on a variety of indexical properties. These expectations are likely to also influence what type of information is attended to, how heavily it is weighted, when it is integrated, and so forth. Therefore, studying the influence of sociolinguistic expectations on language processing in general is likely to add to our understanding of language processing mechanisms and to contribute to our understanding of social interactions.

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Notes

1. The results of this task were reported in Experiment 2 in Lev-Ari and Keysar (2012). These results indicate that the task was successful at eliciting a different processing manner in the NS and NNS conditions.
2. In this and all other analyses reported in this paper, we examined whether slopes for any of the fixed effects would improve the model using a Ratio Likelihood Test (Baayen, 2008, p. 275) without leading to overparameterization (Jaeger, 2008). Unless otherwise noted, running the analyses with a fully saturated model does not change the significance of the effects reported in this paper.
3. The first 12 participants received a slightly different form with an average of 17 responses per question. This form was later modified by deleting responses that were never circled, and collapsing over a few responses that were very similar.
4. We chose this statistical method over d' because the distribution of correct detections and false alarms differed. Calculating the d' statistic, however, shows the same pattern—a significantly higher d' for participants who interacted with an NS rather than an NNS.

References

Anderson, M. C., Bjork, R. A., & Bjork, E. L. (1994). Remembering can cause forgetting: Retrieval dynamics in long-term memory. *Journal of Experimental Psychology: Learning, Memory and Cognition*, *20*(5), 1063–1087.

Arnold, J. E., Kam, C. L. H., & Tanenhaus, M. K. (2007). If you say thee uh you are describing something hard: The on-line attribution of disfluency during reference comprehension. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *33*(5), 914.

Baayen, R. H. (2008). *Analyzing linguistic data: A practical introduction to statistics using R*. Cambridge, UK: Cambridge University Press.

Babel, M., & Russell, J. (2015). Expectations and speech intelligibility. *The Journal of the Acoustical Society of America*, *137*(5), 2823–2833.

Barbu, S., Martin, N., & Chevrot, J. P. (2014). The maintenance of regional dialects: A matter of gender? Boys, but not girls, use local varieties in relation to their friends' nativeness and local identity. *Frontiers in Psychology*, *5*, 1251.

Biersack, S., Kempe, V., & Knapton, L. (2005) Fine-tuning speech registers: A comparison of the prosodic features of child-directed and foreigner-directed speech. In *Proceedings of the* 9th Eurospeech–Interspeech, Lisbon, pp. 2401–2404. Lisbon, Portugal.

Ciranni, M. A., & Shimamura, A. P. (1999). Retrieval induced forgetting in episodic memory. *Journal of Experimental Psychology: Learning, Memory and Cognition*, *25*(6), 1403–1414.

Drager, K. (2005). From bad to bed: The relationship between perceived age and vowel perception in New Zealand English. *Te Reo*, *48*, 55–68.

Drager, K. (2011). Speaker age and vowel perception. *Language and Speech*, *54*(1), 99–121.

Hamilton, D. L. (1989). Understanding impression formation: What has memory research contributed?. In P. R. Solomon, G. R. Goethals, C. M. Kelley, & B. R. Stephens (Eds.), *Memory: Interdisciplinary approaches* (pp. 221–242). New York: Springer.

Hanulikova, A., Van Alphen, P. M., Van Goch, M., & Weber, A. (2012). When one person's mistake is another's standard usage: The effect of foreign accent on syntactic processing. *Journal of Cognitive Neuroscience*, *24*(4), 878–887.

Jaeger, T. F. (2008). Categorical data analysis: Away from ANOVAs (transformation or not) and towards logit mixed models. *Journal of memory and language*, *59*(4), 434–446.

Johnson, K., Strand, E. A., & D'Imperio, M. (1999). Auditory-visual integration of talker gender in vowel perception. *Journal of Phonetics*, *27*, 359–384.

Koops, C., Gentry, E., & Pantos, A. (2008). The effect of perceived speaker age on the perception of PIN and PEN vowels in Houston, Texas. University of Pennsylvania Working Papers in Linguistics, *14*(2), 12.

Lev-Ari, S. (2015). Comprehending non-native speakers: Theory and evidence for adjustment in manner of processing. *Frontiers in Psychology*, *5*, 1546.

Lev-Ari, S., & Keysar, B. (2012). Less-detailed representation of non-native language: Why non-native speakers' stories seem more vague. *Discourse Processes*, *49*, 523–538.

Lindemann, S. (2002). Listening with an attitude: A model of native-speaker comprehension of non-native speakers in the United States. *Language in Society*, *31*(3), 419–441.

Lippi-Green, R. (1997). *English with an accent: Language, ideology, and discrimination in the United States*. New York: Routledge.

Long, M. H. (1983). Linguistic and conversational adjustments to non-native speakers. *Studies in Second Language Acquisition*, *5*(02), 177–193.

Munro, M. J., & Derwing, T. M. (1995). Processing time, accent, and comprehensibility in the perception of native and foreign-accented speech. *Language and Speech*, *38*, 289–306.

Niedzielski, N. (1999). The effect of social information on the perception of sociolinguistic variables. *Journal of Language and Social Psychology*, *18*(1), 62–85.

Rubin, D. L. (1992). Nonlanguage factors affecting undergraduates' judgments of non-native English speaking teaching assistants. *Research in Higher Education*, *33*, 511–531.

Sanford, A. J. S., Sanford, A. J., Filik, R., & Molle, J. (2005). Depth of lexical-semantic processing and sentential load. *Journal of Memory & Language*, *53*, 378–396.

Smith, R. E., & Hunt, R. R. (2000). The influence of distinctive processing on retrieval-induced forgetting. *Memory & Cognition*, *28*, 503–508.

Staum Casasanto, L. (2008). Does social information influence sentence processing? In *Proceedings of the 30th Annual Meeting of the Cognitive Science Society*, pp. 799–804. Washington DC.

Uther, M., Knoll, M., & Burnham, D. (2007). Do you speak E-N-G-L-I-S-H? A comparison of foreigner-and infant-directed speech. *Speech Communication*, *49*, 2–7.

Veling, H. P., & van Knippenberg, A. F. M. (2004). Remembering can cause inhibition: Retrieval-induced inhibition as cue independent process. *Journal of Experimental Psychology–Learning, Memory and Cognition*, *30*(2), 315–317.