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An experimental study of the role of social factors in language change: The case of loanword adaptations

Abstract: There is great variation in whether foreign sounds in loanwords are adapted or retained. Importantly, the retention of foreign sounds can lead to a sound change in the language. We propose that social factors influence the likelihood of loanword sound adaptation, and use this case to introduce a novel experimental paradigm for studying language change that captures the role of social factors. Specifically, we show that the relative prestige of the donor language in the loanword's semantic domain influences the rate of sound adaptation. We further show that speakers adapt to the performance of their 'community', and that this adaptation leads to the creation of a norm. The results of this study are thus the first to show an effect of social factors on loanword sound adaptation in an experimental setting. Moreover, they open up a new domain of experimentally studying language change in a manner that integrates social factors.

1 Introduction

Why is it that Hebrew speakers refer to a general as a /ˈɡeneʁal/ yet say about someone that he is a /d͡ʒentelmen/? In other words, why do Hebrew speakers adapt /d͡ʒ/, which does not exist in their language, to /g/ in the loanword *general* but retain it in *gentleman*? In this paper we argue that social factors, such as the donor language's prestige in the loanword's domain, and the way in which one's interlocutors produce the loanword, can influence the likelihood of loanword sound adaptation. We explore these effects using a novel experimental paradigm

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that allows studying language change in general in the lab and in a manner that integrates social factors. Using this paradigm, we also examine how the effects at the individual level can lead to effects at the group level. As the retention of foreign sounds in loanwords can lead to a sound change (Winford 2005), this process of norm emergence can also help us understand the process of language change.

1.1 Loanword sound adaptation

There is variation in whether and how foreign sounds in loanwords are adapted. Phonological and phonetic accounts of sound adaptation attempt to explain such variation by referring primarily to constraints of the native phonological grammar and to the role of non-native speech perception (for a review, see Kang 2011). For example, it has been suggested that the fact that the English sibilants /s, z, ʃ, ʒ/ are adapted to /h/ in New Zealand Maori but to /k/ in Hawaiian is due to the difference in the phonemes that /h/ and /k/ contrast with in those languages (Herd 2005). As contrastive features are more likely to be retained than non-contrastive ones, different phonemes are judged as most similar to the En-
to tgrguage

ever, the factors governing the likelihood of sound adaptation versus retention are still largely unknown.

Understanding which factors promote adaptation versus retention of foreign sounds in loanwords is particularly important, as frequent retention of foreign sounds can lead to language change. For example, the large-scale borrowing of /v/-initial French words into old English following the Norman invasion, led to the phonemization of /v/, which had hitherto been present only as an allophone of /f/ (Winford 2005). It is therefore important to understand which factors sound adaptation is sensitive to. A potential key may lie in the processes governing borrowing in general.

1.2 Borrowing

Borrowing is a social phenomenon, involving more than just the need to fill lexical gaps. In particular, borrowing is not random, as languages typically borrow words from the languages that are dominant and/or hold prestige in the semantic domain (e.g., Hock and Joseph 1996). Additionally, borrowing is only one way in which a lexical gap can be filled. Language-internal solutions, such as coinage of new words, exist as well, and selecting one alternative over another depends on social and language attitudes, which are linked to national attitudes (Jernudd and Shapiro 1989). Thus, borrowing can even take place in the absence of a lexical gap. For example, French borrowed the word *job* from English, despite the presence of the French word *boulot*, which carries the same meaning and is in the same register as the loanword *job*. Borrowing, then, is only partly driven by linguistic needs; social goals, such as a wish to affiliate with the donor culture or to express expertise, intellectualism, modernity, economic success, cultural superiority, and so on, are also important (e.g., Weinrich 1968; Hock and Joseph 1996; Field 2002). Therefore, sound adaptation in loanwords might be driven by social factors as well. If a word is borrowed in order to express affiliation with the donor culture, then retaining its foreign pronunciation would serve this purpose better than adapting the sound. Given that, as mentioned above, the retention of foreign sounds in loanwords can induce sound change.

1.3 The social propagation of sound change

The role of social factors in sound adaptation, and consequently, sound change, seems even more plausible considering the degree to which articulatory variation and sound change in general depend on social factors such as gender, age, socio-

economic status, the formality of the situation, and so on (Trudgill 1972; Lakoff 1975; Coates 1986; Labov 2001). Speakers project and construct an identity with their linguistic productions. By pronouncing a feature in a certain way, they express group affiliation. For instance, speakers exaggerate dialectal features when the identity that is associated with this dialect is challenged (Bourhis and Giles 1977). Furthermore, socially-driven linguistic choices in pronunciation can ultimately lead to language change. Thus, language change has been found to be driven and propagated by linguistic differentiation along gender and socioeconomic lines (e.g., Labov 1972; Holmquist 1985; Guy 1989; Clarke et al.1995).

The spread of (external) sound change occurs via interaction, and thus depends on the dynamics of the interaction. Indeed, the dynamics of social circles have been argued to determine the propagation of sound change[1] (e.g., Milroy and Milroy 1985; Kerswill and Williams 2000; Labov 2001; Trudgill 2004; Stanford and Kenny 2013). Using simulations, Nettle (1999) has even argued that language change can only come about when the social conditions are suitable. Specifically, he argued that language change can occur only when, firstly, speakers widely differ in their status, and secondly, individual speakers adapt to the influential speakers (but see Labov 2007). In general, interlocutors accommodate to one another linguistically and non-linguistically, and such accommodation is at least partially driven by non-automatic social goals, as indicated by cases of hyper-accommodation and divergence (for a review, see Giles et al. 1991). The role of social factors in communication accommodation is also reflected in its sensitivity to factors such as speakers' desire for social affiliation (Natale 1975; Putman and Street 1984), speakers' prestige (Gregory and Webster 1996), and interlocutors' liking and attitude towards one another and the closeness of their relationship (Bourhis and Giles 1977; Gregory et al. 1997; Chartrand and Bargh 1999; Babel 2010, 2012; Pardo et al. 2012). Speakers have been shown to accommodate to their interlocutors' dialectal pronunciation, speech rate, level of standardness, frequency and length of pauses, gestures, and so on (Jaffe and Feldstein 1970; Coupland 1980; Street 1982; Thekarer et al. 1982; Chartrand and Bargh 1999). Therefore, speakers' rate of sound adaptation in loanwords might also be influenced by their interlocutors' rate of adaptation. This effect can come about either via interlocutor-specific accommodation or via alignment with the norm established in the interaction. In fact, previous studies often described accommodation in terms

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1 In this paper we limit our discussion to changes from above, also called external changes, and ignore changes from below, i.e., internal changes. External changes are ones that spread by diffusion from one group of speakers to a geographically, socially, or economically different group with which the group members have contact.

of conversational norms or pacts (e.g., Brennan and Clark 1996), yet the focus was usually on differentiating a priming explanation from a speaker-accommodation explanation. Even when the focus was different, these studies always included accommodation to a single interlocutor, or to two interlocutors in two separate interactions, thus confounding speaker-specific accommodation and accommodation to more general established conversational norms (Malt and Sloman 2004). As interactions can lead to the emergence of group norms, it is important to distinguish between the two types of alignment and study the role of each on language use at the individual and societal level, as well as their ability to lead to the propagation of sound change.

One may wonder whether accommodation to other speakers can lead to language change. Indeed, while early studies argued that it can, and provided evidence based on cases of dialect leveling, among others (e.g., Britain 1997; Trudgill 2004), others have later challenged these arguments (e.g., Hinskens and Auer 2005; Baxter et al. 2009). A couple of recent empirical studies speak to this issue. Goldinger and Azuma (2004) show that exposure to speech in the lab can influence pronunciation six days later. Another study examined a real-life situation – co-habitation of previously unacquainted roommates (Pardo et al. 2012). Analyses showed that the speech of the roommates exhibited modest convergence by the end of the first semester of co-habitation, and that this convergence related to roommates' perceived closeness. This is in line with the general finding that accommodation depends on attitude towards one's interlocutor (e.g., Giles et al. 1991). This study then lends some support to the argument that accommodation can influence pronunciation in the long term, at least at the individual level. Additionally, in a recent study we not only found that speakers adjust their likelihood of loanword sound adaptation according to their interlocutors' level of bilingualism, but also that there exist different adaptation norms for different geographic areas that differ in residents' level of bilingualism. Importantly, speakers' area of residence predicted their amount of adaptation, even after controlling for their interlocutors' and their own level of bilingualism. This pattern suggests that the area norms might have emerged as a result of repeated accommodation to a specific level of bilingualism through repeated interaction with speakers of that area who mostly have this level of bilingualism (Lev-Ari et al. under review).

Despite the wide agreement that social factors can influence sound change, this question has not been examined in relation to sound adaptation in loanwords, and, more importantly, the influence of social factors on language change in general has rarely been tested experimentally (but see Bourhis and Giles 1977; Gregory et al. 1997; Chartrand and Bargh 1999; Babel 2010, 2012; Pardo et al. 2012 for the role of social factors in accommodation).

1.4 Studying language change in the lab

Due to the slow nature of the process of language change, it is not straightforward to study experimentally. Language change research therefore often relies either on extensive documentation that spans decades or on cross-sectional studies (Labov 1972; Hopper and Traugott 1993). One exception is a body of research that uses experimental methods to investigate how articulation and perceptual constraints can lead to sound change (e.g., Ohala 1974, 1983, 1990; Hombert et al. 1979; Janson 1983; Guion 1998; Beddor et al. 2007; Engstrand et al. 2007). The past two decades, however, have seen a change of approach, and a growing number of researchers now attempt to model or experimentally simulate language change in order to trace the emergence of certain properties, such as compositionality (e.g., Brighton 2002; Christiansen et al. 2002; Kalish et al. 2007; Selten and Warglien 2007; Kirby et al. 2008). These studies, however, focus almost exclusively on language creation and learning, as their paradigm typically starts with a situation in which participants do not have or do not share a communication system and have to develop one. These studies are therefore less informative about the process of language change once an existing communication system is in place. To take a couple of examples, there are likely differences in what triggers the creation of a novel feature versus the modification of an existing one, and there might also be differences in the way that the novelty spreads. After all, creating a norm for a meaning that is not yet codified does not require the overriding of an existing norm, as in the case of a change. Experimental and computational studies of language *change* rather than language creation will allow us to understand when, why, and how new features are added or existing ones change, and how additions and changes in one feature influence other features. Furthermore, the focus on language creation in both modeling and experimental work has led to a focus on the role of communicative efficiency in language development, while the triggers for changes in existing languages are often social, such as patterns of social differentiation or affiliation and expression of socioeconomic status (Labov 2001). Similarly, because of the focus on language creation, common triggers to language change, such as language contact, have so far been ignored in these recent approaches.

In this study we focus on the process of change in an existing language and introduce a novel methodology of experimentally studying such change, or, in our case, its precursors, in the lab. In this methodology participants interact in small groups, allowing us to investigate the spread of a language feature through social interaction. Specifically, we explore the process of loanword sound adaptation. As language contact is a common trigger to language change, and both borrowing and pronunciation in general are aspects of language use that are highly

sensitive to social factors, this case is ideal for examining the role of social factors in influencing the course of language change.

2 Study

This study tests the influence of social factors on sound adaptation. Specifically, we test whether the prestige of a language in the loanword's semantic domain decreases the likelihood that foreign sounds in the loanword would be adapted. We additionally test whether speakers' likelihood of loanword sound adaptation depends on the productions of other speakers, and if so, whether speakers accommodate to their addressee's productions or to their community's productions. To test the influence of these social factors on sound adaptation, we designed a game that requires participants to use a novel word in spontaneous sentences. Specifically, we presented small groups of native French speakers with a novel Italian product that had a novel Italian name, Genna, /dʒɛnːa/, the initial affricate of which does not exist in French. The novel product was a novel Italian ice cream in half of the sessions, and a novel Italian beer in the other half. We chose these products to ensure we have both cases where participants perceive Italy's relative prestige with regards to France's as high (in the case of ice cream) and ones where they perceive it as relatively low (in the case of beer). The product was introduced via a recording of a supposedly French-Italian bilingual, who pronounced the novel word with the initial Italian affricate. Participants then played a modified version of the game Go Fish[2] centered on the new product. The cards in the game did not have a written label, and could only be requested by providing a thorough description, thus necessitating use of the novel word in spontaneous speech. The game was recorded and the speech was later analyzed for retention of the foreign sound /dʒ/ or its adaptation as a French phoneme. At the conclusion of the game, participants rated the prestige of multiple countries, including Italy and France, in terms of ice cream and beer, as well as their motivation to pronounce each of the languages they know without a foreign accent. We tested for the influence of these factors on the rate of sound adaptation, as well as examined the relation between interlocutors' rates of adaptation and their modulation as the game progressed.

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2 The goal of players in this game is to complete as many sets as possible by asking other players for their cards. The game is popular in many countries and is also known by the names *Happy Families*, *Sept familles*, *Quartetts*, and רביעיות, among others.

2.1 Method

2.1.1 Participants

Fifty-nine native speakers of French (F = 47, M = 12) participated in the experiment in 18 groups of three to four people each. Their average age was 22.8 (range: 18–44). One participant was excluded from all analyses because he did not rate France's prestige in the domains of beer and ice cream.

2.1.2 Stimuli and design

2.1.2.1 Recording

We recorded a native speaker of French providing information about the novel product. The speaker introduced himself at the beginning of the recording as a simultaneous French-Italian bilingual highly familiar with both cultures. The speaker then introduced the novel product and highlighted its advantages and its prestige. The speaker pronounced the name Genna with its initial affricate /dʒ/. The recordings for the two versions of the game were highly similar in structure, content, and length, and each included the novel name 14 times, including twice in a verb form: the infinitive *genner* /dʒene/ 'to eat/drink Genna'[3] and the gerund *gennant* /dʒenɑ̃/ 'eating/drinking Genna'. The recordings lasted 104 and 108 seconds for the beer and ice cream versions, respectively.

2.1.2.2 Card game

Participants played a modified version of a Go Fish game. In each version of the game, there were four sets of cards, each containing six cards (See Figure 1 for the cards). The cards themselves were not labeled, but the names of the sets were provided in written form (*servir Genna et bière/glace* 'to serve Genna and beer/ice cream', *repose-Genna et repose-bière/glace* 'Genna-holder and beer/ice cream-holder', *Genna et bière/glace débordent/fondent* 'Genna and beer/ice cream overflow/melt' *aller et être en train de genner* 'going to and being in the process of genning'; see Figure 1). Each set contained both target cards depicting the novel product as well as cards depicting the familiar version of the product (ordinary beer or ice cream). This necessitated use of the novel name in order to distinguish the target cards from the others. The sets were constructed such that description of the cards encourages use of the novel word in different syntactic roles and morphological structures: a noun in subject or object positions in two sets, a com-

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3 This verb form of the loanword is similar to the way other loanwords into French are used as verbs, for instance, *bluffer* 'to bluff'.
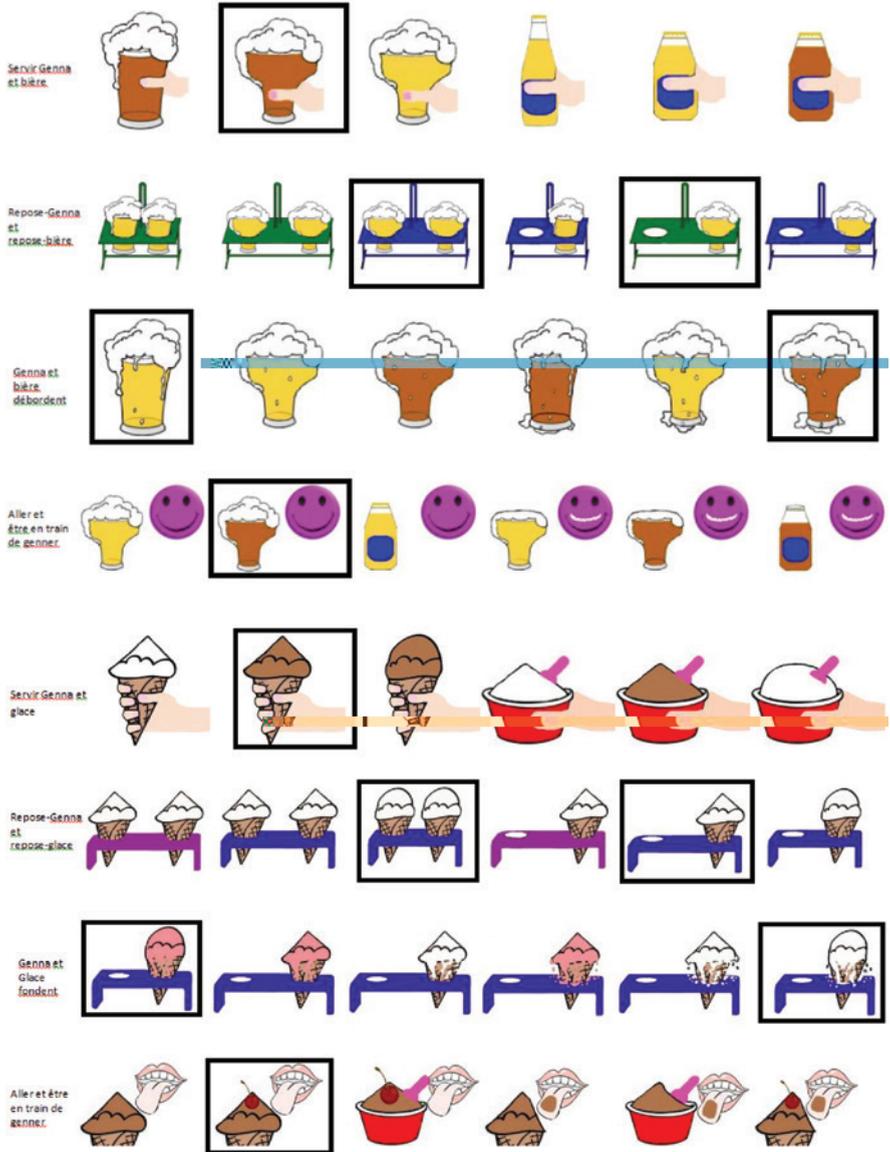
Fig. 1: The board and cards used in the game. Each participant received such a board that depicted all cards together with the names of the sets. The black rectangles indicate which cards a given participant might have received at the beginning of the game. Genna beer could be distinguished from ordinary beer by being served in a wider glass, supposedly because, unlike ordinary beer, it needs to breathe. Genna ice cream could be distinguished from ordinary ice cream by its conical shape, supposedly because it is better to serve it that way due to its unique texture.

pound noun in a third set, and a verb in the fourth set. The structure of the sets was identical for the two versions of the game.

2.1.3 Procedure

Participants played in groups of three or four. None of the participants knew any of the other participants in their group. The experimenter explained to the participants that they would play a modified version of Go Fish, and then detailed the rules of the game, which were as follows: Participants' goal was to accumulate as many sets of cards as possible. In each turn, a participant requested a specific card from one of the other participants. If the addressed participant possessed the card, she handed it to the requester, who could then request an additional card. If the addressed participant did not possess the card, the turn ended. Unlike the classic Go Fish game, turns did not go to the participant who answered 'no', but progressed in a fixed order, such that in each round of the game, each of the participants served once as a requester, and thus had an opportunity to use the novel name. The first requester was chosen randomly. Once a participant possessed all six cards of a set, the set was completed, and its cards could not be requested by others. The game ended once all sets had been accumulated.

After explaining the rules of the game, the experimenter explained that the game would revolve around a novel product, and then played the recording. Following the recording, the experimenter showed the participants the cards, and explained how to distinguish the novel product from ordinary ones. The experimenter produced the product's name with an unadapted /ʤ/ during her explanation. Once all participants understood the game, the experimenter distributed the cards and started recording the session.

After the game had ended, participants filled out a questionnaire about the prestige of different countries in terms of beer/ice cream, their liking and consumption of the product in general, how Italian the word sounded, as well as their proficiency in foreign languages and their motivation for speaking these languages without a foreign accent.

2.2 Coding

2.2.1 Adaptation

All occurrences of the novel word in all morphological forms were analyzed and coded for retention or adaptation of /ʤ/. Adaptation was always to the French phoneme /ʒ/. There were a total of 1,046 tokens. The number of tokens per ses-

sion ranged from 29 to 114 (M = 58, SD = 20.8), and the number of tokens per speaker ranged from 5 to 55 (M = 17.6, SD = 8.8). The shortest game ended during the 2nd round, the longest one during the 8th (M = 4.8). Ten percent of the data (N = 105) were also coded by a second coder. There was 96.2% agreement between the two coders. Overall, the average adaptation rate was relatively low, and stood at 17%.

2.2.2 Relative prestige

Participants were asked to rate the prestige of 12 different countries, including France and Italy, in terms of their ice cream/beer on a 10-point scale. Italy's relative prestige was calculated for each participant as the difference between the rating given to Italy and that given to France in the product's domain.

2.2.3 Pronunciation motivation

Participants rated for each of the languages they speak their motivation for pronouncing it without a foreign accent using a 10-point scale. Six participants indicated knowing some Italian. For these participants, the rating they provided for Italian was used. For all other participants, the average of all the Pronunciation Motivation ratings they provided was used.

2.2.4 Addressee-specific accommodation

For each token, we calculated the frequency that the sound /dʒ/ was adapted by the participant's addressee in that utterance until that point in the game.

2.2.5 All-interlocutors' accommodation

For each token, we calculated the frequency that the sound /dʒ/ was adapted by all other interlocutors until that point in the game.

2.3 Results and discussion

First, we examined whether our product manipulation was successful in eliciting different relative prestige levels for Italy. We therefore ran a regression with Prestige rating as a dependent measure, and Country (Italy, France) and Product

(Beer, Ice Cream) as predictors. The analyses revealed the predicted interaction between Country and Product (β = −6.1, SD = 0.78, t = −7.75, p < 0.001). Italian ice cream was rated as more prestigious than French ice cream (M = 9.77, SD = 0.5 and M = 5.55, SD = 2.58, respectively; β = 4.23, SD = 0.54, t = 7.86, p < 0.001, Cohen's d = 2.27), while French beer was rated as more prestigious than Italian beer (M = 5.89, SD = 2.56 and M = 4.04, SD = 2.19, respectively; β = −1.85, SD = 0.57, t = −3.25, p < 0.01, Cohen's d = 0.78). Additionally, an examination of participants' questionnaire responses revealed that they found the novel word to be Italian sounding (M = 8.35 on a 10-point scale). Therefore, assured that our manipulation succeeded, we used participants' relative prestige ratings in the full analysis, as this measure is more fine-grained.

We ran a full mixed model analysis with Maximum Likelihood fitting with Participant as a random factor, and Addressee-Specific Productions, All-Interlocutors' Productions, Relative Prestige, Pronunciation Motivation, as well as the interaction of Relative Prestige with Pronunciation Motivation, as fixed factors. The model included an intercept and a slope for All-Interlocutors' Accommodation for the Participant variable.[4] As predicted, a language's relative prestige in the domain of the product influenced the rate of adaptation (β = −0.36, SD = 0.17, z = −2.13, p < 0.04), such that participants were less likely to adapt the foreign sound the more prestigious they found Italy compared to France in the product's domain. Results also showed that participants were also influenced by the behavior of their interlocutors as a whole – they accommodated to the entire group (β = 3.75, SD = 1.7, z = 2.2, p < 0.03), yet not to their specific addressee (β = 0.95, SD = 0.74, z = 1.28, n.s.). Additionally, participants were marginally less likely to adapt the more motivated they were to pronounce foreign languages without a foreign accent (β = −0.17, SD = 0.1, z = −1.75, p < 0.08).

Next, we examined whether participants' adaptation to other interlocutors indeed led to an emergence of a norm. To do this, we considered those sessions in which at least two full rounds took place and in which participants did not all exhibit the exact same rate of adaptation in the first round, such that they had room for convergence. This was the case for 8 out of 18 sessions. To test whether there was convergence to a norm as the game progressed, we calculated Shannon's H index of entropy for the first and for the last round in every game. In cases

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4 We did not include a slope for Addressee-Specific Productions, as a likelihood ratio test indicated that it does not improve the model, even when using much more lenient p-values (p > 0.2; Baayen 2008). Note that the main reason for including slopes is to prevent spurious effects. As described later, we did not find an effect for Addressee-Specific Accommodation anyway. Other factors were manipulated between participants, and therefore their slopes cannot be modeled.

of uniform behavior in the last round, we replaced the probability of 0 with $1/2n$, where n stands for the number of tokens in that round. We then compared with a t-test the H index values for the first and last round. Analysis showed that participants' variability in these sessions was reduced by the end of the game ($t(7) =$ 2.58, $p < 0.05$; see Figure 2). Specifically, the average entropy value decreased from 0.47 in the first round to 0.17 in the last round. As can be seen in Figure 3, the decrease in variation was quick. Indeed, the average entropy value dropped to 0.27 by the second round.

One may wonder whether an existing norm can change. While we did not have enough information to test this formally, we explored the data for qualitative patterns. We thus looked at the sessions that had at least two full rounds and started with full consensus. There were nine such sessions. We examined whether any of the participants in these sessions introduced a change, and if so, whether and how it influenced the group norm. In two of the sessions, none of the participants diverged from the norm throughout the game. In four others, one of the participants introduced a change, but when it was not picked up by any of the other participants the next time they spoke, the diverging participant returned to the group norm. In yet another session the change was introduced in the last round of the game, so we cannot track its development. Interestingly, in the remaining two sessions a norm change seems to have taken place. Specifically, in one of the sessions, even though no participant adapted during the first round, one of the participants adapted in the second round, a change that was gradually taken up by the others, leading to an average adaptation rate of 17% in the second round and 54% by the third and last round (see Figure 4). In the other session, one of the participants introduced a specific complex norm in the second round, that is, adaptation only when the word appears as a verb (e.g., *genner* 'to eat/
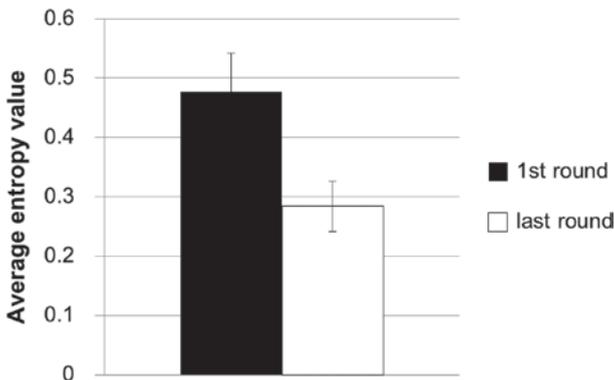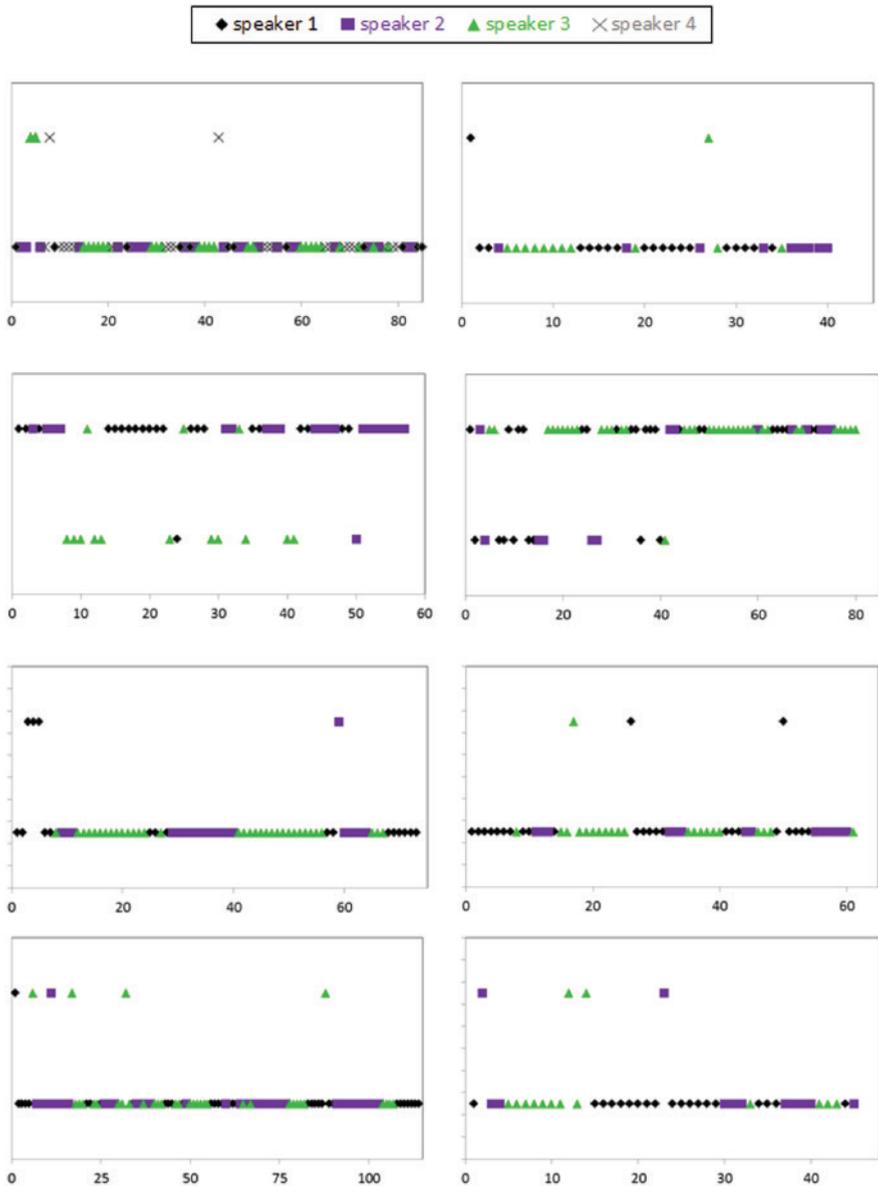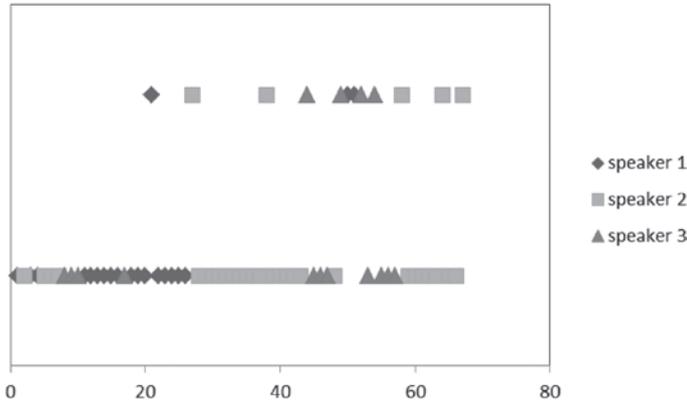

Fig. 2: Average entropy in the first and last rounds of the game.

Fig. 3: Adaptation by speaker along the sessions (each panel presents one session). The x-axis indicates the serial number of each token. The y-axis indicates whether the sound had been adapted. The top row indicates adaptation, and the bottom row indicates retention.
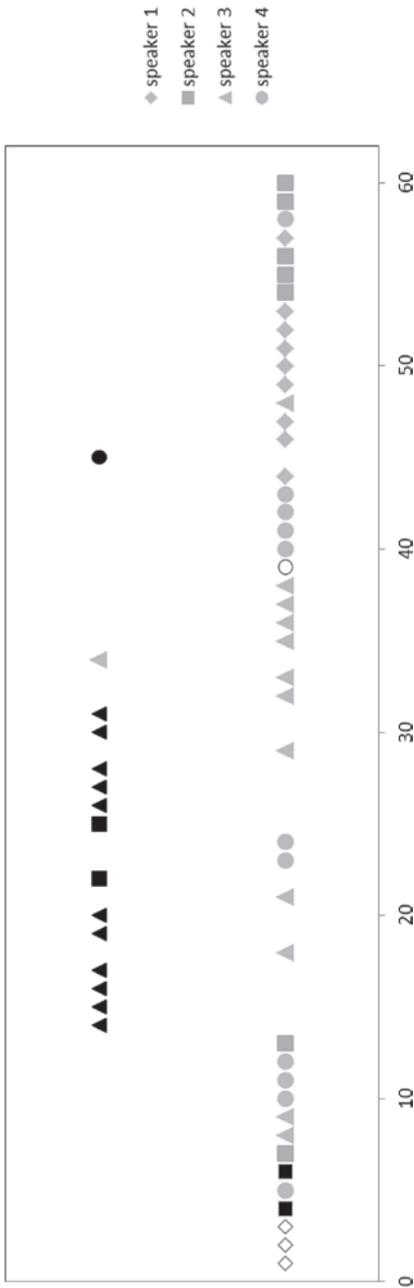
Fig. 4: Adaptation by speaker along the session. The x-axis indicates the serial number of each token. The y-axis indicates whether the sound had been adapted. The top row indicates adaptation, and the bottom row indicates retention. Speaker 1 introduced adaptation in round 2, and this behavior was gradually taken up by the other speakers.

drink genna'). This norm was immediately picked up by the others: in *all* following productions of the word as a verb, by *any* of the speakers, the sound was adapted. In contrast, the sound was rarely adapted when it later appeared in other morphological forms (3% adaptation rate; see Figure 5). It seems, then, that convergence on a norm might not always represent an end state, but that at any given point in time, an interlocutor can challenge the norm, and potentially lead to its change.

3 Conclusion

The results of the present study show that some of the variability in loanword sound adaptation can be accounted for by social factors. The results further trace the way that effects at the individual level later lead to the emergence of sound adaptation norms, which are precursors to sound change. They show the importance of both situation-independent and situation-specific factors. Thus, general social attitudes, such as the donor language's prestige, influence whether or not its sounds will be retained in loanwords. At the same time, the dynamics of the interaction itself have an influence as well. That is, speakers' likelihood of adapting a foreign sound depends on their interlocutors' rate of adaptation, thus leading to convergence and the emergence of adaptation norms. Note that our methodology does not allow us to differentiate convergence as a result of all group

Fig. 5: Adaptation by speaker along the session. The x-axis indicates the serial number of each token. The y-axis indicates whether the sound had been adapted. The top row indicates adaptation, and the bottom row indicates retention. Color indicates word type (gray: monomorphemic noun; white: compound; black: verb. Speaker 3 introduced a new norm of adapting the sound only when it is in a verb form in round 2, and this norm was immediately adopted by the others.

members adjusting to all other group members and convergence as a result of all group members adjusting to one influential speaker. Nevertheless, the study shows how social attitudes, the dynamics of social circles, and factors relating to interactional dynamics could influence loanword sound adaptation and, in the long term, sound change. The results of this study are in fact in line with recent *sociolinguistic* evidence we gathered regarding the pattern of loanword sound adaptation in loanwords from Spanish into Mexicano (Lev-Ari et al. under review). The data we examined came from spontaneous productions of real loanwords during group interactions. We found that, similarly to here, speakers were more likely to retain the foreign sounds in loanwords in domains in which Spanish is more prestigious than Mexicano (e.g., education, technology) than in domains in which Mexicano is more prestigious than Spanish (the social domain). Moreover, as in this study, speakers were more likely to adapt a foreign sound if their interlocutor had just adapted that sound. This study provides converging experimental evidence to these findings.

Our unraveling of the role of social factors is possible due to the focus on language change rather than language creation. As mentioned in the introduction, while sociolinguistic studies of language change examine the role that social factors play in language change, previous experimental studies focused instead on perceptual constraints and on communication efficiency. The focus on non-social factors is partially due to the growing tendency to simulate the process of language creation rather than change. It is by tracing the evolution of existing communication systems that we can understand the role of socially complex situations and examine common triggers to language change.

Our study introduces a novel methodology for studying loanword sound adaptation, and language change in general. Most studies on language change make use of the methodology of iterated learning, where participants' or models' input is contributed by previous participants or models (e.g., Selten and Warglien 2007; Kirby et al. 2008). While this methodology has been proven useful for understanding some aspects of language evolution, it lacks the social aspect of language use, which, as has been shown here, plays a significant role in language change. The methodology of using an interactive game to study cultural evolution has been used previously (Baum et al. 2004). We show that it can be adapted to the study of the precursors of sound change.

Our findings open an avenue for the study of social factors in sound adaptation and language change, as has been done in the study of communication accommodation (see Bourhis and Giles 1977; Gregory et al. 1997; Chartrand and Bargh 1999; Babel 2010, 2012; Pardo et al. 2012). Based on our findings, we suggest that future research should examine the role of interactional factors, such as interlocutors' personality and status, in sound adaptation. Such factors could

influence the degree and stability of convergence, since accommodation is not always symmetrical (e.g., Giles et al. 1991). If a loanword is more likely to be used by members of a specific social group, then interaction-specific factors could exert the same influence in multiple interactions in parallel, thus potentially influencing sound change. The fit of the loanword with social stereotypes might also matter. We introduced a loanword that our participants perceived as very Italian-sounding. If the loanword is less typical or representative of the donor language, sound adaptation might not depend on the donor language's prestige to the same degree.

Finally, our results raise questions regarding the role of situation-specific vs. situation-independent factors over time. With further generations, the weight of these two types of social factors could change, depending on whether social attitudes at the societal level change or remain the same, and on the degree to which an adaptation process can be reversed. The methodology used in this study could be modified to answer such questions by adding and removing participants to add a generational aspect (see Baum et al. 2004), and by manipulating participants' knowledge of the words' origin, participants' social status, and so on. The results of this study, then, do not only show an effect of social factors on loanword sound adaptation, but open up a new domain of experimentally studying sound adaptation, and more generally language change, in a manner that integrates social factors.

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Appendix: Additional analyses

We conducted a few additional analyses to rule out the possibility that the effects we found are due to correlation with unexamined factors.

A.1 Additional unexamined factors

First, we examined a few additional factors that could potentially influence adaptation rate. We ran a more comprehensive model that included the following additional factors.

A.1.1 Liking of the product

We wanted to ensure that prestige ratings indeed reflect prestige rather than liking of the product. The questionnaire that participants filled out at the conclusion of the game included a question that asked them to rate how much they like beer/ice cream. We entered this rating into the model.

A.1.2 Familiarity with the product

We wanted to ensure that prestige ratings do not reflect familiarity with the products. The questionnaire that participants filled out at the conclusion of the game included a question that asked them to rate how often they consume beer/ice cream. We entered participants' rating into the model.

A.1.3 Word type

To ensure that the effects are not due to an uneven distribution of use of word types among participants, we coded for each token whether the word was a monomorphemic noun, a compound, or a verb, and entered this into the model.

The final model then included Participants as a random variable, and Relative Prestige, All-Interlocutors' Production, Addressee-Specific Production, Pronunciation Motivation, Liking, Consumption, Word Type, and the interaction of Prestige and Pronunciation Motivation as fixed factors. The analysis included both an intercept and a slope for All-Interlocutors' Productions for the random variable. This analysis revealed a marginal effect of Liking. Participants were

marginally less likely to adapt the sound the more they liked the product (β = −0.28, SD = 0.15, p < 0.06). Word Type also played a role: monomorphemic nouns were less likely to be adapted than compounds (β = –1.03, SD = 0.44, p < 0.02) and verbs (β = –1.46, SD = 0.36, p < 0.001). Importantly, the effect of Relative Prestige remained significant (β = −0.41, SD = 0.17, p < 0.02). The effect of All-Interlocutors' Productions remained significant as well (β = 4.67, SD = 1.72, p < 0.001). The effect of Pronunciation Motivation was significant (β = −0.21, SD = 0.1, p < 0.04), as was the interaction of Pronunciation Motivation and Relative Prestige, which moderated each other's effect (β = 0.06, SD = 0.03, p < 0.03).

A.2 The specificity of prestige

We also examined whether the effect of prestige that we found is specific to the prestige of Italy in the product's domain rather than in general. In 14 out of the 18 sessions, participants rated the prestige of France and Italy in both the domain of ice cream and beer (in the first four sessions, we have incomplete data regarding the domain that was not used in the game). Running the comprehensive model, including the Relative Prestige of Italy in the irrelevant domain on the data from these 14 sessions reveals that Relative Prestige in the irrelevant domain does not influence rate of sound adaptation (z < 1), while Relative Prestige in the relevant domain and All-Interlocutors' Productions remain significant predictors (β = −0.7, SD = 0.3, p < 0.03; β = 6.29, SD = 1.53, p < 0.001). Additionally, Relative Prestige significantly interacted with Pronunciation Motivation (β = 0.1, SD = 0.04, p < 0.01).

A.3 Pronunciation motivation versus ability

The target segment in the study was one that can easily be produced by native French speakers. Still, it is important to ensure that underlying differences in ability to produce the segment do not underlie the effect of Pronunciation Motivation, as ability and motivation might be correlated. Indeed, the two were correlated in our data set (r = 0.34, p < 0.01). Nevertheless, alternative models that included Pronunciation Ability instead of or in addition to Pronunciation Motivation revealed a positive association between ability and adaptation rate, such that higher self-ratings of Pronunciation Ability in other languages was associated with higher rates of adaptation. This pattern is the opposite of the one found for Pronunciation Motivation, and therefore, the effect of Pronunciation Motivation cannot be explained by differences in ability.