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Handling Language:

How future language teachers adapt their gestures to their interlocutor

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Abstract

This paper addresses the question of how speakers adapt their gestures according to their interlocutor's proficiency level in the language of the interaction especially in the specific context of foreign language teaching. We know that speakers make changes in their speech when addressing a non-native speaker, called *Foreigner Talk* (Ferguson, 1975) to make their speech more comprehensible. However, whether and how gestures are also modified along with speech has hardly been addressed in the literature. In this study, we examined the speech and gesture of future teachers of French in a word explanation task to see what types of adjustments they made when explaining a word to a native speaker and a non-native speaker. We had ten future teachers of French explain the same 12 words to a native and a non-native speaker of French and compared the explanations. We found that the future teachers produced significantly more gestures, significantly longer gestures in duration, significantly more illustrative (iconic and deictic) gestures, and significantly larger gestures when addressing a non-native

interlocutor. These results show that native speakers make not only speech adjustments but also gesture adjustments in addressing non-native speakers.

Keywords: gestural accommodation, foreigner talk, gesture, teachers' gestures, gesture space.

Introduction

Communication is a social, cultural and multimodal action. It involves not only speech but also co-speech gesture, which together form a single-integrated system representing both the verbal and the imagistic aspects of language and thought (McNeill, 1992, 2005, 2012). Co-speech gestures are movements of the hands and arms that occur spontaneously with speech when people speak (McNeill, 1992). They cannot be understood without the speech they accompany as they complement it, are synchronous with it, and have the same pragmatic and semantic functions (Kendon, 2004; McNeill, 1992). Co-speech gestures tend to occur with speech that is high in communicative dynamism - contrastive, focused, or new information (McNeill, 1992) and have both cognitive and communicative functions, which they often perform simultaneously (Stam & McCafferty, 2008). They differ from another type of gesture that also occurs with speech: speech-linked gestures (Stam, 2013). Like co-speech gestures, speech-linked gestures occur with speech, but they are asynchronous with it. They fill an empty grammatical slot in the sentence, a speech gap, and complete a sentence, such as in the following utterance: "Sylvester went [gesture of an object flying out laterally]" (McNeill, 2005 p. 5).

Both co-speech gestures and speech-linked gestures can be analyzed according to their semiotic properties: how they refer to something, point to something, highlight parts of the discourse, and show interaction (Stam, 2013). Thus, they can be analyzed according

to their degree of “iconicity, metaphoricity, deixis, ‘temporal highlighting’ (beats), social interactivity” (McNeill, 2005, p. 41). The type of speech and gestures used in an interaction is affected by a number of factors: the socio-cultural context, who the participants are, where the interaction is taking place (setting), the task, and the goals of the interaction (Stam, 2016; Stam & Tellier, 2017; Tellier & Stam, 2012; Tellier, Stam & Bigi 2013; Tabensky, 2008). In addition, speech and gesture are affected by potential difficulties in conversation, i.e. if there is common ground or shared knowledge between participants or not (e.g., Galati & Brennan, 2013; Gerwing & Bavelas, 2004; Holler & Stevens, 2007; Holler & Wilkin, 2009; Hoetjes, Koolen, Goudbeek, Krahmer, & Swerts, 2015; Jacobs & Garnham, 2007), whether interlocutors understand what has been said (Hoetjes, Krahmer & Swerts, 2015), and the location of the speaker and interlocutor in the interaction, sitting side by side or face to face (Özyürek, 2002). For example, Gerwing and Bavelas (2004) explored how gesture forms are a combination of both what they are referring to and the conversational situation in which they are produced, that is, whether there is common ground or not and how it affects gesture production. They found that absence of common ground elicits gestures that are “more informative, complex, or precise” (p. 168).

Additionally, Holler and Wilkin (2009) investigated the amount of semantic information expressed in speech and gesture in a narrative task in two conditions: common ground and no common ground. They found that speakers produced fewer words with less semantic information but a greater number of iconic and deictic gestures in the common ground condition. They concluded that the gestures were important in providing additional information that was missing from speech.

Moreover, Galati and Brennan (2013) investigated whether addressee status - old or new - affected speakers' gestures in a narrative task. Each speaker narrated a cartoon three times twice to one addressee and once to the other addressee. They found that the speakers gestured more in narrating to new addressees and that their gestures were more precise than in narrating the second time to old addressees.

Furthermore, Hoetjes, Koolen, Goudbeek, Krahmer, and Swerts (2015) conducted two experiments to investigate the relationship between linguistic and gesture reduction. In Experiment 1, they hypothesized that gestures with initial references would be longer, larger, and two-handed gestures than subsequent references where common ground had been established. They found that gestures in second and third references had fewer form features than first references. Experiment 2 consisted of a judgement test of the precision of gestures. Participants viewed pairs of video clips and judged which gesture was more precise. The results showed that initial gestures with more features were judged more precise.

All of these studies clearly showed that common ground had an effect on gesture production. They suggest that speakers take into account what their addressees do not know and how it could affect their comprehension and thus provide meaningful information through their gestures. However, the participants in these studies were all native speakers of the language in which the interaction occurred. Consequently, regardless of the task they performed in the experiments, they all shared common ground in terms of language and culture. This raises an important question: what occurs in situations when the interlocutors are not all from the same language and culture and lack this common ground? This paper addresses this question of how gesture and speech are affected by the identity of the speaker (future language teacher), the identity of the

interlocutor, (native or non-native speaker), the interlocutor's level of proficiency in the language of interaction, and the pedagogical intent of the task.

Communication Accommodation Theory

Speaking and listening are a joint activity since speakers monitor their actions by considering the feedback provided by their addressees showing their understanding (Clark & Krych, 2004). Therefore, during an interaction, speakers are continually adjusting to the needs and understanding of their interlocutors. These speech adjustments can be explained by Communication Accommodation Theory – CAT (Giles et al. 1991). CAT considers the interlocutor (the addressee) to be the heart of an interaction. Interlocutors are viewed as actual participants in the interaction, and speakers shape their speech for them (Giles et al., 1991, p. 6). Complementarity is an important concept of CAT and concerns cases where interlocutors differ in terms of status or power, for example employer-employee / teacher-pupil. Brennan and Hanna (2009, p. 275) define complementary discourse as “when adjustments take the specific needs, knowledge, or perspective of the partner into account.” The way we adapt our speech to our interlocutor is based mainly on the stereotyped representations we have of our addressee’s communicative needs (Giles et al, 1991). Accommodation requires speakers to assess the needs of their interlocutors in terms of their comprehension or shared knowledge and adapt their speech to the actual or supposed needs of the addressee. This is particularly visible in the registers of baby talk or motherese - language used when addressing a baby, elderspeak - language used with an older person, or in foreigner talk - language used with a non-native speaker (Beebe & Giles, 1984; Zuengler, 1991).

Although Giles *et al.* (1991) mention the multimodal aspects of accommodation, their reference to it is very limited. They argue that accommodation in communication is

both verbal and nonverbal, but the nonverbal cues they mention are restricted to smiles, gaze, and postures. To our knowledge, co-speech gestures have not been analyzed in CAT studies except for a few studies that focused on *gestural mimicry* (e.g., Kimbara, 2006; Holler & Wilkin, 2011), but these were not based on the communicative needs of the addressee.

Foreigner Talk

Considerable research has been conducted on the speech adjustments that native¹ speakers make in addressing non-native speakers, (e.g., Ferguson, 1975; Gass & Varonis, 1985; Long, 1981; Ravid, Olshtain, & Ze'elon, 2013; Snow, van Eeden, & Muysken, 1981; Ulichny, 1979)². These adjustments termed *foreigner talk*, FT, (Ferguson, 1975) involve the use of shorter sentences, basic vocabulary, and present tense. They also involve more careful articulation, frequent repetition, louder and slower speech, and the use of gestures (Ulichny, 1979). Some foreigner talk adjustments are ungrammatical while others are grammatical (Derwing, 1987).

All the studies on FT have concentrated on speech adjustments except for Adams (1998) who examined gestural adjustments native English speakers made when addressing non-native speakers. His participants consisted of 20 native speakers of English who narrated the cartoon *Canary Row* to 20 other native English speakers and 20

¹ We use the terms "native" and "non-native" here for convenience and simplification, although they may be controversial, particularly because the category "native speaker" is far from homogeneous, if we consider the great inter-individual variety in the proficiency and use of a language by so-called native speakers. The same can be said for the non-native.

² The peak of foreigner talk research was in the 1970s and 1980s when the basic theoretical framework was established. Once the register was laid out there has been little subsequent research, which explains why we do not mention more recent references on that topic.

native speakers of Korean, ESL students in an intensive English Language Program at the university. He hypothesized that native English speaker narrators would use more mimes, iconics and deictics with non-native speakers than with native speakers because he saw these particular gestures as being more illustrative and helpful in interpreting the verbal language. Although he found that these types of gestures were more frequent, he found only significant differences for deictics . He also found that the same amount of metaphors and emblems were used in both conditions, something he had not hypothesized. He had hypothesized that the native speakers would use fewer “1] metaphors because their expression bears no or only little direct resemblance to linguistic referents and thus their meaning is opaque when compared with other types of gestures... and 2] emblems because they are not readily interpretable and accurately interpreted outside of the speech community in which they are used” (Adams, 1998, p. 30) than in the non-native condition.

These results showed that even if native speakers gestured more to help their interlocutors understand them, their gestures were not necessarily helpful. One explanation for this phenomenon might be that the participants were students who may not have been experienced in non-native interactions. Snow et al. (1981) studying FT found variance in the way speakers address non-native interlocutors. They argued that “[s]ome personality types may be more prone to producing FT than others. Alternately, native speakers who had considerable experience with foreigners may be more aware of the kinds of linguistic modification which can aid communication, whereas native speakers who have little contact with foreigners literally don’t know how to talk FT” (pp. 81-82). They suggest that language teachers may be more efficient in terms of FT use than ordinary speakers.

Teacher Talk, Pedagogical Intent and Pedagogical Gestures

Teacher talk in the language classroom is similar to FT as it includes “slow-pace, careful articulation, high pitch and exaggerated intonation” as well as “shorter sentences, fewer subordinate clauses, and more frequent repetitions” (Early, 1985, p. 27). However, teacher talk is a distinct register (Hallet, 2000), and one of its most important features is its grammaticality (Wong-Fillmore, 1985). Teacher talk is also characterized by a pedagogical intent. Teachers have a pedagogical agenda with multiple goals that they want to achieve and they adapt their language to meet learners’ communication and comprehension needs. To reach these goals and help language learning, teachers use various scaffolding strategies that can be both verbal and nonverbal.

There has been a long history of examining teachers’ gestures in the language classroom (for reviews, see Stam, 2013; Stam & McCafferty, 2008). Some of these studies have highlighted the pedagogical functions of gestures in the classroom. For instance, Tellier (2008) defined 3 main pedagogical functions of language teachers’ gestures: *informing* (about vocabulary, grammar, phonetics or pragmatics of the target language and culture), *managing the class* (interaction management, attention, and giving instructions) and *assessing* (providing feedback). Some studies have focused on one of these functions or even a sub-function like the use of gestures for lexical explanation (e.g., Allen, 2000; Lazaraton, 2004). Other studies (e.g., Hauge, 1998; Sime, 2006; Tellier, 2008; Azaoui, 2016) have investigated learners’ perception, use, and interpretation of teachers’ gestures. Most of these studies have shown that language teachers’ gestures can help learners’ comprehension (see Sueyoshi & Hardison, 2005), but they can also lead to misunderstanding because the gestures produced may be too ambiguous, abstract, or culturally embedded as is the case with metaphors and emblems.

These studies have all looked at experienced teachers and how they gesture spontaneously in the classroom, but none of them have explored how future teachers vary their speech and gesture when they address native vs non-native speakers of a language. This is the topic examined in this paper.

Current study

This study builds on Adams' (1998) study (see above) and investigates the idea that speakers with the goal of teaching a language to non-native speakers will be more sensitive to the needs of their non-native partner and may be more likely to adapt their gestures to facilitate comprehension (following CAT theory). However, our study has two main differences from that of Adams.

First the main speakers of our study are language teachers in training unlike Adam's native speakers. Second, the task in our study differed from the narrative task used by Adams. Different tasks have different demands and different degree of involvement for participants (Stam, 2016). We chose a semi-controlled quasi-experimental explanation task, in which the interlocutors had to guess the word being explained. It is more interactive than a narrative task, it requires more involvement from both speakers, it is more purposeful, and it simulates what foreign language teachers actually do in the classroom. We predicted that the speakers would be more sensitive to the pedagogical issues of the task because they were teachers in training.

Similar to Adams, we examined gesture dimensions, or "types" (see description under Coding) and the number of gestures produced, but we also analyzed the duration of gestures (the length of time they lasted), gesture rate (gestures per words), and the use of gesture space in both conditions, native and non-native (see Figure 2 and description under Coding).

Hypotheses

Based on the perspective that gesture and speech are a single integrated system (McNeill 1992), we posit that the verbal changes that occur in FT and teacher talk have equivalents in the gestural production of the speakers. Like Adams (1998), we hypothesized that there would be differences in the dimensions of the gestures produced by the main (native) speaker depending on the interlocutor (native vs non-native). In addition, in accordance with CAT, we hypothesized that because our main participants were teachers in training, they would make these adaptations more visible through gesture than in Adams' study when they addressed non-native speakers to meet the communicative needs of the learners. Our hypotheses are also based on previous work by Tellier et al. (2014) who found that, similar to changes in speech, speakers gesture differently when teaching versus having a conversation particularly in terms of gesture size, gesture rate, and gesture dimensions (more iconics are used even for abstract concepts), showing that the accommodation in gesture production depends on the context and the identity of the interlocutors.

Thus, we hypothesized the following:

- Hypothesis 1: The future teachers will produce more gestures when addressing non-native partners.
- Hypothesis 2: The future teachers will produce gestures of longer duration when addressing non-native partners to align with the fact that speech rate is slower in FT.
- Hypothesis 3: The future teachers will produce more illustrative gestures (iconics and deictics) to make speech more comprehensible for non-native interlocutors.
- Hypothesis 4: The future teachers will produce fewer abstract gestures (metaphorics and emblems) when addressing non-native interlocutors because their expression

bears little resemblance to their linguistic referent and their meaning may be more opaque for the interlocutors (Adams, 1998).

- Hypothesis 5: The future teachers will produce larger gestures to make them more visible when addressing non-native partners.

Method

Participants

As the interactional situation was based on a guessing game where a future teacher had to make the interlocutor guess a series of words, there were three types of participants, all of whom signed an informed consent:

- 10 students in Master 1, Master's of French as a Foreign Language (FLE) Program at Aix-Marseille Université who were enrolled in this program to become French teachers and were native speakers of French. There were one male and nine females (since there are more female students in this curriculum), age range 22-48, mean age 33. They participated in the role of the person who had to make the interlocutor guess the words and are referred to as “future teachers” in the study.
- 10 non-native speakers of French from different language groups (exchange students at the university learning French, at the B1/B2 level according to the CEFR³), age range 20-25. Many of them were Erasmus students from different European countries but also from other countries such as Egypt or Vietnam. They participated as the individual who had to guess the words and are referred to as “non-native interlocutors” in the study.

³ Common European Framework of Reference for Languages (2001) Council of Europe.

- 10 native speakers of French, (students in another program at the university), age range 22-25. They participated as the individual who had to guess the words and are referred to as “native interlocutors” in the study.

Procedure

Each future teacher was randomly assigned to a native partner and a non-native partner. The future teachers were informed in advance about the status and language proficiency of their partners (native or non-native). Before the task started, they were given a few minutes to get acquainted and for the future teacher to assess informally the level of French of the non-native interlocutor.

For each partner, the future teacher was asked to explain the same 12 French words, (see Table 1), which they drew randomly from a box, and the interlocutor was instructed to guess the words. The instructions were the same in both conditions. The words were selected based on the European Framework for languages (2001) for levels B1 and B2 for French. We also wanted to make sure that all parts of speech were represented. Therefore, we chose 3 nouns, 3 verbs, 3 adjectives, and 3 adverbs. In addition, we wanted to see if there were differences between abstract and concrete words. The only constraints were that the future teachers could not use any words from the same word family or translations of words from another language, and of course they could not use the target word. There was no time restriction.

Table 1

List of Words

Target words	Word category	Translation
<i>Grimper</i>	Verb	Climb
<i>Emballer</i>		Wrap

<i>Se souvenir</i>		Remember
<i>Trottoir</i>	Noun	Sidewalk
<i>Océan</i>		Ocean
<i>Jalousie</i>		Jealousy
<i>Usé</i>		Used
<i>Râpé</i>	Adjective	Grated
<i>Fière</i>		Proud
<i>Approximativement</i>		Approximatively
<i>Doucement</i>	Adverb	Softly
<i>Rapidement</i>		Rapidly

The order of explanations was counterbalanced. Half the participants explained the words first to the native interlocutor, and the other half explained them first to the non-native interlocutor.

Data

All the interactions during the task were videotaped, a total of two hundred and forty explanations (10 future teachers explaining 12 words to 2 interlocutors: 10x12x2). This corpus called *Gesture in Teacher Talk* (GTT) is comprised of 5 hours of interaction. It is archived in the ORTOLANG repository⁴.

⁴ Reference : Département FLE - Français langue étrangère, Université d'Aix-Marseille, Laboratoire parole et langage - UMR 7309 (LPL) (2010). GTT: Gestures in Teacher Talk [Corpus]. ORTOLANG (Open Resources and TOols for LANGuage) - www.ortolang.fr, <https://hdl.handle.net/11403/sldr000012/v1>. Part of the data from the corpus has been used to

Coding

The data were coded using ELAN software (Sloetjes & Wittenburg, 2008). This included the transcription of the speech of all participants on separate tiers and the annotation of gesture dimensions (semiotic properties) and gesture space for each gesture produced by the future teachers, the focus of the study. Using ELAN to code gesture and transcribe speech automatically gives us the duration of speech and gestures (gesture phrases) for each speaker that we used in the analysis of the results.

The coding of gesture dimensions was based on McNeill's (1992, 2005) coding scheme to which we added complementary aspects developed by other researchers (Bavelas et al., 1995). To make our work comparable with Adams, we coded whether the gesture was a deictic, iconic, metaphoric, beat or emblem. Gestures with iconicity (iconic gestures) refer to concrete actions or objects, e.g., two hands rotating indicating rolling, whereas those with metaphoricity (metaphoric gestures) refer to abstract ideas and are affected by culture (McNeill, 1992, 2005, 2012), e.g., two hands facing each other holding an *idea*. Gestures were coded "metaphorics" when they represented an abstract concept and did not show information related to size, shape, action, direction, or location, for instance, when the speaker was holding metaphorically the concept in their hands

investigate the functions of gestures during pauses, verbal strategies and gestures, and gestures with concrete and abstract words (see Stam & Tellier, 2017; Tellier & Stam, 2012; Tellier, Stam, & Bigi, 2013; Tellier, Stam, & Ghio, 2018). However, this is the first time the data from the entire corpus has been presented regarding the original intent of the study due to the time it took to code and analyze it.

(“conduit metaphor”, McNeill, 1992). A lot of research (Kendon, 2004) on how gestures facilitate speech comprehension contrast representational gestures (iconics, deictics and metaphors) and non-representational (beats). We consider metaphors as representational but with a low degree of iconicity and helpfulness in facilitating understanding for learners, and thus we treated metaphors separately in our hypotheses and analysis.

Gestures with deixis (deictic gestures) are pointing gestures that point to the location of an entity or time. Gestures with temporal highlighting are also called beats. They are quick vertical or horizontal movements of the hand aligned with the speech rhythm and highlight information: they occur with repairs, introduce new information, and summarize action. They can also be superimposed on other gestures for emphasis. Social interactivity (interactive) gestures indicate interaction between speakers and listeners, such as when speakers finish a turn and extend their hand to their listener for the listener to reply (Bavelas *et al.* 1995; Stam, 2013). Besides these gestures, speakers also produce Butterworth or word searching gestures (McNeill, 1992). We also coded emblems that are culturally specific gestures similar to idiomatic expressions and can occur without speech (Morris *et. al.* 1979), for example, pulling down your lower eyelid with a forefinger to say “I don’t trust you” in French or “thumbs up” to approve in several cultures. Finally, gestures can be labeled “aborted” (McNeill, 1992) when speakers start gesturing and interrupt their movement suddenly. All these dimensions are used in the current study (See Table 2).

Table 2

Gesture Dimensions Coding Scheme

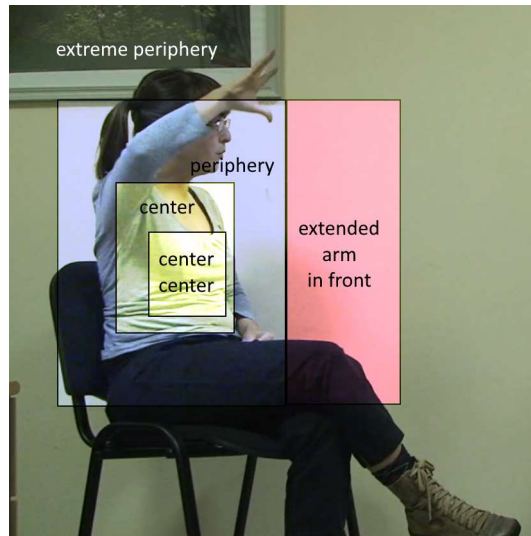
Deictic	Pointing gesture
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Iconic	Gesture representing a concrete object, action, size, shape, direction, location
Metaphoric	Gesture illustrating an abstract concept that does not show information about object, action, size, shape, direction, location
Beat	Small rhythmic movement of hand
Emblem	Culturally specific gesture
Butterworth	Word search gesture
Interactive	Gesture addressed to interlocutor
Aborted	Gesture begun and then abandoned

For the coding of gesture space (where the gesture was produced), we used an adapted version of McNeill's 1992 diagram (see Figure 1) and coded whether the gesture occurred in center-center, center, periphery, and extreme periphery. The space used was determined by the location of both the hand and fingers (when relevant) in gesture space. When a gesture crossed several spaces or when both hands were in different spaces, we chose the largest one because we were looking at the size of the gesture.

Figure 1

Gesture Space Coding Scheme



While McNeill's diagram is very helpful for the coding of space, it has one major problem. It is two-dimensional while gestures are three-dimensional. Thus, gestures made in center-center, close to the body, are encoded in the same way as gestures that occur in the center with the arm stretched forward. These gestures are clearly not the same size and may not be perceived in the same way by the interlocutor. Consequently, we added an additional gesture space — *extended arm in front* — to annotate gestures that occur within this area and are projected towards the listener. In Figure 2, for instance, the speaker on the left explains what a *trottoir* (sidewalk) is. In the first picture, she produces a gesture with both hands in the periphery and then extends her arms and produces a gesture in the extended arm in front area.

Figure 2

Extended Arm Gesture



The coding of gesture dimensions and gesture space was first done by one main coder. After this, the entire coding was double checked by two independent coders. Any disagreements in coding (about 10% of the coded gestures) were then discussed until agreement was reached, and the coding was revised when necessary.

Analysis: Software and Method

In this study, we quantitatively and qualitatively analyzed only the speech and gestures produced by the future teachers. All statistical tests were performed in the R software environment version 3.4.4 (R Development Core Team, 2008). Linear regression mixed models were used to analyze continuous data as durations and rates (lme 'R' function). Mixed models have the advantage of dealing with interspeaker variability, repeated-measures designs (by speaker and by word) and missing data (ex: interaction without gesture). In our study, the 12 explanations (words to guess) by speaker by condition (native vs non-native) is a repeated measure by speaker. As fixed effect, the interlocutor category (native vs non-native) was systematically included to test the impact of this condition on all dependent variables. In all models, the future teacher constituted a random effect (intercept only).

To analyze the effect of the interlocutor category (native vs non-native) on the ratios of gesture by category (e.g., deictic, iconic, emblem, metaphoric) or by gesture

space (e.g., center, periphery), we used Wilcoxon signed rank test, which is a non-parametric statistical analysis with paired samples because it was more adapted to paired data with non-Gaussian distributions.

In all analyses, we considered a p-value of less than 0.05. as significant. To precisely illustrate the effect, we report the estimated value of means, standard deviations, sample sizes and p-values.

Results

Interaction, Speaking and Gesturing Time Spans

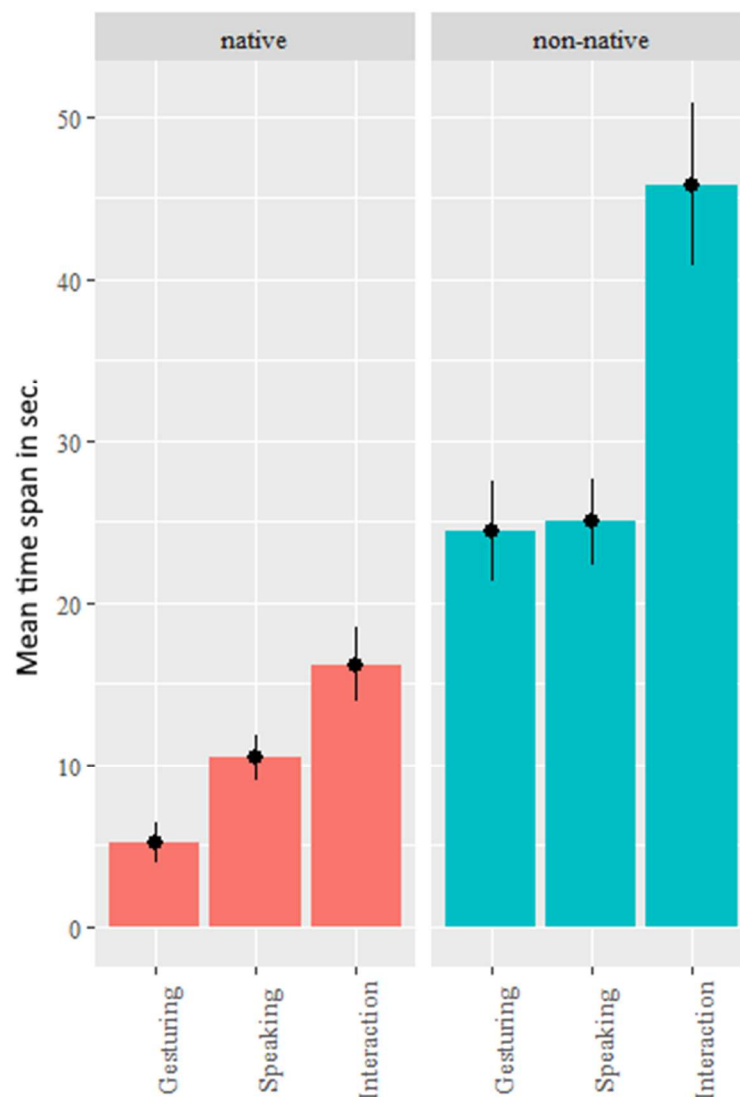
Before we address our hypotheses, it is necessary to provide an overview of how the task differed across both conditions in terms of time spans. The “interaction time span” begins when the future teacher starts the word explanation and finishes when she/he moves on to the next word (usually when the interlocutor utters the word or gives up). The “speaking time span” represents the sum of all the future teachers’ verbal utterances in seconds. We excluded silent pauses longer than 200ms (pauses that are not for breathing but other purposes such as thinking, rhetorical effect and allowing the interlocutor to respond). The “gesturing time span” represents the sum of all the future teachers’ gestures in seconds (this is based on the whole gesture phrase, holds included), for each future teacher. These time values were calculated for each word explanation and a mean time span was computed by condition (native vs non-native).

Interaction mean time span was significantly longer, almost three times, when the interlocutor was a non-native speaker (45.84s) than a native speaker (16.19s) due to the difficulty of the task for the non-native interlocutor. Furthermore, the mean time spans of the two modalities (speech and gesture) in the interaction differed in both conditions (see Figure 3). In the non-native condition, the time spent by the future teacher gesturing

(24.40s) and speaking (25.30s) is similar. This is not the case with native addressees where the time spent gesturing (5.14s) is much shorter than the time spent speaking (10.42s). We statistically analyzed this aspect by computing a modality index which is the ratio between the gesture time span divided by the speech time span. The mean ratio is equal to 0.97 (sd = 0.8 ; n=120) for the non-native condition and to 0.46 (sd = 0.44; n=120) for the native condition. This difference is significant ($p < .0001$).

Figure 3

Interaction, Speaking and Gesturing Mean Time Spans



Note. The error bar is 95% Gaussian confidence interval of mean.

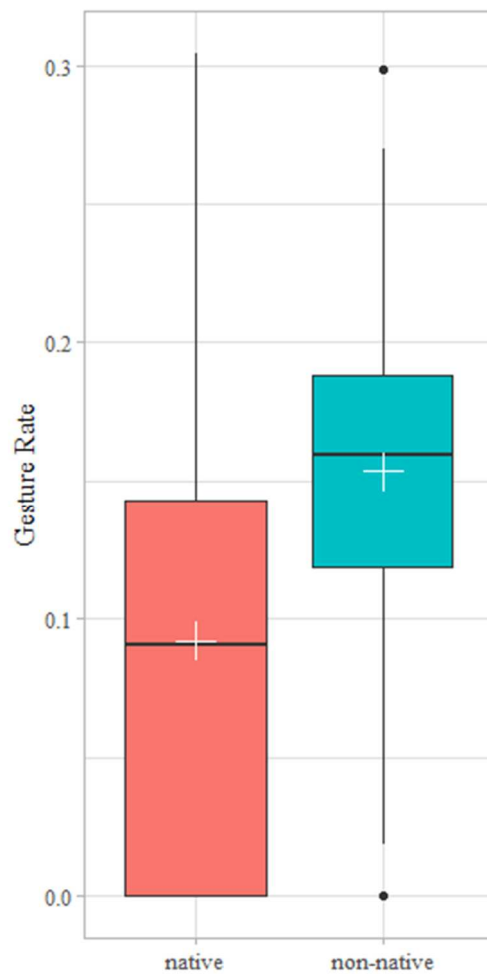
Gesture Rate

We predicted that the future teachers would produce more gestures when addressing non-native partners (Hypothesis 1). To address this hypothesis, we calculated the future teachers' gesture rate by dividing the number of gestures by the number of words produced by the future teachers during the interaction. The mean gesture rate is equal to 0.092 (sd = 0.083; n=120) for the native condition and to 0.154 (sd = 0.06; n=119) for the non-native condition (see Figure 4). The difference is significant ($p < .0001$), which supports Hypothesis 1. It should also be pointed out that in the native condition, over the 120 explanations, more than ¼ of the explanations (35) were done without a single gesture which only occurred twice in the non-native condition (on 120 explanations) with the words *se souvenir* ('to remember') and *ocean* ('ocean').

Figure 4

*Gesture Rate in the Both Conditions*⁵

⁵ The horizontal black line is the median, the white cross is the mean, and the middle "box" represents the two central quartiles.



Mean Duration of Gestures

To answer Hypothesis 2 which stated that the future teachers would produce gestures of longer duration when addressing non-native partners, we calculated the mean duration of gestures by dividing the total time spent gesturing (see “gesture time span” above) by the total number of gestures produced. The mean duration of gestures is equal to 1.554 sec. (sd = 0.686; n=83) for the native condition and to 2.00 sec. (sd = 0.527; n=112) for the non-native condition (Figure 5). The difference is significant ($p < .0001$) and confirms Hypothesis 2.

Figure 5

*Mean Duration of Gesture in Both Conditions*⁶



Gesture Dimension

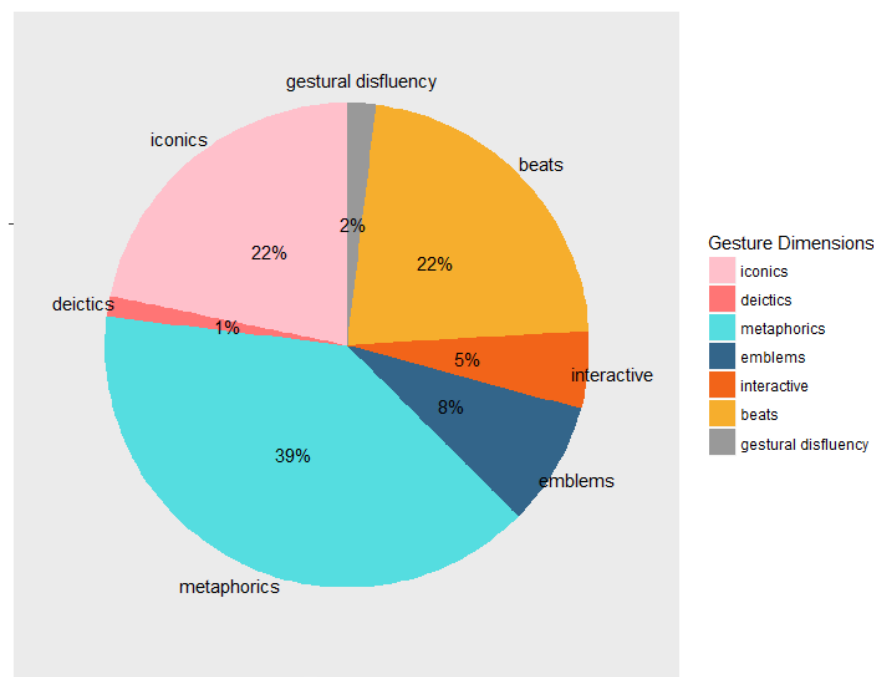
To address both Hypothesis 3 that the future teachers would produce more illustrative gestures (iconics and deictics) and Hypothesis 4 that the future teachers would produce fewer abstract gestures (metaphorics and emblems) when addressing non-native interlocutors to make speech more comprehensible for them, we calculated gesture dimension ratios. For each interaction, we computed the ratio of each gesture dimension which is the number of gestures for each dimension divided by the total number of gestures. Because of the small number of aborted and Butterworth gestures, we grouped them under *gestural disfluency* since they accompany verbal disfluency (pause,

⁶ The horizontal black line is the median, the white cross is the mean, and the middle “box” represents the two central quartiles.

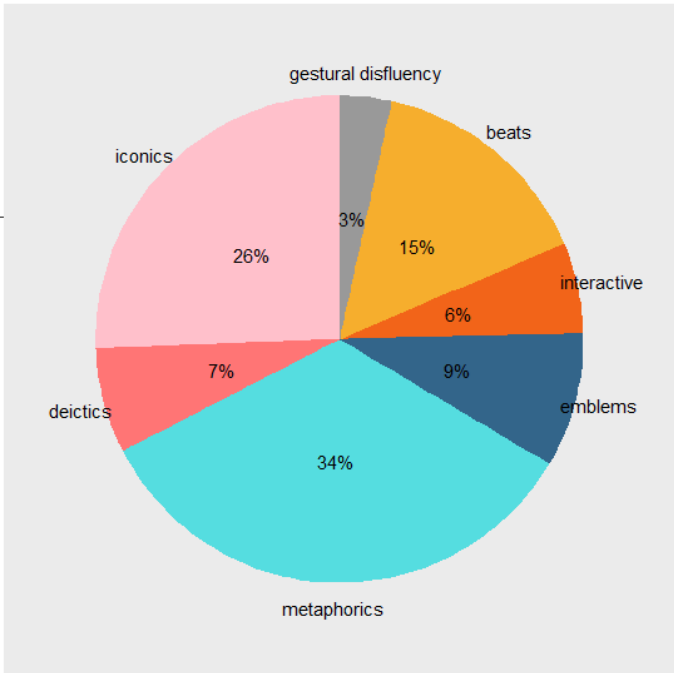
hesitations, false starts). In Figure 6, we use the rounded percentage which is the ratio x 100. The sum of these seven percentages equals one hundred percent.

Figure 6

Gesture Dimension Percentages in Both Conditions



native condition



non native condition

In terms of gesture dimensions, the main difference when addressing a non-native interlocutor is the percentage of illustrative gestures produced (iconics and deictics). For instance, of all the gestures produced by future teachers in the non-native condition, 26% were iconics and 7% were deictics, whereas in the native condition, 22% were iconics and 1% deictics. We analyzed these ratios as dependent variables of the factor ‘interlocutor’ (native vs non-native). As this data does not have a Gaussian distribution, we used Wilcoxon signed rank test (which is a non-parametric statistical analysis with paired samples (same speakers, same words in both conditions)). The differences by condition are significant for the use of iconics ($p=.012$) and deictics ($p<0.0001$). This result validates Hypothesis 3. However, Hypothesis 4 was not supported, the differences are not statistically different in the two conditions for the use of metaphors ($p=.08$) and emblems ($p=.052$). Gestural disfluency gestures (Butterworth and aborted) were also produced in greater proportion in the non-native condition 3% to 2% in the native condition ($p=.0041$) although the amount is low. This will be discussed in the qualitative results and in the discussion.

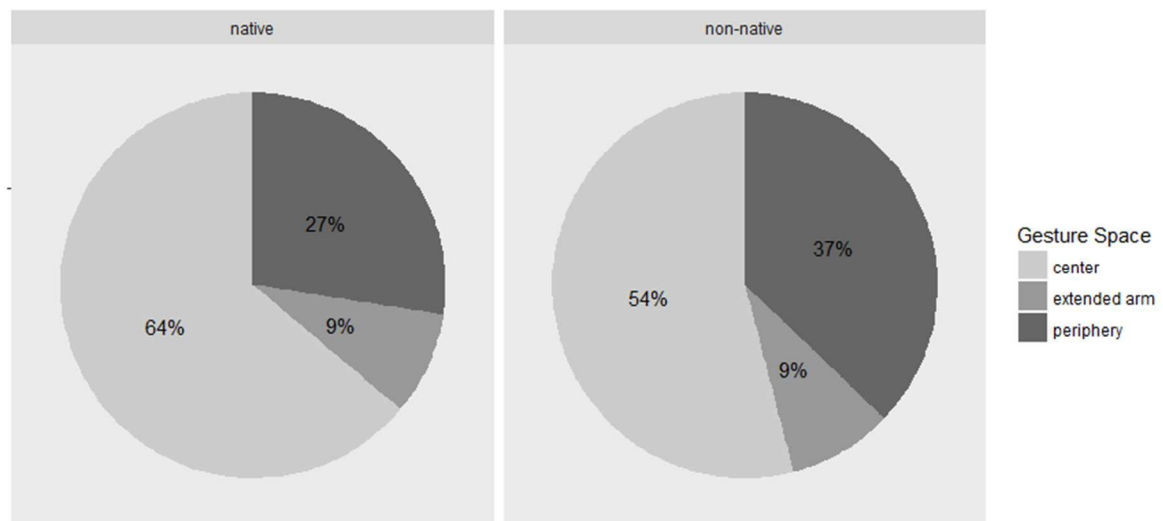
Gesture Space

Hypothesis 5 predicted that the future teachers would produce larger gestures to make them more visible when addressing non-native partners. To address this hypothesis, we analyzed the use of gesture space. For each interaction, we identified where each gesture occurred in space. When working on the results, we realized that we had too many categories and that for instance, the difference between “center” and “center center” was too subtle for our study. Since we wanted to distinguish between small vs large gestures and gestures towards the interlocutor, we decided to combine center-center and center (now referred to as “center”), periphery and extreme periphery (now referred to as

“periphery”), similar to Gullberg and Holmqvist (1999), and kept “extended arm” as its own category. We then divided these categories by the total number of gestures produced (see Figure 7).

Figure 7

Gesture Space in Both Conditions



We analyzed these ratios as dependent variables of the factor ‘interlocutor’ (native vs non-native). As this data does not have a Gaussian distribution, we used Wilcoxon signed rank test. Results show that when addressing a native partner, future teachers use significantly smaller gestures that are produced in the center space, the torso area ($p=.0037$). Sixty four percent of the total number of gestures produced in the native condition occurred in center space compared to 54% in the non-native condition. When the future teachers explained words to a non-native partner, they enlarged their gestures by producing them in the peripheral area: 37% of the gestures produced in the non-native condition were produced in this area compared to 27% in the native condition, the difference is significant ($p=.0019$). As for extended arm, data distribution does not enable us to conclude about a potential difference.

Qualitative Results

In this section, we present examples from our data that not only illustrate the quantitative differences in both conditions but also display specific features that occurred in the non-native condition.



Same Speech, Different Gestures.

In many explanations, future teachers utter the same sentence to their partners in both conditions. However, their gestures are not always the same. For instance, in the following example (Figure 8), for the verb *grimper* ('to climb'), the future teacher (on the left of the picture) says the same sentence "*c'est un verbe synonyme de escalader*" ('it's a verb synonym of rock-climbing'), but the co-speech gesture produced along with the keyword "rock climbing" differs. In the native condition, he produces a metaphoric that represents the concept of rock-climbing (like holding the idea) whereas in the non-native condition, he illustrates the action of rock-climbing with an iconic. Thus, this example is a good illustration of accommodation phenomenon, especially of *complementarity* (Brennan & Hanna 2009) since the gesture produced with speech conveys more concrete meaning in the non-native condition, as if the speaker intended to help oral understanding. It is noteworthy that the accommodation is performed only through the gestural channel.

Figure 8

Gesture Dimension Differences in Both Conditions

Native Condition	Non-Native Condition
------------------	----------------------

	
<i>c'est un verbe synonyme de (340 ms) de [escalader]⁷</i>	<i>c'est un verbe (890 ms) euh synonyme de [escalader]</i>
it's a verb synonym of (340 ms) of [rock-climbing]	it's a verb (890 ms) hum synonym of [rock-climbing]

In the next example (Figure 9), the future teacher explains *emballer* ('to wrap'). In both conditions, she explains that it is the action that one does "when making a gift package," and she produces an iconic gesture depicting the action of covering an object with paper. In the native condition, her gesture is produced close to her chest in the center-center space whereas in the non-native condition, she extends her arms towards her interlocutor thus making her gesture more visible and more towards her addressee (who reacts by mimicking the gesture).

Figure 9

Gesture Space Differences in Both Conditions

Native Condition	Non-Native Condition
------------------	----------------------

⁷ The words in brackets [...] show the parts of speech accompanied by a gesture. The figures in parenthesis i.e. (340ms) show the duration and location of speech pauses.

	
<i>quand tu fais un (300 ms) un [paquet cadeau]</i>	<i>quand on fait un paquet [cadeau voilà / on]</i>
when you make a (300ms) a [gift package].	when one makes a gift [package that's it / one].


Noticeable Changes in Speech and Gesture

When we compare speech in both conditions, we notice three major characteristics of the non-native condition: 1) *speech disfluency*, 2) *speech pauses*, and 3) *changes in explanation strategies*. All these verbal characteristics also affect gesture production. In the next examples (Figures 10 and 11), the future teacher explains the word *océan* ('ocean'). With her native partner, after a hesitation followed by a pause of 1200ms, she starts a rather fluent explanation with just one repetition of the word "two". Her explanation relies on the opposition between seas and oceans. She starts off by explaining that there are two kinds of water spread over the earth and illustrates this with a very large gesture of both hands depicting the shape of the planet. Then she contrasts seas and oceans by producing a metaphoric gesture on the right to accompany the utterance "there are the seas" and a similar gesture on the left with "and the..." followed by a speech pause. This last gesture is held for 1710ms to show that she expects her addressee to complete the sentence. Her hands are held and oriented in a palm-up position, her gaze is towards the

addressee, the syntax of the sentence is left unfinished, and her prosody is rising at the end to indicate a question thus using different modalities to invite the native speaker to answer (this is similar to turn giving gestures described by Bavelas et al., 1995 and teachers’ gestures to question learners described in Azaoui, 2016).

Figure 10

Speech and Gesture in the Native Condition Explaining ‘Océan’

Car.1	<p><i>euh hum (1200 ms) il y a deux deux sortes d'étendues [d'eau au niveau mondial {1}] [il y a les mers{2} et les (1380 ms) {3}]</i>⁸</p> <p>well hum (119 ms) there are two two kinds of [water spread at the world level]</p> <p>[there are the seas and the (138 ms)]</p>
	<div> <div>{1}</div> <div>{2}</div> <div>{3}</div>  </div>
	<p>{1} iconic gesture produced in the extreme periphery and draws the shape of a circle to represent the earth</p> <p>{2} metaphoric gesture produced in the extreme periphery, on the right-hand side with both hands in cup-shape</p>

⁸ Numbers in parentheses show the duration of speech pauses in milliseconds, numbers in {...} indicate the number of the picture of the corresponding gesture, words in [...] indicate the verbal utterance co-occurring with speech.


	{3} metaphoric gesture produced in the extreme periphery, on the left-hand side with both hands in cup-shape, this is part of the same gesture as {2} and used to contrast two ideas
--	--

In the non-native condition, the speech is more disfluent with truncated words, interruptions and repetitions (in bold in the transcription) such as “*tu re- su- sur le le globe*” showing that the future teacher is looking for a way to explain things to her non-native interlocutor. Generally, the future teachers’ speech is more disfluent in the non-native condition either because they are thinking online about how to make their speech comprehensible or because their partner is struggling to find the answer and they need to look for another strategy. Therefore, the speech in the non-native condition is characterized by false starts, repetitions and a lot of hesitation markers such as “euh” or “hum” in French. This also explains why aborted gestures and Butterworths are more numerous in this condition for they reflect the disfluency of the verbal utterances.

Figure 11

Speech and Gesture in the Non-Native Condition Explaining ‘Océan’

Car.1	<p><i>quand tu [re- su- sur le le globe terrestre {1}] [quand tu regardes la Terre (530 ms){2}] [il y a la mer (540 ms){3}] [et il y a également une très grande (400 ms) plusieurs{4}] [grandes grandes mers (550 ms){5}] [on appelle ça (1110 ms){6}] [il y a il y a Atlantique Pacifique Indien (720){7 - 8}] voilà</i></p> <p>when you loo- o- on the the globe {1}][when you look at the Earth (530 ms){2}][there is the sea (540 ms){3}][and there is also a very large (400 ms) several{4}][large large seas (550 ms){5}][this is called (1110 ms){6}] [there is there is Atlantic Pacific Indian (720 ms){7 - 8}] that’s it</p>
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	<p>{1} Iconic gesture of the right hand that draws a circle to represent the Earth, produced in the extreme periphery.</p> <p>{2} Iconic gesture with hand going down and slowing facing the speaker's face, to mean "look at the Earth"</p> <p>{3} Deictic gesture on the right side of the speaker in the extreme periphery, locating the sea (like on a map)</p> <p>{4} Iconic gesture on the left side of the speaker with the same hand shape as in {3} but drawing small circles to picture the several other seas (i.e. the oceans)</p> <p>{5} Iconic gesture like {4} to represent the large seas on the map</p> <p>{6} Interactive gesture towards the interlocutor to elicit an answer</p> <p>{7} Emblem showing 1 with the thumb to enumerate the different oceans by their name</p> <p>{8} Emblem showing 2 with the thumb and index to enumerate the different oceans by their name (this gesture is followed by the emblem indicating "3")</p>

Additionally, there are differences in the specific use of speech pauses between the two conditions. In the short explanation (17 seconds and 760ms) above, we notice no less than 6 speech pauses (between 400ms and 1100ms) in the non-native condition. Every key idea of the explanation is followed by a pause as if to give the interlocutor time to assimilate it. These speech pauses also facilitate oral speech segmentation which is very helpful for a L2 learner. This appears primarily in the non-native condition and seems characteristic of language teachers' speech (Tellier, Stam & Bigi, 2013; Stam & Tellier, 2017).

Last, there is also a change in the strategy the future teacher uses to explain *ocean* to her non-native interlocutor. She does not contrast sea and ocean as she did with the native interlocutor maybe because she considers this semantic distinction too complicated for a learner. Instead, she uses the word "sea" as a synonym and defines oceans and "large seas." She also draws these "large seas" on an imaginary map by locating her gestures in different parts of her gesture space. Then, she gives examples of oceans by enumerating their names and helps oral segmentation by gesturing (1,2,3) with each name. Thus, her explanation in the non-native condition relies more on concrete elements (like locations on a map and large seas) and is characterized by an intense use of gestures. Every keyword of the explanation is illustrated by a gesture: the globe, look, the sea, several large seas, the enumeration of the names of the different oceans.

Another particularly interesting instance related to accommodation occurs with the explanation of *grimper* ('to climb'). One future teacher starts the task with the native partner and says that this action can be done on a mountain, a ladder, a stool (she enumerates several examples until her addressee provides the right answer). Then, in the non-native condition, she uses the same strategy, but while speaking, she realizes that "a

stool” (*un tabouret*) may not be an easy word for a learner, and she decides not to use it and goes to a more common word “a chair” (*une chaise*). This is visible when analyzing her very disfluent speech that contains many hesitation markers. She says “*un*” (a masculine determinant in French) as she is about to say “*un tabouret*” then changes to “*une chaise*” (a feminine word).

This aborted example of the stool is also visible in her gestures (Figure 12). When she is looking for an example of something we can climb on, she produces little circles with her hand on her right-hand side, drawing the round shape of a bar stool seat. While doing this, she gazes only at her hand. When she finally drops this idea and chooses “a chair,” her hand stops moving, and she looks at her partner again⁹.

Figure 12

Aborted Example of a Stool in Speech and Gesture

<i>euh on monte (270ms) euh sur une échelle (310ms) euh sur euh une table (300ms) sur {1} euh {2} hum (210ms){3} un {4} (220ms) hum {5} une chaise {6} (1220ms) euh</i>
uh we go up (270ms) uh on a ladder (310ms) uh on uh a table (300ms) on {1} uh {2} um (210ms) {3} one {4} (220ms) um {5} a chair {6} (1220ms) uh

⁹ All this was confirmed by the future teacher in an informal discussion. She indeed considered a stool too complicated a word for a learner and abandoned that example.



sur {1} euh {2} hum (210ms){3} un {4} (220ms) hum {5} une chaise {6}

Summary

These quantitative and qualitative results show that future teachers adjust both their speech and gesture in explaining words to non-native interlocutors. In some instances, they use the same speech but different gestures. In others, they change both their speech and gesture. They also produce more pauses in the non-native condition mainly to make their speech more comprehensible (see Tellier, Stam & Bigi, 2013; Stam & Tellier, 2017). In addition, they produce more gestures, gestures with a longer duration, more illustrative gestures (iconics and deictics), and larger gestures in the non-native condition.

Discussion and Conclusion

We sought to investigate whether future teachers varied their speech and gesture when they address native speakers and non-native speakers of a language. To determine this, we devised a word explanation task, where the same future teachers explained the same twelve words in two conditions: with a native and a non-native partner. We hypothesized the following: Hypothesis 1: the future teachers would produce more gestures when addressing non-native partners; Hypothesis 2: the future teachers would produce gestures of longer duration when addressing non-native partners; Hypothesis 3: the future teachers would produce more illustrative gestures (iconics and deictics) to make speech more comprehensible for non-native interlocutors; Hypothesis 4: the future teachers would produce fewer abstract gestures (metaphorics and emblems) when addressing non-native interlocutors; and Hypothesis 5: the future teachers would produce larger gestures to make them more visible when addressing non-native partners.

Hypotheses 1, 2, 3 and 5 are supported by our results. The future teachers produced significantly more gestures in the non-native condition. In fact, of the 120 explanations in the native condition, 35 were done without gesture whereas this occurred only twice in the 120 explanations in the non-native condition with the words *se souvenir* ('to remember') and *océan* ('ocean'). In addition, the future teachers' gestures lasted significantly longer when they addressed a non-native partner. The future teachers also produced significantly more illustrative (iconics and deictics) and thus more comprehensible gestures with non-native interlocutors. This result is consistent with the difference in the production of deictics in the non-native condition in Adam's (1998) results. However, it differs from Adams' results in that we found a significant difference in the use of iconics. In short, when language proficiency of the addressee is low and

access to meaning difficult, the future teachers use iconics and deictics to convey meaning (gestures are often redundant with speech as examples in Figure 8Figure 9 show). Iconics and deictics here are considered more comprehensible than the other dimensions because they illustrate the content of speech by conveying visible information related to size, shape, location, or action of the speech they accompany. Thus, in the specific context of language teaching and learning they support access to meaning with more efficiency than metaphors do.

Finally, our results show a significant difference in the size of the gestures between the two conditions: gestures are indeed produced in a larger area when addressing a non-native partner, thus making the hands more visible. These results suggest that future teachers make their gestures more visible depending on the language proficiency of their interlocutor. This also contributes to making gestures more visible and may be related to the meaning of particular words explained as well (for instance, the word *trottoir* – ‘sidewalk’ - is often accompanied by a gesture in extended arm space).

Hypothesis 4, in contrast, is not supported by our results. We had originally hypothesized that there would be fewer metaphors and emblems because metaphors do not have concrete meaning and emblems being culturally specific could lead to confusion. However, the future teachers did not produce significantly fewer metaphors and emblems in the non-native condition. This result is also consistent with what Adams (1998) found. This may be the case because speakers are often not aware of the culturally specific aspects of emblems and which of their gestures are emblems. In addition, they may also not be aware of the metaphoric gestures they use and that these gestures too have cultural aspects, though not codified (McNeill, 2012), and can be unclear for the interlocutor (Hauge, 1998; Sime, 2006).

Disfluency gestures (Butterworth and aborted) were also produced in greater proportion in the non-native condition although the amount was low. This can be explained by the fact that the non-native condition leads to more disfluency because the future teachers are conscious that they should simplify their speech and they constantly look for simple ways of explaining things as our qualitative analysis has shown. Moreover, when the interlocutor does not find the word immediately (which is frequent in the non-native condition), the future teachers have to look for another way of explaining, and this creates more disfluencies (false starts, repetitions, pauses) and hesitations.

Generally, our results show that future teachers adapt their gestures to the level of language proficiency of their interlocutor like adjustments speakers make in speech when addressing non-native interlocutors. Gestures are used as a real strategy to co-construct meaning. Most of the time they illustrate keywords of the verbal utterance (words that are necessary for understanding), they are produced in synchrony with speech and are often held during speech pauses to help the interlocutor focus on them (as seen in our qualitative analysis). Our results support CAT (Giles et al. 1991), where the interlocutor (the addressee) is the heart of an interaction. The future teachers adjusted their gestures to meet the needs of their non-native interlocutors. These adjustments clearly illustrate complementary discourse (Brennan and Hanna, 2009).

Our study also supports research on common ground (e.g. Galati & Brennan, 2013; Gerwing & Bavelas, 2004; Holler & Stevens, 2007; Holler & Wilkin 2009; Jacobs & Garnham, 2007) that has shown that there is a reduction in gestures when there is common ground developed through a task. An important distinction between this work and ours, however, is that when individuals are native speakers of a language as they were

in the studies cited, they already have common ground in terms of language, culture, and shared assumptions (Stam, 2010). This means that cultural knowledge can be taken for granted, and this was not necessarily the case with the non-native interlocutors in our study and affected the gestures the future teachers used to meet their needs.

Are these changes in gesture production helpful for the non-native interlocutors? Previous research on gesture in the context of foreign language teaching has shown that learners rely on their teacher's gestures to access meaning (Sime, 2006; Tellier, 2008) and that nonverbal cues are generally important for listening comprehension in a foreign language (Sueyoshi & Hardison, 2005). Even if research has found that participants understand better because of the use of gestures (see Holler, Shovelton & Beattie, 2009 for a review), a few studies have demonstrated that gestures are more useful for non-native than native speakers in listening comprehension (Kang et al., 2013; Dahl & Ludvigsen, 2014). This raises another question: does the type of gesture matter? Kang et al. (2013) showed that representational gestures (metaphorics, iconics and deictics) help adults learn new concepts better than beats do. We assume that iconics and deictics are more useful than metaphorics to compensate for information that non-native speakers cannot access through the verbal channel since "[m]etaphoric gestures (...) depict abstract referents or ideas metaphorically, where the hand movement does not directly correlate with the physical information, that is, they present an image of the invisible" (Kang et al., 2013, p. 827). The contribution to meaning of iconics (Holler, Shovelton & Beattie, 2009) and deictics (Kelly et al., 1999) has been specifically addressed and demonstrated. This is probably why our future teachers often spontaneously used them more with non-natives (see Figure 8). More studies investigating the role of each gesture dimension on comprehension of foreign language speech are needed.

This study like all studies had some limitations. The limitations are mainly related to the small number of participants (10 future teachers) although the fact that we analyzed 240 lexical explanations enabled us to run consistent statistical analysis. Moreover, a larger number of target words could have been used. In our material, we chose both abstract and concrete words but not in equal amount (4 abstract words and 8 concrete words). If we were to replicate this study, it would be beneficial to use the same number of concrete and abstract words because we know that word category influences gesture production (Tellier, Stam & Ghio, 2018). Additionally, it would be beneficial to analyze the future teachers' gestures according to the three functions Stam and Tellier (2017) identified for gestures in pauses: *production oriented* (lexical search), *interaction oriented* (turn giving/taking, requesting feedback, and *comprehension oriented* (supports comprehension) to determine when gestures and what kinds of gestures are produced for self and for other along with speech.

Another interesting research question for future research would be to qualitatively analyze classroom recordings to see whether teachers use iconic gestures when explaining abstract concepts to non-native speakers. In our data, it seems that future teachers tend to use different verbal strategies when explaining abstract words. For instance, for jealousy, instead of saying "it's a feeling of envy" as they did with native speakers, they set a concrete example such as "when a child has a toy and another child wants it...". This change of verbal strategy led to a larger use of iconic and deictic gestures even when they explained abstract words. Analysis of classroom data would enable us to determine if what we found was a result of the task or is a more universal phenomenon.

In conclusion, despite any limitations, this study, the first to examine interaction between future teachers and native and non-native speakers in a word explanation task,

clearly shows that speakers adjust not only their speech but also their gestures in addressing non-native interlocutors. This is an important finding. It confirms that both speech and gesture need to be examined in interaction and that adjustments in both need to be considered to understand what actually occurs in communication. Additionally, this study is relevant for language teaching and sheds light on gestures that future teachers use. Language teacher training should consider the importance of pedagogical gestures and help teachers in developing this particular skill (Tellier, 2008).

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