

# The Effect of Iconic and Beat Gestures on Memory Recall in Greek's First and Second Language

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**Abstract**—Gestures play a major role in comprehension and memory recall due to the fact that aid the efficient channel of the meaning and support listeners' comprehension and memory. In the present study, the assistance of two kinds of gestures (iconic and beat gestures) is tested in regards to memory and recall. The hypothesis investigated here is whether or not iconic and beat gestures provide assistance in memory and recall in Greek and in Greek speakers' second language. Two groups of participants were formed, one comprising Greeks that reside in Athens and one with Greeks that reside in Copenhagen. Three kinds of stimuli were used: A video with words accompanied with iconic gestures, a video with words accompanied with beat gestures and a video with words alone. The languages used are Greek and English. The words in the English videos were spoken by a native English speaker and by a Greek speaker talking English. The reason for this is that when it comes to beat gestures that serve a meta-cognitive function and are generated according to the intonation of a language, prosody plays a major role. Thus, participants that have different influences in prosody may generate different results from rhythmic gestures. Memory recall was assessed by asking the participants to try to remember as many words as they could after viewing each video. Results show that iconic gestures provide significant assistance in memory and recall in Greek and in English whether they are produced by a native or a second language speaker. In the case of beat gestures though, the findings indicate that beat gestures may not play such a significant role in Greek language. As far as intonation is concerned, a significant difference was not found in the case of beat gestures produced by a native English speaker and by a Greek speaker talking English.

**Keywords**—First language, gestures, memory, second language acquisition.

## I. INTRODUCTION

**C**O-SPEECH gesture is a universal human behavior and an integral part of the way we communicate with each other. Speech and gestures together form an integrated system which succeeds in improving communication by supporting the meaning of the discourse. Abundant research provides significant evidence that gestures play a dominant role in comprehension, memory and recall and support that by enacting speech, memory is facilitated and listeners get the meaning of the discourse in a more efficient way [1], [16], [25], [28], [43].

So et al. [44] tested the impact of two kinds of gestures (iconic and beat) on comprehension and memory in adult and children native English speakers. Results indicate that adults were assisted from both kinds of gestures but this was not true for children. Only iconic gestures assisted children's memory and recall. Such an impact was not found for

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beat gestures on children. Levantinou & Navarretta [31] in their study replicated So et al.'s [44] experiment with the difference of applying it to second language English speakers. They demonstrated that iconic gestures assist second language speakers. This was not the case for beat gestures since they were not beneficial for memory or recall.

Building on the investigation by So et al.[44] and Levantinou & Navarretta [31], the present investigation aims to explore the effect of iconic and beat gestures on native Greek speakers, in their mother tongue and in English as their second language. It is important to examine the validity of iconic and beat gestures in Greek due to the fact that no preceding studies on gestures related to memory for the Greek language exist. It is also important to investigate the impact of gestures on Greeks who speak a second language which is an area that has also not been investigated yet.

The aim of the present study is to test whether iconic gestures and beat gestures help memory recall in Greek adult native speakers in their mother tongue and in their second language. Firstly, it is expected that this will be the case for iconic gestures on both languages and secondly that beat gestures will have a positive effect on Greek's mother tongue. On the contrary, it is expected that the effect of beat gestures to be less strong in recall in the second language of native Greek speakers. Since beat gestures are aligned to prosody of a language, second language speakers might not benefit from them as they might retain their mother language's prosody. Furthermore, beat gestures are not representational but are related to information structure, thus they might increase the cognitive load in L2 speakers who are still not able to distinguish these signals of new emphasized information.

## II. RELATED LITERATURE

Gesture is a form of non verbal communication in which body actions channel specific messages. McNeill [36] argues that gestures and speech develop simultaneously and they are based on the same internal process and structure. He suggests that gestures co-occur with speech and they convey semantic and pragmatic messages along with speech. Gestures and speech are parallel functions in regards to the conveyance of the meaning since they are part of the same computational stage.

A large part of the literature related to gestures concerns the reason for the production of gestures, and which purposes they serve. Two main branches have developed. The first, tries to explain the production of gestures from the speakers perspective, and the other from the listeners. Nevertheless, all of them conclude that gestures are produced to assist brain

cognitive mechanisms to facilitate linguistic procedures. Either a speaker produces them in order to assist him convey the meaning of the discourse to the listener, or to have easier access to his mental lexicon or mentally conceptualize the information correctly. All these aspects can be considered interrelated, even overlapping. [2], [9], [29], [30].

An aspect of the use of gestures is the belief that gestures serve a communicative role. This theory focuses on the meaning that gestures may convey and the assistance for the listener to get a better grasp of it. From this point of view, gestures are produced to help the speaker to convey the message that speech alone is unable to channel and they assist the listener's comprehension. According to the belief that gestures serve a communicative role, each of their type carry a specific obligation which is: to accompany speech and aid the channeling of the meaning, in their own specific way. For instance, iconic gestures illustrate the meaning of the word produced, metaphoric gestures describe abstract concepts, deictic gestures are gestures point to a certain direction, and finally, beat gestures are the rhythmic gestures which accompany the intonation of speech and have a meta-cognitive function. Based on this categorization, many cognitive studies have been made, on the premise that gestures appear in relation to speech [1], [12], [47].

Gestures have also been studied in relation to memory. Studies have demonstrated that in general they aid memory and recall. More specifically, the different kind of gestures provide different levels of help in the recalling procedure and memory in total [13], [34]. According to these studies, the reason may be is that gestures leave a richer trace in memory, thus they help the process of recall [11], [14], [38], [42].

As mentioned before, So et al. [44] tested the impact of iconic and beat gestures on comprehension and memory in adults and children native English speakers. Results showed that adults were assisted from both kinds of gestures but children did not. Only iconic gestures benefited children's memory and recall.

The impact of gestures has also been pointed out in second language speakers. Studies [23], [21], [33], [39], [45] provide evidence that they can be beneficial during the learning process of a second language. They show that enactment supports comprehension and recall of new information. In this research line, Levantinou and Navarretta [31] tested the impact of iconic and beat gestures on second language speakers. They demonstrated that although iconic gestures provide significant support to memory and recall, the result for beat gestures was not the same. Beat gestures do not benefit second language speaker's recalling procedure.

When it comes though to gestures which are not representational or deictic but serve meta-cognitive function, such as beat gestures, their production is directly correlated to the prosody and the information structure of a language. The intonation of a language such as Greek is important because in Greek different types of sentences exist which share the same linguistic factors but carry a different meaning. These sentences differ only in prosody. This is the factor that the meaning often depends on [3], [4], [5], [7] [8].

Taking inspiration from So et al. [44] and Levantinou &

Navarretta, [31], the present study investigates the impact of both iconic and beat gestures in Greek language. Furthermore, it is examined whether or not the same impact of these two types of gestures exists on Greek speakers' second language. Taking into account the characteristics of the Greek language, study of So et al. [44] is replicated and modified into the Greek modality and it is tested if iconic and beat gestures have an impact in Greek language and on Greek speaker's second language.

### III. METHODOLOGY

To demonstrate the role of gestures in memory and recall, memory recall experiments were run involving speech alone, and speech co-occurring with gestures with Greek participants. Two groups of participants were formed comprising of 11 Greeks that reside in Greece (five males and six females) and 12 Greeks that reside in Copenhagen (seven males and five females). All participants were between the age of 25-35, their mother tongue was Greek and their second language is English. The level of participant's second language was certified as the highest, since all of them acquired Certificate of Proficiency in English and they were also required to complete a test prior to the experiment.

Participants viewed 12 videos in which a narrator said words accompanied with iconic and beat gestures and with words alone. The first three videos were in Greek. In the first video a native Greek narrator said ten words accompanied with iconic gestures, in the second video the same narrator said ten words accompanied with beat gestures, and in the third video, the narrator simply said the words without any representation. In these videos all Greek words followed the English intonation system with the stress placed on the last or the penult syllable. For the next three videos the same procedure was followed. They were also recorded in Greek with the difference that there was a variation in the prosody. In this case the words were stressed on all the final three syllables (last, penult and antepenult), thus it was more representative of the Greek variation in intonation. In the next three videos, a native English speaker said English words. The same procedure as in the previous three videos was followed. The last three videos were said in English but by a Greek speaker. The same procedure was also followed here. The duration of each video is 33 sec for the iconic gestures video, 26 sec for the beat gesture video and 22 sec for the non-gesture video. Both iconic and beat gestures lasted about 3 msec each. Iconic gestures were selected based on how often they were used by a native speaker to accompany the words used in this experiment. For beat gestures, it is used the up and down movement that So et al. [44] uses in their experiment.

All the words were motion verbs and were randomly shuffled. Furthermore, during the selection of the Greek words, it was extremely important to choose words in which there was no semantic connection between them at all in order to eliminate any chance of any mental correlation between them.

The participants first watched the three lists of two or three syllable Greek verbs in the following order: Iconic gestures, Beat gestures and No gestures. After viewing each video,

they were asked to recall as many words as they could without reproducing the gesture. Subsequently, they watched the videos with the two, three or four syllable Greek words in the same order and the same procedure was followed. They were then presented with the three videos in which the native speaker says the English words. The order of the presented videos was the same as previously, and similarly they were asked to recall the words. Finally, they watched the three videos in which the Greek speaker says the English words. The order of three conditions was fully counterbalanced. All the participants were asked to hold a pen throughout the whole procedure as it was important that they did not reproduce the gestures while they were watching the videos and while they were trying to recall the words. According to the Dual coding theory [9] and Lexical retrieval hypothesis theory [30] if participants had been free to gesture during the time of watching the videos and during the recalling procedure it would have helped them to memorize the words more efficiently. After each video, they were asked to complete a mathematical task in order "to prevent retroactive interference of the words from the previous conditions" [44].

#### IV. RESULTS

A two-tailed statistical analysis consisted of One-way ANOVA repeated measures and One-way ANOVA with POST-HOC TESTS revealed whether or not a significant difference exists between the three gesture conditions of the same group of participants and between the groups of participants on the same gesture condition.

Results demonstrate that for the Greeks that live in Greece, a significant difference exists when iconic gestures accompany words from both languages. As it is demonstrated on table I the outcome of the comparison between the three types of gestures for the Greeks who reside in Greece, in Greek words of two or three syllables, is that a significant difference exists between the pair iconic-beat gestures as  $p = 0.02$ , where the value of  $p$  must be lower than 0.05 in order to obtain significant difference. In the case of the pair iconic-no-gestures,  $p = 0.0001$ , signifying that in this pair the highest degree of significant difference is found.

In Table II, it is demonstrated the significant difference between the three states of gestures for the Greeks who live in Greece in Greek words of two, three and four syllables. As the results illustrate, in the pair iconic-beat gestures a significant difference exists since  $p = 0.0001$ . In the pair iconic-no-gestures,  $p = 0.0001$ . Both results indicate the highest degree of difference. Likewise, Table III shows the significant difference between the three types of gestures for the Greeks that live in Greece but in their second language. The words in this case are said by a native English speaker. As the table illustrates, the pairs in which we can see significant difference are the pair of iconic-beat gestures with  $p = 0.002$  and the pair iconic-no-gestures with  $p = 0.002$ . These results indicate the same tendency as the results on the participants' mother language. Iconic gestures provide significant assistance in the recalling procedure. It is not the same for the states of beat gestures and in the absence of gestures. Comparing these two, no significant difference was found.

TABLE I  
 GESTURES ACCOMPANYING GREEK WORDS WITH 2-3 SYLLABLES

	Iconic	Beat	No-gestures
Iconic		0.02	0.0001
Beat	0.02		0.712
No-gestures	0.0001	0.712	

TABLE II  
 GESTURES ACCOMPANYING GREEK WORDS WITH 2-4 SYLLABLES

	Iconic	Beat	No-gestures
Iconic		0.0001	0.0001
Beat	0.0001		1.0
No-gestures	0.0001	1.0	

TABLE III  
 GESTURES ACCOMPANY ENGLISH WORDS BY A NATIVE

	Iconic	Beat	No-gestures
Iconic		0.002	0.002
Beat	0.002		1.0
No-gestures	0.002	1.0	

Table IV shows the significant difference between the three types of gestures for the Greeks that live in Greece in their second language but with words were said by a Greek speaker. As it is displayed, the only pair that have a significant difference is the pair iconic-no-gestures with  $p = 0.028$ . The other two pairs, iconic-beat gestures and beat-no-gestures, show no significant difference since  $p = 0.146$  and  $p = 1.000$  respectively. In total, iconic gestures in comparison to beat and no-gestures, provide significant assistance in memory recall. This is not the case for beat and no-gestures state. No significant difference was found, indicating that beat gestures should not be viewed as an aid to memory. When it comes to comparison of the same state of gestures (Tables V-IX) in the three different word categories, it is noticed that a significant difference exists in the beat gestures state between a native English speaker and a Greek speaker talking English (shown at Tables VII and VIII). The pair of beat gestures in English from a native speaker-beat gestures in English from a Greek speaker is the only pair in which significant difference is present, as  $p = 0.032$ . The same is also true in no-gestures state as in the pair of no-gestures in English from a native speaker-no-gestures in English from a Greek speaker, a significant difference exists as  $p = 0.023$ .

TABLE IV  
 GESTURES ACCOMPANY ENGLISH WORDS BY A GREEK SPEAKER

	Iconic	Beat	No-gestures
Iconic		0.146	0.028
Beat	0.146		1.0
No-gestures	0.028	1.0	

TABLE V  
 ICONIC GESTURES ACCOMPANY THE 3 DIFFERENT WORD CATEGORIES

	Iconic Gr (2-3 syl.)	Iconic Native English	Iconic Greek-English
Iconic Gr (2-3 syl.)		0.623	1.0
Iconic Native English	0.623		0.382
Iconic Greek-English	1.0	0.382	

TABLE VI

ICONIC GESTURES ACCOMPANY THE 3 DIFFERENT WORD CATEGORIES

	Iconic Gr (2-4 syl.)	Iconic Native English	Iconic Greek-English
Iconic Gr (2-4 syl.)		0.127	1.0
Iconic Native English	0.127		0.382
Iconic Greek-English	1.0	0.382	

TABLE VII

BEAT GESTURES ACCOMPANY THE 3 DIFFERENT WORD CATEGORIES

	Beat Gr (2-3 syl.)	Beat Native English	Beat Greek-English
Beat Gr (2-3 syl.)		0.623	0.765
Beat Native English	0.623		0.032
Beat Greek-English	0.765	0.032	

TABLE VIII

BEAT GESTURES ACCOMPANY THE 3 DIFFERENT WORD CATEGORIES

	Beat Gr (2-4 syl.)	Beat Native English	Beat Greek-English
Beat Gr (2-4 syl.)		1.0	0.288
Beat Native English	1.0		0.032
Beat Greek-English	0.288	0.032	

TABLE IX

WORDS ALONE IN THE 3 DIFFERENT STATES

	No-gest. Gr	No-gest. Nat.Eng.	No-gest. Gr. Eng
No-gest. Gr		1.0	0.223
No-gest. Nat. Eng.	1.0		0.023
No-gest. Gr. Eng	0.223	0.23	

As far as the group of the Greeks that live in Copenhagen is concerned, the percentages of the recall words in Greek of 2-3 syllables and of 2-4 syllables are almost identical. As a result ANOVA calculations were the same, and that is the reason for displaying the results in Greek without any different illustration of the syllables. As Table X shows that participants who live in Copenhagen displayed a significant difference between the pairs iconic-beat gestures in Greek and iconic-no-gestures in Greek. P value in these cases is  $p=0.01$  and  $p=0.00$  respectively. Furthermore, Table XI shows the difference in the three different types of gestures on their second language for the Greeks that live in Copenhagen. Between the pair iconic-beat gestures, a significant difference exists as  $p=0.031$ . In the pair iconic-no-gestures a significant difference also exists since  $p=0.001$ . These findings indicate the same tendency which was also found in the group of Greeks that live in Greece. They tend to remember more words accompanied with iconic gestures, and fewer with beat or no gestures.

Finally, Table XII shows the comparison of the different gestures when the English words were said by a Greek speaker and the only significant difference was found in the pair iconic-no-gestures ( $p$  in this case is  $p=0.002$ ).

In most cases, like the Greeks that live in Greece, a

TABLE X

GESTURES ACCOMPANYING GREEK WORDS

	Iconic	Beat	No-gestures
Iconic		0.01	0.00
Beat	0.01		0.193
No-gestures	0.00	0.193	

TABLE XI

GESTURES ACCOMPANYING ENGLISH WORDS BY A NATIVE

	Iconic	Beat	No-gestures
Iconic		0.031	0.001
Beat	0.031		0.498
No-gestures	0.001	0.498	

TABLE XII

GESTURES ACCOMPANY ENGLISH WORDS BY A GREEK SPEAKER

	Iconic	Beat	No-gestures
Iconic		0.07	0.002
Beat	0.07		1.0
No-gestures	0.002	1.0	

significant difference exists between the pairs of iconic-beat gestures and iconic-no-gestures. Similar to the first group, it is signified that beat gestures do not provide any significant help in Greek. Analogous results are also present for English language. When the comparison is held between the same gesture but in the different states (Greek, English from native and from a Greek speaker), the only significant difference exists in the pair no-gestures Greek-no-gestures English from Greek speaker where  $p=0.046$  (Tables XIII-XV). This means that a significant difference is present only in the state where words are not accompanied from any kind of gesture.

TABLE XIII

ICONIC GESTURES ACCOMPANY THE 3 DIFFERENT WORD CATEGORIES

	Iconic Gr	Iconic Nat. English	No-gest. Gr. Eng.
Iconic Gr		1.0	0.708
Iconic Nat. Eng	1.0		0.619
Iconic Gr Eng.	0.708	0.619	

TABLE XIV

BEAT GESTURES ACCOMPANY THE 3 DIFFERENT WORD CATEGORIES

	Beat Gr	Beat Nat. English	Beat. Gr. Eng
Beat Gr		1.0	1.0
Beat Nat. Eng	1.0		1.0
Beat Gr Eng.	1.0	1.0	

TABLE XV

WORDS ALONE IN THE 3 DIFFERENT STATES

	No-gest Gr.	No-gest Nat. Eng.	No-gest Gr.Eng
No-gest Gr		1.0	0.046
No-gest Nat. Eng	1.0		0.202
No-gest Gr Eng.	0.046	0.202	

A last Post-Hoc Analysis between the two groups in all the videos (Table XVI) was run in order to measure whether or not a significant difference exists in each gesture type between the two groups and no significant difference is found. Although the



absolute numbers of the recalled words are different between the two groups, this difference is not sufficiently large to be depicted in the ANOVA Post-Hoc analysis results.

TABLE XVI  
 COMPARISON OF THE TWO GROUPS IN EACH VIDEO

	Gr live in	Gr-Gr live in Cph
Iconic Gest. Gr. (2-3 syl)		0.272
Beat Gest. Gr. (2-3 syl)		0.699
No-Gest. Gr. (2-3 syl)		0.362
Iconic Gest. Gr. (2-4 syl)		0.122
Beat Gest. Gr. (2-4 syl)		0.852
No-Gest. Gr. (2-4 syl)		0.362
Iconic Gest. Nat. Eng.		0.892
Beat Gest. Nat. Eng.		0.418
No-Gest. Nat. Eng.		0.691
Iconic Gest. Greek-English		0.669
Beat Gest. Greek-English		0.283
No-Gest. Greek-English		0.573

## V. DISCUSSION

The purpose of this investigation was to study the effects of iconic and beat gestures in memory and recall on native Greek speakers in their mother language and in a second language, in this case Greek and English. The hypothesis was that iconic gestures will facilitate memory recall either in the first or the second language. Different results were expected for the assistance of beat gestures. They are expected to be supportive of the memory in the first language but not in the second. The intonation though was expected to play a major role since it was anticipated a difference would be apparent at the group level.

The results from the memory recall experiments in Greek language (the words were either of two-three syllables or of two-four syllables) showed that for both groups iconic gestures are the most beneficial for memory, compared with the beat gestures condition and the absence of gestures condition. As expected, participants remembered a larger amount of words when they were accompanied with iconic gestures than in the other two conditions and this finding is consistent with So et al. [44] finding for iconic gestures.

Iconic gestures carry the same meaning as the accompanying words thus they activate semantic information related to the meaning of those words. In this way the trace of the word in the working memory is deeper and this helps the recalling procedure. Furthermore, iconic gestures work in a way in which they decrease cognitive load during the language processing [17] and aid conceptual processes before speech [2], [47]. Many studies [13], [46], [26] are in line with the results of the present investigation demonstrating that iconic gestures facilitate memory 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 efficient" [32] referring [10], [9], [41].

The fact that iconic gestures facilitate memory is also true for second language speakers. It has been demonstrated that iconic gestures assist the learning of new words in a second language in early stage learners [27]. It has also been shown that enactment enables children to get a better grasp of the meaning of difficult novel words [40].

The findings of the present investigation demonstrate that iconic gestures can enhance memory in Greeks speaking a second language. In this case, both groups recalled more words accompanied with iconic gestures than in the other two conditions. Previous research shows that encoding speech with iconic gestures facilitates comprehension, learning and memory in second language speakers. This is true not only for adults, but also for children [45], [11], [42].

The present research shows that speech and gestures form an integrated system. In both cases, first language or second language, gestures accompany speech and assist in channeling the meaning in a more effective way [18], [19], [20], [22]. In a broader approach the use of iconic gestures has been explained by cognitive theories. They facilitate the lexical retrieval from the speaker's mental lexicon through cross modal priming [30] and also according to Information packaging theory [29] they help the process of transition of thoughts into language by facilitating the organization and packaging of the new information. Finally, McNeill [37] suggests that gestures help to surpass the 'lexical gaps' that exist between the different languages. In other words when a manner of motion is not available in a language, the speaker will use iconic gesture to overcome this gap in speech and give the explanation needed.

Although in the case of iconic gestures the results were clear and they matched the results of So et al. [44], it was not the same in the case of beat gestures. Statistical tests revealed that Greeks in their mother language did not derive significant help from beat gestures condition. This result indicates that Greek speakers do not use beat gestures like English speakers do. A possible reason for this is that Greek is a highly intonational language in which the rhythm itself points out the necessary information in speech. The role of beat gestures is to create emphasis in certain parts of the utterance and grab the attention of the listener. Beat gestures mark the important points in a conversation and they help listeners realize and understand a critical concept. They are not representational but serve a meta-cognitive function by emphasizing the parts of the speech that the speaker wants to highlight [44].

Greek language uses different kinds of stresses. Their major role is to place emphasis on a part of the discourse. In this way, when a spoken part needs to be highlighted, stress underlines it. The most important stress type is sentence stress which is always adjusted so as to give the emphasis needed in a part of the speech [6] [7] [5] [8]. In Greek different prosodies exist for different kinds of sentence structures. In this way, it is easier for a Greek listener even in the absence of context, to realize the message by decoding the different prosodies. The results of the present study support these findings about the emphasis with prosody. In their mother tongue Greeks use prosody to convey underlined messages and focus on certain information. This is also the case when introducing new information. Indeed, when observing Greek people producing beat gestures, it is obvious that they do not use them as often as might be the case in other languages. It depends on the language's structure and the way in where beat gestures are used. As shown in the experiment of So et al.[44], beat gestures on English isolated words can be beneficial for the listener. The same was not found though for the Greek language.

Qualitative data from different situations in Greece indicate that Greeks produce beat gestures when they want to emphasize the meaning of their discourse or when they want to introduce new information. In this way, Greeks manage to turn listeners attention to certain parts of the meaning and highlight them.

The results from this study point out another issue related to the fact that Greeks residing in Greece recalled more words from a Greek speaker talking English accompanied with beat gestures, and the group of Greeks residing in Copenhagen recalled more words from an English native speaker accompanied with beat gestures. Despite the fact that this is not confirmed from the statistical analysis and a significant difference was not found, the absolute numbers show a tendency which can be explained again by prosody, the extra cognitive load and cross-linguistic influences.

As Marianne Gullberg has proposed [22], cross-linguistic influences appear not only at the semantic level, but also in the production of gestures. According to Gullberg's study, beat gestures, which accompany the intonation of the language, in the case of second language speakers, are produced following the intonation for the mother tongue. More specifically, in the present investigation, beat gestures were aligned in two different prosodies. Beat gestures generated from a Greek speaker speaking English were aligned to Greek prosody and beat gestures generated from a native English speaker were aligned to the English prosody. When Greeks, who live in Athens viewed words accompanied with beat gestures aligned in a different prosody than the Greek one, their mental process increased. According to Hubbard et al. [24], the function of beat gestures is different than the representational ones. They serve a meta-cognitive function and when they co-occur with speech they might increase the cognitive load if the speaker has not learned to perceive what they signal. A native speaker recognizes beat gestures and successfully integrates their cognitive and communicative function. A second language speaker on the other hand, might not be able to integrate multiple sensory modalities like a native speaker can when gestures and stress provide extra information which is not related to the meaning of the word. The cognitive load is heavier, thus beat gestures have a negative effect on memory recall of single words. That may be an explanation of why Greeks that reside in Greece recalled more words from a Greek generating beat gestures. When saying the words accompanied with beat gestures, the speaker generated the gestures according to Greek prosody, thus it was easier for Greeks that have low experience of English prosody, to remember more words. For the same reason, Greeks that reside in Copenhagen recalled more words from a native English speaker. According to Gullberg [22], adults have the ability to re-construct the meaning of the second language by detecting the differences between the mother and the second language. This means that the more proficient the speaker is in a second language the less influences he has from his mother tongue. The second language speaker, who is more exposed to the second language, has spotted the differences in semantics or syntax or prosody and has adjusted his way of expressing himself in the second language as close as can be to that of

native speakers. This is also true for gestures and especially in the case of gestures that co-occur with a different prosody. Since, Greeks residing in Copenhagen are regularly exposed to English and often work in an international environment, they get used to a different prosody than the Greek one. That might be the reason why it was easier for them to follow the native English production of beat gestures and recall more words accompanied with beat gestures spoken by a native English speaker. In conclusion "Prosody of the L2 is not easy to acquire for adult speakers, and this might explain why providing emphasis on single words through beat gestures did not support short memory in 2L speakers." [31]

## VI. CONCLUSION AND FUTURE WORK

The present study confirms original observations of So et al. [44] for iconic gestures but not for beat gestures. It was found that when iconic gestures accompany a word, they support memory and recall. Consistent with my hypothesis, participants in their mother tongue recalled more words accompanied with iconic gestures than accompanied with beat gestures or not accompanied at all. This was also the case for second language. Whether iconic gestures were produced by a native English speaker, or by a Greek speaker speaking English, all participants recalled more words accompanied with iconic gestures. Also, no difference was found in the amount of recalled words between the various groups (Greeks that reside in Greece and Greeks that reside in Copenhagen). Both of them recalled more words in Greek and in English accompanied with representational gestures than in the other two conditions. Since almost the same number of words was recalled, this shows that iconic gestures provide significant support in memory. On the other hand, the present investigation failed to support the hypothesis that beat gestures also support memory. In So et al. [44] investigation native English speakers also benefited from beat gestures. This is not true for Greeks. Maybe due to predetermined prosody, Greeks seem that they do not use rhythm gestures as English speakers do. Results also demonstrate that Greek speakers did not benefit from beat gestures in the second language. Statistical tests did not manage to show a significant difference between the amount of words recalled accompanied with beat gestures and the amount of words recalled when presented alone. Prosody seems to be more helpful in this case. Comparing the two groups, Greeks that reside in Greece seem to benefited from beat gestures generated from a Greek speaker talking English, while Greeks that reside in Copenhagen seem to benefited from the beat gestures produced by the native English speaker.

Since Greeks seem not to be affected on memory when beat gestures accompany isolated words, this means that beat gestures have not exactly the same functions in Greek as in English. The present investigation demonstrates that there is a large discrepancy regarding how in these two languages accompanying single words with the same kind of gesture affect memory. Areas in need of further investigation can be generated from this finding. Future studies can focus on how beat gestures are used in the Greek language, locate

the differences in use of beat gestures between the two languages, and investigate how they can contribute to the better acquisition of English as a second language and aid Greek students to learn better English. These studies will examine how teachers can provide special attention to beat gestures and how this kind of gesture can help Greek students to acquire native pronunciation and intonation more efficiently. Since Greek accent is grammatically predetermined and the use of beat gesture is mostly required in order to place emphasis on and highlight information, future studies will investigate how teachers can incorporate beat gesture into the teaching procedure in order for the students to learn to generate beat gestures like English native speakers. They will explore whether the use of beat gesture during the learning procedure facilitates English learning for Greek students. If two groups of students were examined, one exposing to beat gesture and one not exposed, the study would investigate whether there would be a difference in the acquired language. And on the other hand, it would be interesting to examine the impact of using beat gesture of an English native speaker while speaking Greek and discover whether English native speakers manage to generate beat gesture like Greeks.

Beat gestures can also be investigated further in relation to their function in a narrative task or in the context of a sentence. Especially in the Greek language where the stress is adjusted to the area of the sentence that needs to be focused on [7], how beat gestures influence the memory if they are combined with the stress-focused area needs to be further investigated. Feyereisen [15] investigated beat gestures in the context of the sentence finding that beat gestures can benefit memory and recall also in this case. Therefore, one more suggestion for further research is to investigate beat gestures in Greek language within the context of a narrative task [15]

Finally, for future work it seems relevant to study the cross linguistic differences of iconic gestures among languages. As Gullberg [22] suggested, when adults learn a second language they initially correlate the second language with the first through translation. They do not build an independent system from the beginning. For that reason iconic gestures are used to overlap the semantic gap and the lexical difficulties that appear [35].

Second language speakers' gestures differ from those of natives even in advanced levels because of the cross-linguistic influences that appear also in gestures and this can cause misunderstandings and confusion. In order to overcome that, second language learners have to detect the differences between the L1 and L2 and adjust their production of gestures accordingly. This re-constructing procedure is possible if these differences are acknowledged. This leads to a new field of studies which will deal with iconic gestures and the different ways they represent the meaning of a word.

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