

An investigation of the effect of beat and iconic gestures on memory recall in L2 speakers

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Abstract

Previous studies have showed that iconic hand gestures aid memory recall and support comprehension in adults and children native speakers. In this paper, we investigate whether gestures might have an assisting role in second language acquisition. Repeating a previous experiment formed on native speakers, we used three types of stimuli (list of words accompanied by iconic gestures, beat gestures and no gestures) in order to test in which state the participants remember the most words. The result was that iconic gestures, compared to the other two states, provided significant support in memory recall and comprehension. However such an effect was not found with beat gestures whose presence gave worse results than the condition where no gestures were provided. This may indicate that beat gestures augmented the cognitive load of L2 speakers who have not learned yet how to interpret them.

1. Introduction

People use hand movements when they speak and these movements have many functions such as aiding comprehension or emphasizing the meaning of the discourse. This paper is about gestures and the meaning they convey along with speech and whether or not the use of gestures improves or ameliorates word recall. It appears that second language acquisition is a less focused on area and this raises the question of the validity of the assumption that gestures are an asset in any learning process. It is crucial to look at the role of gestures in second language acquisition and if they have an impact on the learning process and memorization. The main reason for this is that comprehension in a second language is made more difficult by several factors such as lack of vocabulary, different syntax, pronunciation and intonation differences. Therefore the inclusion of gestures in second language acquisition can possibly be very important.

Getting inspiration from So et al. [1], we will investigate the assistance that iconic and beat gestures may give in regards to L2 state. Similarly to So et al. [1] who investigated the assistance that gestures provide in native speakers' recalling ability, we replicate the experiments with non-native speakers of English.

The aim of this study is to investigate whether or not iconic and beat gestures aid memory and improve recall in L2 state, as they do for native speakers. Iconic and beat gestures have a different usage in language though. Iconic gestures are related to the meaning of the word with which they co-occur. On the other hand, beat gestures are not related to the meaning of the words with which they co-occur. They accompany the rhythm of speech and are aligned to the intonation of the language.

Since intonation of a foreign language can be difficult to learn, when people speak a second language, they often use the intonation of their mother language. Indeed, when So et al. [1] investigated the impact of beat gestures in memory recall of children, they found that children were not assisted by the presence of beat gestures. Since children have not learned to interpret beat gestures which are related to information structure and the rhythm of the language, it is obvious that their memory will not get support from them. We assume that we will find the same tendency in second language speakers that is beat gestures will not aid comprehension and memory recall.

Therefore, we expect that the participants will remember more words represented with iconic gestures and less with beat gestures or words which are not accompanied by gestures at all. We anticipate that the percentage of the recalled words accompanied by iconic gestures will be higher than the percentage of the words recalled in the other two states.

This paper is divided into four main sections. The first part (section 2) concerns studies on gestures in general and on comprehension and memory specifically. In this part we also introduce the main hypothesis. The second part, section 3, concerns the design of the experiment in which we elaborate on the methodology of the study. The third part, section 4, consists of the results and findings of the research and the final part is the discussion (section 5). The discussion summarizes the results and compares them with other related works that may explain them. Furthermore, it proposes future work.

2. Related literature

Much research has been made in regards to gestures in general and to how they aid memory and recall. Ekman and Friesen [2] first categorized hand gestures in three types based on the "origin, coding and usage of the act": emblems, illustrators and adaptors. Building on these findings McNeill [3] introduced the categories of hand gestures: "iconic, metaphoric and deictic gestures". Iconic gestures represent the meaning with specific movements that are related to the meaning of the word and help convey it to the listener. Indeed Kendon [4], Alibali et al. [5] and Ozyurek [6] proved that iconic gestures serve a major communicative role and they aid listeners' comprehension. Metaphorical gestures convey meaning in a more abstract way. McNeill [3] specified some types of metaphoric gestures and he introduced "batonic (beat)" gestures. "*These movements are rhythmic and the movement is a simple up and down motion.*" (McNeill, [3], p. 84). This distinction is relevant because it points out the difference between beat gestures and other non-representational gestures. Since many gestures are produced

unconsciously and speakers do not think before they produce them (McNeill [3]), it is important to see whether these gestures actually help the listener understand the message. Jacobs and Garnham [7] studied the effect of gestures in a narrative task. They found that gestures produced throughout the time of narration assist listener's comprehension. They proved that in a narrative task gestures play a major role in the overall understanding of the story. Alibali et al. [5], Kendon [4] and Ozyurek [6] studied the role of gestures in speech production and they concluded that the different kinds of gestures are different in execution but serve the same purpose: to convey the meaning efficiently and to assist the listener to get a better grasp of the meaning. Furthermore, Goldin-Meadow et al. [8] also showed that gestures may provide assistance in serving the meaning in a way that speech alone is unable to convey. Research into the communicative aspect of gestures begins from the point that important information can be conveyed non-verbally. Abundant research demonstrates the communicative role of gestures. Gestures constitute non-verbal cues that facilitate problem solving (Goldin-Meadow et al. [9], Kelly et al. [10], [11]) and they help disambiguation of similar terms which can be also referred to as "lexical discrimination" (Tompson and Massaro, [12]). One more relevant point in the communicative role of gestures, also mentioned before, is how enactment supports narrative processing (McNeill, Cassel and McCullough, [13]). Recently the mnemonic aspect of gestures has also been increasingly studied. Kelly, Barr, Church and Lynch [14] conducted experiments in which they investigated the impact that In a broader approach, Tellier [24] investigated the role of gestures in teaching and she pointed out the importance of using gestures during teaching. In 2008 [25], she focused on second language acquisition and she showed that gestures assist reproduction of knowledge and help memorization in L2 state. She indicated that multimodality favors memory since gestures are not only a visual modality but also a motor one which have as a result richer trace in memory. Not only Tellier but also Gullberg along with others pointed out the importance of gestures in second language acquisition (Gullberg [26]; Gullberg et al. [27]; Macedonia et al., [28], Morett [29]).

Finally, So et al [1] studied the mnemonic effect of iconic and beat gestures in adults and children and they asked whether or not gestures need to be meaningful in order to facilitate recall and promote memory. They tested two groups of people, adults and children, on the same task adjusted to their abilities, in representational and non-representational gestures. They reached the conclusion that enactment enhances memory in both adults and children. Recall was better in the case of iconic and beat gestures for adults, but only in case of iconic gestures for children. They remembered more words accompanied with iconic gestures than when they were accompanied with beat gestures.

The evidence stated above suggests that at least to some extent it is proven that gestures aid memory and recall. Building on these previous works and especially So et al.'s [1] experiments, we would like to evaluate the tendency that subjects may have to show greater recalling abilities when exposed to specific kinds of gestures within the context of second language acquisition.

3. Methodology

gestures may have on comprehension and memory. They showed that speech and gestures work together and equally help to channel a meaning. Equivalently, Cook, Mitchell and Goldin-Meadow [15] found that when children gesture during the learning process of a new concept, gestures help preserve new information. In this study, members of the control group, which did not use gestures, were not so effective in memorizing the new task and this showed that gestures are a tool for increasing children's ability to memorize. Similarly, Stevanoni and Salmon [16] focused on new knowledge storage and found that gesturing promote and support learning and the process of memorizing. Furthermore, Goldin-Meadow and Wagner [17] supported that gestures provide a profound knowledge into the speakers' thoughts and they pointed out that gestures are an effective tool in learning, comprehension and memory. They gave evidence that they help speech to convey meaning and support memory. Dual Coding Theory (Clark & Paivio [18]) is a related theory which also supports the idea that multimodal learning reinforces memory. This has been also introduced before by Baddeley [19] who said that the role of gestures is to effect memory in a more efficient way. A lot of studies have been made on multimodality in learning and they have shown that multimedia learning is more efficient since two parts of the brain are involved: the auditory and the visual (Moreno & Mayer [20]). In addition, gestures enhance the trace in memory and make it stronger and more efficient and they assist the process of recall (Engelkamp and Cohen [21]; Cohen and Otterbein [22]; Nyberg [23]).

We replicated the methodology of So et al.'s [1] study on non-native speakers of English. In our experiment, we used three videos in each of which a native English speaker says a list of 10 words. In the first video the narrator uses iconic gestures, in the second beat gestures, and in the third, no gestures at all. The words are the same as those used in So et al.'s [1] study (see Table 1).

Table 1. Lists of words.

List 1	List 2	List 3
Come	Write	Cycle
Think	Strum	Run
Fly	Cut	Read
Comb	Walk	Carry
Stir	Swim	Inject
Pray	Throw	Climb
Stack	Turn	Bounce
Beg	Eat	Brush
Hammer	Open	Knock
Cry	Push	Listen

All words are English verbs of one or two syllables. So et al. use three lists because they test the three conditions on the same participants and memory would be affected if the same list is repeated three times. We have reused their list in order to be able to compare our results with theirs. The duration of the videos is the following: 33sec the iconic gestures video, 26sec the beat gesture video and 22sec the non-gesture video. Both iconic and beat gestures last approximately 3msec.

Two groups of participants were tested. They were all university students, aged 24-35. The first group was the

control group and was composed of 4 native English speakers. They were tested on the same task in order to test whether we could replicate the results and justify the findings in So et al. [1]. If we can obtain similar results the control group as those obtained by So et al. then it would be reasonable to perform the same test on English non-native speakers.

The second group was composed of 10 non-native speakers of English (4 males and 6 females), and was used to test the hypothesis. The non-native speakers, have a high level of English as they are all currently enrolled in an international master at the university of Copenhagen where English is the teaching language.

Both groups had to follow the same procedure. The participants were asked to see three videos. In each video the English narrator went through the list of English verbs. In the first video the narrator accompanied the words with iconic gestures (i.e. gestures which visually represent the meaning of the verbs in real time), in the second video, he said the words accompanying them with beat gestures¹ and in the third video he said the words without performing any gesture. Iconic gestures were chosen based on how often they were used by a native speaker to accompany these words.

After each video the participants were asked to recall as many words as they could without any time limitation. Furthermore, the participants were asked to hold a pen in order to inhibit gesturing both while they watched the video and while they recalled the words. The reason for this is that if they gestured during the playback of the video, gesturing could have helped word memorization and if they gestured during recall, gesturing could have facilitated retrieval of the words according to the Lexical Retrieval Hypothesis (Holler et al. [30]).

Moreover, participants were not allowed to repeat the words during playback of the video. Between each video, the participants were asked to solve a simple mathematical task in order to prevent interference of the words between the conditions (So et al. [1]). By using an unrelated mathematical task, we also wanted to distract the participants from a linguistic retrieval mental process.

4. Results

The main hypothesis we wanted to test is that the participants would remember more words accompanied with iconic gestures, less with beat gestures, and the fewest with no gestures at all.

The analysis that we performed on the data was mainly made with SPSS along with some coded calculations via Python programs written for this purpose.

First, we counted the number of the correctly recalled words and we calculated the percentage of the recalled words for each condition. As shown in Table 2 the percentage of the words recalled from the iconic video is higher than the percentage of those recalled in the two other conditions. For the control group it is 73.3% and it is slightly higher than for the treatment group for which is 71%. However, the results obtained with 2L speakers indicate the same effect. In both groups, the percentage of the words recalled from the iconic

gestures video is higher than the words recalled from the other two videos. For native speakers, the percentage of words recalled from the video with beat gestures is larger than the percentage of words recalled from the non-gesture video, which is opposed to the results for non-native speakers. These percentages are 50% for the beat gestures video and 40% for the non-gestures video for native speakers, while the respective numbers for non-native speakers are 37% and 48%. Thus, we obtained for our control group results similar to those obtained in the experiment by So et al. [1] that is beat gestures have a positive effect on memory recall for native speakers of English, but this effect is not as large as that provided by iconic gestures.

A first analysis of the data indicates that iconic gestures aid memory in English even when the participants are non-native speakers, but we do not have the same indication for beat gestures. On the contrary, the second language speakers recalled more words from the non-gesture video than from the beat gesture video.

Table 2. Percentage of the words recalled

	Iconic gestures	Beat gestures	Non gestures
Control group	73.3%	50%	40%
Test group	71%	37%	48%

In a second analysis, we calculated the minimum, the maximum and the mean of the words recalled. As it is shown in Table 3, the sample of the words is 10. The minimum number of recalled words accompanied with iconic gestures is 5, while with beat gestures it is 0 and with no gestures 3. On the other hand, the maximum number of recalled words accompanied by iconic gestures is 10, with beats and no gestures it is 7. The mean of the recalled words accompanied with iconic gestures is 7.1, with beat gestures the mean is 3.7 and for the non-gestures condition it is 4.8. Obviously, taking into consideration both percentage and mean, the figure suggest the same tendency as that provided by Table 2. Iconic gestures are more helpful for memorization and recall than beat gestures and no gestures. In the case of beat gestures and no gestures, recall is better when no gesture accompanies the words to be remembered.

Table 3. Descriptive statistics

	N	Min	Max	Mean	Std D
Iconic	10	5	10	7.10	1.449
Beat g	10	0	7	3.70	1.829
Non g	10	3	7	4.80	1.398

Subsequently, we used SPSS in order to investigate if there is a significant difference between the results obtained with the three different conditions. After checking our data for normality using Kolmogorov-Smirnov Test we applied non-parametric pair tests in order to determine the significant difference between the results for the three conditions.

In order to test the difference between the three conditions, we performed one way- Anova analysis. In this case the subjects of a group are measured in multiple comparisons under three different gesture conditions. The analysis has been made to compare the group's answers under the three different

¹ "Beat gestures can take various forms of hand shapes and movements. One of the most typical forms of beat gesture is a hand with open palm flips outwards" (McNeill, [3] referenced in So et al., [1], p.5)

conditions. The result will be whether or not significant difference (*Sig. value*) exists between the three conditions of the same group. If *Sig. value* is equal to or less than .05 (e.g. .035, .02, .005), then a significant difference exists between the three conditions of the same factor. (Pallant J. [31]).

Table 4. Tests of Normality

	Statistics	df	Sig.
Iconic g	.176	10	.200
Beat g	.265	10	.045
Non g	.316	10	.005

For the first two pairs, the iconic-beat gestures pair and the iconic-non gestures pair, the difference is statistically significant. For the last pair, beat-non gestures, the difference is not statistically significant.

Table 5. P-values between the conditions

	Iconic gestures	Beat gestures	Non gestures
Iconic g		.00001	.002
Beat g	.00001		.437
No g	.002	.437	

More specifically, the difference between the first pair, iconic-beat gesture, is statistically significant since $p=0.0001$. The same goes for the second pair, iconic-non gesture. In this pair, $p=0.002$ and it is clear that there is also a statistically significant difference here. The same cannot be said though, for the third pair, beat-no gesture. The difference between them is $p=0.437$.

The results indicate the same tendency among native and non-native speakers in regards to whether or not words accompanied with iconic hand gestures aid memory. The same tendency was not found among the groups as it concerns words accompanied with beat gestures or words alone. Furthermore, our results demonstrate that words accompanied by iconic gestures are easier to be recalled by a non-native speaker than words that are accompanied by beat gestures or that are presented alone. We did not find a significant difference between the results obtained with beat gestures and no gestures and this suggests that in non-native speakers there is no difference as to whether we use beat gestures or not. However, the data indicate a tendency for having worse results in the beat condition than in the no gesture condition for 2L speakers.

5. Discussion

The purpose of the study was to investigate the impact of two different types of gestures on memorization and comprehension in second language speakers. The assumption that iconic gestures facilitate comprehension and recall was fully confirmed. Iconic gestures assisted memory recall in second language English speakers, as they did for native English speakers. Results showed that iconic gestures provide the same support to non-native speakers as they do to native speakers. Similarly to So et al's [1] findings on the impact that iconic gestures have on comprehension and memory, participants recalled more words from the first list, which were

accompanied with iconic gestures, than from the other two lists of words which were accompanied with beat gestures or not accompanied at all. The explanation may lie in the fact that iconic gestures are representational of the meaning of a word (McNeill [3], Kendon [32]).

On the other hand, beat gestures or the absence of gestures, did not assist memory recall like the iconic gestures. Findings indicate a significant difference between the words recalled when they were accompanied by iconic gestures and beat gestures or words accompanied by iconic gestures and no gestures at all. Furthermore, comparing the number of words recalled accompanied by beat gestures and the number of the words recalled without any representation, we can see that participants remembered more words without any representation than with beat gestures. In explanation, participants claimed that beat gestures confused them and they got distracted from the words. For them hearing the words alone without any accompanying gesture was easier, and they were able to stay focused on the task. Thus it was easier to recall the words afterwards.

The difference of results obtained in the iconic gestures condition and the beat gestures condition is probably due to the fact that beat gestures are not representational, thus they do not convey or define the meaning of a word. As we have explained before, beat gestures co-occur with speech and are aligned to its rhythm. They follow the prosody of the language and contribute to information structure, i.e. they contribute to indicate new or important information. Since different languages have different patterns of intonation, it is often difficult for non-native speakers to follow the rhythm of the new language and discharge the rhythm of their native language. As a result, beat gestures aligned to a different intonation may cause cognitive overload and as a result they can be confusing for second language speakers. It is difficult for a non-native speaker to coordinate speech accompanied with beat gestures in a different intonation than the one they know and they are already used to. As our findings showed, words that had no distraction from the beat gestures were easier to remember (Gussenhoven [33]).

Nevertheless, our study also pointed out that iconic gestures have a positive impact in second language acquisition. Quinn and Allen [34] as well as Kelly et al. [35] have also demonstrated the fact that enactment assists learning of a second language. In fact, many researchers have shown that when iconic gestures co-occur with speech, they promote comprehension, improve memorization and assist memory recall (Tellier [36], [25]; Wagner, Nusbaum, Goldin-Meadow [37]). This happens because representational gestures make stronger impressions on the brain as two areas of it are involved, the auditory and the visual, thus the trace is more strong (Cohen & Bean, [38]; Clark & Paivio, [18]; Nilson & Craik, [39]).

The present study though, did not prove any positive impact on memory recall from beat gestures. Opposed to the findings of So et al. [1], beat gestures did not provide any assistance to adult non-native speakers of English. This needs further investigation and the new study should probably focus on beat gestures, but within the context of larger discourse context. If one or two words are emphasized in a sentence by beat gestures, they will probably be beneficial for memory and recall also for non-native speakers. The same task was used by Feyereisen [40] when he investigated the mnemonic effect of iconic and beat gestures within the context of a sentence. He

concluded that meaningful (that is representational) gestures benefit memory recall, more than non-meaningful (in the sense of non-representational) gestures. He also proved that non-meaningful gestures are more beneficial than no gestures at all. However, also Feyereisen [40] as So et al. [1] conducted the study on native speakers; therefore one suggestion is to perform an investigation of the same task on a second language. A suggestion for further investigation in the field of beat gestures could be a study with non-native speakers that have lived many years in the second country. These participants will be used to the intonation of the second country's spoken language and it would be interesting to investigate if beat gestures will provide assistance in memory and understanding.

In any case, the fact that gestures aid comprehension as they make listeners encode new knowledge to a more permanent and stable format has been demonstrated here, and in previous studies (Goldin-Meadow, Nusbaum, Kelly & Wagner [41]; Wagner, Nusbaum, Goldin-Meadow [37]) This was also proven in the case of learning (Bruken, Steinbacher, Plass & Leutner [42]; Mayer & Moreno [43]).

Further investigation could be also initiated in deictic gestures for second language comprehension: whether or not the relation of speech with the environment and pointing gestures towards objects will be helpful during the process of learning a new language (investigated in native speakers by Ballard, Hayhoe, Pook, & Rao [44]; Grant & Spivey [45]).

Furthermore, the present study focused on short term memory of non-native speaker adults, a suggestion for further research is to investigate long term memory in L2 or maybe to examine whether or not the same tendency can be found in young children. Additionally, since a language does not consist only of verbs, it would be interesting to explore the impact of gestures with other classes of words, like nouns and adjectives.

Since the current study was a pilot study, the nationality of each non-native participant was not taken into consideration, or how similar their mother language is with the English language, which was the language they tested on. Additional limitations are that the level of proficiency in English was not taken into consideration as well as the standard of pronunciation of the participants. Studying this may enlighten the obscure field of beat gestures since pronunciation is directly connected to the prosody and the intonation of a language and some languages have more similar prosody than others.

In conclusion, encoding words with gestures can be beneficial in second language acquisition since enactment aids comprehension and enhances memory recall. According to the findings, iconic gestures assist memorization but the same was not proven for beat gestures. Further research should be made in addition by looking at the impact of different kinds of gestures on second language acquisition.

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