THE INFLUENCE OF SPOKEN THEMATIC ROLE ORDER ON NON-VERBAL BEHAVIOUR: A STUDY OF PATIENT-INITIAL AND ACTOR-INITIAL STRUCTURES IN THE GESTURES OF NATIVE ENGLISH SPEAKERS.

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Abstract: Recent cross-linguistic studies examined the influence of spoken language on non-verbal behaviour. Non-verbal descriptions of transitive events were found to share the same thematic role order, regardless of the order in which these thematic roles occurred in participants' spoken languages (Goldin-Meadow et al., 2008). If the event involved a non-human Patient, the non-verbal description was consistent with Actor-Patient-Act order, and if the event involved a human Patient, Actor-Act-Patient order was preferred (Hall et al., 2013). Prior research formed these conclusions based on the study of speakers of Actor-initial (SOV or SVO) languages. As such, the purpose of this study was to determine whether non-verbal descriptions of transitive events remained Actor-initial when their corresponding spoken structure would be Patient-initial. The effect of a human or non-human Patient was also examined. Syntactic priming was utilised to examine Actor-initial (active) structures and Patient-initial (passive) structures in native British English speakers. This study found frequent argument omission in participant responses, which predominantly consisted of Patient-Act and Act gestures. The frequent Patient-Act gestures found are consistent with the findings of Goldin-Meadow et al. (2008), but the use of Patient-Act gestures for reversible events is inconsistent with the findings of Hall et al. (2008). Furthermore, in events containing human Patients, spoken thematic role order was found to be a correlate for argument omission, suggesting that spoken thematic role order does influence non-verbal behaviour. To understand these findings, I examined methodological differences, argument omission in signed and spoken languages, as well as participant effects and item effects.

Keywords: thematic role order, transitive events, non-verbal communication, gesture study, priming, argument omission.

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The influence of spoken thematic role order on non-verbal behaviour: A study of Patient-initial and Actor-initial structures in the gestures of native English speakers.

1. Introduction

1.1 Non-verbal studies of the order of events

Every transitive event consists of three constituents which, in speech, are produced individually and in varying orders cross-linguistically. Studies using non-verbal methodologies have found cross-linguistic similarities regarding the order in which these constituents occur in the gestural modality. It is possible to describe the relation between these three elements using syntax (word order) or semantics (thematic role order). Prior to discussing the existing literature, it is necessary to establish consistent and suitable terminology to discuss non-verbal depictions of transitive events. Previous non-verbal studies vary in the terminology used to discuss the order of constituents in transitive events; initial research used Actor-Patient-Act (Goldin-Meadow et al., 2008), whilst later research predominantly used Subject-Object-Verb (Langus & Nespor, 2010; Meir et al., 2010; Gibson et al., 2013; Hall, Mayberry & Ferreira, 2013; Christensen, Fusaroli & Tylén, 2016; Vastenius, van de Weijer & Zlatev, 2016).

Langus and Nespor (2010) found that gestures 'do not appear to be governed by the computational system of grammar' (syntax) and are instead governed by an interaction between the sensory-motor system (phonology and phonetics) and the conceptual system (semantics). As such, gesture productions should be described using thematic role order, not word order. The current study will use the same terminology used in Goldin-Meadow et al. (2008) to discuss thematic role order; Actor will refer to the thematic role of Agent, the animate entity willingly performing an action, Act will refer to the action being performed, and Patient will refer to the thematic role of Theme, the entity that undergoes an action. To maintain consistency, the current study will use this terminology when discussing prior

studies that used word order to describe these elements; Actor will refer to the Subject, Act will refer to the Verb, and Patient will refer to the Object.

Goldin-Meadow et al. (2008) began a line of enquiry into whether non-verbal behaviour is influenced by the spoken language an individual has acquired. This research examined four spoken languages which use Actor-Act-Patient or Actor-Patient-Act order to describe transitive events. Two methodologies, a communicative gesture task and a non-communicative transparency task, were used to examine the order in which these three elements were produced non-verbally. In the gesture task, participants were shown vignettes and asked to describe the events in speech, to confirm their dominant speech order, and then in gesture, to answer the research question.

The researchers found that 'participants adhered to a consistent ordering even though consistency was not demanded by either task'. In both tasks, participants predominantly used gesture strings consistent with Actor-Patient-Act order, regardless of the order used in their respective spoken languages. The researchers used this finding, alongside the prominence of SOV word order in the world's languages (Dryer, 2013) and the presence of SOV word order in new emerging sign languages (Sandler et al., 2005), to conclude that Actor-Patient-Act reflects 'a natural sequencing for representing events' (Goldin-Meadow et al., 2008). This paper also concluded that the thematic role order in an individual's spoken language does not influence their non-verbal behaviour. However, this can be disputed. Whilst the order in which the Act and Patient occurred was not influenced by the participants' spoken languages, this is not necessarily true for the Actor; the four languages spoken by participants were Actor-initial, as was the predominant gesture order. Languages and constructions with Patient-initial and Act-initial thematic role orders must also be examined to confirm the extent to which thematic role order in spoken language influences non-verbal behaviour.

It is necessary to note that Actor-Patient-Act gestures did not make up the majority of participant responses in the gesture task. Following the discussion in Goldin-Meadow et al. (2008), further information regarding coding and analysis of the task revealed that out of the gesture strings produced, only 113 contained all three thematic roles, and that 501 gesture strings contained only two thematic roles. This section of the paper also states that 2-gesture strings were analysed as Actor-Patient-Act if they were in some way consistent with this pattern; Patient-Act and Actor-Act gestures were classified as Actor-Patient-Act. Therefore,

as Actor-Patient-Act was the dominant gesture pattern, and as the vast majority of gesture strings contained only two thematic roles, participant responses predominantly consisted of either Patient-Act or Actor-Act gestures. The frequency with which each of these gesture strings occurred is unknown as no further information is provided, and the omission of arguments is not discussed further. As argument omission was not the focus of this research, Goldin-Meadow et al. (2008) coded this data relative to their research question. However, I would argue that the frequency with which argument omission occurred merits discussion and that the frequency of each type of 2-gesture string should be provided for transparency and use in future research.

Langus and Nespor (2010) aimed to replicate Goldin-Meadow et al. (2008) and investigated the cognitive biases of the two most frequently occurring word orders of the world's languages. This study successfully replicated the results of Goldin-Meadow et al. (2008) with Italian (Actor-Act-Patient) and Turkish (Actor-Patient-Act) participants. Their investigation of cognitive biases found that gestures are governed by an interaction between the sensory-motor system and the conceptual system, but not by the computational system of grammar. In light of this finding, the researchers erred in using word order to describe something not governed by the computational system of grammar; this research contradicts itself in using syntax to describe something not governed by syntax. Despite this flaw, the researchers were transparent regarding the 2-gesture strings produced. Langus and Nespor (2010) state that participants were instructed to produce 3 gestures to describe each stimulus. This was not always successful, as 2-gesture strings made up a significant proportion of responses (41.4% in Italian participants, 36.8% in Turkish participants). These 2-gesture strings consistently contained an Act gesture and contained Patient gestures more frequently than Actor gestures; the most frequent 2-gesture strings consisted of Patient-Act order. As in Goldin-Meadow et al. (2008), the omission of arguments was not discussed further. I argue that the frequent occurrence of 2-gesture strings, despite direct instructions to produce 3 gestures, merits further discussion.

Further research extended this line of enquiry to reversible constructions, examining whether gesture order differed when a participant was asked to gesture a non-reversible construction (i) or a reversible construction (ii) (Meir et al., 2010; Gibson et al., 2013; Hall et al., 2013).

(i) The boy kisses the ball.

(ii) The man pushes the girl.

The construction in (i) is non-reversible as the Actor and Patient roles cannot be reversed; it is not possible for the inanimate ball to kiss the boy. Prior research solely focused on constructions with non-human Patients such as this. The construction in (ii) is reversible as the Actor and Patient roles could be reversed; it is possible for the girl to be the Actor performing the push and the man to be the Patient being pushed. These studies found that Actor-Patient-Act gesture order was dominant for non-reversible events, but that this order was consistently avoided in favour of Actor-Act-Patient gesture order for reversible events.

Hall et al. (2013) argue that their role conflict hypothesis, which proposes that individuals will avoid Actor-Patient-Act order due to production constraints, accounts for the difference between reversible and non-reversible events. They propose that using Actor-Patient-Act order for reversible events, without actively switching back into the Actor role prior to producing the Act, may cause role conflict; the individual feels as though it is the Patient, not the Actor, that is performing the Act. The role conflict hypothesis accounts for participant behaviours in Hall et al. (2013), such as repeating the Actor gesture prior to the Act, as well as the most common participant response, producing Patient-final (Actor-Act-Patient) gestures.

Hall et al. (2013) formed this conclusion based on the results of three experiments. In experiment 1, non-reversible and reversible events were mixed; in experiment 2, non-reversible and reversible events were separated into blocks, with non-reversible events occurring first; in experiment 3, participants were split into three groups, one in which events were mixed, one in which events were shown in blocks with non-reversible events occurring first, and one in which events were shown in blocks with reversible events occurring first. Hall et al. (2013) found that the bias toward Actor-Patient-Act order for reversible events was stronger when events were blocked and weaker when events were mixed.

The participants in Hall et al. (2013) omitted arguments significantly less frequently than those in prior research. This is attributed to the use of practice trials to encourage participants to convey all important stimuli information in their gestures. Note than mention of ‘subjects/agents, objects/patients, or verbs/actions’ was avoided in this encouragement. In experiment 1, Hall et al. (2013) concluded that this was ‘largely successful’ as, of all the

gesture strings produced, 97.2% contained Actor, 99.1% contained Patient, and 99.9% contained Act. Similar success was found in experiment 3; of all the gesture strings produced, 82.3% contained Actor, 93.5% contained Patient, and 99.8% contained Act. Though Actor omission occurred comparatively less than in prior studies, it remained the most frequently omitted argument. In experiment 2, the frequency with which each thematic role occurred was not provided in writing. It can, however, be inferred from the visual statistic that Actor omission occurred in approximately 20% of responses for non-reversible events; Patient-Act gestures accounted for approximately 20% of responses in this condition. Patient-Act gestures also occurred in all three groups tested in experiment 3, and only in the non-reversible condition. No further discussion was had regarding why Actor omission only occurred in the non-reversible condition as the resultant Patient-Act gestures were considered consistent with Actor-Patient-Act order and the role conflict hypothesis.

An additional finding not discussed further in Hall et al. (2013) is the presence of null argument gestures in experiment 3; in all three groups tested, gestures consisting solely of Act were found. Furthermore, null argument gestures occurred more frequently for reversible events than for non-reversible events; the participant group exposed to non-reversible events first never produced null argument responses for non-reversible events but produced null argument responses for approximately 15% of reversible events. The presence of null argument gestures in experiment 3, but not in the previous experiments whose methodology was partially replicated, is suggestive of a sampling effect. However, as null argument responses occurred more frequently for reversible events, this suggests that null argument responses are not solely a result of participant effects but are also impacted by reversibility.

The methodology used by Hall et al. (2013) in experiment 2 was partially replicated by the current study, as blocking events yielded the strongest results and as argument omission occurred significantly less frequently than in prior studies. In pilot study 1, the methodology was extended to Patient-initial stimuli. In pilot study 2 and the main study, the methodology was extended to Patient-initial stimuli and syntactic priming was necessarily used to elicit both Actor-initial and Patient-initial structures in speech.

1.2 Syntactic priming

Syntactic priming is ‘the tendency for processing of a particular syntactic construction to increase the ease of subsequently processing of the same or a related syntactic construction’ (Branigan, Pickering & Cleland, 1999). This method has been used to successfully elicit active and passive structures in speech (Bock, 1986; Weiner & Labov, 1983), meaning syntactic priming could be used to examine Actor-initial (active) structures and Patient-initial (passive) structures in the same language population.

To examine processing of the same construction, an active or passive construction must be used prior to participant production; Bock (1986) found ‘an increased tendency to produce an active target picture description after an active prime (iii), a passive target picture description after a passive prime (iv), and so on’.

(iii) One of the fans punched the referee.
(iv) The referee was punched by one of the fans.

(example from Bock, 1986)

If, however, the above priming sentences were immediately followed by intervening sentences, the target description would be less likely to match the syntax of the prime as ‘memory for the prime syntax decays significantly’ when filler sentences intervene (Bernolet, Collina & Hartsuiker, 2016). Producing the same syntactic construction that you aim to elicit is effective in speech but cannot be used in non-verbal studies of thematic role order, as the order in which the thematic roles occur in a spoken prime will likely impact the order in which they occur in a non-verbal production. Instead, a related construction must be used, such as a question foregrounding the Actor or Patient. The participant would be asked this question after being shown visual stimuli, prompting them to use an active (v) or passive (vi) description.

(v) What did one of the fans do?
(vi) What happened to the referee?

Syntactic priming has been used to evidence the mental representation of spoken active and passive structures ‘without engaging explicit or conscious strategies’ (Bock, 1986). As such, this methodology can be used to elicit Actor-initial and Patient-initial structures whilst avoiding participant effects and biases. Bock (1986) also found syntactic priming to be

equally effective for sentences unrelated in meaning; the repeated production of Actor-initial or Patient-initial structures is not a result of repeated words or types of event, which occur in the current study, but is a direct result of sentence structure.

Similarly to Hall et al.'s (2013) finding that providing reversible and non-reversible constructions in blocks elicited stronger results, Weiner and Labov (1983) found a tendency for passives to be used more frequently following the production of another passive. Thus, to elicit the strongest results possible, both active and passive stimuli, and reversible and non-reversible stimuli, should be provided in blocks. As the current study is concerned with both the syntactic priming of passives and reversibility, it is necessary to note than in child language production, reversibility has been found to impact the syntactic priming of passives (Gámez & Vasilyeva, 2015). Specifically, the effects of syntactic priming are 'boosted by animacy in production of passives'. The impact of this on an adult population and on the gestural modality is unknown. As such, this finding should be taken into consideration when observing differences between reversible passive and non-reversible passive gesture productions.

2. Research question and hypotheses

Prior cross-linguistic research has shown speech-independent gesture strings to have the same dominant thematic role order in languages with varying word orders; Actor-Patient-Act order for non-reversible events, and Actor-Act-Patient order for reversible events. This finding was reached based on the study of languages with Actor-initial spoken word orders. I propose to use English active (Actor-initial) and passive (Patient-initial) structures to investigate whether gesture strings remain Actor-initial when their corresponding spoken structure would be Patient-initial. This study will provide further insight into whether the thematic role order of gesture strings is influenced by or independent of spoken language.

The hypotheses are as follows:

1. In non-reversible active constructions, the predominant gesture order will be Actor-Patient-Act; the findings of Hall et al. (2013) will be replicated.
2. In reversible active constructions, the predominant gesture order will be Actor-Act-Patient; the findings of Hall et al. (2013) will be replicated.

3. In non-reversible passive constructions:
    a. If altering the initial thematic role has no effect, predominant gesture order will remain Actor-Patient-Act.
    b. If altering the initial thematic role does have an effect, predominant gesture order is expected to be Patient-Act-Actor, the thematic role order of spoken English passives. This is consistent with the Patient-Act gesture order found in non-reversible events.
4. In reversible passive constructions:
    a. If altering the initial thematic role has no effect, predominant gesture order will remain Actor-Act-Patient.
    b. If altering the initial thematic role does have an effect, predominant gesture order is expected to be Patient-Act-Actor, the thematic role order of spoken English passives. This is not consistent with the role conflict hypothesis as an animate Patient, not the Actor, occurs prior to the Act.

3. Pilot study 1

3.1 Methodology

This pilot study aimed to test whether simple animated clips were able to elicit both active and passive structures in the speech and gestures of participants. The participants consisted of two university-educated, native British English speakers, aged 20-21 years old. Participants provided informed consent to partake in and be filmed for the study. The participants were seated in a room with an experimenter, both of which were familiar to them. The set-up consisted of a laptop in front of the participant, on which the stimuli clips were played, a camera to capture the participant straight-on and an additional camera to capture the participant's profile.

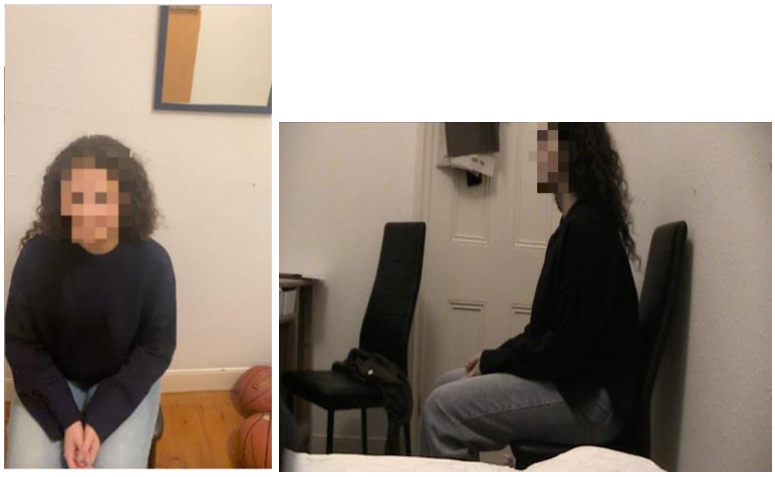
Figure 1 – Stills of a participant from both camera angles.

This experiment aimed to replicate the methodology used by Hall et al. (2013, experiment 2) and extend it to passive structures. As such, the stimuli were comprised of four conditions; the two conditions present in Hall et al. (2013), active non-reversible and active reversible, as well as two additional conditions, passive non-reversible and passive reversible. This created a control group of active stimuli responses to compare with the passive stimuli responses being tested. The dependent variable was the thematic role order found in the gestures of participants.

The four conditions were presented in blocks to strengthen the findings, as mixing stimulus types has been shown to dilute results (Hall et al., 2013). Active stimuli were blocked together, and passive stimuli were blocked together. Within each of these conditions, non-reversible events were blocked together, and reversible events were blocked together. To ensure consistency with Hall et al. (2013), the non-reversible event was shown prior to the reversible event. Within each block, the stimuli were then pseudorandomised. Between-subject manipulation was also used to determine whether being exposed to Actor-initial or Patient-initial stimuli first impacted results.

The first four stimuli clips were practice trials, which depicted a human Actor performing an intransitive Act. The remaining 24 stimuli clips consisted of a human Actor (girl, boy, man, woman) carrying out a transitive Act (push, lift, kiss), on a human or non-human Patient. The two non-reversible conditions used non-human Patients (ball, car, bike) and the two reversible conditions used human Patients (girl, boy, man, woman). To avoid possible confusion in reversible conditions, Actors and Patients of the same gender were not used in

conjunction. To enable an accurate comparison, and to replicate findings regarding reversibility in active constructions, all Actors, Acts, and Patients used in this study were also present in Hall et al. (2013) (see Appendix A for full stimuli list).

To elicit passive constructions, the Patient was foregrounded by appearing on screen first and performing the majority of the movement across the screen. The Actor then appeared, followed by the event. To elicit active constructions, the Actor was foregrounded by appearing on screen first and performing the majority of the movement across the screen. The Patient then appeared, followed by the event.

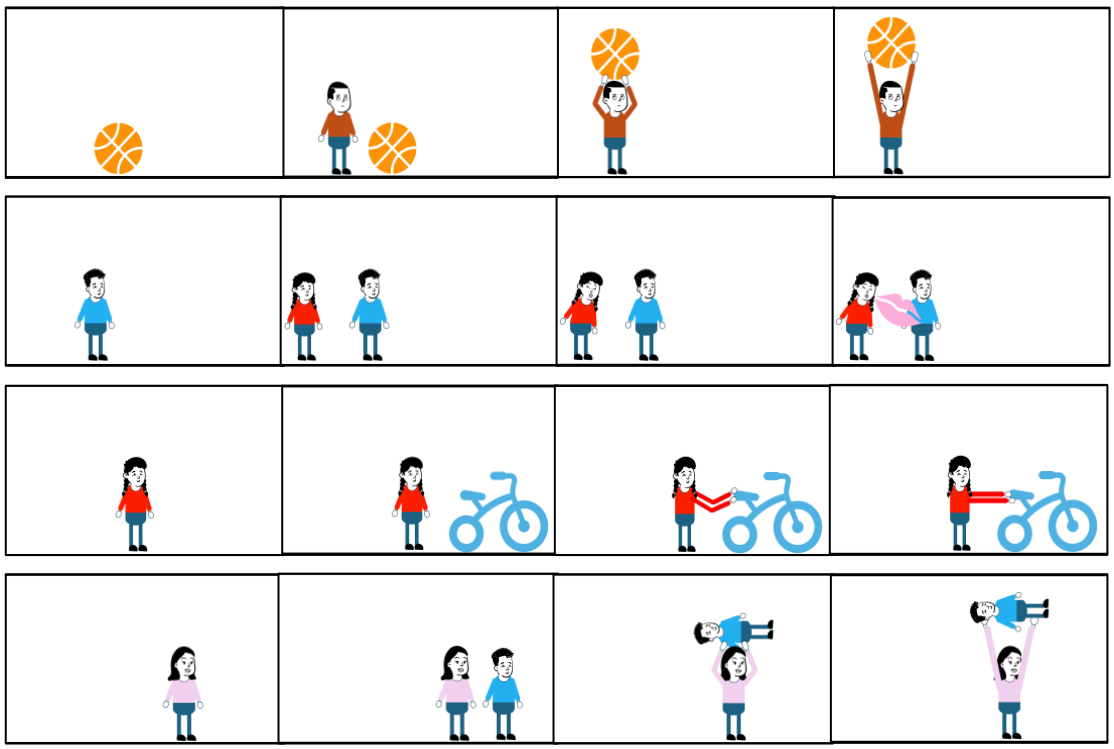

Figure 2 – Stills from the stimuli clips. Top to bottom: passive non-reversible 'the ball is lifted by the man', passive reversible 'the boy is kissed by the girl', active non-reversible 'the girl pushes the bike', and active reversible 'the woman lifts the boy'.

Following each clip, the participants were asked to describe the event non-verbally, using gesture. The clips were then repeated, and the participants were asked to describe each event verbally. This ordering was replicated from Hall et al. (2013).

The independent variables, therefore, consisted of: the order in which the thematic roles were presented in the stimuli (Actor-initial or Patient-initial), whether the event was reversible or non-reversible, and whether the communication was non-verbal (to test thematic role order in

gesture responses) or verbal (to test whether the stimuli elicited active or passive structures in speech).

3.2 Findings

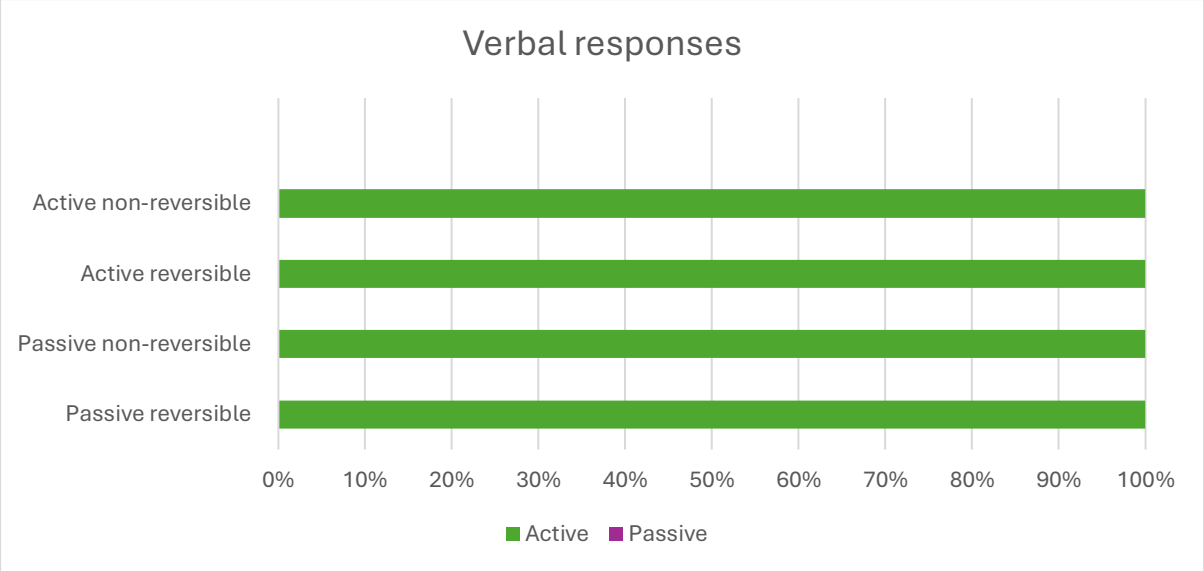

Figure 3 – Percentage of active and passive verbal responses in each condition.

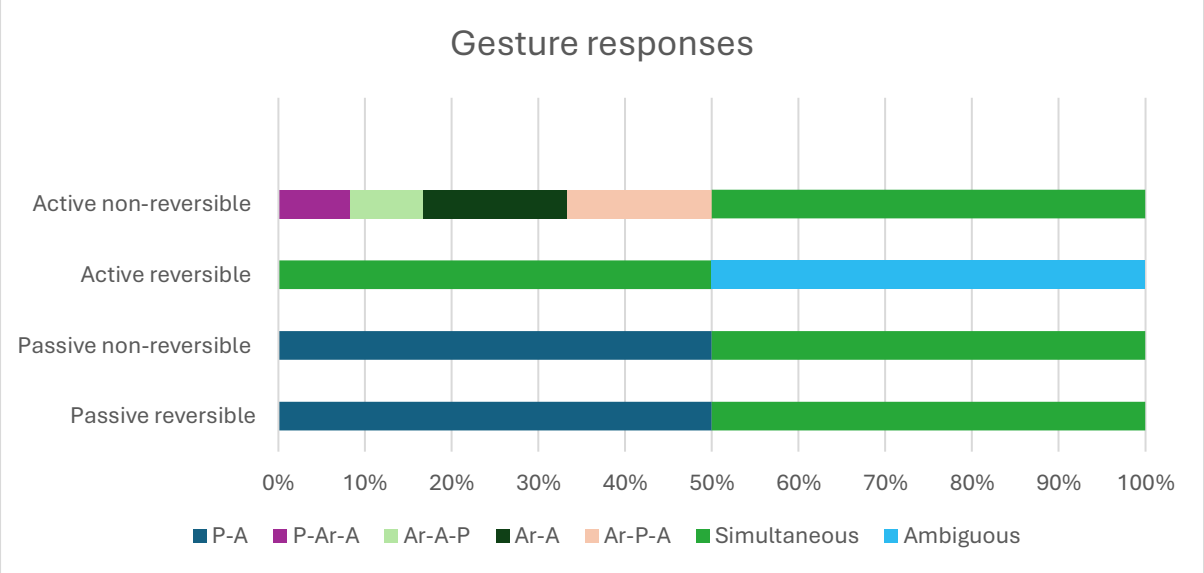

Figure 4 – Percentage of thematic role order gesture responses in each condition.
(P = Patient, A = Act, Ar = Actor)

3.3 Discussion

The participants' spoken responses to the stimuli consisted solely of Actor-Act-Patient thematic role order; passive structures were not elicited by foregrounding the Patient in the

visual stimuli. Further measures, therefore, are required to prime the participants to produce passive structures.

A significant observation is that, in both participants, when a gesture was used to represent the Actor in reversible conditions, the same gesture was also used to represent the Patient. In participant 1, any ambiguity caused by this was mitigated by the Act, which made clear which thematic role each gesture represented. In participant 2, however, the Act did not mitigate the ambiguity caused, thus preventing the order in which Actor and Patient gestures occurred from being known in 12.5% of responses. The use of differently gendered Actor and Patient pairs in each stimuli clip aimed to avoid this lack of clarity, but did not succeed in doing so. This occurred to a greater extent than in Hall et al. (2013), who found < 5% of responses in the reversible condition to be 'ambiguous'. This finding is unexpected as Hall et al. (2013) also ensured that that the Actor and Patient pairs featured in reversible events differed in gender, age, or both. Further measures, therefore, are required to prompt the participants to use different gestures for the Actor and Patient pairs in reversible events.

I also observed that participant 1 produced simultaneous gestures for the Actor and Patient in all conditions, both non-reversible and reversible. This is significantly greater than in Hall et al. (2013), who found < 5% of responses to be 'simultaneous' in the reversible condition and an absence of 'simultaneous' responses in the non-reversible condition. As simultaneous responses were only found in one participant, this may be a result of individual variation. Further studies with an increased sample size will determine whether this is the case.

Additionally, it is important to highlight that participant 2 only produced gestures for the Actor in the active conditions. The absence of gestures for the Actor in all passive conditions suggests that foregrounding the Patient did have some effect, despite verbal passive constructions not being produced. This Actor omission is significant as Hall et al. (2013) found Actor gestures in up to 97.2% of stimuli responses (not including excluded, ambiguous, or simultaneous responses). In British Sign Language (BSL), along with other signed languages, Actor omission is commonplace (Cormier & Fenlon, 2009). In sign languages this omission is a result of PRO-drop; the Actor is omitted but, underlyingly, the constructions remain Actor-initial. However, as this study is solely observing gesture, the participants are not communicating using language so PRO-drop cannot occur; the Actor simply is not present in the gesture sequence. As this omission was only found in one

participant, further studies using an increased sample size will determine whether this finding is significant or a result of individual variation. Measures will be taken in the following study which aim to avoid Actor omission.

4. Pilot study 2

4.1 Methodology

This pilot study aimed to test whether simple animated clips, followed by syntactic priming, were able to elicit both active and passive structures in the speech and gestures of participants. The participants consisted of two university-educated, native British English speakers, aged 57 years old. This pilot study replicated the methodology used in the first pilot study, with four key changes.

1. The four practice trials consisted of ditransitive events (instead of intransitive events), taking three arguments: two human and one non-human. The presence of two human arguments in the practice stimuli aimed to prompt participants to use unique gestures for the Actor and Patient pairs in reversible events, and aimed to avoid argument omission by encouraging the participants to produce gestures for all arguments present in the stimuli.

2. Syntactic priming of Actor and Patient-initial structures in speech was added, as simply visually foregrounding the Actor or Patient was found ineffective. In speech, syntactic priming has been used to successfully elicit active and passive structures and evidence their mental representation (Bock, 1986; Weiner & Labov, 1983; Brannagan et al., 1999). Syntactic priming using questions in which the Actor or Patient is foregrounded enables the elicitation of active and passive constructions without using active or passive structures (see question and answer exemplars below).

(vii) Priming an active construction

q. What is the man doing?

a. The man is lifting the ball.

(viii) Priming a passive construction

q. What is happening to the ball?

a. The ball is being lifted by the man.

Whilst the priming literature consists solely of studies on language production, there is no reason to suspect that syntactic priming would not be equally effective on gesture. As such, each stimulus clip, in both verbal and gesture conditions, will be followed by a question which aims to prime the participant to produce either an active or passive response. The independent variables, therefore, consisted of: the thematic role foregrounded in the prime (Actor or Patient), whether the event was reversible or non-reversible, and whether the communication was non-verbal (to test thematic role order in gesture responses) or verbal (to test whether the stimuli elicited active or passive structures in speech).

3. A ten-minute conversational break was added to prevent unwanted priming effects between the gesture and speech conditions. To avoid the possibility that the proximity between the active and passive prime may cause participants to produce passive constructions in response to the active stimuli, or vice versa, it was necessary to add some degree of separation between the gesture and speech condition. In the syntactic priming of active and passive transitive events, 'participants' memory for the prime syntax decays significantly' when intervening sentences occur between the prime and the target production (Bernolet et al., 2016).

4. The quantity of stimuli shown to participants was reduced. This aimed to increase efficiency as this was just a pilot study. A subset of eight stimuli were used to investigate whether syntactic priming was effective in eliciting passives and actives in speech. Only if this priming occurred successfully would the participants be tested on both gesture and speech with a further subset of eight stimuli. Each subset of stimuli used consisted of two active non-reversible events, two active reversible events, two passive non-reversible events, and two passive reversible events (see Appendix B).

The second pilot was, therefore, conducted as follows:

1. Verbal responses elicited using a set of two ditransitive trial stimuli.
2. Verbal responses elicited using a set of eight transitive stimuli (see Appendix B1-B4).

(If the priming in 2 successfully elicits actives and passives, the pilot study continues.)

3. A 10-minute conversational break.
4. Gesture responses elicited using a second set of two ditransitive trial stimuli.
5. Verbal responses elicited using the second set of two ditransitive trial stimuli.
6. Gesture responses elicited using a second set of eight transitive stimuli (see Appendix B5-B8).
7. A 10-minute conversational break.
8. Verbal responses elicited using the second set of eight transitive stimuli (see Appendix B5-B8).

If passive and active structures are correctly elicited in speech during this pilot study, this methodology will be replicated using the full set of stimuli (see Appendix A) with a larger participant sample size.

4.2 Findings

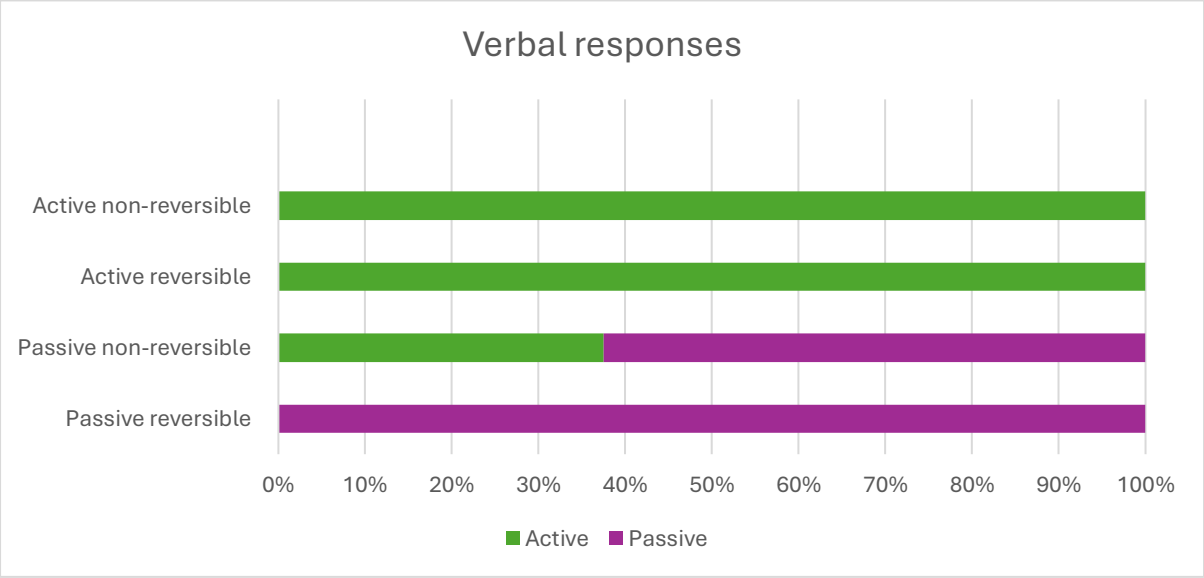

Figure 5 – Percentage of active and passive verbal responses in each condition.

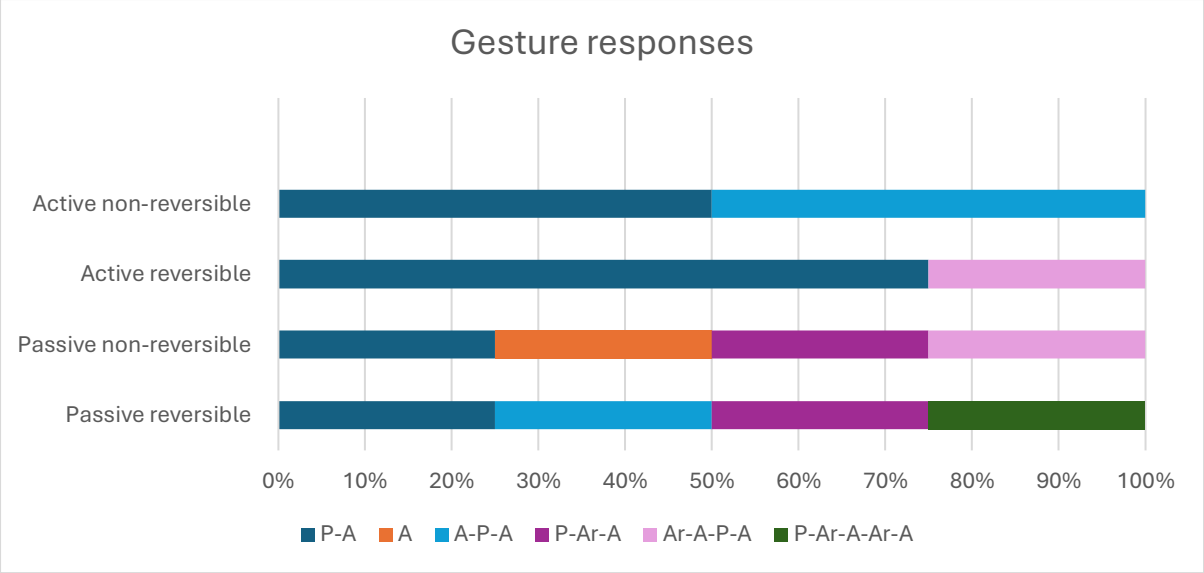

Figure 6 – Percentage of thematic role order gesture responses in each condition.
(P = Patient, A = Act, Ar = Actor)

4.3 Discussion

The participants' spoken responses to the stimuli consisted of Actor-Act-Patient and Patient-Act-Actor thematic role orders; both active and passive constructions were elicited. For the most part, syntactic priming occurred successfully, with active speech being elicited in all active conditions and passive speech being elicited solely in passive conditions. However, in the passive non-reversible condition, 37.5% of responses consisted of active constructions. All these active constructions were produced by one participant, meaning 75% of the passive non-reversible stimuli incorrectly elicited active constructions in this participant's speech. The participant in question was exposed to the passive stimuli first, whilst the other participant was exposed to the active stimuli first, suggesting an ordering effect. Alternatively, this finding may be due to the effect of animacy on eliciting passives; the absence of animate Patients in the non-reversible condition may reduce the effectiveness of the passive prime (Gámez & Vasilyeva, 2015). To determine whether this difference in spoken responses is caused by an ordering effect or animacy effect, and to determine whether this effect extends to gesture, the study must be conducted with a larger sample size.

Regarding the methodological measures taken to improve issues found in the first pilot study, ambiguous and simultaneous gestures were successfully avoided. As such, the order in which Actor and Patient gestures occurred was made clear. The measures taken to avoid omission of arguments, however, were not successful.

One observation is that Actor omission did not occur with the same frequency in the first pilot study, which could suggest that syntactic priming is responsible for this change. In the first pilot study, the Actor was omitted in 50% of passive condition gesture responses, whilst in the second pilot study, the Actor was omitted in 50% of gesture responses in the passive condition and 62.5% of gesture responses in the active condition. As this omission occurred in both pilot studies, in three of four participants, it appears to be more than a result of individual variation.

A possible explanation for the Actor omission occurring in active conditions in the second pilot study is the presence of the Actor in the syntactic prime (see (ix)).

(ix)

q. What is the man doing?

a. ~~The man is~~ lifting the ball.

An answer such as this would not be unexpected in a spoken response as the referent 'man' has been established in the question. Whilst this omission could occur naturally in a spoken response to this prime, it does not take place in any of the participants' spoken responses. Additionally, if the Actor were being omitted due to its presence in the prime, it logically follows that the Patient would also be omitted in the passive conditions when it is present in the prime. As this does not occur, with the exception of one response in which both arguments are omitted, the Actor omission is not a result of its presence in the syntactic prime. The frequency with which Actor omission occurred was unexpected; replicating this experiment with a larger sample size and full set of stimuli will determine whether this finding is statistically significant.

A further finding not present in the first pilot study was the repetition of thematic role orders: 37.5% of participant gestures contained Act twice and 6.25% of participant gestures contained Actor twice. This finding was not unexpected as Hall et al. (2013) also found Act, Actor, and Patient repetition within gesture strings.

5. Main study

5.1 Methodology

This study aimed to test the thematic role order of gesture strings elicited by non-reversible active stimuli, reversible active stimuli, non-reversible passive stimuli, and reversible passive stimuli. The participants consisted of 20 university-educated, native British English speakers, aged 19-60 years old. This study replicated the methodology used in the second pilot study, using the full set of stimuli (see Appendix A).

The study was conducted as follows:

1. Gesture responses were elicited using four ditransitive trial stimuli.
2. Verbal responses were elicited using the same four ditransitive trial stimuli.
3. Gesture responses were elicited using 24 transitive stimuli.
4. A 10-minute conversational break.
5. Verbal responses were elicited using the same 24 transitive stimuli.

5.2 Results

5.2.1 Visual statistics

A chi square test of goodness of fit, $X^2(1) = 3.46$, $p = 0.063$, was conducted to determine where there was an order effect of being exposed to either the active or passive condition first. As the test did not detect an order effect on participants' gesture responses, the findings from both orders of exposure have been combined. The verbal responses from both orders of exposure have also been combined (reported separately in Appendix C). It should be noted that this does not definitively mean that there is no order effect, but that if an order effect is present, it is not detectable using this statistical test.

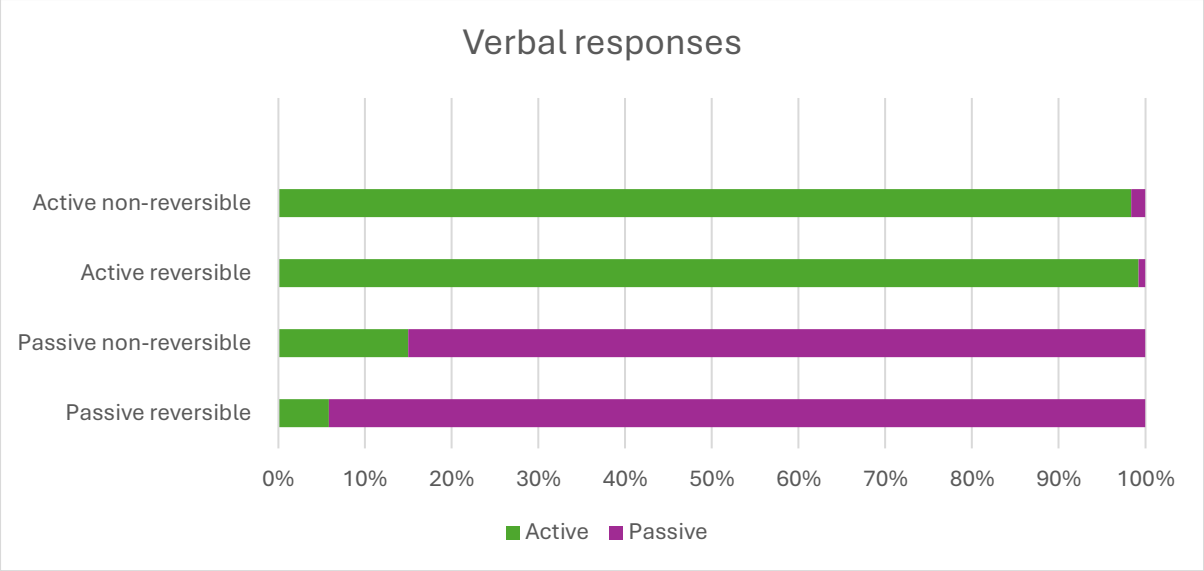

Figure 7 – Percentage of active and passive verbal responses in each condition.

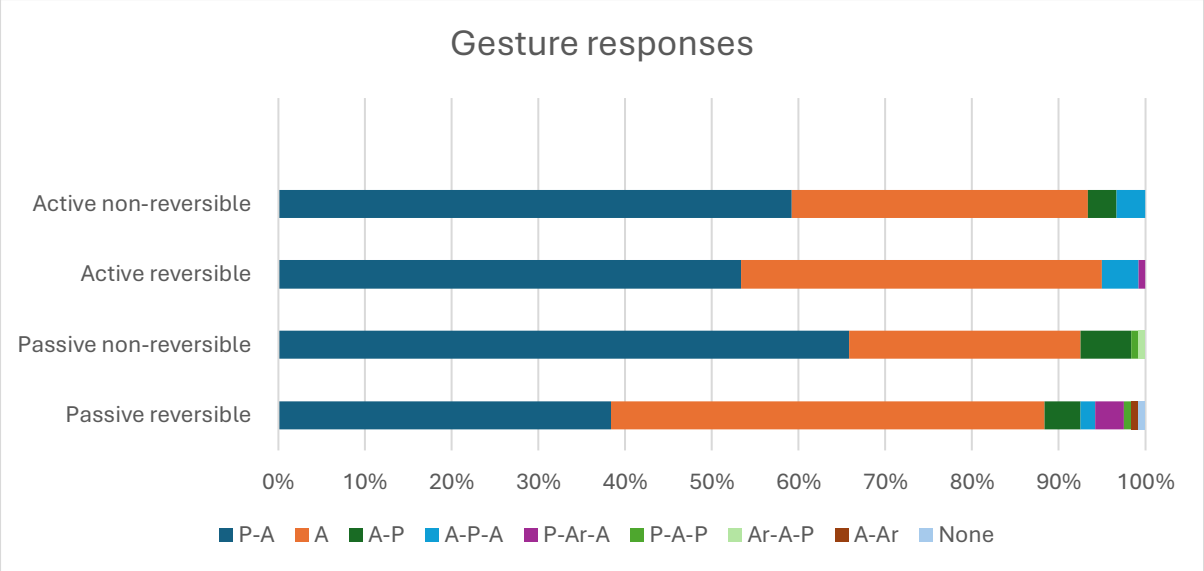

Figure 8 – Percentage of thematic role order gesture responses in each condition.
(P = Patient, A = Act, Ar = Actor)

This study found that participants consistently omitted the Actor from their gesture strings; null-subject (Patient-Act) and null-argument (Act) gestures formed the vast majority of responses.

5.2.2 Statistical analysis

Chi square tests of independence[1] were conducted to determine whether statistically significant differences in thematic role gesture order occurred between active, passive,

[1] Reported as: chi square value (degree of freedom), p value; odds ratio (95% confidence interval)

reversible, and non-reversible conditions. These tests examined the two dominant thematic role orders: Patient-Act, and Act.

For Patient-Act gesture order, a statistically significant difference was not detected between all active and passive conditions, $X^2(1) = 0.84$, $p = 0.36$; OR = 1.18 (95% CI: 0.83, 1.69), between active non-reversible and active reversible conditions, $X^2(1) = 0.83$, $p = 0.362$; OR = 1.27 (95% CI: 0.76, 2.11), or between active non-reversible and passive non-reversible conditions, $X^2(1) = 1.14$, $p = 0.286$; OR = 0.75 (95% CI: 0.45, 1.27).

For Patient-Act gesture order, a statistically significant difference was detected between all non-reversible and reversible conditions, $X^2(1) = 13.43$, $p = <0.001$; OR = 1.97 (95% CI: 1.37, 2.84), between passive non-reversible and passive reversible conditions, $X^2(1) = 18.18$, $p = <0.001$; OR = 3.1 (95% CI: 1.83, 5.25), and between active reversible and passive reversible conditions, $X^2(1) = 5.44$, $p = 0.02$; OR = 1.84 (95% CI: 1.10, 3.07).

For gestures consisting solely of Act, a statistically significant difference was not detected between all active and passive conditions, $X^2(1) = 0.01$, $p = 0.925$; OR = 0.98 (95% CI: 0.68, 1.42), between active non-reversible and active reversible conditions, $X^2(1) = 1.43$, $p = 0.231$; OR = 0.73 (95% CI: 0.43, 1.23), between active non-reversible and passive non-reversible conditions, $X^2(1) = 1.59$, $p = 0.207$; OR = 1.43 (95% CI: 0.82, 2.48), or between active reversible and passive reversible conditions, $X^2(1) = 1.68$, $p = 0.195$; OR = 0.71 (95% CI: 0.43, 1.19).

For gestures consisting solely of Act, a statistically significant difference was detected between all non-reversible and reversible conditions, $X^2(1) = 12.09$, $p = <0.001$; OR = 0.52 (95% CI: 0.36, 0.75), and between passive non-reversible and passive reversible conditions, $X^2(1) = 13.82$, $p = <0.001$; OR = 0.36 (95% CI: 0.21, 0.62).

For both Patient-Act and Act gesture orders, a statistically significant difference between non-reversible and reversible gestures was present, but only in the passive condition. Patient-Act gestures made up the majority of responses in the passive non-reversible condition, whilst Act gestures made up the majority of responses in the passive reversible condition. This is highly statistically significant as the p-value was <0.001 in all relevant chi square tests.

For Patient-Act gesture order, a statistically significant difference between active and passive gestures was present, but only in the reversible condition. Patient-Act gestures occurred more frequently in the active reversible condition than in the passive reversible condition. This is statistically significant as the p-value was 0.02 in the relevant chi square test.

5.2.3 Participant effects and item effects

Possible participant effects were examined to determine whether the statistical significance found was caused by participant effects or by the conditions that the study aimed to test. 85% of participants were found to have a single dominant gesture order; for 60% of participants Patient-Act was dominant, for 25% of participants Act was dominant. The remaining 15% of participants had an equal split between Patient-Act and Act gestures. This consistent preference for a dominant order, or orders, displays that participant effects did occur. As each participant produced an equal number of responses in each condition, their preferred gesture orders are unlikely to have caused the statistically significant differences found between conditions.

For each dominant order group, item effects were examined to determine whether the statistical significance found was caused by the four conditions that the study aimed to test, or by alternative factors.

Within the Patient-Act dominant participants, within-participant variation occurred consistently. The majority of variation within these participants occurred when the Act ‘kiss’ was in the item, most frequently resulting in omission of the Patient. The second most cause of variation occurred when the Act ‘push’ was in the item. Whilst the condition type did impact some participant responses, this did not occur consistently and no patterns were found. Gesture order variation within these participants, therefore, was largely a result of item effect, specifically the Act used. This is unlikely to have affected the statistically significant differences found between conditions as each Act was present an equal number of times in each condition.

Within the Act dominant participants, within-participant variation occurred in 60% of participants; the remainder solely used Act gestures. The majority of variation in these

participants occurred in non-reversible conditions, in which Patient-Act gestures were produced; the Patient was only produced when non-human. Gesture order variation in these participants, therefore, was a direct result of the conditions being tested, specifically reversibility.

Within the split dominance participants, variation occurred as a result of both item effects and the conditions being tested. For example, one participant solely used Act for reversible conditions and Patient-Act for non-reversible conditions, similarly to the Act dominant participants. Another participant omitted the Patient most frequently when the Act 'kiss' was in the item, similarly to the Patient-Act dominant participants. One participant's gestures showed effects of both item, using Actor-Patient solely for the Act 'kiss', and conditions, producing the Actor only in passive reversible conditions.

Whilst the thematic role order of gestures did not differ significantly between active and passive constructions, 50% of participants did use other methods to differentiate between their active and passive gestures. 40% of these participants used gesture to represent themselves as the Patient in passive conditions (see figure 9); 50% did so consistently, 12.5% did so on one occasion only, 12.5% did so in some responses though no pattern was present, 12.5% did so solely in reversible conditions, and 12.5% did so solely when the Act was 'kiss'. 15% of these participants used gesture to differentiate between the Act in active and passive conditions; for the Act 'push', 100% used a firm forward pushing motion in active conditions and a sideways sweeping motion in passive conditions (see figure 10), and for the Act 'lift', 33.33% fully extended their arms overhead in active conditions and raised upturned palms in passive conditions (see figure 11).

PATIENT ACT ACT PATIENT

Figure 9 – A participant gestures 'kiss' in the active condition (left) and indicates themselves as the recipient of 'kiss' in the passive condition (right).

Figure 10 – A participant uses different gestures for ‘push’ in the active condition (left) and in the passive condition (right).

Figure 11 – A participant uses different gestures for ‘lift’ in the active condition (left) and in the passive condition (right).

5.3 Discussion

5.3.1 Addressing the research question and hypotheses

It must first be stated that my research question, whether speech-independent gesture strings remain Actor-initial when their corresponding spoken structure would be Patient-initial, cannot be answered due to the frequent argument omission in participants’ gesture responses.

The first hypothesis predicted that the predominant gesture order in non-reversible active constructions would be Actor-Patient-Act, and the second hypothesis predicted that the predominant gesture order in reversible active constructions would be Actor-Act-Patient. These predictions were not borne out; not only were the gestures not Actor-initial due to frequent argument omission, but the same predominant gesture order, Patient-Act, was found in both conditions. No significant difference in thematic role order was found between the gestures for active reversible and non-reversible events. As such, the findings do not align with Hall et al.’s (2013) role conflict hypothesis that proposes a ‘cognitive constraint against the conjunction of a human patient followed by an action gesture’.

The third hypothesis proposed that the predominant gesture order in non-reversible passive constructions would either be Actor-Patient-Act or Patient-Act-Actor, and the fourth hypothesis proposed that the predominant gesture order in reversible passive constructions would either be Actor-Act-Patient or Patient-Act-Actor. None of these predictions were borne out due to the frequent omission of arguments. In the passive non-reversible condition, the dominant gesture order was Patient-Act. Though Patient-initial gesture strings were found, these were not caused by the passive condition as the same Patient-initial gesture strings were dominant in the active condition responses. In the passive reversible condition, the dominant gesture order was Act, meaning a significant difference in thematic role order was found between the gestures for reversible and non-reversible events in the passive condition but not in the active condition.

5.3.2 Significant findings

With regard to reversibility, the current study was unable to replicate Hall et al.'s (2013) finding that Actor-Patient-Act gestures were dominant for active non-reversible events and avoided for active reversible events. In fact, the current study found no significant effect of reversibility on gesture order in the active condition. However, reversibility was found to have a significant effect on gesture order in the passive condition ($p = <0.001$), as well as overall when both active and passive conditions were combined ($p = <0.001$), but the effect found differed from that reported by Hall et al. (2013). It is plausible that the significant difference between the passive reversible and passive non-reversible condition is not solely a result of reversibility but in-part due to syntactic priming, as animacy has been found to boost syntactic priming effects in the production of passives in children (Gámez & Vasilyeva, 2015). This idea is supported by participant responses in the verbal condition, in which a greater number of passives were elicited by reversible stimuli, which contained animate Patients, than by non-reversible stimuli, which contained inanimate Patients. It is likely that this effect occurred to a greater extent in participants' gesture responses than in their verbal responses as they were asked to use part of their communication system differently; the grammar available for their gesture productions is comparable to the developing language system available to children.

In the passive non-reversible condition, Patient-Act gestures made up the majority of participant responses; though the Actor was omitted, responses maintained the Patient-Act order found in Hall et al. (2013). In the passive reversible condition, Act gestures made up the majority of responses; participants consistently produced null argument gestures rather than altering the order in which the Act and Patient roles were produced. This suggests a preference to omit the Patient rather than change the order of arguments. This apparent preference occurred throughout the study, with Act gestures being the second-most frequent response in all active conditions and in the passive non-reversible condition. Methodological differences and argument omission in language will be examined to explain these findings.

With regard to the active-passive distinction, a statistically significant difference ($p = 0.02$) was only found between the active reversible condition, in which Patient-Act gestures were dominant, and the passive reversible condition, in which Act gestures were dominant. The current study was unable to find a significant difference between active and passive gesture order in the non-reversible condition, as well as overall when both reversible and non-reversible conditions were combined. Participants often preferred to indicate the active-passive distinction by treating themselves as the Patient in passive constructions, rather than altering the thematic role order. This is a direct result of the requirement to elicit passives to be able to study Patient-initial constructions in this language population. This could be avoided in a future study which has access to one of the 15 known languages which uses Patient-initial order for active structures, such as Hixkaryana or Nadëb (Brazil) (Dryer, 2013).

The effects of animacy on syntactic priming (Gámez & Vasilyeva, 2015) could explain why a statistically significant difference was found between the active and passive reversible conditions but not between the active and passive non-reversible conditions. The passive reversible condition was the only condition in which Act gestures were dominant, in the remaining three conditions Patient-Act gestures were dominant; gesture responses in the passive non-reversible condition bore more similarity to responses in the active conditions than to those in the passive reversible condition. It is possible that this is a result of the syntactic priming of passives being less effective when the prime and target contain an inanimate Patient. To avoid this possibility, languages which do not require passives to be syntactically primed for Patient-initial constructions to be produced must be studied.

Under the assumption that animacy positively impacts the efficacy of syntactic priming, the gesture responses in the passive reversible condition could be a more accurate representation of passive structures than gesture responses in the passive non-reversible condition. As this study found a statistically significant difference between gesture order in the passive reversible condition and the active reversible condition, this suggests that Patient-initial structures are not represented in the same way as Actor-initial structures. My results suggest an interaction between non-verbal argument omission and spoken thematic role order, so cannot support Goldin-Meadow et al.'s (2008) conclusion that spoken thematic role order does not influence non-verbal behaviour. However, the frequent Patient-Act gesture responses in the current study are not inconsistent with the findings of Goldin-Meadow et al. (2008).

5.3.3 Methodological differences

A key question raised by these findings is, why did argument omission occur so frequently? Possible methodological causes for this difference must be examined.

Firstly, it should be noted that stills of the visual stimuli used in prior research were not provided in the literature. As such, the order in which thematic roles were presented is unknown. The thematic roles could have been presented in varying orders across the stimuli or consistently presented in a specific order. If it were the case that the thematic roles were presented in a specific order, the particular order used, and its effect, are unknown. Alternatively, the thematic roles of Actor and Patient may have been presented simultaneously. If it were the case that these thematic roles were presented simultaneously, the role which altered first or moved the greatest amount, and the effect of this, is unknown. The possible effect of thematic role order presentation on the results of previous studies has not been explored and cannot currently be known due to a sheer lack of information. The possible differences between the stimuli used in this experiment and the stimuli used in prior research also remain unknown, meaning any effects of this possible methodological difference cannot be examined further.

The second methodological difference is that, in the current study, participants were familiar with the experimenter and setting in which the study was conducted. This familiarity was conducive to forthcoming participants. For example, following the task, participants

voluntarily informed the experimenter that they either consciously maintained consistency in their responses or made a conscious effort to 'improve' their responses throughout the task. In the current study, the majority of participants fell into the former category whilst in the second pilot study, both participants fell into the latter category. The variation between these two studies, evidenced by gesture responses in the experiments and by communication with participants following the experiment, displays a sampling effect.

In the current study, it is possible that the participants' choice to maintain consistency increased the likelihood of argument omission; if a participant omitted an argument in their first gesture response, the remainder of their responses were likely to follow suit. Furthermore, all participants were exposed to the non-reversible condition first. Initial exposure to a condition in which Patient-Act order is 'permissible', combined with a desire to maintain consistency, could explain why Patient-Act order is used in the following reversible conditions despite Hall et al. (2013) identifying a cognitive constraint against this gesture order. Whilst participants in Hall et al. (2013) were also exposed to non-reversible events first, it is possible that these participants did not consciously maintain consistency due to the same sampling effect causing variation between the current study and the second pilot study. Therefore, participants' desire for consistency provides a possible explanation as to why Patient-Act order frequently occurred in reversible events and cannot be accounted for by the role conflict hypothesis. To determine whether participants' desire for consistency caused this outcome, a future experiment could replicate the current study with varied orders of exposure to determine whether Patient-Act gestures occur in the reversible condition when participants are exposed to reversible events first.

The third methodological difference examined is the way in which experimenters ensured all three thematic roles were elicited in gesture. Hall et al. (2013) used practice trials to encourage participants to convey all important stimuli information in their gestures. Consequently, argument omission occurred in no more than approximately 20% of critical trials. Despite attempting to partially replicate the methodology used in Hall et al. (2013), the current study rarely elicited all three thematic roles. The argument omission that did occur in Hall et al. (2013) is consistent with that found in the current study; null argument gestures occur more frequently in reversible conditions than non-reversible conditions and Patient-Act gestures occur more frequently in non-reversible conditions than reversible conditions. However, the current study's findings are also inconsistent with the findings of Hall et al.

(2013), as Patient-Act gestures still occur frequently in the in reversible conditions, opposing the role conflict hypothesis.

In Goldin-Meadow et al. (2008), argument omission occurred significantly more frequently as no attempt was made to ensure that all three thematic roles were elicited in gesture. This led to participants predominantly producing gesture strings containing only two thematic roles. As these 2-gesture strings were not reported individually but combined into two categories, those consistent with Actor-Patient-Act order (Actor-Act, Patient-Act) and those inconsistent with Actor-Patient-Act order, the dominant thematic role order produced by participants in this study is unknown.

Langus and Nespor (2010) aimed to elicit all three thematic roles by instructing participants to describe each stimulus using 3 gestures. Consequently, 2-gesture strings were produced less frequently than in Goldin-Meadow et al. (2008) but still accounted for a significant proportion of responses. These 2-gesture strings are comparable to those produced in the current study in three ways. Firstly, the 2-gesture strings always contained a gesture representing the Act. Secondly, participants omitted the Actor more frequently than the Patient in these gesture strings. Thirdly, the dominant order for the 2-gesture strings was Patient-Act. These 2-gesture strings occurred despite the experimenter instructing participants to produce 3 gestures. In the current study, participants were not instructed to produce a particular number of gestures for each response. This methodological difference may explain why arguments were omitted with greater frequency in the current study.

Participants' desire for consistency provides a possible explanation as to why Patient-Act order frequently occurred in reversible events and cannot be accounted for by the role conflict hypothesis. The latter two studies support the dominant Patient-Act order found in the current study, but none of the studies discussed investigate or explain why argument omission occurred.

5.3.4 Argument omission in language

To understand why participants omitted arguments in gesture responses, it is necessary to discuss null arguments in the context of languages.

It should first be noted that in the current study, some participants omitted the Actor in their verbal responses in the active condition and omitted the Patient in their verbal responses in the passive condition. This was not reported in prior studies and was likely a result of the Actor being present in the active prime and the Patient being present in the passive prime. I did not find this to be a correlate for argument omission in gesture responses; a finding supported by Langus and Nespor (2010), in which argument omission occurred in gesture responses but never in verbal responses. Therefore, argument omission in verbal responses is not relevant to the analysis of argument omission in gesture responses and will not be discussed further.

Null arguments can occur in sign languages, such as American Sign Language, which use agreement verbs and spatial verbs. It should be noted that some accounts of signed language attempt to combine these verb classes into one category (de Quadros & Quer, 2008). However, collapsing these categories poses a number of issues, one of which is relevant to the interpretation of null arguments (Oomen & Kimmelman, 2019; Kwok, Berk & Lillo-Martin, 2020). A key difference between agreement verbs and spatial verbs is that of syntax, which cannot be applied to non-linguistic gestures, and semantics, which is applicable to non-linguistic gestures. As null arguments and the syntax/semantics distinction have relevance to this analysis, agreement verbs and spatial verbs will be considered individually. Agreement verbs modify the start and endpoint of verb signs to indicate the person, or number, of the subject and object; agreement verbs are concerned with syntax. Spatial verbs also modify the start and endpoint of verb signs but do so to indicate the location of arguments; spatial verbs are concerned with semantics and thematic roles (see x).

(x) A. Did John send Mary the paper?
(in which John has been established at *a* and Mary at *b*.)
B. YES, $_{a}$SEND$_{b}$.
Yes, (he-) sent (it) to (-her).
(example from Lillo-Martin, 1986)

In spatial verbs, arguments are omitted when the referent's location is already determined in space. The motion of this sign can occur horizontally or vertically, depending on the location of the referents. I propose that, in the current study, argument omission may have occurred due to the referents' location being established in the stimuli clips.

(xi) A. Stimuli clip shown: ‘the man pushes the girl’
(in which the man has been established on the left (l) and the girl on the right (r))
B. Gesture response: $_{l}$PUSH$_{r}$.

(xii) A. Stimuli clip shown: ‘the girl lifts the boy’
(in which the girl has been established at the bottom (b) and the boy at the top (t))
B. Gesture response: $_{b}$LIFT$_{t}$.

(xiii) A. Stimuli clip shown: ‘the man kisses the woman’
(in which the man has been established at the lips (l) and the woman in front (f))
B. Gesture response: $_{l}$KISS$_{f}$.
(participant moves hands from *l* to *f* to indicate argument location)

This could account for all null argument gestures containing the Act ‘push’ or ‘lift’ as these were consistently gestured from one location to another, on either a horizontal or vertical plane. However, this does not account for all null argument gestures containing the Act ‘kiss’, as many participants solely used lip movements or placed palms on their heart to convey this Act. This difference between Acts could be explained by psych-verbs, which convey an emotional state and are frequently body-anchored (Oomen, 2017; Oomen and Kimmelman, 2019).

For this analysis, it is necessary to state that many participants did not use the verb ‘kiss’ in their verbal descriptions, instead preferring to use ‘love’; a psych-verb pertaining to an emotional state. In signed languages, ‘love’ is a body-anchored verb, not a spatial verb, as it necessarily occurs on the body; its start and endpoint cannot be altered. Oomen (2017) argues that body-anchored verbs are iconically motivated and can reflect ‘a metaphoric location of an emotion (e.g. ‘loving’ is in the heart)’. Whilst iconicity has impacted signed languages, it is also available to non-signers, which accounts for the similarity between the gesture response and the sign for ‘love’. This could explain why participant gestures for ‘kiss’ cannot always be accounted for by the spatial verb analysis.

Oomen and Kimmelman's (2019) research on German Sign Language and Russian Sign Language found that null subjects occurred frequently in clauses containing body-anchored verbs. However, when body-anchored verbs occurred in conjunction with a third person subject, the subject was rarely dropped. The researchers concluded that the third person subject of a body anchored verb cannot be dropped, even in simple clauses. In the current study's stimuli, the Actor was consistently third person (man/woman/boy/girl), and in the participant responses, the Actor was frequently omitted, appearing to oppose Oomen and Kimmelman's (2019) conclusion. However, in all active constructions, and most passive constructions, participants performed the gesture as though they were the Actor; their performance of the gesture converted the third-person subject in the stimuli to a first-person subject. In accordance with Oomen and Kimmelman (2019), it is now permissible to omit the Actor; as it is no longer third person, there is no restriction.

Spatial verbs are able to explain null argument responses for 'push', 'lift' and 'kiss', whilst body-anchored verbs can be used to explain the Actor omission in gestures for 'kiss', when interpreted as 'love'. However, this does not explain why stimuli containing 'kiss' elicited null argument responses more frequently than those containing 'push' or 'lift'. To examine why item effects such as this occurred, the participants' spoken language must be examined.

In spoken English, the Act 'kiss' can be used without an overt object, but the Acts 'lift' and 'push' cannot be; 'kiss' has an intransitive use even if the object is implied. This could explain why Patient omission occurred more frequently when stimuli contained the Act 'kiss'. A further difference between 'kiss' and the remaining Acts is that 'kiss' usually entails reciprocation, whilst the other Acts do not. However, the visual stimuli did not convey 'kiss' as reciprocal; the Act was only performed by one party, the Actor (see figure 2: 'the boy is kissed by the girl'). Null argument gesture responses for stimuli containing the Act 'kiss' were found not only in participants that predominantly produced gestures consisting solely of Act, but also in participants that predominantly produced Patient-Act gesture strings. The presence of this response across the majority of participants suggests that this is not a sampling effect but a result of influence from the participants' spoken language. I suggest that future studies examining the gesture order of transitive events do not use the Act 'kiss' due to the possible impact of its intransitive use on participant responses.

Patient omission also occurred more frequently for reversible events than non-reversible events. This occurred in participants that predominantly produced gestures consisting solely of Act, but not in participants that predominantly produced Patient-Act gesture strings. This suggests that the Act dominant participants deemed it necessary to specify the Patient when it was non-human. This may be a result of events such as 'a boy kissing a ball' being unusual and unrealistic compared to 'a boy kissing a girl'; the events involving human Patients are more naturalistic and likely to resemble real life events experienced by the participants. As such, participants may feel the need to specify an unexpected non-human Patient but not a human Patient.

In sum, spatial-verbs and body-anchored verbs, as well as influence from the participants' spoken language and experiences, are able to account for the frequency of argument omission in gesture responses.

6. Conclusion

This study found two predominant gesture orders across the four conditions tested: Patient-Act gestures, in which Actor omission occurred, and null argument gestures consisting solely of Act. Whilst frequent argument omission in gesture responses prevents the research question from being answered directly, this study provides new information regarding the impact of spoken thematic role order and reversibility on non-verbal productions.

With regard to reversibility, this study found no significant difference between the gesture productions for active reversible and active non-reversible events, both of which were predominantly Patient-Act order. Although a significant difference was found between passive reversible and passive non-reversible events, with Act gestures making up the majority of responses in the passive reversible condition, Patient-Act gestures remained either the most or second-most frequent response. This does not support Hall et al.'s (2013) role conflict hypothesis, which proposed a cognitive constraint against a human Patient immediately followed by an Act. These results are, however, in-line with the dominant Patient-Act gesture responses found in Goldin-Meadow et al. (2008). To determine whether this response was caused by sampling effects, specifically a desire for consistency, combined with initial exposure to the non-reversible condition in which Patient-Act order would be

‘permissible’, a future experiment could replicate the current study with a larger sample size and varied orders of exposure.

With regard to spoken thematic role order, this study found no significant difference between the gesture responses for active non-reversible and passive non-reversible events. However, a significant difference was found between the active reversible and passive reversible conditions. A key finding is that this significant difference was not in the order of thematic roles produced but in the omission of thematic roles, with null argument responses occurring significantly more frequently in the passive reversible condition. As a result, the current study is unable to support the claim that spoken thematic role order does not impact non-verbal behaviour (Goldin-Meadow et al., 2008). This difference may occur solely between reversible conditions due to animacy boosting the effects of syntactic priming in passives (Gámez & Vasilyeva, 2015). To determine whether this is the case, a future study with greater resources could examine speakers of Patient-initial languages, removing the need for syntactic priming altogether. This would also avoid participants roleplaying as the Patient, as was the case in passive conditions in the current study.

To answer the intended research question, whether gesture strings remain Actor-initial when their corresponding spoken structure would be Patient-initial, future studies should aim to elicit all three thematic roles. In order to elicit all three roles, I suggest that researchers employ methodologies such as further encouraging participants to produce all relevant information in responses to the trial stimuli, as this was successful in Hall et al. (2013); instructing participants to avoid using their body’s physical presence to represent an individual in the stimuli, as this may reduce Actor omission; avoiding use of the Act ‘kiss’, due to its possible intransitive use and consequent Patient omission; and studying larger sample sizes, as sampling effects have been identified in this research. Regardless of the frequency of argument omission found or the exact question a researcher aims to answer, I urge future research to continue to discuss argument omission with transparency and detail to ascertain the extent to which spoken thematic role order and reversibility impact argument omission in non-verbal behaviour.

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8. Appendix

Appendix A – Stimuli items for pilot study 1 & main study.

Actor	Act	Patient
Boy	Kiss	Ball
Man	Push	Car
Girl	Lift	Ball
Woman	Kiss	Car
Girl	Push	Bike
Boy	Lift	Bike

Figure A1 - Non-reversible Actor-initial stimuli.

Actor	Act	Patient
Man	Push	Girl
Woman	Lift	Boy
Man	Kiss	Woman
Girl	Lift	Boy
Woman	Push	Man
Boy	Kiss	Girl

Figure A2 - Reversible Actor-initial stimuli.

Patient	Act	Actor
Bike	Push	Woman
Ball	Kiss	Boy
Car	Push	Girl
Ball	Lift	Man
Car	Kiss	Man
Bike	Lift	Boy

Figure A3 - Non-reversible Patient-initial stimuli.

Patient	Act	Actor
Boy	Lift	Woman
Woman	Kiss	Man
Boy	Push	Girl
Girl	Lift	Man
Boy	Kiss	Girl
Woman	Push	Man

Figure A4 - Reversible Patient-initial stimuli.

Appendix B – Stimuli items for pilot study 2.

Actor	Act	Patient
Boy	Kiss	Ball
Man	Push	Car

Figure B1 - Active non-reversible stimuli, tested in the verbal condition only.

Actor	Act	Patient
Woman	Lift	Boy
Man	Kiss	Woman

Figure B2 - Active reversible stimuli, tested in the verbal condition only.

Patient	Act	Actor
Car	Push	Girl
Ball	Lift	Man

Figure B3 – Passive non-reversible stimuli, tested in the verbal condition only.

Patient	Act	Actor
Boy	Push	Girl
Woman	Kiss	Man

Figure B4 – Passive reversible stimuli, tested in the verbal condition only.

Actor	Act	Patient
Girl	Lift	Ball
Woman	Kiss	Car

Figure B5 - Active non-reversible stimuli, tested in both gesture and verbal conditions.

Actor	Act	Patient
Man	Push	Girl
Girl	Lift	Boy

Figure B6 - Active reversible stimuli, tested in both gesture and verbal conditions.

Patient	Act	Actor
Bike	Push	Woman
Ball	Kiss	Boy

Figure B7 – Passive non-reversible stimuli, tested in both gesture and verbal conditions.

Patient	Act	Actor
Girl	Lift	Man
Boy	Kiss	Girl

Figure B8 – Passive reversible stimuli, tested in both gesture and verbal conditions.

Appendix C – Verbal responses to stimuli; active-initial and passive-initial exposure reported separately.

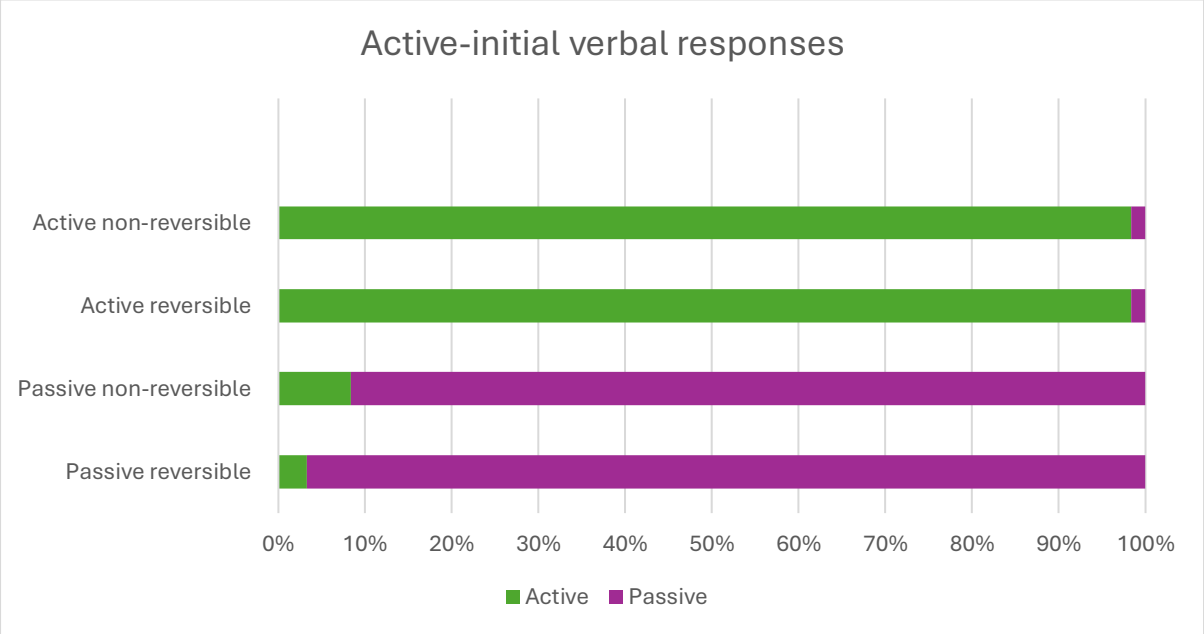

Figure C1 - Percentage of active and passive verbal responses in each condition; participants exposed to active conditions first.

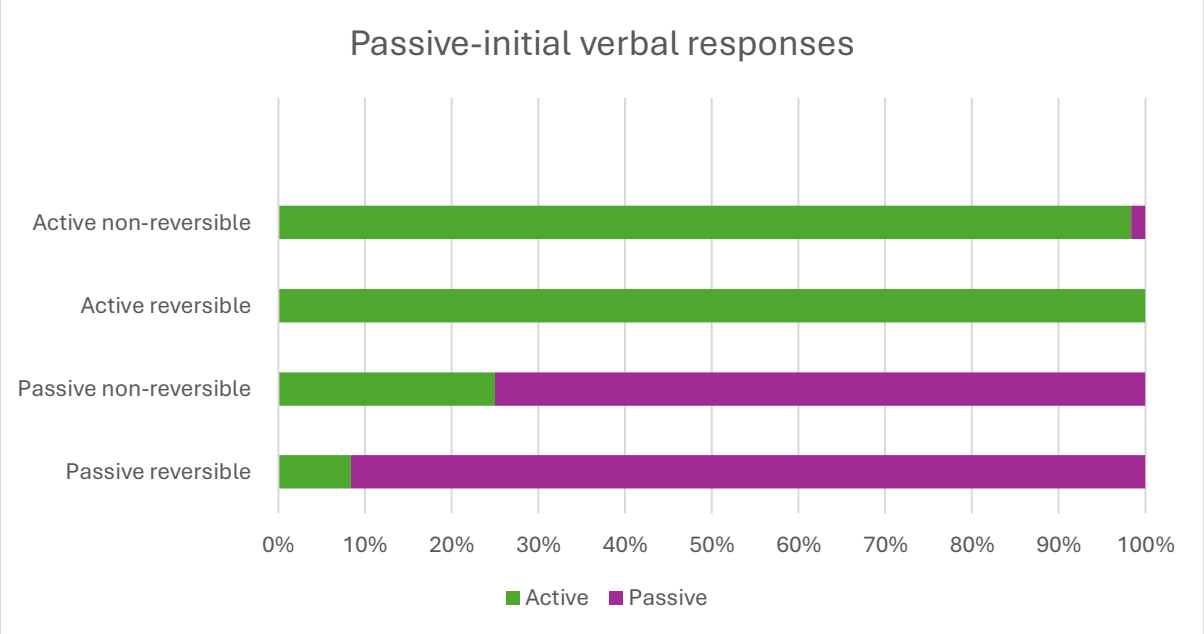

Figure C2 - Percentage of active and passive verbal responses in each condition; participants exposed to passive conditions first.