Is gesture impactful on the quality of spoken language?

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Abstract (Lisa, Line)[1]

Two main theories dominate the domain of gesture: The hypothesis of Mutually Adaptive Modules (MAM), claiming the role of gesture is to communicate supplementary information visually, and Lexical Retrieval Facilitation (LRF), claiming gesture aids word retrieval.

The LRF-hypothesis has mainly focused on one-person experiments, and has thereby excluded the communicative aspect that one would suspect word retrieval is targeting. MAM-research have done investigations from the perspective of the receiver, but including the visual aspect of gesture, and therefore blurring the effects we might want to investigate regarding lexical retrieval.

This paper is investigating if the presumably increased fluency in verbal performance from using gesture (Morrel-Samuels & Krauss, 1992) is impactful on the receiver, when they are offered only the verbal outlet. We asked participants to rate fluency, understandability and confidence on a 1-10 scale in spatial navigations performed by people from two conditions: Either using gesture or prohibited from using gesture. The hypothesis was that gestured navigations would receive better ratings, as gesture has shown increased fluency in spatial content.
Additionally, we wanted to investigate if people gesturing would be attributed to being more confident.

Neither rating of fluency, understandability nor confidence showed significance as predictors of gesture: Particularly fluency and understandability ratings did not differ whatsoever between the two conditions, suggesting that even if gesture increases fluency in spatial

[1] The first name is the main responsible for writing the given section

explanations, these were not profound enough to be impactful on the receiver. Hence, the LRF-hypothesis could not on this basis be furtherly validated. The effect of confidence did point in the direction in which we had hypothesized, although results were not quite significant.

Key words

Gesture spatial fluency communication cognition

Introduction

Motivation for the study (Line, Lisa)

It is well-accepted that gesture has a communicative role. Especially when having to explain complex matters, humans are helped on the way by their hands. Most often it comes to us very naturally, and we might not even be aware that we are gesturing. However, when talking on the phone, obviously your counterpart cannot see you. If the role of gesture is solely communicating, it seems illogical to gesture when talking on the phone. In this study, we give our best attempt to how this phenomenon could be investigated. We do this by investigating different hypotheses regarding the role- and nature of gesture.

Why we gesture (Lisa, Line)

Two main hypotheses rule the landscape of the role of gesture: Mutually Adaptive Modalities Hypothesis, MAM (de Ruiter, 2006) - also referred to as *Information communication (Wu & Coulson, 2007)* - and Lexical Retrieval Facilitation, LRF (Krauss, 1998).

Mutually Adaptive Modalities hypothesis

The first theory seems somewhat obvious; it is even embedded in our spoken language, in the way *body language* is used more or less interchangeably with *gesture*: This is the role of gesture as a conversational, communicative medium (Wu & Coulson 2007).

Gesture has many times shown significant for improving understandability by the conversational receiver. In situations of limited verbal clarity - fx unintelligible speech or noisy surroundings - gesture appears to take over part of the role of communicating information, as listeners rely on this information rather than the blurry auditory input (Massaro, Thompson, Barron, & Laren, 1986).

Even unambiguous speech is influenced by gesture, Gunter, Weinbrenner, and Holle (2015) showed with findings of impairment in the receiver's understanding when speech was accompanied by inconsistent use of gesture.

Singer and Goldin-Meadow (2005) found that gesture can attribute additional information to the receiver: They tested school children taught in three different conditions, in which they found higher level of knowledge in the kids whose teaching involved gesture - although only inasmuch as the gesture took form of convoying different content than the spoken word. When the information in gesture was redundant to speech there was no added effect to the kids´ learning. This indicates gesture can serve the receiver, not only by supporting the message of speech, but can even attribute with additional information.

In an experiment by Graham and Argyle (1975) participants were assigned in pairs of two, in which one would have the task of describing a geometrical drawing to the other participant,

who would then have the task of reproducing the drawing based off of the explanations. In one condition the explaining party was allowed to gesture freely, which they - not surprisingly, considering the spatial descriptions - did to a high degree. In the other condition gesture was not allowed. The drawings reproduced in the gestured condition turned out more accurate than those from the no-gesture condition. The content of speech in the two conditions did not differ noticeably, but when reproduced with speech-related dependent variables (Graham & Heywood, 1975) significant differences were found regarding spatial explanations and demonstratives. When not allowed to gesture the amount of spatial descriptions increased, and demonstratives such as “this” and “that” decreased. The verbal aspect of communication becomes more extensive when gesture is not possible, suggesting spoken language is taking over communicating additional information that gesture could otherwise have provided.

Lexical Retrieval Facilitation

The second widely accepted theory of the role of speech is that of *Lexical Retrieval Facilitation, LRF* (Krauss, 1998). According to this position gesture aids word retrieval.

If this is the case, the word-facilitating gesture (the *lexical gesture*) must precede the word being facilitated (the *lexical affiliate*). Morrel-Samuels and Krauss (1992) set up an experiment to investigate this hypothesis: They looked into the timing between the onset of the lexical gesture and the lexical affiliate being expressed verbally. The asynchrony between the two varied between 0 and 3.75 seconds, meaning the word articulation followed gesture, and never the other way around, supporting the idea gesture is facilitating word retrieval.

According to Butterworth (1980) hesitations in speech such as “um” (filled pause), unfilled pauses and repeated words are caused by troubles with lexical access. Krauss, Chen, and Gottesman (1997) took these hesitations as a measure of dysfluency in speech, and showed an increased amount of dysfluency when gesture was prohibited in cases of spatial-content with dysfluency rising from 0.265 to 0.285 per word. This tendency was not the case for other content. [See figure 1]

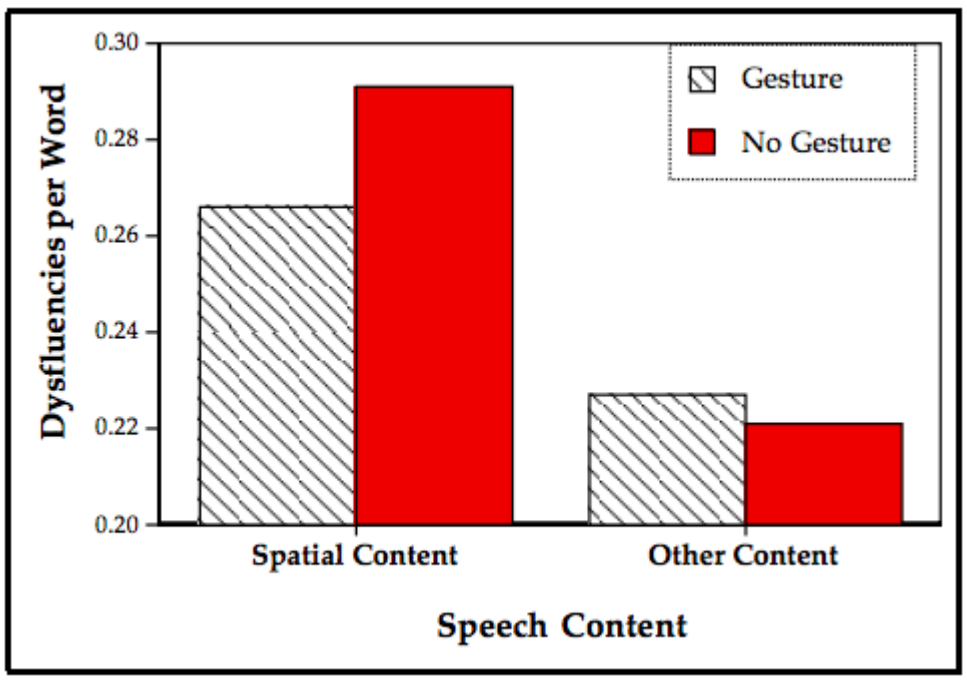

Figure 1. Results from experiment but forward by Krauss et al. (1997). Dysfluency increased from 0.265 per word to 0.285 per word when prohibiting gesture in spatial-content cases.

Experimental findings by Frick-Horbury and Guttentag (1998) showed an increased rate of retrieval failures when gesture was inhibited, suggesting problems with word retrieval and therefore supporting the LRF-hypothesis. When replicated by Beattie and Coughlan (1999), although not significant, the tendency went in the opposite direction: Better retrieval was found in the condition of gesture-prevention.

Newer research has tested this phenomenon with participants, some of which were adults, whereas others were children (Pine, Bird & Kirk, 2007). They found children benefitted to a much greater extent from using gesture in their word retrieval than adults, indicating a difference in cognitive abilities across different age groups within the field of gesture. Differences in the use of gesture can be found also when comparing younger versus older adults (Theocharopolou, Cocks, Pring & Dipper, 2015).

Findings like these have not been met without criticism in their quest of proving the word facilitating aspect of gesture. Results like that of improved fluency (Krauss et al., 1997) could be argued to rather suggest that gesture serves as a supplementary communication form to speech (de Ruiter, 2006). There is a strong correlation between use of gesture and converging spatial information; the role of the gesture may serve additional information for the receiver, as in the case of the teaching experiment earlier mentioned Singer and Goldin-Meadow (2005). Thus, the dysfluency may be due to the unusual situation of having to modify the information gesture could have provided, into verbal language.

Spatial thinking and gesture (Line, Lisa)

Many studies have shown that gesture is not only important for communication with others, it can also be extremely helpful for us as individuals in learning and cognition. To mention a few, there's the Piagetian conservation tasks (Breckinridge-Church & Goldin-Meadow, 1986), gear-rotation tasks (Perry & Elder, 1997) and Tower of Hanoi tasks (Garber & Goldin-Meadow, 2002). Wilson (2002) showed that gesture can help comprehension of very complex and abstract ideas because sensorimotor experiences is linked with mental representations. That is a crucial finding, meaning that gesture is not just a reflection of thoughts, but can

actively transform thoughts and have an impact on learning (Goldin-Meadow & Beilock, 2010). For example, individuals who gesture when they are given a mental rotational test outperform those who do not (Chu & Kita, 2008). Another theory which explains why gesture supports spatial thinking is established by Wesp, Hesse, Keutmann and Wheaton (2001); their study showed that iconic gestures[2] enabled people to unload their spatial information onto their hands to keep spatial representations in working-memory.

Spatial thinking is central to certain problem-solving subjects like science, technology, engineering and mathematics, for short STEM (National Research Council, 2006; Newcombe, 2010). Field observations have shown that people gesture very actively in STEM classrooms and offices, even more so when discussing spatial phenomena (Alibali, 2005; Alibali & Nathan, 2012; Goldin- Meadow & Wagner, 2005; Roth, 2000, 2001; Valenzeno, Alibali & Klatzky, 2003). They also gesture while working alone which gives the first indication that gesture supports spatial thinking and is not solely for communication (Alibali, Spencer, Knox, & Kita, 2011; Schwartz & Black, 1996; Stieff, 2011).

Stieff, Lira and Scopelitis (2016) have made research to investigate which impact gesture has on spatial thinking in relation to STEM. They carried out two studies. In the first study, they wanted to investigate if students would increase their use of gesture as a strategy to support spatial thinking if instructions were given with gesture, and whether that would that would positively affect their results on a spatial STEM assessment. They found that students who used gesture to cope with spatial transformations during their instructions also made use of gesture in later tests, and that they performed better than those students who had only observed the instructors making gesture.

[2] [1] ”Iconic gestures are gestures that represent abstract or concrete entities” (McNeill, 1996).

An explanation to this is that students who only observed gesture failed to reproduce those gestures, and therefore did not perform any better than the students who only read instructions. However, other studies have found contradicting results, in which students could easily replicate gesture just from observations, without copying them during the instructions (e.g., Cook & Goldin-Meadow, 2006; Goldin-Meadow, Cook & Mitchell, 2009).

The second study was made to examine if gestured instruction or instruction with concrete models was most beneficial. This has also been conducted in a research by Stull, Hegarty, Dixon and Stieff (2012). Stieff et al. (2016) found an equal amount of benefit from each method, however those students who had trained using gesture performed equally well with or without the concrete model during assessment, whereas those who had been instructed with a concrete model and no gesture were significantly disadvantaged if they did not have the model at the assessment. This suggests that it is more important to make gesture when learning than during later problem-solving assessments.

This study disagrees with the perspective that cognition is an activity without clear distinction between concrete and abstract representations or semiotic systems. (e.g., Goodwin, 2000; Hollan, Hutchins & Kirsh, 2000).

Although not many studies have been done on the role of gesture in communication of route directions, it has been shown that adult's speech improve when they are gesturing while verbally explaining a route unknown to the listener (Allen, 2003). Children also use gesture in communication of route directions (Iverson, 1999).

A study by Austin and Sweller (2014) addressed the question if - and in that case, *which* - gestures improve spatial message retention and recall. This was done by comparing the gestured, spatial messages to spatial messages with no gestures. They found that in recalling spatial information, only children benefited from gesturing when encoding, whereas no such

effect was found in adults. The second finding was that gesture at encoding had an effect on the type of spatial information recalled, but yet again found only in children, not adults.

In contrast to this study's findings, other studies have found that gesture presented at encoding enriches adult's comprehension and recall for single words (Driskell & Radtke, 2003; So, Chen-Hui & Wei-Shan, 2012), sentences (Thompson, Driscoll & Markson, 1998), and reasoning (Church, Kelly & Lynch, 2000).

A study by Chawla and Krauss (1994) found that people are five times more likely to gesture during spatial content than with non-spatial content (averagely 0.498 gestures pr. word versus 0.101 gestures per word). They also found that people spoke slower when they were not allowed to gesture, however only when the content of speech was spatial (116 vs. 100 words per minute).

Confidence (Line, Lisa)

In both human and nonhuman primates, spread-out, open body postures reflect power; while low power is reflected by contractive, closed postures (Carney, Hall, & Smith LeBeau, 2005; de Waal, 1998; Hall, Coats, & LeBeau, 2005). As an example, think of athletes when they cross the finish line. They open up their arms in a V-shape spontaneously. However, if they get a bad placement in the competition they are hunched over (Tracy & Matsumoto, 2008). These postures both reflect and produce a certain mood, just like smiling (e.g., McIntosh, 1996; Strack, Martin, & Stepper, 1988).

When you hold an expansive posture, the level of testosterone in salivary and blood serum rises. It is a hormone linked to status seeking and dominant behaviour. At the same time, levels of cortisol decrease which is linked to low social status and stress (Carney, Cuddy, & Yap, 2010; Minvaleev, Nozdrachev, Kir'yanova, & Ivanov, 2004).

Studies have shown that people who appear more nonverbally confident have a significantly higher chance of a better evaluation in job interviews (Young & Kacmar, 1998).

Cuddy, Wilmuth, Yap, and Carney (2015) made a study with the hypothesis that preparatory power posing had an effect on the presence of participants when asked to provide a speech in a stressful job interview. This effect was also seen in the judges' hiring and evaluation of the individuals. The best evaluations were given to the individuals who used high-power poses. They were perceived as more confident and they would give more captivating and enthusiastic speeches than those with low-power poses.

Even though they did not use high-power poses during the interview, it had improved their own feeling of power to such a degree that there was a noticeable difference during the following interviews. Using high power poses during an interview is not always a good idea, because it can violate social norms (Tiedens & Fragale, 2003). E.g. in a job interview, the evaluator has higher power than the job seeker, as he makes the decision whether the job seeker will get the job or not.

Nair, Sagar, Sollers, Consedine, and Broadbent (2014) have made a study closely linked to the current one, which showed that compared to sitting in a closed, hunched posture, sitting in an upright, spread-out posture made individuals come across as more positive while giving improvised speeches. It also made them feel happier and less fearful.

The reason why high-power poses have this effect, might be because they reduce stress and anxiety while increasing optimism, which probably makes one more confident and enthusiastic (Anderson & Berdahl, 2002; Anderson & Galinsky, 2006; van Honk et al., 1999).

Hypotheses (Line, Lisa)

This study has two main hypotheses. Firstly we expect to find that navigators will appear more fluent when using gesture than when not, because word retrieval will benefit from gesture. More fluent speech should make for easier understanding, and thus gesture is expected to result in higher understandability score. We expect that being limited to not gesture will act as a hindrance in producing clear and coherent speech.

All of this have been investigated by using only sound recordings. Contrary to most research, we are not investigating whether gesture has an impact on communication with visual stimuli. We want to investigate if the change in gesture will result in a change of speech, and if this difference is impactful on an authentic listener. By authentic listener it is meant random, real-life people for participants, and not a computer-program which can accurately measure speed etc.

As a final investigation, it is expected that in allowing our interviewees to gesture, they will appear more confident than when they cannot gesture, as gesturing makes room for expansive body language, whereas the no-gesture setup makes for a contracting, hunched-back posture. This hypothesis is based on a more precarious base of theory.

Materials and methods

Stimuli (Lisa, Line)

This experiment consists of eight pieces of stimuli, four in each of the two conditions. The stimuli is contributed by two different people: A 24-old, native Danish speaking female, and one 28-old, native Danish speaking male. We call these *the navigators.* The spoken language of the stimuli was Danish. The length of each stimuli varied between 30 and 75 seconds.

Each navigator contributed with two pieces of stimuli in each condition. The navigators were asked to explain how to get from one to them familiar location to another (e.g. from their home to the nearest supermarket). The two conditions were as follows:

1. Gesture condition: The navigators were allowed to give directions without further ado. This allowed for directions with a lot of gesture, as is often the case when expressing spatial content.

2. No-gesture condition: The navigators were asked to keep their hands flat on the surface of a tabletop while giving directions, and thus preventing them from gesturing. As the navigators were sitting down, these instructions made for a hunched body posture.

The contributions were recorded using video recording on smartphones. In one case a participant did not gesture while explaining - these contributions were dismissed, and new stimuli was created in its place, using another participant. The female navigator started out in

the no-gesture condition and proceeded to the gestured condition, whereas the order was the opposite for the male navigator. This was done to even out the possible variance that could occur from practise, which could then cause the third and fourth trial to be more natural and therefore fluent etc.

Materials (Lisa, Line)

The video recordings contributed by the navigators were converted into MP3 audio files.
In the actual experiment participants were given a headset in which they were presented with the eight different auditory stimuli. For simplification the stimuli were always presented in the same order. The order of the stimuli was shuffled by random, and thereby spreading conditions and navigators.

After listening to each navigation, the participants were asked to rate the the performance of the navigator on three different parameters:

1. How understandable the route was explained, 1 being “fuldstændig uforståelig” (not at all understandable), 10 being “ekstremt forståelig” (extremely understandable)
2. How fluent the explanation was, 1 being “slet ikke flydende” (not at all fluent), 10 being “ekstremt flydende” (extremely fluent)
3. How confident the navigator appeared, 1 being “ikke selvsikker” (not confident), 10 being “ekstremt selvsikker” (extremely confident)

Finally, the participants were asked to consider whether they thought the navigator was producing gesture or not. The ratings were filled out using a questionnaire on a laptop.

Participants (Lisa, Line)

Ten of the fifteen participants in this study consisted of students within the field of Cognitive Science at Aarhus University; the other five were people of different backgrounds and ages. The average age of the participants was 27.5 (SD = 12.79). Gender-distribution was 7 females (46.67%) to 8 males (53.33%). All of the participants were native Danish speakers.

Analysis (Lisa, Line)

The data was pre-processed in Excel. The raw data was typed into a data frame. It was done manually, so if there would have been any missing answers or non-sense (e.g. giving every question a score of 1) it would have been discovered. There was none of such. The data frame was then loaded into RStudio. [3]

The statistical test used is logistic regression. The dependent variable was the condition: gesture or no-gesture. The independent variables were the ratings: Fluency rating, understandability rating, confidence rating. Fluency was set as the primary predictor, as research such as that of Krauss´ (1997) has earlier shown a direct correlation between use of gesture and fluency in speech. Secondary predictor was understandability, as we would expect this parameter to explain some of the same variance as fluency. Finally, confidence was added as a third predictor.

To account for the within-participant design, participant ID was added as a random intercept, as we can assume differences in the base level of ratings given being dependent on the rater. Another random effect is that of stimuli ID, as we can expect there to be differences in the base level of rating directly relating to the navigator.

[3] Rstudio is a programming language with packages suitable for among other things conducting statistical analyses (About. (n.d.). Retrieved 4 January 2018, from https://www.rstudio.com/about/)

Results (Lisa, Line)

Fluency-rating was not a significant predictor of gesture, b=-0.10 (SE=0.15), z=-0.70, p=0.48. The results did not differ from what the null-hypothesis would predict, hence there was found no significant difference between the gestured condition and no-gesture condition, which fluency score could account for.

Understandability-rating did not show as a significant predictor of gesture, b=-0.03 (SE=0.11), z=-0.28, p=0.78. The results did not differ from what the null-hypothesis would predict, hence there was found no significant difference between the gestured condition and no-gesture condition, for which understandability score could account for.

Confidence-rating was not a significant predictor of gesture, b=18 (SE=0.12), z=1.5, p=0.133. Although the results were not quite significant (p=0.133), they did point in the direction of a positive relationship between confidence and the gestured condition, as was hypothesized.

Discussion (Lisa, Line)

In analysing the experiment data neither fluency rating nor understandability showed as significant predictors of gesture - in fact the ratings between the two conditions, gesture and no-gesture, did not differ whatsoever. As for the third predictor, confidence, although not quite significant, more of a relation was suggested in the direction that confidence rating could predict gesture.

Participants correctly guessed whether gesture was used or not in only 60% of the cases, just slightly above chance level. Had it been the case that participants could successfully distinguish when gesture was used, and our predictors were nevertheless insignificant, this could indicate that there are other gesture-suggesting factors in play that we have not taken into account, considering participants must have some basis of successfully distinguishing gesture versus no-gesture cases.

On the basis of these results, our hypotheses regarding fluency and understandability can be dismissed. The results between the two conditions did not differ noteworthily. It is of interest to further investigate our third hypothesis of gesture's impact on confidence.

LRF (Lisa, Line)

Our hypothesis of gesture being a predictor of fluency in spatial navigation was largely based on the findings by Krauss et al. (1997). In this experiment, filled- and unfilled pauses, repeated words and repeated sentences in speech were taken as a measure of disfluency. The advantage to this quantitative measure is its ability to capture fine nuances, which an experiment like ours might miss. On the other hand, what we wanted to investigate was the actual impact the LRF-hypothesis could pose on real world-application. Word-retrieval must serve as a mean to successfully communicating with others, hence passing information between people. This is why we set out our experiment to interview the receiving part of communication. What Krauss et. al (1997) found was an increase in disfluency from 0.265 to 0.285 per word when going from a gesture to no-gesture setup in converging spatial information, hence a difference we were not able to find in our experimental setup. It suggests that even if there is a difference in the verbal outlet, the effect may be too subtle for

the receiver to differentiate. This raises the question: If the supposedly word retrieval-promoting quality of gesture is not impactful on the listener, does it make sense to, as LRF does, consider the outright role of gesture as retrieval-promoting?

Our experimental setup holds a flaw in its way of questioning on a 1-10 scale. It's not leaving much room for fine nuances to show. Besides, from our experimental setup we take for granted that people are intuitively able to rate verbal fluency, understandability and confidence. Could it be that eg. understanding does indeed differ, but in subtle ways not accessible to the conscious mind?

MAM (Lisa, Line)

If we were to look at the case from the perspective of MAM, things are not altogether coherent either. MAM suggests the role of gesture is communicational, and the lacking visual aspect of the communication would infer the additional information normally provided by gesture would be adopted in language (Singer & Goldin-Meadow, 2005; Graham & Heywood, 1975). One would then think that the additional, more detailed spatial descriptions that follow in the no-gesture condition would lead to higher understandability score. This was not the case in our findings.
As mentioned before, this is based on the assumption that the people used as participants are themselves able to account for their understandability and rate it reliantly on a 1-10 scale, which is not necessarily the case.

If this experiment were to be redone, it would be interesting to look further into investigating the quality of the stimuli using objective measures: Is there for the our stimuli indeed a

measurable difference in fluency, as that found by Krauss et al. (1997)? Was the amount of spatial content actually larger in the no-gesture condition?On our subjective basis of going through the different pieces of stimuli, we did notice seemingly more detailed descriptions coming from the no-gesture condition.[4]

Implementing speech-related dependent variables like those done by Graham and Heywood (1975) would be a way of approaching this research question.

Chawla and Krauss (1994) found participants spoke more slowly when using gesture; this could be another angle to quantitatively measuring the content of speech between conditions.

This transfer of gestural information into verbal content infers two outcomes: 1. The spatial content in speech will increase, and 2. the extent of using gesture will decrease; since the role of gesture is to communicate, without a receiver around, gesture is excess. In fact, investigating the amount of gesture in situations involving communication, but with nobody around to see - as when talking on the phone - could be a key argument in the MAM versus LRF-discussion: The MAM-hypothesis would strengthen from finding relatively little or no gesture. Whereas LRF would suggest the amount of gesture would remain the same as with people around; if the role of gesture is word facilitation, gesture will be of use whenever one is verbally active.

Another potent field of future investigation is in that of age-related differences in use of gesture and benefits from gesturing. Research this far has suggested gesture particularly beneficial in children's word retrieval (Theocharopolou et al., 2015), and in the domain of spatial tasks, children have been found to benefit greater from gesture than adults (Austin & Sweller, 2014).

[4] Eg. in one case it was specified in which lane one should go in, in order to take a left-turn (rather than just stating "go left")

Rerunning our experiment with children as the navigators could be expected to result in stronger differences between the gesture and no-gesture condition than what was found in this setup.

Spatial thinking (Line, Lisa)

Navigators were given spatial questions based on the findings that people are more likely to use gesture and do it more frequently in spatial matters. We did not count the amount of gestures performed during the interviews, but navigators certainly did gesture.

Much research have found that using gesture helps spatial problem solving (e.g. Chu & Kita, 2008; Wesp, Hesse, Keutmann, & Wheaton, 2001).

Allen (2003) examined that participants could give more clear instructions when using gesture. We, however, did not find significant results supporting this claim. Perhaps the task (explaining a familiar route) simply wasn't complicated enough to create a cognitive burden heavy enough to truly benefit from gesture. Especially in challenging, abstract subjects like chemistry and math, gesture appears to be very valuable for problem-solving (Alibali, 2005; Alibali & Nathan, 2012; Goldin- Meadow & Wagner, 2005; Roth, 2000, 2001; Valenzeno, Alibali, & Klatky, 2003).

Both navigators reported that it was more difficult to navigate without use of gesture. This statement supports the general idea that gesture serves a role in our way of communicating information. What that role is, however, could point in several directions: As being helpful in cognitive processing as the LRF-hypothesis would have it, or as a complementary way of communicating to the verbal outlet (MAM).

Perhaps if the navigators were asked to describe more complex phenomena there would have been a more significant difference in fluency and comprehensibility in speech. They could be given an assignment where they didn't just have to describe something familiar, but first learn a specific task and then later explain that in the recordings. It would come closer to the study by Stieff et al. (2016) who examined that the participants benefited from using gesture during problem-solving.

Confidence (Line, Lisa)

When the navigators were using gesture they naturally had a more open, extensive posture compared to the no-gesture condition in which they were forced into a closed posture. Our experiment differentiates from other studies in the way that there was no use of any specific preparatory power posing (Cuddy et al., 2015); rather, it was the poses during the interview that were manipulated.

Studies that did look at high-power posing during interviews found that it had a negative influence, seemingly because it went against social norms (Tiedens & Fragale, 2003). However, in this experiment you could not see the navigators and therefore it most likely would not violate social norms to the same degree.

Some participants reported that it was difficult to judge whether a navigator was confident or not, and of course it must be stressed that p-values were not sufficient for confidence to show as a significant predictor of gesture. That being said, results were above chance level in pointing in the direction that navigators came off as more confident when gesturing. This was

to us a surprising finding, as this one of our hypotheses is based on only loosely related theory.

This experiment was run with only a minimum of participants, which in itself makes for an unsolid statistical fundament. The slightly suggesting findings of this experiment, however, makes an appealing case for further investigation of this novel field.

Research this far suggest the true value of high-power posing only shows when you can see the person: Tiedens & Fragale (2003) found that it was when people nonverbally appeared more confident and enthusiastic that it made a good impression on evaluators. Our study did not investigate the likability of the navigators. It could also have been investigated how self-confident the navigators felt themselves during the two conditions.

Another downfall to having navigators engage in different postures *during* navigation rather than as a primer is time-effects: The navigators only spend a matter of minutes in each condition. For the body to rise its levels of testosterone and blood serum and decrease levels of cortisol (which all makes you feel less stressed, more dominant etc.) in high power poses and vice versa for low power (Carney et al., 2010; Minvaleev et al., 2004), it is likely that they should have spent more time sitting in each posture. On top of that, each of the navigators performed in both conditions within one session, meaning the no-gesture condition could benefit from formerly performing in the gestured condition.

Limitations (Line, Lisa)

Our study could be thought of as a “prototype”. It is quite an original idea, to our knowledge the first of its kind. However, the experiment was run with a bare minimum of participants.

The sheer number of participants and interviews could be increased dramatically in the attempt of finding more reliable results. With our time limitation it has not been possible to do this. It could also be that there really isn't any significant, consistent difference in spatial routes given with- and without gestures. At least our results suggest this effect is not strong enough to impact the receiver.

Perhaps making this experiment in a more natural setting would give results more in line with those studies suggesting that gesture supports cognition and communication in certain tasks. After all, our experimental setup did hold some disadvantages: The fact that participants knew they were being recorded made them a bit uneasy, thus decreasing confidence. Certainly this factor would be avoided altogether in a real-life situation. Also, being asked to gesture - even if just encouraged to gesture as one normally would - might cause the navigator to overthink their gesturing, rather than allowing it to naturally accompany and/ or facilitate speech.

Navigators were aware the visual aspect of the recording would be hidden to the participants. This could influence their way of explaining, eg. using more spatial content in their speech (Graham & Heywood, 1975), even in the gestured condition.

Several random factors have affected the result which could not be accounted for in the processing of the data. The questions the navigators were asked were of course extremely influential on their answers; it was difficult to know which routes would cause them most trouble explaining, and ideally all questions should be equally challenging. Perhaps the questions asked in the gestured condition were randomly more difficult and therefore led to more influent, incomprehensible answers.

For simplicity, all participants heard the sound recordings in the same order. At first, it can be difficult to rate a description when you don't have any other descriptions to compare it to,

and this may have caused ratings to be more conservative to start off with (first recording played was with gesture).

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