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Lexical Entrainment in Bilingual Language Use

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Abstract

Lexical entrainment is a phenomenon in which people tend to re-use the words used by conversational partners (Brennan & Clark, 1996). It is explained as either an automatic reaction caused by priming (Pickering & Garrod, 2004), or a strategic behavior where two interlocutors achieve conceptual agreements for communicative purposes (Brennan & Clark, 1996). Past studies suggest that speakers tend to entrain more when interacting with listeners with lower language competence, such as computers (Branigan, Pickering, Pearson, McLean, & Brown, 2011), children (Cai, Sun, & Zhao, 2021), and non-native partners (Cai et al., 2021; Suffill, Kutasi, Pickering, & Branigan, 2021). However, few studies have explored how the features of speakers themselves determine the pattern of entrainment, and the studies that do exist suggest that speaker proficiency (as opposed to listener proficiency) may not affect entrainment behavior. In this study, we target bilingual groups and explore individual differences in lexical entrainment by looking at their entrainment behavior with picture matching and naming tasks. Over the course of two experiments, we investigate English entrainment in English-speaking bilinguals, as well as Mandarin entrainment in Mandarin-English bilinguals. Unlike the previous literature, our results suggest that a speaker's language dominance/proficiency may have an effect on that speaker's entrainment: bilinguals who are less dominant/proficient in English tend to entrain more in English, although the effect in Mandarin did not reach significance.

Keywords: lexical entrainment, lexical alignment, bilingualism, proficiency, language dominance

Introduction

In conversations, the language use by two interlocutors becomes more similar at phonological, lexical, and even syntactic levels. The alignment in lexical use is called lexical entrainment (Brennan & Clark, 1996), meaning that people tend to re-use the words from conversational partners. The mechanisms that drive lexical entrainment are still subject to debate. Pickering and Garrod (2004) argued that it is an automatic reaction caused by priming. Another explanation is that entrainment is a high-level strategic behavior to help people communicate (Garrod & Anderson, 1987; Brennan & Clark, 1996). To understand the mechanisms of lexical entrainment, previous studies investigated the factors affecting entrainment behavior. For instance, lexical entrainment is partner-specific: talking to different conversational partners yields different entrainment patterns (Brennan & Clark, 1996; Horton & Gerrig, 2002, 2005; Metzing & Brennan, 2003). Moreover, the linguistic competence of the conversational partner also relates to whether the speaker tends to entrain (Branigan et al., 2011; Cai et al., 2021; Suffill et al., 2021).

On the other hand, language proficiency of speakers has been claimed to be less crucial in predicting their entrainment behavior (Suffill et al., 2021; Zhang & Nicol, 2022). However, there are robust individual differences among speakers in the rates that they entrain (Tobar-Henríquez, Rabagliati, & Branigan, 2020), suggesting unexplained variation on the part of speakers. In the current study, we investigate entrainment in English-speaking bilingual groups and compare their entrainment rates with different measures of language proficiency.

Lexical entrainment

We know that one concept can be expressed in multiple ways using different words. For instance, if we want to describe a computer, the most frequent word is *computer*. Other words like *laptop* can also be used to describe a portable computer. Thus, these two words sometimes can be used interchangeably. When two interlocutors are talking about a portable computer, the speaker in the conversation has at least two options: *laptop* vs. *computer*. The word choice for the speaker is not always consistent throughout the whole conversation. For example, even if the speaker has chosen to use *computer* at first, he or she is likely to change their word choice to *laptop* after hearing many times *laptop* from the conversational partner. This behavior where the speaker changes their word choice to align to the partner is lexical entrainment.

One theory to explain lexical entrainment argues that lexical entrainment reflects conceptual agreements established between a speaker and a conversational partner (Garrod & Anderson, 1987; Brennan & Clark, 1996). Once both the speaker and the conversational partner achieve an agreement with the conceptualizations of the items they are talking about, shared words linked to the concepts can be repeatedly used in the conversation, and in this way entrainment occurs. Moreover, the role of the partner is important in the process of establishing the conceptual agreements. Changing to a new partner would require the speaker to establish new agreements with the new partner (Brennan & Clark, 1996). Under this perspective, factors related to partners are considered important in affecting the speakers' lexical use and entrainment behavior.

On the other hand, lexical entrainment has been claimed to be a consequence of interactive priming effects (Pickering & Garrod, 2004). Pickering and Garrod (2004, 2006) developed an interactive alignment model to investigate the mech-

anisms underlying the alignment (i.e., entrainment) behavior in conversations. In their model, they proposed that two interlocutors align to each other at lexical and syntactic levels. These alignments are caused by priming, so the alignment in these levels is automatic and passive. Alignment in these lower levels then leads to the alignment of representations in a higher level targeting meaning. To make the communication successful, the automatic alignment helps interlocutors to construct common representations, which prevent misunderstandings. Different from the theory of conceptual agreements (Garrod & Anderson, 1987; Brennan & Clark, 1996), this model de-emphasizes the particular effect on alignment or entrainment from the conversational partner.

Partner's language proficiency   Previous empirical studies have investigated possible factors related to lexical entrainment. One of the factors is the language proficiency, or language competence, of conversational partners. In Branigan et al. (2011), the authors showed that linguistic competence affects human speakers' entrainment performance. They tested speakers' entrainment rate when interacting with computers, and found that speakers tended to entrain more when speaking to computers who showed obviously lower language competence compared to speaking to other humans. This finding was supported by a recent study from Cai et al. (2021). In the study, the authors observed the entrainment behavior of human adults when speaking to children and the entrainment of native speakers when speaking to non-native partners. Both groups of participants showed more entrainment, presumably because children and non-native speakers have lower proficiency. The evidence indicates that speakers' entrainment behavior can be predicted at least in part by listener proficiency. When talking to partners who are less proficient in the language—such as children, computers, and non-native partners—speakers tend to adapt their lexical use to more closely match the lexical use of their partners; this adaptation presents as lexical entrainment. Suffill et al. (2021) argued that this result occurs because of audience design, where speakers adapt their speech according to their beliefs about whether the listener understands them. According to this story, when interacting with partners who are less proficient, speakers entrain because they believe this behavior helps the partners to understand them better.

Speaker's language proficiency   While there is robust evidence to support the relationship between entrainment and a partner's (i.e., listener's) language proficiency, we know less about the effect of speakers' language proficiency on their entrainment. Some recent studies have investigated the entrainment of non-native speakers and their language proficiency. However, they did not find that speaker proficiency mediated entrainment rates. Suffill et al. (2021) compared the English entrainment of native speakers vs. non-native speakers when interacting with either native listeners or non-native listeners. Because audience design is cognitively demanding and non-native speakers may have fewer resources to engage in

this sophisticated reasoning in their second language, the authors expected that non-native speakers should entrain less than native speakers when interacting with non-native listeners. They used the Language Experience and Proficiency Questionnaire (LEAP-Q; Marian, Blumenfeld, & Kaushanskaya, 2007), a questionnaire about language exposure and proficiency, to assess English proficiency of their non-native participants. The authors found that native speakers entrained more when interacting with non-native listeners (similar to the results summarized in the previous subsection). However, they did not find a similar relationship in non-native speakers, nor the relationship they hypothesized that non-native speakers entrained less with non-native listeners. By looking at the relationship between non-native speakers' proficiency and entrainment, they concluded that speaker proficiency did not predict the non-native speakers' entrainment.

Zhang and Nicol (2022) arrived at a similar conclusion, namely that speakers' proficiency affects their English entrainment to a lesser extent. They investigated L1 Mandarin–L2 English bilinguals and grouped their participants into lower-intermediate and higher-intermediate groups according to their levels in an English as a foreign language class; they then tested their entrainment rates while manipulating partner language proficiency (native vs. L2 learner). The authors found that Mandarin-English bilinguals entrained more when they perceived that they were interacting with a native speaker compared to L2 learners. This result supports the essential role of partners' proficiency in entrainment. The authors explained that non-native speakers may still be engaged in the process of language learning, which yields entrainment. However, comparing across the groups of lower-intermediate and higher-intermediate participants, they did not find an effect of speaker proficiency. Thus, speakers' language proficiency was claimed to have less impact on entrainment.

Despite these initial findings, the robust individual differences observed in entrainment (Tobar-Henríquez et al., 2020) indicate that there are differences across speakers that have yet to be fully investigated. One feature that may lead to individual differences in lexical entrainment is a speaker's proficiency and language dominance. For non-native speakers, one important process in lexical entrainment is that they assess not only the listener's language competence, but also their own. In other words, (non-native) speakers need to assess if their word choice is appropriate and effective in communication based not only on the proficiency levels of the listener, but also the discrepancy of the proficiency between themselves and the listener. For speakers who are less proficient, they may be more uncertain about their word choice. That uncertainty and reduced confidence possibly affects entrainment behavior. In our study, we therefore target bilingual groups as a lens through which to further explore the individual differences occurring in lexical entrainment.

Studying Entrainment in Bilinguals

The studies of Suffill et al. (2021) and Zhang and Nicol (2022) provide an initial understanding on how bilinguals en-

train in their non-native language, but there are additional factors that underlie the variety of bilingual language use that warrant investigation, specifically those relating to the interaction between a bilingual's L1 and L2.

Bilinguals vary according to their proficiency, dominance, and the language environments they inhabit. For example, some bilinguals speak their native language at home with family but are raised in a society where the dominant language (their L2) is different; these heritage bilinguals wind up using the second language more outside the home and as a result they typically become more dominant in their second language (Polinsky & Scontras, 2020). Other bilinguals may learn a second language in a classroom setting, or acquire their second language as adults. Each of these groups may have differing levels of proficiency or dominance in their two languages, and their language attitudes are likely to differ as well.

Other features of the language environment may contribute to variability. For example, Beatty-Martínez and Dussias (2017) discuss how Spanish-English bilinguals in Spain have different experiences using both languages compared to Spanish-English bilinguals in the U.S. In Spain, where Spanish is the dominant societal language, there is little to no code-switching for Spanish-English bilinguals. In contrast, bilinguals in the U.S. have much more code-switching because their language environment is more varied. Even though these populations may have similar proficiency, they use their language in different ways.

The investigation of bilingual lexical entrainment may benefit from taking into account the variety of bilingual language use, specifically when operationalizing and measuring language proficiency. In Suffill et al. (2021), proficiency was measured by a questionnaire, which relies on the subjective self-assessment of participants. One may ask whether a more objective measure would yield different results. In Zhang and Nicol (2022), although bilinguals were more objectively grouped based on their class levels and exam scores, this coarse sorting may obscure more fine-grained differences among individuals. Moreover, both studies only focused on bilinguals' proficiency and entrainment in their L2. These studies did not look at relative proficiency across the bilinguals' two languages—that is, their relative dominance—nor did they compare entrainment in L1 vs. L2 to see if entrainment behaves differently in the two languages.

The Present Study

In the present study, we targeted bilinguals who are proficient in English, including both L1 and L2 English speakers, and investigated their lexical entrainment behavior and the factors affecting their entrainment rate. Specifically, we test whether speaker proficiency affects entrainment rates. We conducted two experiments. Experiment 1 tested the English entrainment behavior of bilinguals who are proficient in English and another language. Experiment 2 tested the Mandarin entrainment behavior of bilinguals who are proficient in Mandarin (their L1) and English (their L2). Participants in both experiments completed picture-matching and naming tasks for the measurement of entrainment rate. We measured proficiency using subjective self-reports from a demographics questionnaire and a more objective verbal-fluency task eliciting names for category members.

Experiment 1: Entrainment in English

Experiment 1 investigated the entrainment rate in English of bilinguals who are proficient in English. The experiment was conducted online.

Method

Participants   We used our university participant pool and social media to recruit 100 bilinguals who are proficient in English (29 females, 70 males, and 1 unspecified gender). The average age of participants is 27, ranging from 18 to 35. After data cleaning, 67 participants were included in our analyses. These participants include 42 L1 English speakers and 25 L2 English speakers. The majority of participants are Spanish-English bilinguals (44), followed by Chinese-English bilinguals (14), as well as a small number of French (3), Cantonese (2), Vietnamese (1), Japanese (1), Korean (1), and Armenian (1) speakers. All participants were in the U.S. at the time of testing.

Norming   We first performed a norming study to choose the stimuli for our task. Fifty-six English speakers were recruited to perform a spontaneous picture-naming task. In the task, participants encountered 69 images one at a time and typed a name for the object they saw, then they typed a second name. We used these data to measure the frequency of responses for each picture selected for the task. For our main task, we chose pictures that have at least two different words to describe them, and we used their second most frequent description as the entrainment target. Pictures and names were selected for experimental stimuli if the relative frequency of the first vs. second name provided was biased in favor of the first name, with the difference in proportional frequency between the two names ranging between 0.13 and 0.86. 26 stimuli (see Table 1) were chosen and used in the following picture matching and naming task.

Picture matching and naming task   We used a picture matching and naming task to measure the entrainment rate. The task was originally designed and used by Branigan et al. (2011). There are four trials as a sequence for each experimental item in the task, including two matching trials and two naming trials. The matching trial asks participants to match a written word with one of two pictures. The naming trial asks participants to type in the name of a pictured object. The first trial in the four-trial sequence is a matching trial where participants see two pictures and a word on the screen (see Figure 1). The word in the matching trial is a disfavored word selected from the norming study. One of the pictures (i.e., the target picture) can be described with the given word, and another picture is an unrelated distractor.

Object	English	Mandarin
bathtub (浴缸)	tub	澡盆
bike (自行车)	bicycle	单车
boat (帆船)	sailboat	船
bomb (炸弹)	explosive	炸药
bucket (水桶)	pail	桶
bus （校车）	school bus	巴士
chicken (鸡)	hen	母鸡
crackers (饼干)	saltines	苏打饼干
frog (青蛙)	toad	蛤蟆
glasses (眼镜)	spectacles	近视眼镜
gun (手枪)	pistol	枪
handcuffs (手铐)	cuffs	镣铐
jacket (外套)	sweater	夹克
lipstick (口红)	makeup	唇膏
needle (针)	pin	针线
peach (桃子)	nectarine	水蜜桃
pen (圆珠笔)	ballpoint	笔
phone (手机)	cellphone	智能手机
pillow (枕头)	cushion	抱枕
rabbit (兔子)	bunny	野兔
radio (收音机)	stereo	电台
stairs (楼梯)	staircase	台阶
swan (天鹅)	bird	鹅
sword (剑)	dagger	宝剑
tape (磁带)	cassette	录音带
utensils (餐具)	silverware	刀叉

Table 1: English nouns used in experimental stimuli for Experiment 1 and Mandarin translations used in Experiment 2. Nouns in the Object column are the frequent names for the image, while nouns in the English and Mandarin columns are less-frequent names used as the entrainment targets.

Participants need to match the word with the picture by clicking the correct picture. Then, there is a filler naming trial and a filler matching trial. The filler items were selected from our norming data to be pictures that have only one high-frequency name (i.e., almost every participant in our norming study responded with the same word). In the fourth trial, participants completed an experimental naming trial. In this trial, participants encounter the target picture from the first trial in the sequence again and they are asked to name it. If participants name the target picture with the word they previously saw from the experimental matching trial, then we code the response as entrainment. Participants completed a total of 104 trials (i.e., 26 four-trial sequences).

Procedure The experiment was conducted online on Gorilla (https://gorilla.sc/). Participants joined a Zoom session and a researcher introduced the tasks to them. Then, participants moved to a Zoom breakout room to complete the experiment individually. The experiment started with LEAP-Q to assess their language background. Then, participants com-
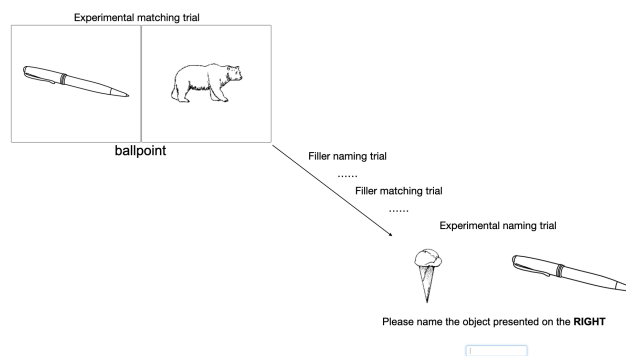

Figure 1: Example experimental matching and naming trails from the picture matching and naming tasks. In the example, participants saw *ballpoint* and needed to match the word with the target picture (i.e., the pen). Then, after two filler trials, they saw the target picture again in the experimental naming trial and were asked to name it. If they produced *ballpoint*, their response was coded as entrainment taking place.

pleted the picture matching and naming task. After the picture matching and naming task, participants completed a verbal fluency task to assess their language dominance/proficiency. In the verbal fluency task, participants were given a series of category names (e.g., *vegetables*) and they spoke as many names for members of the category as possible in 30 seconds. The verbal fluency task was broken into two parts, with four category names in each part. Participants completed the first part in English, and completed the second part in a language that they felt most comfortable to use other than English. Participants were instructed that the language should be either their native language (L1) or their second language (L2). Participants responded to different categories in each language (four chosen from a total of eight), but which categories they responded to in which language was counterbalanced.

Results

We transcribed the data from the verbal fluency task and excluded participants who completed the task incorrectly (i.e., did not follow the instructions or missed more than two categories in one session) or provided invalid responses. After the data cleaning, 67 participants were included in the analysis. For the analysis, we calculated language dominance both from the self-reported proficiency questions (LEAP-Q) and the results of the verbal fluency task (VF). In the questionnaire, there are three questions asking about participants' proficiency in reading, understanding, and speaking in English and their other language. For each question, responses are coded on a scale from 0 to 10. To calculate mean proficiency, we first averaged the answers of the three questions for each language. Then, we subtracted the mean proficiency of the other language from the mean English proficiency to get our self-reported English dominance score. In the verbal fluency task, we calculated the mean of the number of re-
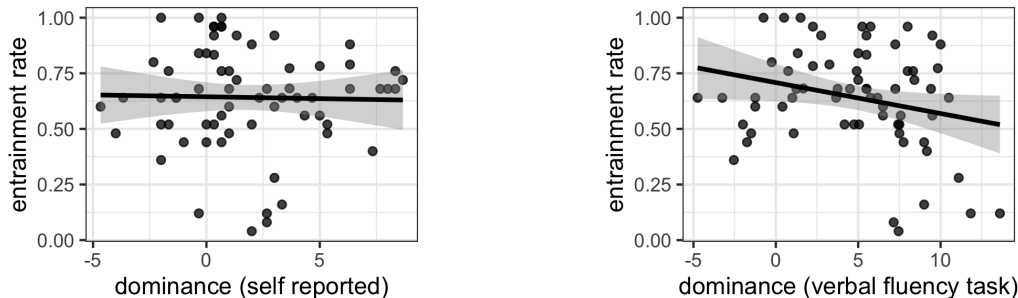
Figure 2: Results of Experiment 1 (entrainment in English): entrainment rate correlated with self-reported language dominance (left), and entrainment rate correlated with verbal fluency (VF) language dominance (right). Dominance was calculated as English dominance (values above 0 indicate that participants are more English dominant).

sponses across the four categories for each language. These means served as the language-specific proficiency score; we calculated English VF dominance by subtracting the other language's mean from the English mean. We used relative language proficiency, indicated as language dominance, instead of language-specific proficiency, as a way to investigate bilinguals who may be highly proficient in both languages but differ in dominance of language use. After calculating dominance scores, we compared the scores with participants' entrainment rates (see Figure 2). We ran a separate logistic mixed effects model predicting entrainment by each language dominance measure with random intercepts for items and participants. The self-reported dominance is not a reliable predictor of entrainment behavior ($\beta = -0.02$, $p = 0.64$). However, the VF dominance is a reliable predictor: English bilinguals who are more dominant/proficient in English tended to entrain less ($\beta = -0.08$, $p < 0.05$).

Discussion

Our results suggest that speaker proficiency as operationalized by language dominance does relate to entrainment rates for English bilinguals, but only some measures of dominance are able to pick up on this relationship. The self-reported dominance scores showed no effect, in line with previous results using these scores (Suffill et al., 2021). However, the verbal-fluency measure showed that dominance negatively correlated with bilingual entrainment rates: bilinguals who are less dominant in English entrained more in English.

Experiment 2: Entrainment in Mandarin

Experiment 2 investigated the entrainment behavior of Mandarin-English bilinguals in their L1 (Mandarin). We expected that the effect of proficiency should extend beyond English.

Method

Twenty-seven Mandarin-English bilinguals were recruited for the study (average age is 23, ranging from 18 to 34); these were international students who currently study in the U.S. 21 of them are females, and 6 are males. All participants

had Mandarin as their L1 and English as their L2. The tasks in Experiment 2 were Mandarin translations of the tasks in Experiment 1. We used the same pictures from Experiment 1, and we performed a separate norming study in Mandarin (n=50) to select the appropriate Mandarin words (cf. Table 1).

Results

As with Experiment 1, here we look at Mandarin dominance from both the LEAP-Q and the verbal-fluency task and their relationships with entrainment behavior. We excluded participants who had issues with the instructions of the verbal-fluency task. Data from 21 Mandarin-English bilinguals are included in the analysis. Using the same analyses as in Experiment 1, here we did not find significant effects of dominance/proficiency on the entrainment rate in Mandarin from either the self-reported dominance ($\beta = 0.15$, $p = 0.18$) or VF dominance ($\beta = 0.10$, $p = 0.09$) (see Figure 3).

Comparison of Experiments 1 and 2 In addition to looking at the effect of dominance within the participants of Experiment 2, we also compared the entrainment rate of Mandarin-English bilinguals in Mandarin (Experiment 2) with the entrainment rate of the 13 Mandarin-English bilinguals who specified Mandarin as their L1 who took part in the English entrainment task from Experiment 1 (see Figure 4). In this comparison, the entrainment rate in Experiment 1 represents their entrainment in L2, and the entrainment rate in Experiment 2 represents their entrainment in their L1. Running a logistic mixed effects model predicting entrainment across the two experiments with random intercepts for items and participants, we found that Mandarin-English speakers entrain more in their L2 (English) than in L1 (Mandarin) ($\beta = -1.37$, $p < 0.01$).

Discussion

While we failed to replicate the VF dominance effect in Mandarin entrainment, the comparison of the Mandarin-English bilinguals in Experiments 1 and 2 shows that these bilinguals entrain more in their L2, which for these speakers is their less dominant language. While our norming studies served
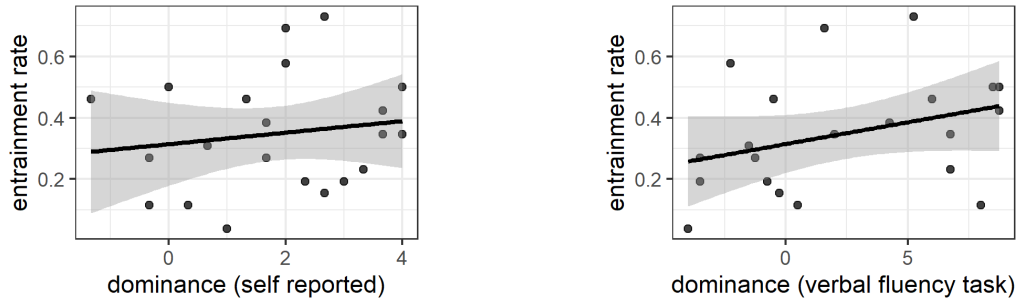
Figure 3: Results of Experiment 2 (entrainment in Mandarin): entrainment rate correlated with self-reported language dominance (left), and entrainment rate correlated with verbal fluency (VF) language dominance (right). Dominance was calculated as Mandarin dominance (values above 0 indicate that participants are more Mandarin dominant).
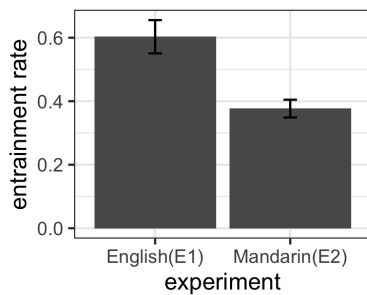

Figure 4: Average entrainment rate of Mandarin-English bilinguals in English (Experiment 1) and in Mandarin (Experiment 2). The mean of the entrainment rate in English is 0.60, and the mean of the entrainment rate in Mandarin is 0.36. Error bars represent bootstrapped confidence intervals drawn from 10,000 samples of the data.

to create parallel materials across the two studies, there remains the possibility that the difference in materials across the two experiment (i.e., the specific English and Mandarin nouns chosen as labels for the images) might have driven this result.

Even more interesting than the comparison across the two experiments is the absence of a dominance effect in Mandarin. While it is possible that the effect is truly absent, it is also possible that the reduced number of participants in this experiment relative to Experiment 1 (21 vs. 67 participants) led to power issues in the current analysis.

General Discussion

Over the course of two experiments, we investigated the role of speaker proficiency in driving bilingual lexical entrainment. Inspired by past work showing a reliable effect of listener proficiency but not speaker proficiency in entrainment, we explored whether different measures of proficiency—specifically those looking at relative dominance of a bilingual's two languages—might reveal a clearer effect. Our results support the conclusion that language dominance/proficiency of speakers does play a role in lexical entrainment, but the way that proficiency gets measured matters for the results that obtain. In Experiment 1, English bilinguals who are more dominant in English according to our verbal-fluency measure—but not the LEAP-Q score—showed less entrainment. The LEAP-Q results replicate the absence of an effect found by Suffill et al. (2021). However, the verbal-fluency results indicate that English bilinguals who are less proficient in English, particularly L2 English speakers, may be influenced more by the lexical choices of their conversational partners. This result is surprising given the findings from previous studies (Suffill et al., 2021; Zhang & Nicol, 2022) and it runs counter to the reasoning from Suffill et al. (2021) that lower-proficiency speakers should entrain *less* than higher proficiency. The result also highlights the central role of measurement in assessing language proficiency: more objective measures like verbal fluency may provide a clearer window onto proficiency, at least those aspects of proficiency that are relevant to entrainment.

Although we did not observe similar results in Mandarin in Experiment 2, the comparison between Experiments 1 and 2 found that Mandarin-English bilinguals tended to entrain more in their L2 (English) than in their L1 (Mandarin)—a result consistent with the observation from Experiment 1 that lower proficiency leads to increased entrainment. It is important to note, however, that the different nouns tested in our English and Mandarin tasks may have led to the observed difference. Moreover, the non-significant dominance result in Experiment 2 may be due power issues with insufficient participants (less than a third of the number tested in Expt. 1).

Taken together, our results indicate that bilinguals may rely on their conversational partner's lexical choices more when bilinguals are less proficient in the language. Bilinguals who are less proficient may be less confident on their own word choices and thus tend to rely more on the word choice of their partners. This finding adds to the findings concerning listener proficiency in entrainment, demonstrating that properties of both the speaker and listener are likely to enter into the calculus of when entrainment takes place.

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