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EFFECTS OF GESTURE ON RECOLLECTION AND DESCRIPTION OF AUDITORY AND VISUAL STIMULI

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Gesture. According to the Merriam-Webster dictionary, it is "a movement usually of the body or limbs that expresses or emphasizes an idea, sentiment, or attitude" (2018). It has commonly been thought of as simply an arbitrary movement of the hands; however. it is much more inherent to communication than an arbitrary movement. More recently, gesture has been analyzed as a communication tool. The field of research on gesture in communication is fairly new but has ignited several exciting questions about and new directions to understanding why humans gesture. Much research has suggested that gesture plays a large role in typical interpersonal communication. Moreover, additional research also suggests it benefits memory (Frick-Horbury & Guttentag, 1998). The purpose of the current study was to examine how individuals use gesture across the domains of interpersonal communication and memory retrieval.

In one of the first studies on gesture and memory, Thompson, Driscoll, and Markson (1998) investigated how gesture develops and influences comprehension and recollection. They found that when gesture was added to spoken language, both adults and children had increased memory retrieval. This suggests that gesture plays a larger role in communication than previously thought. This study gave the first inclination that gesture may be utilized for comprehension and memory purposes.

Similarly, Church, Garber, and Rogalski (2007) studied recall of three categories of video stimuli presentation: "speech only," "gesture only," and "speech+gesture." The video stimuli were short phrases produced by onscreen women, such as "it smelled bad in the room," that were played in video form for each participant. In the "speech only" condition, the stimuli showed a woman saying "it smelled bad in the room" or one of the other phrases included in the study. In the "gesture only" condition, the woman only waved her hand in front of her nose. In the "speech+gesture" condition, the video showed a woman saying "it smelled bad in the room" while waving her hand in front of her nose. The information shared by the speech+gesture video stimulus was best comprehended and recalled by the participant. The researchers concluded that adding gesture to speech improved comprehension and recollection of the stimuli.

The previous studies examined the effects of perception of gesture on memory for stimuli. It is possible that performing gestures, as opposed to merely seeing gestures, might have a greater effect on memory for events. Wagner-Cook, Kuang Yi Yip, and Goldin-Meadow (2010) analyzed how the ability to gesture while encoding information affected the ability to recall a stimulus after various amounts of time. Recall was tested immediately and then again after three weeks; in both instances, participants showed an increased ability to recall stimuli when they had been able to gesture during the learning process. That is, individuals who had seen communication with gesture within the stimuli had better recall of the stimulus than the participants who had not seen stimuli with communication with gesture. In addition, those who had not gestured while encoding the stimuli of the experiment recalled less than those who had gestured. Further, the number of gestures used by the participants was positively correlated with the number of things participants were able to remember. The researchers therefore concluded that gesturing increased memory retention and recollection, as well as made communication comprehension more effective.

In a similar study, Cutica and Bucciarelli (2013) presented participants with various texts and then asked them to recall various words and phrases from the texts. Part of the time, each participant was encouraged to gesture during his or her recall, and the other part of the time, the participant was discouraged from gesturing. When participants gestured, they were able to remember more phrases than when they were discouraged from gesturing. These results agree with those of Wagner-Cook et al. (2010), which suggest that gesturing enhances mental models and increases memory retrieval.

Finally, Frick-Horbury and Guttentag (1998) asked participants to recall SAT vocabulary words. Half the participants were prohibited from gesturing during recall. When gesturing was restricted, lexical retrieval and free recall were reduced, once again suggesting that gesture is influential in the memory process.

Goldin-Meadow, Nusbaum, Kelly, and Wagner (2001) expanded upon the previous study to investigate the effects of gesture on cognitive load. In this study, children and adults were asked to remember a list of words or letters and then were asked to explain the way they solved a math problem. When subjects were allowed to gesture, they were able to recall more items from the word and letter lists and from the math problems than when they were not allowed to gesture. The researchers concluded that gesturing reduces cognitive load by mentally separating the words and letters from the math problems, thus improving recollection.

Not everyone relies on gesture to the same extent to improve memory. Marstaller and Burianová (2013) looked at working memory and how it is influenced by individual differences in gesture. They identified which participants were more likely to gesture, then separated participants into high-gesturing groups and low-gesturing groups. In addition, they identified who had high working-memory (WM) capacity and low working-memory capacity. They found that individuals with low WM capacity who were high-gesturing had reduced WM accuracy when their gestures were restricted;. however, for the other three groups (high WM/high gesturing, low WM/low gesturing, and high WM/low gesturing), there was no effect from gesture inhibition. This study illustrates that an individualistic aspect to gesture and memory capacity could exist that may influence success in a memory task.

The outcome of memory tasks, in general, is often dependent on the type of stimulus presented. In a study conducted by Peters, Suchan, Köster, and Daum (2007), the recollection of auditory and visual stimuli was compared at each step of the memory process: encoding, retrieval, and recognition. The researchers found that individuals process auditory and visual stimuli in different subareas of the brain, which allows the processing method for each modality to be more effective. Auditory memory performance was lower than visual memory performance, most likely due to dual-coding of the visual stimulus. For instance, participants not only recognize the objects but also think of what the names of the objects are when looking at the visual stimuli; in comparison, when listening to a spoken word, participants may or may not imagine the visual object. These results suggest that the encoding process and type of stimulus have a large effect on memory.

These studies offer a variety of perspectives on the complex and emerging knowledge of gesture in regard to language and memory. This information prompts the question of whether gesturing is necessary for a more high-quality recollection of information across any type of stimulus. In addition, most research has examined the receptive qualities and effects of gesture, yet few have looked at the impact of expressing gesture. It has been shown that when a person is listening to a speaker who uses visual information and gesture along with speech, there is increased comprehension and memory of a stimulus. How is a communicator's recollection of the stimuli affected when the speaker is using the gestures, though? Also, how do different types of stimuli play a role in recollection? That is, does gesture have more benefit for memory of visual or auditory stimuli? It was hypothesized that having the ability to gesture would enhance recollection of target words compared to the number of target words recalled by subjects who were unable to gesture with

both auditory and visual stimuli, and that gesture would benefit recall equally for auditory and visual stimuli. This is because during a visual presentation, one is able to map out the spatial details with one's hands. In addition, with an auditory condition, a participant can map out the auditory scene in space and time. Although it is not known whether gesture will have more benefit in one recall situation over the other, recall of information from both modalities could involve similar gestures.

Experiment 1

Method

Participants

In this study, 20 college-age participants (ages 18–25; 13 female, 7 male) from Butler University volunteered to be tested. These participants were motivated to participate in this study through a small incentive, a $5 Starbucks gift card upon completion of the study. Subjects were recruited via advertising around campus with materials such as flyers and posts on the department Facebook page.

Students who decided to participate in the study were informed of the study procedure and asked if they were willing to participate in the study. Potential participants understood that their participation was completely voluntary. In addition, participants agreed to be recorded via video for the sole use of the data being reviewed after completion of the study. All sessions were video-recorded with a CAT Canon Vixia HF R200 HD camcorder. This research project was conducted on Butler University's campus in the Communication Sciences and Disorders research lab.

Design

This experiment used a 2x2 between-participants design. The independent variables were the type of stimuli the participant was presented (auditory or visual) and the ability to gesture (allowed or not allowed to gesture). The dependent variable was the number of keywords from a predetermined list that a participant was able to recall.

Procedure

The 20 participants were separated into four groups, each consisting of five people, by the process of random assignment. Groups 1 and 2 were shown a visual

stimulus on paper, and Groups 3 and 4 heard an auditory stimulus through headphones.

Participants were told that they were either going to see a picture of or listen to a description of a busy, multifaceted scene. They were instructed to remember the details of the scene because they would be asked to recall them later. During these instructions, the word "gesture" was not used. The participants were then presented with the first stimulus scene either visually (see Appendix A) or audibly (see Appendix B).

After each scene, the participant was given a "distraction task." This was a five-minute interview conducted by the student researcher. The researcher asked participants various questions about topics including language education, family vacations, the college experience, and so on. This served as a buffer between the two parts of the experiments, allowing the participants to halt their focus on the stimuli after the designated time and direct their attention elsewhere, in order to assess long-term memory as opposed to working memory.

Following the distraction task, the experimenter asked participants to recall as many things as they could from the stimulus scene. Groups 1 and 3 were asked to do this with no gesture limitations. These groups were not prompted to gesture, but previous literature suggested that the probability that the subjects would use gesture was naturally very high. The goal was to have Groups 1 and 3 describe the stimulus as naturally as possible. Because of this, researchers did not prompt these subjects to gesture or ask them to focus on their gestures during their speech, in order to avoid distracting them. If someone in Groups 1 or 3 used no gesture whatsoever, that person's data were to be eliminated. None of the subjects' data were removed, however, because all participants included gesture during their speech. The remaining groups, Groups 2 and 4, were asked to place their hands on a table as they recalled the stimuli. This was intended to prohibit them from gesturing.

The participants were instructed to recall the picture or recording and to describe what they had seen or heard. They were given two minutes to recall the scene to the researcher. As participants described the scene, the researcher checked items from a keyword list as the participant mentioned them. This type of data collection was completed across all of the groups, regardless of stimulus type or ability to gesture. After the two minutes of recall were complete, the researcher counted the number of keywords named.

This procedure was repeated 10 times, once for each of the 10 scenes. The order of the 10 scenes was randomly generated for each participant to prevent order effects. After a participant had seen all of the scenes, he or she was given a final recall task, during which the researcher asked the participant to remember everything the participant could about the first scene he or she had seen or heard. This was intended to show the effects of longer-term memory recall.

Stimuli

The visual stimuli were a variety of scenes that included dynamic action. One scene, for example, included a park in which several children played on a variety of playground equipment (see Appendix A). In turn, the auditory stimuli were one- to two-minute auditory recordings of a voice describing the same detailed, multifaceted scenes (see Appendix B). These audio descriptions were recorded with a Snowball iCE USB microphone and GarageBand software. The auditory stimuli were recorded prior to the experiment and were played through a set of high-end headphones during the experiment.

Groups 1 and 2, the visual groups, were presented with visually illustrated scenes for approximately one to two minutes. The specific time the participant was allowed to study the picture was dependent on the corresponding audio scene. The participant viewed 10 visual scenes total. Groups 3 and 4 listened to 10 one- to two-minute recordings describing the same scene as the picture. A list of keywords was created to correspond with what was being shown and heard in the stimuli. The keyword lists each consisted of 20 objects or actions occurring in each scene (see Appendix C).

Results

The researcher compared the between-subject variables of gesture (present or absent) and the stimulus type (auditory or visual) using analysis of variance (ANOVA) and post-hoc *t*-tests.

The first analysis examined the average number of keywords recalled across the four groups (see Table 1). For Group 1, visual+gesture, the average number of keywords recalled was 11.56 (SD = 1.13). For Group 2, visual+no gesture, the average number of keywords recalled was 12.12 (SD = 1.33). For Group 3, auditory+gesture, the average number of keywords recalled was 12.30 (SD = 2.69). Finally, for Group 4, auditory+no gesture, the average number of keywords recalled was 12.98 (SD = 1.75). An ANOVA revealed no main effect of type of stimulus

(visual or auditory), $F(1, 16) = .959$, $p = 0.342$, nor of the ability of gesture (gesture or no gesture), $F(1, 16) = .576$, $p = .459$. The interaction between stimulus type and gesture also did not reach significance, $F(1, 16) = .005$, $p = .942$.

Discussion

The results of the study revealed no statistically significant effects on the relationship between ability to gesture and number of keywords recalled. This meant that, unlike the researchers hypothesized, those who were able to gesture did not recall more keywords than those participants who were unable to gesture. In addition, the stimulus modality did not have an effect on the number of keywords recalled, so regardless of whether participants were presented with auditory or visual stimuli, the average number of keywords stayed the same.

This study did have limitations, however. The lack of significance could have been due to the small sample size, given there were only five people per condition. In addition to this, some individuals may have been more inclined to gesture more in general than others. This idea could be manifested in participants not being as affected in the "no gesture" category if they rarely gestured anyway, and vice versa. Similarly, the instructions given to the participants may have not elicited enough gesture because of this variability in participants' reliance on gesture.

Because of this, it seemed imperative to test more participants to gain a greater sample size and to determine whether individual differences in the frequency of gesture of participants may account for varying likelihood of gesturing. The purpose of Experiment 2 was to determine whether there is a relationship between gesturing during conversation and gesturing during recall.

Experiment 2

In Experiment 1, no significant difference was found between the number of keywords that participants were able to recall if gesture was allowed or gesture was restricted. Due to this, in Experiment 2, gesture was not limited, and all participants were able to gesture naturally, but participants' gesture rate (i.e., number of gestures per second) was investigated, because it was found in the previous experiment that certain participants used gesture more in communication than did others.

What does gesture rate look like in different communication settings? Goldin-Meadow (1999) looked at the role of gesture in a broad way and found that

gesture is specifically used in communication. In addition, Thompson et al. (1998) found that gesture is utilized within recollection. Gesture in both communication and recollection has not been studied within the same individuals, however. Do certain people utilize gesture in only one condition or the other, or do they consistently utilize gesture across all communicative situations? It is unknown if those who use a significant amount of gesturing are just "gesturers" or if different communicative situations are completely separate entities within the realm of gesture. Thus, the purpose of the second study was to look at the relationship between gesture during conversation and gesture during recollection. The researchers hypothesized that participants would gesture more, on average, during the recollection portion of the study compared to the conversational portion. In addition, because of the results of Experiment 1, there was no expectation that participants who were presented with the auditory stimuli would remember more or fewer keywords than those presented with the visual stimuli.

Method

Participants

In this study, 20 college-age participants (ages 18–25; 16 female, 4 male) from Butler University volunteered to be tested. Data from these 20 participants were included from 10 participants from Experiment 1 (Groups 1 and 3) and 10 new participants (5 assigned to Group 1, and 5 assigned to Group 3). These participants were motivated to participate in this study through a small incentive, a $5 Starbucks gift card, upon completion of the study. Subjects were recruited via advertising around campus with materials such as flyers and posts on the department Facebook page.

Students who decided to participate in the study were informed of the study procedure and asked if they were willing to participate in the study. Potential participants understood that their participation was completely voluntary. In addition, participants agreed to be recorded via video for the sole use of the data being reviewed after the completion of the study. All sessions were video-recorded with a CAT Canon Vixia HF R200 HD camcorder. This research project was conducted on Butler University's campus in the Communication Sciences and Disorders research lab.

Design

This experiment included both between- and within-subject independent variables. The first independent variable (between-subject) was the type of stimuli the participant was presented (auditory or visual). The second independent variable (within-subject) was communication type (conversation or recall). The first dependent variable was the number of keywords from a predetermined list that a participant was able to recall. Additional dependent variables included number of gestures and gesture rate (number of gestures per second) during both the distraction task and the recollection task.

Procedure and Stimuli

Participants completed the same procedure as did Groups 1 and 3 in Experiment 1; that is, all participants gestured naturally. Ten participants were assigned to Group 1, and ten participants to Group 3. The procedure and stimuli were the same as in Experiment 1.

Results

We combined the data for Groups 1 and 3 from Experiments 1 and 2 to complete three statistical analyses: an independent-samples *t*-test, a Pearson correlation test, and a paired-samples *t*-test. We did not include the data from the 10 subjects in Experiment 1 who were in Groups 2 and 4 (no gesture) because this experiment focused only on naturally gesturing participants.

To determine whether the type of stimuli had an impact on the number of keywords that participants were able to recall from the scenes, we ran an independent-samples *t*-test with stimuli condition (visual or auditory) as the between-subject variable and with number of keywords recalled as the dependent variable. The visual group recalled a mean of 12 words (SD = 2.16), while the auditory group recalled a mean of 11.90 words (SD = 5.47; see Table 1). The *t*-test revealed no significant difference between the two groups, $t\,(18) = 0.54$, $p = 0.958$.

We also analyzed the correlation between the number of gestures used during the conversation distraction task and during the memory-recall portion of the task. A Pearson correlation test did not reveal a significant correlation between the number of meaningful gestures during the distraction task compared to the number of meaningful gestures during the recall task, $r = .152$, $p = .523$. In addition, the number of gestures per second during the distraction task compared to the

number of gestures per second during the recollection task was positively, but not significantly, correlated, $r = .346$, $p = .136$. This means that the number of gestures used during one task did not increase consistently with the number of gestures used in the other task. Essentially, this assesses the idea that some participants are more likely to gesture in general than others in any type of communication. Although participants' number of gestures per second in the distraction task were positively correlated with the number of gestures per second in the recall task, the correlation was not strong enough to be significant.

Lastly, we ran a paired-samples *t*-test with type of task (communication versus recall) as the within-subject variable, and number of gestures used per second as the dependent variable. This analysis revealed fewer gestures per second in the communication task ($M = .17$, SD = .94) than the recall task ($M = .25$, SD = .16), $t\ (19) = 2.285$, $p = .034$, Cohen's $d = 1.022$.

Discussion

The results of the study revealed a positive correlation between the number of gestures a participant used during conversation and the number used during recollection, although this correlation did not reach significance. This finding suggests that there is no relation between number of gestures across communication contexts (conversation and recall). That is, individuals who use more gestures than others in one context (conversation) do not necessarily use more gestures than others in a second context (recall).

We also found that participants typically gestured more during the recollection portion of the task than during the conversational portion. This is consistent with the hypothesis that participants would gesture more when they were trying to recall information than during conversational communication. This finding suggests that gesturing may play a bigger role in recollection than in everyday conversation.

Some limitations to this study existed and should be noted, however. The sample size of Experiment 2 was predominately female (90%). It is unknown whether this would have an effect on gesture, but it is something to consider for future studies, considering that men and women often communicate differently (Hall & Roter, 2002). Some participants used gestures that were difficult to accurately account for because of the retroactive data collection via video recordings. Counting the number of gestures a participant used was completed via the study's recording, so the data could have been susceptible to subjectivity

because no specific a priori criteria, other than research judgment, labeled a participant's motion as a gesture or an arbitrary movement. It may have been helpful to create concrete criteria prior to data collection that detailed what was considered a gesture and what was considered a non-gesture motion (e.g., moving hair out of one's face). Along this same thread, the study was not a blind study, because the researcher knew in which group each participant had been placed. This potentially could have also produced some bias. If the researcher had been blind to which category was being analyzed, or if a different individual had completed the coding of gestures via recorded video after the experiment, there may have been less potential for bias when counting the number of gestures.

Another limitation was that the conversational portion that was analyzed could technically be seen as a recollection as well. The participant was asked to tell the researcher about the favorite trip or vacation the participant had ever taken. Although it is not the same as trying to recall keywords that participants had specifically been asked to remember, it could have had an effect on the conversational communication data. Using a different distraction conversation, such as the participant's favorite things to do in his or her free time, might eliminate the effects of the recollection involved with talking about a previous trip.

Because of this, future directions include a potential third experiment that diversifies the sex of participants and uses a blind study methodology. In addition, it would be insightful to tweak the methodology and stimuli to focus on eliciting more gesture. This could be used to see if prohibiting gesture does have an effect on the ability to recall information.

General Discussion

The purpose of this study was to analyze the role of gesture in communication and recall. The findings suggest that individuals gestured equally across auditory and visual conditions but were more likely to gesture when they were trying to recall stimuli than when they were simply having a conversation. Moreover, individuals were not more likely to be "gesturers" over others. Instead, gesture was seen more as a recollection tool than as an individual trait. This aids the thought that gesture may be utilized differently across different situations.

Future directions for this research could include trying to alter the stimuli by possibly employing the "tip-of-the-tongue phenomenon" to spark retrieval failure or to use stimuli scenes that are more complex. This could elicit increased gesture or a different kind of gesturing response. In future experiments, it may be

beneficial to have participants encode both auditory and visual stimuli during their session, instead of just one, for comparative purposes. Introducing reaction time as a dependent variable in order to assess whether gesture plays a role in how quickly one is able to recall something might also yield interesting data. In addition, requiring participants to indicate a "feeling of knowing" before producing the answer could supply more insight. This might help identify in which specific phase or part of the recollection process gesture is utilized.

These results, if replicated and generalized, could be valuable in the future in a clinical setting. For instance, gesture could be applied to help children in the education system recall important material. Similarly, creating visual and kinesthetic association with material, possibly even in a speech therapy setting, could potentially aid in learning, especially if there is a disorder or deficit. Other advancements could be made with this research in populations with memory problems, such as dementia and mild cognitive impairment.

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Table 1

Mean Number of Target Words Recalled (and Standard Deviation) from Experiments 1 and 2

	Gesture	No Gesture
Experiment 1		
Visual	11.56 (1.13)	12.12 (1.33)
Auditory	12.30 (2.69)	12.98 (1.75)
Experiment 2		
Visual	12.00 (2.16)	
Auditory	11.90 (5.47)	

Appendix A

Example of Visual Stimuli

Appendix B

Example of Transcribed Recording of Auditory Stimuli

Researcher:

> You are standing in front of a park scene with many children and families enjoying the beautiful day. Closest to you on the right side, a few children are playing with their sailboats in the fountain. A little farther back from the sailboat kids, seven children are playing and spinning on the merry-go-round. Still on the right-hand side, but even farther back, there is a swing set with three swings, a man/father is pushing a little boy. In the background, there are brightly colored trees lining the edge of the park, where a group of children are playing soccer. Landscaping throughout the park includes brightly colored flowers and green grass for visitors to play on, and families stroll on walking paths/sidewalks together. Farthest from you on the left-hand side, there are many children/kids playing on the large red slide. Closer to you on the left side, a brown-and-black dog sits next to

a bench where two women and a child sit watching a baby in a baby stroller. In the center of your view, there is a boy holding an orange ball, walking with a friend on the pathway.

Appendix C

Example of Keyword List for Visual/Auditory Stimuli

Visual # 6 - Park - (1:07)

1. Park
2. Sailboats
3. Fountain
4. Merry-Go-Round
5. Swingset
6. Swings
7. Man / Father
8. Trees
9. Soccer / Kickball
10. Flowers
11. Grass
12. Families
13. Walking Paths / Sidewalks
14. Children / Kids
15. Slide
16. Dog
17. Bench
18. Baby Stroller
19. Orange Ball
20. Women / Woman