

## The Cognitive Interplay between the Screen and the Hands

MASTER GENERAL LINGUISTICS

Teacher who will receive this document: Dr. J. G. Geenen

Title of the document:

The Cognitive Interplay between the Screen and the Hands

Date of submission: August 1st, 2017

The work submitted here is the sole responsibility of the undersigned, who has neither committed plagiarism nor colluded in its production.

**Abstract**

Lausberg and Kita (2003) found that hand choice was determined by the spatial location of geometrical objects on screen. The left hand displayed the object on the left side of the screen, and the object on the right was referred to with the right hand. This paper aimed to investigate the influence of the movements and locations of entities in a cartoon video on hand choice and its concurrent speech. The cartoon video was more complex than Lausberg and Kita's (2003) experiment in that it revolved around character's attributes, actions, and events. The methodology consisted of participants retelling the events of a cartoon video to a recipient. Hand choice was thoroughly examined through a qualitative analysis in relation to the following motion features of the video: location, trajectory, viewpoint and manner. The research questions under scrutiny were: how is spatio-motoric information of the stimulus video represented in gesture? Which hands are used to depict the video's motion properties? And furthermore, why do the hands depict these spatial features in this way? The why-question linked the findings to Kita and Özyürek's (2003) Interface Hypothesis. It was found that (1) character and dual viewpoint gestures were sometimes narrated from observer perspective, (2) the location and trajectory of the hands tended to be similar to the spatial location and path of the protagonist on screen, and (3) manner gestures from observer viewpoint sometimes had a trajectory that did not correspond to the trajectory in the video. In light of the Interface Hypothesis, the Action Generator might alter the trajectory of such manner gestures. This cognitive alteration facilitates the classification of event sequences from each other, and could therefore be considered a mnemonic benefit for speakers to cognitively organise their narrative for the purpose of the cartoon retelling task.

**Key words:** hand choice, gesture, screen influence, spatio-motoric information, location, trajectory, viewpoint, manner, Interface Hypothesis, narrative retelling, cognition.

## Table of Content

<b>1. Introduction .....</b>	<b>5</b>
<b>2. Literature Review.....</b>	<b>9</b>
2.1 Gestures.....	9
2.1.1 Gesture Features .....	11
2.1.2 Gesture Categories and Functions .....	12
2.2 The Effect of Various Factors on Hand Choice .....	14
2.3 The Cognitive Link between Gesture and Speech .....	18
2.3.1 Cognitive Model: The Interface Hypothesis .....	22
2.4 The Theory of Embodied Cognition .....	24
2.5 The Representation of Trajectory, Manner, and Viewpoint .....	26
<b>3. Methodology .....</b>	<b>31</b>
3.1 Stimulus.....	31
3.2 Participants .....	31
3.3 Procedure.....	31
3.4 Data Collection.....	32
3.5 Ethical Considerations .....	33
<b>4. Results and Analysis.....</b>	<b>34</b>
4.1 The Screen Influence on the Trajectory and Location of the Hands.....	34
4.1.2 Vertical Trajectory.....	40
4.1.3 Location .....	44
4.2 The Screen Influence on Character and Dual Viewpoint Gestures.....	55
4.3 No Screen Influence on the Description of Entities.....	59
4.4 No Screen Influence on the Manner of Motion .....	62
<b>5. Discussion .....</b>	<b>69</b>
5.1 The Screen Influence on Character and Dual Viewpoint Gestures.....	69
5.2 The Screen Influence on the Trajectory and Location of the Hands.....	71
5.3 No Screen Influence on the Manner of Motion .....	74
5.3.1 Clarifications for the Prioritisation of Manner over Direction in Gesture .....	74
5.3.2 The Interface Hypothesis: a Cognitive Interpretation of Manner .....	79
<b>6. Conclusion.....</b>	<b>84</b>
<b>7. References .....</b>	<b>88</b>
<b>8. Appendix (USB).....</b>	<b>93</b>

## 1. Introduction

Our hands are a rich source of information. They frequently accompany linguistic units that contain spatio-motoric information, for instance, the descriptions of the interior of a house (e.g. Seyfiddingur & Kita, 2003), route directions (e.g. Allen, 2001), or illustrations of shapes (e.g. Graham & Argyle, 1975) and motions in space (e.g. Kita & Özyürek, 2003). McNeill (2005) classified such hand movements as gestures, and defined them as “the spontaneous, unwitting, and regular accompaniments of speech we see in our moving fingers, hands, and arms” (p. 3). Gestures are an important means of communication as Cassell, McNeill, and McCullough (1999) posited that speech and gesture “give rise to one unified representation in the listener” (p. 2). This suggests that recipients are able to glean information from gesture and its co-expressive speech segments. Cartmill, Beilock, and Goldin-Meadow (2012) observed that listeners found it easier to grasp meaning when gestures accompanied speech as compared to when there were no gestures at all. Furthermore, research by Cassell et al. (1999) and Beattie and Sale (2012) on iconic and metaphoric gestures respectively showed that listeners even attended to speech-gesture mismatches, where the gestural and verbal channels both conveyed different kinds of information. Cassell et al. (1999) also found that speakers tended to incorporate these mismatched gestures into their own narrative retellings. Since listeners take up the information presented in gesture, it is thought that gestures have a complementary role. They “have been shown to elaborate upon and enhance the content of accompanying speech” (Cassell et al., 1999, p. 2). For example, gestures may provide additional information about the size of an object, or the manner in which the motion is executed, which is not always expressed verbally. Beattie and Sale (2012) argued that only the combination of the two channels can successfully convey the speaker’s entire message, and not the channels separately.

Not only do gestures have a communicative function, they work on a cognitive level too. McNeill (2005) claimed that gesture co-occurs with descriptive speech 90% of the time. The fact that speech and gesture occur so regularly together is, as McNeill (1992) contended, because they form an unbreakable cognitive unit. Holler and Wilkin (2011) contributed to this by saying that gestures are linked to speech semantically, pragmatically, and temporally. Cassell et al. (1999) further asserted that since “gesture and speech arise together from an underlying propositional representation that has both visual and linguistic aspects, the relationship between gesture and speech is essential to the production of meaning and its comprehension” (p. 3). Such a tight cognitive bond has implications for a reciprocal

relationship between the two modalities, where gesture can affect speech, and speech can affect gesture. Moreover, this unbreakable speech-gesture unit might also benefit the speaker as it may help to retrieve words from memory (Butterworth & Hadar, 1989) and play a facilitatory role in conceptual planning (Krauss, Chen, & Gottesman, 2000) and problem-solving tasks (Cartmill et al., 2012).

Although McNeill (2005) attested to a high gesture rate for descriptive speech in general, Laverne and Kimura (1987) demonstrated that gesture frequency depends on the speech topic. They found that gesture frequency was much lower when talking about abstract or verbal topics as compared to when talking about spatial topics. Alibali, Heath, and Myers (2001) observed that the gesticulations during a cartoon retelling were nearly twice as likely to occur with spatial prepositions than with units that did not contain such prepositions. The chosen speech topics are part of an experiment's empirical protocol that may have an effect on gesture rate.

The empirical protocol may also influence hand choice. Hand choice, or handedness, can be defined as “the individual's preference to use one hand predominantly for unimanual tasks and/or the ability to perform these tasks more efficiently with one hand” (Papadatou-Pastou, 2011, p. 249). It has also been referred to as hand dominance, hand preference, and hand use. Lausberg and Kita (2003) demonstrated the influence of the experimental setup on hand choice. Their participants were shown animations of two geometric objects moving on a horizontal line. The animations consisted of a red ball, a blue square, and a green triangle that could slide, or move in a rolling or jumping manner. After the objects were presented on a screen, the participants were asked to narrate about what they had seen. It was found that the right hand was used to refer to the object on the right side of the screen, and the left hand referred to the object on the left. This indicates that hand choice can be determined by the relative spatial location of the objects on screen. In other words, the object's spatial location is binary mapped onto a particular hand. Their experiment, however, was highly controlled for complexity and the frequencies of the movements on the left and right side of the screen.

This study further explored the influence of the screen on hand choice in a less controlled and more naturalistic and communicative design. Participants were presented with a cartoon narrative in video format, titled *Home Tweet Home*, which they had to recount to a recipient. The video revolved around Sylvester who undertook a number of what turned out to be failed attempts to catch Tweety. Compared to Lausberg and Kita's (2003) experiment, this cartoon video was more complex because of its characters' attributes, actions, and events. Moreover, the actions consisted of the following motion properties: location, trajectory,

manner, and viewpoint. There were three viewpoints narrators could choose from: observer, character, or dual viewpoint. These viewpoints will be discussed in detail later on. The complexity of the cartoon video could complicate Lausberg and Kita's (2003) findings.

There was one other study that addressed the influence of cartoon videos on hand choice. Kita and Özyürek (2003) investigated the informational coordination between gesture and speech cross-linguistically, in Turkish, Japanese, and English. In accordance with their Interface Hypothesis, they found that “regardless of the trajectory shapes and the language types, (...) gestures regularly encode the directional information in the (...) event that is never verbalised” (p. 17). Their paper outlined the analysis of one stimulus event. They observed that gestures only *regularly* encoded directionality, which suggests that gestures *not always* encoded directionality. The current study tried to elaborate upon Kita and Özyürek's (2003) results, and to make clear when gestures encode directionality, and when they do not. The information presented here has built up to the following research questions: how is spatio-motoric information of the stimulus video represented in gesture? Which hands are used to depict the video's motion properties? And moreover, why do the hands depict these spatial features in this way? The why-question tried to link the findings to Kita and Özyürek's (2003) Interface Hypothesis, which contributes to the understanding of how spatio-motoric representations take shape in memory and give rise to co-speech gestures.

To start with, this study hypothesises that the screen influences the spatial location and trajectory of the hand(s) of observer viewpoint gestures of locomotion of animate characters. That is, participants will employ their left and right hand correspondingly to depict the relative spatial location and motions of entities on screen. This concurs with Lausberg and Kita (2003). However, I also believe that there are ‘exceptions’ to this hypothesis that have yet to be investigated, which is what can be inferred from Kita and Özyürek (2003). No specific claims were made about character viewpoint gestures. Parrill (2011) showed that observer and not character viewpoint gestures tend to encode trajectory. Hand choice was subjected to a qualitative analysis. The following motion features were studied: location, trajectory, viewpoint and manner, and afterwards, interpreted according to Kita and Özyürek's (2003) Interface Hypothesis.

Although handedness has been frequently studied in gesture research (e.g. Kimura, 1973; Laverne & Kimura, 1987; Stephens, 1983; Kita et al., 2007), it has, to my knowledge, not been investigated by means of cartoon retellings, with the exception of Kita and Özyürek (2003). A thorough qualitative analysis of how the screen influences hand choice may provide further insight into the cognitive processes that underlie gesture and speech. Any differences

in how participants use their hands and what they see in the stimulus video suggest that they do not exactly reproduce what they see. Some cognitive alteration therefore must have taken place.

The structure of this study is as follows: an extensive amount of literature will be addressed in section two. This includes information about handedness, the cognitive link between speech and gesture, embodied cognition, and the representation of trajectory, manner, and viewpoint. The literature background is followed by an explanation of the used methodology in section three. Section four will show a detailed qualitative analysis of how participants have used their hands to encode motion properties of the cartoon events. In section five, the hypothesis and handedness patterns from section four will be discussed in relation to the Interface Hypothesis. A summary of this study will be given in section six, as well as its relevance and implications for future research.



## 2. Literature Review

In order to understand how spatio-motoric information is represented in gesture, and how this may affect hand choice, as well as the cognitive processes underlying speech and gesture, the gesture basics need to be explained first. The scope will then be broadened to hand choice, as the methodology has hand choice as its central focus. Therefore, previous research on hand choice has to be addressed as well. Researchers have examined hand choice in relation to all kinds of factors that may influence it, such as language lateralisation and gesture categories. After this, the cognitive link between speech and gesture will be discussed. There are different viewpoints on the nature and locus of this link, including Kita and Özyürek's (2003) Interface Hypothesis. The Interface Hypothesis will be discussed separately, since it contributes to the explanation of our data. Furthermore, a subsection on embodied cognition is provided, which further clarifies the link between hand, mind, and the world. It is believed that bodily experiences are integral to our thoughts and language. The background literature will end with an outline of the motion properties trajectory, manner, and viewpoint, which I believe play a pivotal role in clarifying the handedness patterns found in our data.

### 2.1 Gestures

This subsection elucidates what gestures are, and a comparison is drawn between gesture and sign language. People are more familiar with sign language and are inclined to think of gestures as signs. This section demonstrates that gesture and sign language share some similarities, but also some differences.

Gestures, as McNeill (2005) described, “are everyday occurrences – the spontaneous, unwitting, and regular accompaniments of speech we see in our moving fingers, hands, and arms” (p. 3). He further posited that other body parts, such as the head, nose, and feet, can function as a ‘third arm’ when the use of hands is restricted in some form. This study, however, has been restricted to the use of the hands and arms only. Although the hands, arms, and fingers are part of our body, McNeill and Pedelty (1995) argued that gesture should not be thought of as a code of body language. This would suggest that it is distinctive from speech, while the opposite holds true: gesture is *part* of a system of language. Speech and gesture form an integrative multimodal unit that is language (McNeill, 2005).

Thinking of gesture as part of a multimodal unit separates it from what it has commonly been associated with: sign language. As the term itself already indicates, ‘sign

language' is a language, while gesture by itself is not a language. Kendon (1988) placed gesture and sign language, in relation to speech, at both ends of his continuum, as figure 1 demonstrates (qtd. in McNeill, 2005):

<b>Gesticulation</b>	<b>→ Emblems</b>	<b>→ Pantomime</b>	<b>→ Sign language</b>
Obligatory presence of speech	Optional presence of speech	Obligatory absence of speech	Obligatory absence of speech

Figure 1. Continuum 1: in relation to speech.

Figure 1 shows that gestures are obligatorily accompanied by speech, while sign language is not dependent on speech. The latter contains properties of a language, as Ortega and Morgan (2015) stated that sign languages are “fully-fledged linguistic systems exhibiting all levels of organisation found in spoken languages (i.e. phonology, morphology, syntax)” (p. 446).

Gestures, at the other end, have little syntax. This syntax property can be found in the synchronous speech (McNeill & Pedelty, 1995). Another difference between the two is that gestures are “creations of the moment and reflect the speaker’s imagery [i.e. mental representation of some object, act, or event]” (McNeill, 2005, p. 8). They are created in the moment of speaking and can bear any form, whether made with one hand or both hands in different ways. Hence, gestures are not fixed. Signs, on the other hand, are constrained by the phonological properties of a sign language (McNeill & Pedelty, 1995).

Singleton and McNeill (1995) asserted that when gestures occur as a single modality, such as signs in sign languages, their form can have an ultimately complex internal structure (qtd. in McNeill & Pedelty, 1995). This implies that when gestures accompany speech, their structure is not as complex as those of signs. However, to argue that gestures cannot be complicated is to underestimate the matter. Gestures, like signs, can be analysed according to their handshape, finger orientation, location, orientation, and direction (i.e. trajectory) of the hand (McNeill, 1992; Ortega & Morgan, 2015). Speakers can also use the gesture space in the same way as sign languages do to indicate spatial distinctions and relations, as well as to structure discourse (McNeill & Pedelty, 1995).

It has been established that gestures occur with speech, but this is not to say that they cannot occur without speech. When they do not accompany speech, qualitative alterations take place in gesture, and a shift on the continuum occurs towards language (i.e. to the right) (McNeill & Pedelty, 1995). The gestures that do occur with speech have a communicative function, which enables listeners to glean information from them (Cassell et al., 1999;

Cartmill et al., 2012). This excludes emblems, which are conventionalised signs (i.e. ‘thumbs-up’), because they do not accompany speech. Other gestures that have not been the subject of the current analysis are interactive gestures and ‘third arm’ gestures.

Gestures can consist of a number of properties. Their co-expressiveness, non-redundancy, synchrony with speech, anatomy, and communicative dynamism will be explained in the subsequent section. Gesture’s categories and functions will also be briefly mentioned.

### 2.1.1 Gesture Features

Gestures contain a number of features. They carry meaning and are co-expressive with the speech they accompany. Gesture and speech occur in synchrony. This means that the moment the speaker utters a word, its corresponding gesture is presented at the same time. Both modalities represent the same underlying idea simultaneously, but express it in their own distinctive ways (McNeill, 2005). Hence, gestures are co-expressive with speech. They are also non-redundant, and therefore, have a complementary role, as they “elaborate upon and enhance the content of accompanying speech” (Cassell et al., 1999, p. 2). McNeill (1992) claimed that since gesture is synchronous with speech, this “implies that, at the moment of speaking, the mind is doing the same thing in two ways, not two separate things” (p. 22). This is, as McNeill (1992) argued, evidence for an integrative cognitive speech-gesture unit.

Gestures are also temporally bound to speech. The anatomy of a gesture unfolds during the production of an utterance. McNeill (2005) distinguished six phases that occur during this unfolding: the preparation, prestroke hold, stroke, stroke hold, poststroke hold, and retraction phase. The stroke is deemed to be the most important phase, because at this stage the meaning of the gesture is presented. Without it, McNeill (2005) argued, no gesture will occur. Also, the other phases are organised around this stroke. It is prepared for, withheld if needed by a prestroke hold, and held until the synchronous speech is finished. Yet, a gesture may also anticipate its co-expressive linguistic segment, and therefore, “signal the introduction of [a] new meaning into the conversational stream before it surface[s] in speech” (McNeill, 2005, p. 37). The fact that gestures may precede their co-expressive speech segments was reason for McNeill and Duncan (2000) to argue that the visual and verbal elements are integral parts of a cognitive unit, which is ‘unpacked’ when it is presented in speech and gesture (qtd. in Ceinki & Muller, 2008).

Gestures are usually part of a larger discourse, which may alter the quantity and quality of gestures and speech. McNeill and Levy (1993) found that gesture and speech would

“increase at points of topic shift, such as new narrative episodes or new conversational themes” (p. 365). When describing something that is complex, the speaker may add extra details to the story and gestures may increase in complexity in order to contribute to the listener’s understanding of the larger discourse. This dynamic feature of gestures and speech is referred to as communicative dynamism and regarded as “the extent to which the message at a given point is pushing the communication forward” (McNeill, 1992, p. 207). A clause, such as the underlined phrase in ‘he ran and he jumped’ is unlikely to be accompanied by a gesture as the noun phrase is highly predictable. Yet, clauses where a break in the flow of the conversational stream occurs, like ‘the next thing he did’, have a maximal discontinuity and are accompanied by the highest degree of gesture materialisation (McNeill, 2005). Thus, gestures accompany the least predictable, the most discontinuous, and most complex segments of a narrative.

### 2.1.2 Gesture Categories and Functions

Many gestural classification systems have been proposed throughout the years (e.g. Efron, 1941; Efron & Friesen, 1969; McNeill & Levy, 1982; McNeill, 1992). The most well-known system for classifying gestures comes from McNeill (1992), who distinguished four main gesture categories: iconic, metaphoric, deictic, and beat gestures. McNeill (2005) depicted iconic gestures as “gestures in which the form of the gesture and/or its manner of execution embodies picturable aspects of semantic content” (p. 39). They describe an object, action, or event. For example, the phrase *Sylvester is looking at Tweety through a pair of binoculars* may be represented by two hands which are shaped as two cones in front of the eyes. Iconic gestures may provide additional information, which is not always conveyed verbally (Cassell et al., 1999). Lüke and Ritterfield (2014) called this “semantic enrichment” (p.5). Cassell et al. (1999) gave the example of the phrase *he went back and forth*, whereby the speaker wiggles the fingers of his gesture hand as if portraying a character that is walking very fast, as opposed to being tossed back and forth. This gesture shows an extra layer of semantic meaning as it demonstrates the manner and pace of the motion. Another property that could be semantically enriched is the shape of an object.

Iconic gestures may also specify the storyteller role in a narrative. This is the viewpoint from which the speaker tells the story. When a speaker adopts a character viewpoint, his hands map onto the protagonist’s hands as if the narrator is depicting the actions of the protagonist himself. From observer viewpoint, the speaker’s hands map onto the character’s body, and portray the actions of the character in the gesture space, or they may

depict an object or path. Dual viewpoints can be a combination of both viewpoints, or two character or two observer viewpoints. For example, when the hand is cupped and moved to the head. The hand may be framing Tweety from observer perspective, while the head refers to Sylvester's head, portrayed from character perspective.

Metaphoric gestures, on the other hand, present "some abstract content of something else, often a concrete image" (McNeill, 2005, p. 48). To give an example, talking about a 'memory', the speaker may hold this concept as an object in both his hands. The concrete entity, that is the gesture itself, is the iconic component of the metaphoric gesture.

Furthermore, metaphoric gestures may have a temporal function. A reference to the next scene can be held as an object in one hand, while at the same time the hand is placed in a certain space to the left and then to the right, indicating a time line (Ceinki & Muller, 2008). In describing a character's actions, the narrator may use this type of gesture to present the future and past, resembling a character's previous and upcoming actions. Such gestures also bear a deictic loading.

Deictic gestures are usually gestures made by pointing to a space in front of the speaker, but as McNeill (2005) said they can "almost [consist of] any extensible body part or held object" (p. 41), including the head, hands, elbows, or a pair of glasses. McNeill (2005) further added that "deixis entails locating entities and actions vis-à-vis a reference point" (p. 41), which Bühler referred to as 'origo'. The narrator locates himself inside the story in relation to, for example, another character or object which is observed from his perspective. To illustrate this, when saying 'oak tree', the speaker is making a bending back movement, as if bending back the tree himself. Here the tree is seen as in relation to the speaker, who is acting out of character viewpoint perspective. Cassell et al. (1999) suggested that iconic gestures are also important components of origo gestures, like the tree in the bending back example. Simply pointing to a space may also refer to the spatial location of an entity, or locating each hand in a different (front) gesture space may refer to two different characters.

The last gesture category is beats, or batons (Efron, 1941). Beats are "mere flicks of the hand(s) up and down or back and forth that seem to 'beat' time along with the rhythm of speech" (McNeill, 2005, p. 41). Adding to this, they are "simple and rapid" (Beattie & Shovelton, 2002, p. 409). Beats can be used to emphasise elements of the story that the speaker feels is important in context of the larger discourse, such as the first mentioning of a character (McNeill, 2005).

Although gestures have just been described as 'separate' gesture categories, McNeill (2005) stressed that "none of these 'categories' are truly categorical" (p. 41). He rather

referred to them as dimensions and suggested that they may overlap with each other, when he said that “most gestures are multifaceted – iconicity is combined with deixis, deixis is combined with metaphoricity, and so forth” (p. 38). This may complicate the classification of gestures as the division is not as clear-cut as initially laid out. However, McNeill (2005) advocated for this dimensional framework, since it posits no hierarchical order among gestures. Categories should not be deemed to be subordinate or dominant to one another. Instead “in a dimensional framework, we think of every gesture as having a certain loading of iconicity, metaphoricity, deixis, temporal highlighting, and social interactivity; these loadings vary from zero upwards” (p. 41). This implies that because of their multifaceted nature gestures may bear narrative functions from different gesture categories. While McNeill’s (2005) dimensional framework suggests that gestures should not be categorised, the classification of gestures may provide a good starting point to provide a structure of the discourse and gesture.

Gesture categories have been studied in relation to handedness (e.g. Sousa-Poza et al., 1979; Stephens, 1983; Foundas et al., 1995; Kita et al., 2007). Handedness has frequently been the topic of gesture research. All kinds of factors have been linked to handedness in order to gain further insight into the link between hand and mind. These factors will be outlined here as they might explain some of the handedness patterns found in our data.

## 2.2 The Effect of Various Factors on Hand Choice

A wide array of studies have examined hand choice in relation to all kinds of factors which may have an effect on it and could clarify the link between hand and mind. One of the first pioneering research studies was done by Broca (1861). His research, however, did not explicitly focus on handedness itself, but his intention was to gain further insight into language in the brain. He believed language to be ‘functionally lateralised’, which is “the degree to which a particular function is controlled by one rather than two hemispheres” (Crooks & Baur, 2010, p. 119). He discovered that language could be generally found in the left hemisphere. Evidence for this claim came from his study on aphasia patients. All his patients, suffering from a speech production impairment, also had lesions located in the left side of the brain. That is the frontal lobe’s part that is most anterior, now also known as Broca’s area (qtd. in Papadatou-Pastou, 2011). Broca’s (1861) study only included right-handers, and nothing was yet known about left-handers. The initial surmise was that left-handers would have language lateralised to the right hemisphere. This would be a reversal of Broca’s (1861) findings and is known as Broca’s rule, which Broca, ironically, never

formulated himself, nor made any speculations about (qtd. in Papadatou-Pastou, 2011). Broca's rule would suggest a link between handedness and language lateralisation.

However, the relationship between handedness and language lateralisation is not as straightforward as Broca's rule might suggest. A frequently cited study on this issue is Kimura (1973a, b), which stated that left-handers have a bilateral language representation, compared to right-handers. She studied the frequencies of the right and left hand use among different 'types' of participants. They were either right-handed or left-handed with a right- or left ear advantage. Her findings showed that right-handers were inclined to use their right hand over the left hand during speaking (left:right 10:31). Similar results were produced by Dalby et al. (1980) and Foundas et al. (1995). Left-handers with a left ear advantage mainly used their left hand (left:right ratio 83:29), while those with a right ear advantage would use both hands (left:right 48:42) (Kimura, 1973b). The ratio of right hand gestures in left-handers with a left ear advantage was high enough for Kimura (1973b) to claim that all left-handers have a bilateral language lateralisation when she writes " (...) where speech is not unilaterally organised, gesturing should also be manifested less unilaterally" (Kimura, 1973b, p. 54). Hence, left-handers would rely on the right hemisphere when they gesticulate with their left hand, but when they use their right hand, they would rely on the left hemisphere. Right-handers, on the other hand, would have a unilateral language representation with language being localised to the left hemisphere. However, her findings do not explain why right-handers use their left hand, if language is lateralised only to the left hemisphere.

Lavergne and Kimura (1984) later on argued that hand choice is not only determined by language lateralisation. The type of task also plays a role in which hand is used, as the "shifts in hand preferences reflect the engagement of the cerebral hemisphere that is preferentially involved in performing a task" (qtd. in Lausberg and Kita, 2003, p. 58). Their claim was based on an experiment with a manipulation of blocks by Hampson and Kimura (1984). A comparison of verbal and non-verbal tasks showed differences in handedness for right-handers. In comparison to a neutral condition, verbal tasks involved a higher right-hand preference, whereas a greater left-hand use was observed in non-verbal tasks. The spatial processing of the blocks in the non-verbal condition only required the involvement of the right hemisphere, while the speaking condition also involved the processing of the left hemisphere.

Lavergne and Kimura (1987) further explored the idea that the speech topic could alter the right-hand preference in right-handers, in response to Hampson and Kimura (1984). Participants were asked to give route descriptions of the university, name definitions of

abstract words and verbatim descriptions of recent telephone conversations, and talk about their everyday school routine. The authors expected a greater left hand use when talking about spatial topics, since they believed that this would require a greater right hemisphere processing. However, no significant differences in right-hand preference between the spatial and non-spatial topics were observed, and therefore, they concluded that hand preference was not influenced by speech topic nor right cerebral hemispheric processing for spatial tasks (qtd. in Kita et al. 2007). Lausberg and Kita (2003) doubted their used methodology as to whether *talking* about a spatial task was entirely appropriate to test processes that are specific to the right cortex.

Although Kimura's findings on hand choice have provided major input for gesture research from a neuropsychological perspective, her work also showed some flaws. Kimura (1973b) asserted that left-handers have a bilateral language representation, but this argument does not explain the left hand preference in left-handers with a left ear advantage (Lausberg et al., 2007). Also, she did not clarify why there were some right-handers who used their left hand (ratio left:right 10:31) (Lausberg & Kita, 2003). Other studies reported a left-hand percentage in right-handers that ranged between 25 and 39%, which is a fairly large percentage, and larger than the one reported by Kimura (1973b) (Dalby et al, 1980; Lavergne & Kimura, 1987; Sousa-Poza et al., 1979; Stephens, 1983). Furthermore, Lausberg and Kita (2003) found no significant right-hand preference in right-handers during the verbal narration, as was hypothesised by Kimura (1973a). Adding to this, their silent condition showed no decline of right-hand gestures, while Kimura (1973a) contended that speaking would generate a higher right-hand preference. An absence of speaking, thus, would imply, according to Kimura (1973a), a decrease of right-hand gestures. Lausberg and Kita (2003) argued that language lateralisation cannot explain why the right-hand and left-hand have equally frequently been used to refer to iconic gestures. However, Kimura (1973a, b) used a different task than Lausberg and Kita (2003). Kimura's (1973a, b) participants were asked to talk about "various topics" (p. 45), while the participants in Lausberg and Kita's (2003) study were first presented with moving objects on a screen, after which they narrated about what they had seen. They reasoned that the screen must have had an influence on handedness.

Other studies have attempted to generalise hand choice to particular gesture categories. Right-handers would have a right-hand preference for iconic gestures (e.g. Sousa-Poza et al., 1979; Stephens, 1983; Foundas et al., 1995). Wilkins (2003) observed a right-hand preference for deictic gestures. Stephens (1983) found a stronger right-hand preference for both iconic and metaphoric gestures than beat gestures. Sousa-Poza et al. (1979), in contrast, observed no



specific hand preference for beats, while these had a right-hand preference in Foundas et al. (1995). Lausberg and Kita (2003) even criticised Kimura (1973a, b) for not having categorised her gestures, as she interpreted her free hand movements as “any motion of the limb which did not result in touching of the body or coming to rest” (p. 46). Yet, it could be questioned whether the categorisation of certain gestures types to a particular hand has any academic relevance, especially since McNeill (2005) argued that gesture categories are never truly categorical, and therefore, every gesture has a loading of iconicity, deixis, metaphoricity, and beats. Furthermore, classifying gestures is a thorough and complex process, and gesture ‘types’ can easily be misinterpreted as fully beat, while they may also have a deictic quality. As explained, gesture types may serve as a starting point in the analysis, but a researcher should not forget the different dimensions of gestures.

Another factor that has been related to hand choice is content of speech. While Lavergne and Kimura (1987) argued that speech content has no effect on handedness. Kita, de Condappa, and Mohr (2007) drew a different conclusion. They found a higher right-hand preference in right-handers for concrete (e.g. *to rotate a desk around*) and abstract expressions (e.g. *a change of circumstances*), compared to metaphorical expressions (e.g. *to turn the tables*). Casasanto (2009, 2010) further specified the content of speech, and suggested that hand choice could be linked to emotional valence that speakers may attribute to the content of speech. Positive valence is associated with perceptuomotor fluency (Winkielman, Schwarz, Fazendeiro, & Reber, 2003). Casasanto (2009, 2010) asserted in his body-specificity hypothesis that “people with different bodily characters, who interact with their physical environment in systematically different ways, should form correspondingly different mental representations” (p. 351). He contended that right-handers and left-handers act differently in the world, since right-handers are fluent with their right hand, and left-handers with their left. He continued by saying that they both create different mental representations as right-handers implicitly associate positive assertions more strongly with the right and negative ideas with the left, which would be a reversed pattern for left-handers. Casasanto (2009, 2010) employed several paradigms to test his body-specificity hypothesis. The findings from his behavioural data and observational data supported his hypothesis. For his behavioural paradigm, right-handed and left-handed participants were asked to map abstract concepts, like *deceit* and *honesty*, onto a spatial location (i.e. left or right). Casasanto (2010) also used real life data. He examined the positive and negative assertions made by different right-handed and left-handed American presidential candidates in political debates.

I did an attempt to investigate Casasanto’s (2009, 2010) findings by means of a

cartoon retelling task, prior to examining the influence of the screen on hand choice. The link between handedness and valence in cartoon narratives was studied to test how participants link positive and negative associations to characters, their attributes, actions, and events. Such an analysis would also make clear whether Casasanto's (2009) body-specificity hypothesis is also applicable to cartoon retellings, where negative and positive valence are not polarised. Participants might attribute good qualities to evil characters, and bad characteristics to good characters, as well as to their actions, attributes, and events, which might complicate Casasanto's (2009) straightforward division between positive and negative valence. For the preliminary testing, I used a script-based methodology, as I thought that the screen would have an influence on hand choice, and therefore, would be a confounding factor. This methodology resulted in a very low gesture frequency. The length of the script might have been problematic. The script was not long enough to get speakers involved in the story, and some speakers tried too hard to remember everything, even though they were told detail did not matter. This might have impeded their gesture rate. It was decided to alter the approach of handedness and to investigate the link between the screen and hand choice, since there was rarely information to be found on this topic.

Many of the aforementioned researchers have studied the differences in handedness between right-handers and left-handers, while they do not discuss how participants differ in the use of their left hand and right hand. The left and right hand use within participants will not be left undiscussed in this study. Yet, before hand choice is examined in the analysis, the literature background will continue with a section on the cognitive link between speech and gesture.

### 2.3 The Cognitive Link between Gesture and Speech

As has become clear, gesture and speech are intricately linked to each other (McNeill, 1992; Cassell et al., 1999). The most well-known take on this speech-gesture relationship has been put forward by McNeill (1992). However, there are also other prominent views on the relationship between gesture and speech that describe the locus and the nature of the link differently.

The first view presupposed that gesture and speech work as two independent communication systems, but "any existing links between the two modes are the result of the cognitive and productive demands of speech expression" (e.g. Butterworth & Beattie, 1978; Levelt, Richardson, & La Heij, 1985; Hadar, 1989; Hadar, Wenkert-Olenik, Krauss, & Soroker, 1998) (Iverson & Thelen, 1999, p. 20). Gestures may support the speaker when, for

instance, laughing or coughing, temporally disrupts the speech production process. When speech is interrupted, feedback moves from speech to gesture, and not from gesture to speech. This feedback is unidirectional; gesture is unable to influence speech or any of its cognitive processes (Iverson & Thelen, 1999).

Other studies advocated for a bidirectional speech-gesture link with a limited scope (e.g. Rausher, Krauss, & Chen, 1996; Krauss, 1998; Krauss & Hadar, 1999). The link between gesture and speech can be pinpointed to a specific moment in the speech production process, which could be the phonological encoding stage (cf. Levelt, 1989), or the moment of lexical retrieval, also phrased as the Lexical Retrieval Hypothesis. This hypothesis posits that gestures are rooted in spatial imagery. Gestures activate “spatio-dynamic features”, after which conceptual information is activated (Iverson & Thelen, 1999, p. 20). Through cross-modal priming, the lexical retrieval from memory is facilitated. However, this reciprocal link is restricted in that gesture can only influence speech when the speaker encounters a difficulty in word retrieval (Iverson & Thelen, 1999). Also, the gesture production anticipates the formulation of the speech process entirely (Mol & Kita, 2012).

The leading viewpoint on this relationship comes from McNeill (1992). He believed that the two modalities constantly interact with each other. McNeill’s (1992) view aligns with those of Cassell et al. (1999), who stated that “since gesture and speech arise together from an underlying propositional representation that has both visual and linguistic aspects, the relationship between gesture and speech is essential to the production of meaning and its comprehension” (p. 3). Since speech and gesture form a single system of communication that arises out of one underlying thought process, both authors claimed that speech and gesture together form one tight cognitive unit. Furthermore, this tight cognitive bond is visible throughout the speech production process, “occurring at levels of discourse, syntax, and prosody” (Iverson & Thelen, 1999, p. 20). McNeill (1992), however, did not specify the individual contribution of each channel to this tight cognitive unit. He only alleged that gestures always contribute essential information, which is not necessarily encoded in speech. They are therefore “necessary to provide a complete insight into the scene the narrator has in mind” (Holler & Beattie, 2003, p. 110). Holler and Beattie (2003) disputed this view. They encoded the complexity of each semantic feature (e.g. identity, movement, body part) as well as its occurrence in speech, gesture, and both of them simultaneously. Their findings showed that the interaction between speech and gesture differs from feature to feature, with some features being represented in both speech and gesture. Unlike McNeill (1992) argued, they put forward that gestures may also add redundant information.

The Information Packaging Hypothesis, like McNeill (1992), posits that there is a reciprocal link between gesture and speech that helps to constitute thought. Instead of activating certain features, like the Lexical Retrieval Hypothesis puts forward, the Information Packaging Hypothesis states that gestures also structure spatio-motoric information into verbalizable units. The spatial or motoric properties of a referent are activated by gestures, which are then organised by these gestures into unit sequences for the speech production process (Mol & Kita, 2012). Kita and Özyürek's (2003) Interface Hypothesis follows a similar train of thought as the Information Packaging Hypothesis. Kita and Özyürek (2003) believed that spatio-motoric processes may influence the gesture and speech production processes. This hypothesis contributes to the understanding of the cognitive processes that underlie gesture and hand choice in our data, as it proposes that gestures originate from spatio-motoric information (of the stimulus video). The Interface Hypothesis will be discussed in more detail in the literature section later on.

Further evidence for McNeill's (1992) tight cognitive speech-gesture unit comes from experimental observations. McNeill (2005) demonstrated that speakers became more hesitant and slow in speech, whilst listening to their own delayed speech over earphones. Despite the hesitancy, gesture and speech remained in synchrony. Other disruptions in speech flow, like stuttering, also impeded gesture fluency. This indicates, as McNeill (2005) claimed, that speech and gesture form a strong cognitive bond. McNeill (2005) argued that observations of blind speakers who gesture while they speak are also evidence for this tight cognitive bond. While they communicated with some other person, blind speakers also gesticulated, even though they knew the recipient could not see. This was observed for blind speakers who became blind later on in life, as well as congenitally blind speakers. Cassell et al. (1999) also asserted that cross-channel migration might be a reason for why this bond is so strong. They demonstrated that information in gesture might be recalled later in speech, but not as gesture. They called this transfer from gesture to speech cross-channel migration. Kelly, Barr, Church, and Lynch (1999) showed that the relationship between speech and gesture is symmetrical, since semantic meaning can also be transferred from gesture to speech (qtd. in McNeill, 2005). These observations further contribute to the argument that the relationship between gesture and speech is reciprocal, and hence, that speech can influence gesture, and gesture can influence speech (McNeill, 2005).

This tight cognitive speech-gesture unit might be beneficial for the speaker. Gesticulation whilst speaking "frees up working memory" (Cartmill et al., 2012, p. 131). It lowers the cognitive cost of maintaining information in memory. For example, Goldin-

Meadow, Nusbaum, Kelly, and Wagner (2001) examined children's performance on a problem-solving task. In one condition, children were allowed to gesture during their explanations, whilst in the other condition they were told not to. After each explanation, children had to recall the remembered items. They found that children's recall was more accurate when they gestured during their explanation than when they did not. The same finding for adults was observed in Wagner, Nusbaum, and Goldin-Meadow (2004). Cartmill et al. (2012) further added that gestures provide "kinaesthetic and visual" (p. 131) information that allows the speaker to work through multiple solutions to a problem and "gather info about the alternatives through visual and motor feedback of their own gestures" (p. 131). Gestures may play a facilitatory role in conceptual planning as well (Krauss et al., 2000).

The strong cognitive speech-gesture unit also has mnemonic benefits. Hostetter and Alibali (2008) described mental representations as "mental imagery" (p. 499), which "retain the spatial, physical, and kinaesthetic properties of the events they represent" (p. 499). Properties of images can be visualised, like pictorial imagery. The more properties an image, or concept has, the easier it is to visualise it and the more strongly it is associated with verbal recall (Paivio, 1963, 1965). Paivio (1968) observed that the successfulness of verbal recall is dependent on how easy it is to recreate an image mentally, and it is not related to factors as the concreteness or meaningfulness of verbal associations (qtd. in Hostetter & Alibali, 2008). The memorisation of mental imagery has two benefits. First, images contribute an extra dimension to lexical retrieval as "highly imageable concepts can be recalled either by remembering their verbal labels or by remembering their visual images" (Begg, 1972, qtd. in Hostetter & Alibali, 2008, p. 499). Second, several concepts are incorporated into an image, which makes it easier to memorise concepts in relation to each other (Paivio, 1963, 1965). Gestures are much alike imagery. Multiple components (e.g. hand shape and path) are integrated into a single gesture, and like imagery, information is globally presented. This means that the gesture's semantic meaning is determined from the gesture as a whole. Thus, gestures maintain imagery-like properties that facilitate memorisation and lexical retrieval.

This section has explained that gestures are linked to speech in some way or another. There are different interpretations on how they may interact. The Interface Hypothesis has briefly been touched upon, but more detail will be provided in the subsequent section. This is followed by a detailed account on embodied cognition that provides a deeper understanding of the link between hand, mind, and the world.

### 2.3.1 Cognitive Model: The Interface Hypothesis

The Interface Hypothesis proposes that gestures originate from a spatio-motoric representation that is tailored for speaking. In Kita and Özyürek's (2003)'s words, "the interface representation between speaking and spatial thinking" (p. 5). Kita and Özyürek (2003) argued that gestures are determined by a language's linguistic encoding possibilities, and the spatio-motoric properties from the stimulus video that are never formulated verbally. They stated that spatio-motoric processes interact online with the speech production processes. The Interface Hypothesis is shown in figure 2.

Kita and Özyürek (2003) modified Levelt's (1989) speech-gesture model. In their model, Levelt's (1989) Conceptualiser, which provides input for the linguistic formulation procedure, consists of two parts: the Communication Planner and the Message Generator. The Communication Planner roughly determines when and what should be communicated, and in which modalities. It generates a "communicative intention" (Kita & Özyürek's, 2003, p. 34). This information is passed on to the Action and Message Generator. The Action Generator then selects spatio-motoric information from working memory and makes a plan for gesticulation. The content in memory is of imagistic nature, and therefore, may influence gesture, but is not mentioned in speech. The spatio-motoric representation, as generated by the Action Generator, is turned into a propositional format and sent to the Message Generator. This linguistic proposition is made ready for its verbalisation in speech. The link between the Action and Message Generator is bidirectional. The proposition, formulated by the Message Generator, is also returned to the Action Generator. The two Generators also exchange information about what has to be presented in gesture and what in speech. The Action Generator has some autonomy in to what information to select from the Message Generator.

The Message Generator is also continuously receiving feedback from the Formulator. The Formulator informs the Message Generator whether the message fits into a "processing unit" (Kita and Özyürek's, 2003, p. 7). This exchange is also bidirectional. Evidence from Kita and Özyürek's (2003) cross-linguistic study on Turkish, English, and Japanese demonstrated that the information expressed in speech and gesture is constrained by this unit. This means that some languages are only able to encode one property into a unit, while other languages may express more. For example, a verb-framed language, like Turkish, needs to encode manner and trajectory into two sentences. Thus, the English intransitive verb *rolls down the hill* is encoded in Turkish as *descends the slope, as s/he rolls*. It is therefore highly likely that these two properties are also presented in two separate gestures. Satellite-framed

languages, on the other hand, express manner and trajectory into a single gesture and one syntactic unit. As explained, this model hypothesises that gestures are also shaped by the spatio-motoric information that is displayed on screen, but not formulated verbally. More information about spatio-motoric properties, including manner and trajectory, will be given later on. The reciprocal link between the Action Generator and Message Generator, as well as between the Message Generator and Formulator, contributes a clarification to why McNeill's (1992) speech-gesture bond is so tight.

The cognitive link between speech and gesture has been explained. McNeill (1992) has argued for a close bond between the two modalities, where speech can influence gesture, and gesture can influence speech. A link is now made to gesture, thought, and experiences.

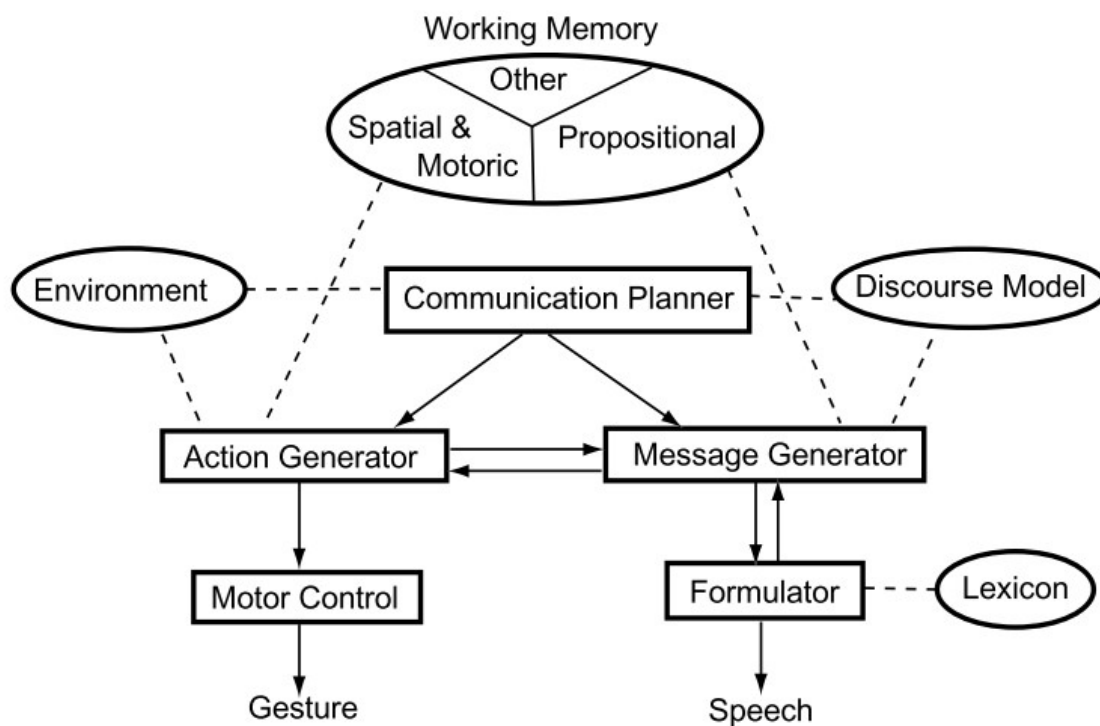


Figure 2. The Interface Hypothesis

## 2.4 The Theory of Embodied Cognition

Embodied cognitivists reckon the body and mind to be one integrated system. As Iverson and Thelen (1999) clarified, “cognition depends crucially on having a body with particular perceptual and motor capabilities and the types of experiences that such a body affords” (p. 19). Perception, action, and bodily experiences are therefore crucial to the understanding of how the mind works. Mental representations of certain referents or events grow out of past bodily experiences, when the speaker interacted or perceived the object or action in the real world (Iverson & Thelen, 1999; Beilock & Holt, 2007; Cartmill et al., 2012). For example, it was found that skilled typists had a preference for pairs of letters for which the typist used different fingers on different hands (e.g. letters *f* and *j*). They already had experience with typing and reckoned this letter combination was easier to type. Novice typists, on the other hand, did not have such a preference. Both groups could not explain the differences between the letter pairs, suggesting that affective judgements are unconsciously based on past motor experiences of how easy or hard it was to type the letter combination for skilled typists (Casasanto, 2009; Cartmill et al., 2012). The mind is intricately linked to the body and the world (Iverson & Thelen, 1999).

Gestures are deemed to be an “outgrowth” of simulated actions reflecting past motor experiences (Goldin-Meadow & Beilock, 2010, p. 669). Cooks and Tanenhaus (2009) demonstrated that gestures represent real-world actions. In their study, two groups of adults were asked to solve the Tower of Hanoi puzzle. The first group solved the puzzle with real objects, which had to be physically moved; the other group did the same task on the computer. After the problem-solving task, the adults were asked to explain how they solved the puzzle to a recipient. Gestures and speech were examined during these explanations. Cooks and Tanenhaus (2009) found no differences between the two groups in the amount of words they used, nor in the number of gestures per word. Differences, however, were observed in gestures. The first group using real objects presented more gestures with grasping hand shapes and their gestures consisted of more curved trajectories than the computer group. The second group produced gestures that reflected the horizontal path of the computer mouse. Their gestures tended to simulate the “kinematic object and outcome details from the motor plan they had used to move the disks” (Goldin-Meadow & Beilock, 2010, p. 669). During these explanations, participants generated a mental image of what they had seen and activated a motor plan. Support for this motor plan comes from the domain of sentence comprehension. It has been observed that participants “are slower to respond when required to produce an



action that is incompatible with a motion implied by the meaning of a sentence (e.g. a motion of the arm away from the body would be incompatible with *Sarah opened the drawer*)” (Parrill, 2010, p. 654). Motor plans are automatically triggered during sentence comprehension, when the sentence involves a motion (Parrill, 2010). Thus, gestures reflect motor experiences of the real world.

Furthermore, gestures are more solidly embedded in thought than real-life actions. Unlike actions, gestures are representational. This means that they do not directly affect the real world, since, for example, the gesture of a twisting motion does not actually open a lid. They are not able to offload some of the energy of an action onto the environment, while actions are acted on the physical world (Cartmill et al., 2012). As speakers cannot “rely on affordances of the object to direct their gestures, they must instead create a rich internal representation of the object and the sensorimotor properties required to act on it” (Goldin-Meadow & Beilock, 2010, p. 670). This suggests that when speakers gesticulate, they must build entirely upon the mental sensorimotor representations of the object or actions they want to represent. Gestures may therefore reinforce the link between action and thought. This is also implied by McNeill (1992) who argued that gestures can affect thought.

The fact that gestures can affect thought might also be explained when their developmental origins are under scrutiny. Iverson and Thelen (1999) have sought to clarify McNeill’s (1992) tight cognitive link between speech and gesture. They argued that this link is established in “early hand-mouth linkages” (p. 20), which is the moment when the child starts his intensive word learning period. During this period, the child repeats the meaningful words over and over again, while simultaneously activating gestures sufficiently in order to form “synchronous couplings” (p. 20). The two channels become entrained and remembered as an ensemble early on in life. Iverson and Thelen (1999) speculated that the tight temporal bond, emergent so early in life, makes speech and gesture unbreakable. When speech and gesture couple simultaneously, “the stroke, or active phase, of the gesture is timed precisely with the word or phrase it accompanies” (p. 35). Furthermore, they believed that the semantic and communicative burden speech and gesture both carry is a reason for why this speech-gesture unit is so strong. Damage to other motor activities, such as walking, do also not disrupt the tight timing between them, which makes the speech-gesture unit an integrated system distinct from other motor systems (Iverson & Thelen, 1999).

Bodily experiences are deemed to be integral to cognition. Gestures are grown out of these physical experiences, which reveal something about our thoughts and language. The next section considers trajectory, manner, and viewpoint in detail. These motion properties

can be explained in light of the participant's perception of certain events, characters, and actions in the stimulus video.

## 2.5 The Representation of Trajectory, Manner, and Viewpoint

The encoding of motion events that are co-expressed in gesture has been explored across languages in order to find cross-linguistic differences. All cartoon narratives are built up out of motion events, such as *Sylvester jumping up and down*. The way languages parse motion events may differ. Talmy (1995) distinguished five components in which motion events can be separated: “the fact of motion itself, the moving object (figure), the element relative to which motion occurs (ground), the trajectory of motion (path), and how the motion was carried out, typically referring to any internal structure of the motion (manner)” (qtd. in Parrill, 2011, p. 63). Languages may describe both path and manner of motion, or only express one of those. Talmy (1995) came up with a typology of how languages may encode path. The encoding of path in a satellite would classify the language as satellite-framed. Dutch and English are satellite-framed languages. Their verbs conflate both path and manner of motion (e.g. English: *roll*, *waddle*; Dutch: *waggelen*). The path may also be encoded in particles (e.g. English: *go out*; Dutch: *uit-gaan*). The other type of languages is known to be verb-framed. In Spanish, only path is shown in the verb, for example *entrar* (English: *enter*), while the manner of motion, if it is encoded at all, is encoded in a separate phrase (qtd. in Parrill, 2011). Gestures of different languages may thus encode these motion event components differently.

The gestures that encode path, also referred to as trajectory, have a “translational component that semantically maps onto a trajectory in the event being described” (Parrill, 2011, p. 63). However, the event being described in speech does not always show a trajectory, or a direction of path, like in *Tweety walked there*, suggesting that the spatial details are not consequential for the plot line. Gestures may express such components, since because of their imagistic nature “certain features of the event, such as the direction of the motion, have to be specified regardless of their significance in the discourse” (Kita & Özyürek, 2003, p. 11). The speaker has shaped its mental representation of the stimulus event based on what he has seen in the video, which includes the direction of the trajectory.

Gestures can also show the manner in which an action is executed, even if this information is not conveyed verbally (Cassell et al., 1999). Unlike path of motion, manner of motion contains a secondary component to trajectory. Its internal structure typically shows a repeated action. To illustrate this, the verb *rolls down the hill* has next to its downward

trajectory also a secondary component: a rotation. The rotation component may be presented separately from the downward component, or they may be combined into a single gesture. Parrill (2011) asserted that manner can also consist of agitation, which is “a more generic form of iterated motion of the narrator’s hands and arms” (p. 64). A speaker might use wiggling fingers to depict *rolls down the hill*, while simultaneously portraying a downward path with the same hand. The wiggling motion does not entirely correspond to the rotational component of *roll*. It lacks “semantic precision” (Parrill, 2011, p. 64), and is thus, semantically underspecified.

Motion events can be expressed from different viewpoints. The speaker can narrate the story from a certain perspective. Parrill (2011) claimed that viewpoint is “the experiencer’s consciousness from which a narrator is representing an event” (p. 62). This definition might not be entirely appropriate as speakers are not aware of the fact that they are putting themselves in a certain storyteller role. Parrill (2011), nonetheless, believed that this definition captures the physical manifestation of gestures of a “conceptual point of view” (p. 62). McNeill’s (2005) characterisation of the two viewpoints might be more suitable to illustrate this physical manifestation. He suggested that speakers can adopt a character viewpoint (cvpt), observer viewpoint (ovpt), or dual viewpoint (dvpt). From a character viewpoint, or first-person perspective, the narrator’s hands and body map onto those of the character as if the narrator is portraying the actions of the character himself. The observer viewpoint, or third-person perspective, on the other hand, is viewed from a distance, whereby the speaker portrays the action of the character in the gesture space in front of him, or depict an object or path (Parrill, 2011). McNeill (2005) also contended that gestures can be a combination of two viewpoints, referred to as dual viewpoint. The speaker might portray a scene from an observer as well as character viewpoint. He provided the example of Sylvester propelling himself upwards on a catapult, grabbing Tweety in his hand, and then falling back to earth, while still holding Tweety. Sylvester’s grasping hand is depicted from character viewpoint, whereas the trajectory downwards is viewed from an outside perspective (ovpt). Other combinations of dual viewpoints are also possible, such as two character viewpoints, or two observer viewpoints. Such examples will be provided by the data in the analysis section.

Cartmill et al. (2012) believed that gestures from a character viewpoint are more complex than observer viewpoint gestures. For character viewpoint gestures, the speaker has to make a mental representation of an imaginary object and event, but also simulate the perspective of the character at the same time. Simulating objects in actions is a cognitively complex process, since the speakers is simulating the action itself (e.g. the hammering), and

the object involved in the action (e.g. the hammer). The speaker could imagine an object, or use a body part instead to represent the object in action. Moreover, the motion of action involves movement which adds another level of complexity to the simulation. Cartmill et al. (2012) further argued that when speakers present imaginary objects, the objects are more closely related to real-world actions and “require the gesturer to have a strong mental representation of the tool or object involved in the action because there is no physical placeholder standing in for the tool” (p. 133). This suggests that character viewpoint gestures have a more detailed mental representation than observer viewpoint gestures (Beattie & Shovelton, 2002). Hostetter and Alibali (2008), like Cartmill et al. (2012), asserted that when narrators simulate motor actions, they adopt gestures from a character viewpoint. Furthermore, they allege that observer viewpoint gestures are based on the simulation of visual imagery, involving the perception of some object. They thus propose a clear distinction between visual and motor imagery. Parrill (2010) disputed this view. He believed that visual and motor imagery cannot be entirely separated, since visual imagery involves “transduction” (p. 656). A prior motor action is ‘transferred’ into a visual experience. He continued that dual viewpoint gestures are a good example of this transduction as they contain both imagistic and motoric features of a mental representation.

While Parrill (2011) posited that character and observer viewpoints correlate with features of path and manner expressed in gesture, Tversky and colleagues (1996, 1999, 2000) and McNeill (1992) argued otherwise. Tversky (1996) observed that speakers would take a first person perspective when depicting spaces with a single dimension, while an observer viewpoint was adopted when the space described varied in scale (qtd. in Parrill, 2011). However, their methodology consisted of route descriptions. It is unknown whether these results also apply to narratives. McNeill (1992) believed that gestural viewpoint interacts with transitivity of the accompanied speech. Transitive sentences, like *Sylvester grabs Tweety*, would take on a character viewpoint, whereas intransitive sentences, like *Sylvester ran*, would be viewed from an observer viewpoint perspective. Furthermore, he suggested that the centrality of the event itself may be a determining factor. The more central the event, the more likely it is the speaker would adopt a character viewpoint. Parrill (2011), however, did not agree with McNeill (1992) on transitivity being one of the determining factors. He argued that event structure interacts with viewpoint in gesture. As explained, a phrase like *Sylvester climbed up the ladder*, may be portrayed from a character, or observer viewpoint. If the speaker decides to take Sylvester’s point of view, where the hands would portray the iterative action of the character’s hands, manner of motion would be correlated with character

viewpoint. On the other hand, if the speaker takes on an outsider perspective, it would be more likely that an upward trajectory is presented in gesture. Then path is correlated with observer viewpoint. Parrill (2011) advocated for a link between motion event features and gestural viewpoint.

McCullough (1993) and Kita and Özyürek (2003) demonstrated that “regardless of the trajectory shapes and the language types, (...) gestures regularly encode the directional information in the (...) event that is never verbalised” (p. 17). It can be inferred that hand choice might be influenced by the direction of the trajectory of the stimulus event. This means, as Lausberg and Kita (2003) argued, that the left hand is used for a direction towards the left, and when the movement is directed towards the right, the right hand is presented. Nothing is known yet about whether there are other motion properties that could influence hand choice, such as viewpoint, or manner. Although Kita and Özyürek (2003) showed that the direction can be reflected in gesture, they observed that gestures only *regularly* encoded directionality, which indicates that gestures *not always* encoded directionality. Therefore, this study investigated when directionality is encoded in gesture, and also when directionality is left out. This has led to the following research questions: how is spatio-motoric information of the stimulus video represented in gesture? Which hands are used to depict the video’s motion properties? And furthermore, why do the hands depict these spatial features in this way? The latter question tried to clarify the cognitive processes that play a role in how mental imagery generates gestures, and will be linked to Kita and Özyürek (2003)’s Interface Hypothesis. I hypothesised that the screen influences the spatial location and trajectory of the hand(s) of observer viewpoint gestures of locomotion of animate characters. This is in line with Lausberg and Kita (2003). However, I also reckoned that this hypothesis has ‘exceptions’, which will be explored in the analysis. This is what can be implied from Kita and Özyürek (2003). Such an analysis will provide a further understanding into the cognitive processes that underlie gesture and speech, and the cognitive alterations that may take place, if any differences between the screen and hand use can be detected.

This section has provided an overview of a wealth of different background literature. All kinds of factors have been shown to correlate with handedness. Some are highly disputed, such as language lateralisation and gesture categories. Many researchers that investigated these factors have discussed the handedness patterns between right-handers and left-handers, while hardly any information is given on the left hand and right hand use within a participant. This study explores these intra-participant differences as well. It has also been established that speech and gesture form a tight cognitive bond. They can affect each other, as Kita and

Özyürek (2003) have explained in detail in their Interface Hypothesis. Furthermore, embodied cognition has deemed gestures to be an outgrowth of bodily experiences, which may affect thought and give rise to language. A prior visual experience of spatio-motoric information on trajectory and manner (and viewpoint) might be reflected in gesture. Trajectory has also shown to influence hand choice, as Lausberg and Kita (2003) have explained. A further detailed analysis of hand choice is given in the analysis section. The methodology will make clear which procedures were undertaken for this analysis.

### 3. Methodology

This section outlines the experimental procedures that have been undertaken to analyse the data and makes clear to what extent the hypothesis that the screen may have an influence on the spatial location and trajectory of the hand(s) of observer viewpoint gestures of locomotion of animate characters holds.

#### 3.1 Stimulus

The stimulus was a cartoon video titled *Home Tweet Home*, which was taken from the website dailymotion.com. The story revolved around Sylvester who undertook a number of vain attempts to catch Tweety. The stimulus was about six minutes long and participants were asked to watch the video twice, without any pausing in between to ensure that participants were in the same condition. They were given the opportunity to take notes and reread the notes after watching the video. This opportunity was given due to the length of the video. The video was presented on a laptop.

#### 3.2 Participants

Five native speakers of Dutch and two non-native speakers of English participated in the experiment. Six were female and one male. Participants were recruited among friends and family members, except for the two non-native speakers. They were taken from Dr. Geenen's data as there was not enough time left to recruit many new participants due to the first failed experiment on handedness and valence. For the non-native speakers, the prerequisite for participation was that they were highly proficient in English, which would be at least C1.

#### 3.3 Procedure

Participants were instructed to watch the cartoon video twice and recount the story they had watched to a recipient. Gestures were not mentioned in the instruction. The experimenter informed the participants that it did not matter if they forgot about detail or the sequence of events. The previous experiment on handedness and valence had pointed out that when participants retold what they had read as accurately and detailed as possible, they tended to have very low gesture frequency. After watching the stimulus video, participants told their story to either the experimenter, or a recipient, who had no knowledge of the story. Participants who told their narrative to the experimenter were tricked into believing that the experimenter had not seen the stimulus video beforehand. They were told that the

experimenter had to test new stimulus video material. The other participants, who recounted the story to a recipient, were informed that the recipient would answer some questions about their story afterwards. This was to enhance the communicative value. Recipients were not given a specific instruction except that they should listen to the story. Participants were recorded on video, and transcriptions of the video were categorised according to McNeill (1992).

### 3.4 Data Collection

After the narrative retellings had been transcribed, and, if needed, translated to English, the data were subjected to an analysis. First, each gesture was linked to its co-expressive linguistic segments. After this step, the different hands, which presented the gesture, were considered: the left, right, or both hand(s). As a starting point of the analysis, gesture categories were taken into account: metaphoric, deictic, iconic, and beats. It was thought that the spatial location of an entity, for example, would be referred to with a deictic gesture. The categorisation was flexible and took into consideration McNeill's (1992) argument on gestural dimensions. These categories, thus, were not the explicit focus of the analysis, but were analysed to facilitate the data analysis process.

The motion properties of the event were then considered. Gestures were analysed according to their viewpoint. They could be narrated from character (cvpt), observer (ovpt), or dual (dvpt) viewpoint. Parrill (2011) contended that observer viewpoint gestures tend to correlate with trajectory, and manner with character viewpoint gestures. This was followed by studying the trajectory, location, and manner of the hands, if they depicted any. These observations were then linked to the stimulus event, and they were analysed according to whether their depiction by the hands, or rather hand choice, would correspond to how they are represented in the stimulus video. This means, for instance, that the left hand would map onto the location of a character on the left side of the screen, or a protagonist's trajectory from left to right. It was also studied whether manner would be portrayed the same way as in the animation video. Then, the results were linked to Lausberg and Kita (2003).

The last step in the data analysis was to fragment the video recordings into clip stills, which showed the gesture, and hand(s), with their concurrent speech. Hand choice was compared inter- and intra-participant to discover any handedness patterns and to determine what influences hand choice.



### 3.5 Ethical Considerations

To ensure anonymity, participants were assigned numbers. No further information was asked from them other than their native language. The information was solely used for the present research only. Before the experiment took place, participants had agreed upon being recorded. Some measures were taken to also anonymise the clip stills at participants' request.

## 4. Results and Analysis

When handedness, gesture, and speech were examined in relation to each other and to the stimulus events in the cartoon video, several patterns in handedness emerged. These patterns show inter-participant and intra-participant differences and similarities. This section will discuss these patterns and support for them will be given by the data samples of the participants in order to investigate the hypothesis. The hypothesis entails that the screen has an effect on the spatial location and trajectory of the hand(s) of observer viewpoint gestures of locomotion of animate characters. The patterns will make clear when the left, right, and both hands are used. To note, the abbreviation P6-79, for instance, refers to participant 6 and gesture 79.

### 4.1 The Screen Influence on the Trajectory and Location of the Hands

Gestures tend to encode an animate character's on-screen trajectory and spatial location. Trajectory can be further divided into horizontal and vertical movements, which have similarities as well as differences in how participants use their hands.

#### 4.1.1 Horizontal Trajectory

The hands may portray horizontal movements similar to the character's motion on screen. The data show that horizontal trajectories of animate characters from the left side of the screen to the right tend to be made with the left hand from observer viewpoint. Characters moving horizontally from the right side to the left in the video are likely to involve the right hand. This handedness pattern aligns with Lausberg and Kita's (2003) results on geometrical objects. Samples from the data provide evidence for this pattern:

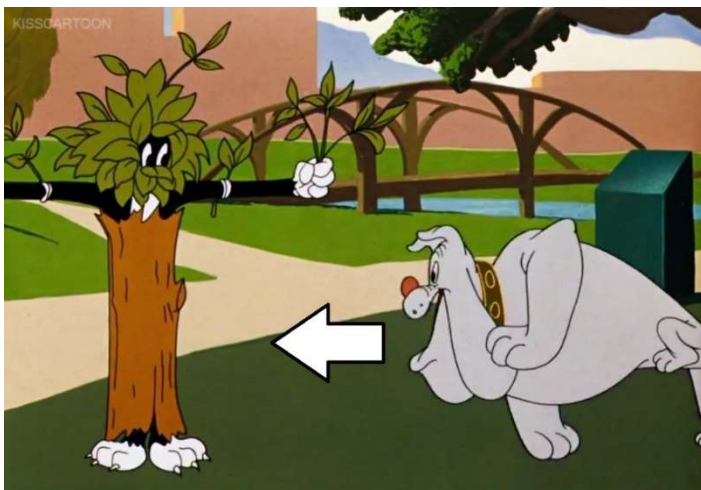


Figure 3. The dog approaches the tree from the right.



Figure 4. P6-79 (ENG): *the dog came*.



Figure 5. Sylvester hopping to the right.



Figure 6. P2-1 (NED): *En Sylvester (die kwam naar hem toe).*  
(ENG): *And Sylvester (came to Tweety).*

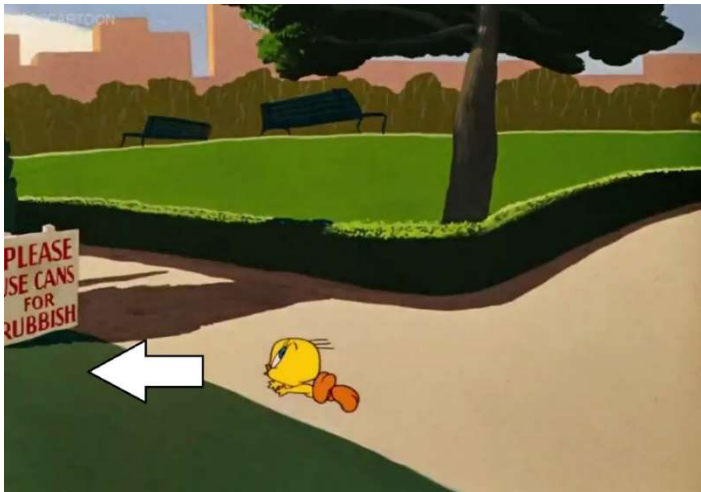


Figure 7. Tweety running to the left while fleeing from Sylvester.



Figure 8. P4-98 (NED): *En Tweety die rent weer weg.*  
(ENG): *And Tweety runs away again.*

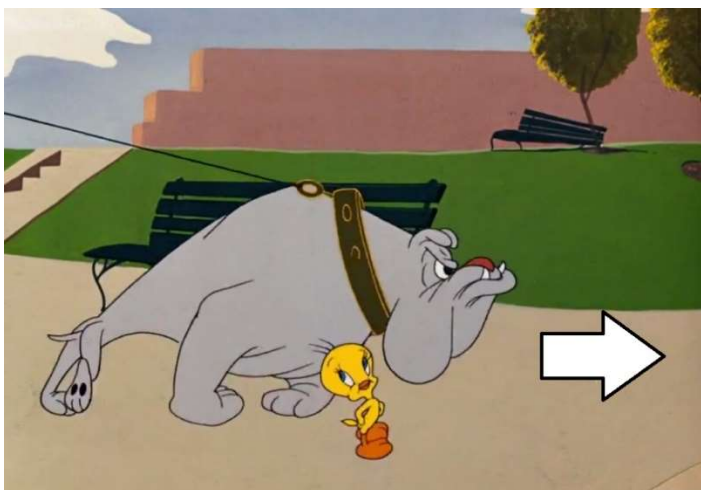


Figure 9. Tweety together with the dog walks to the right.



Figure 10. P7-52 (ENG): *the bird is like following the dog.*

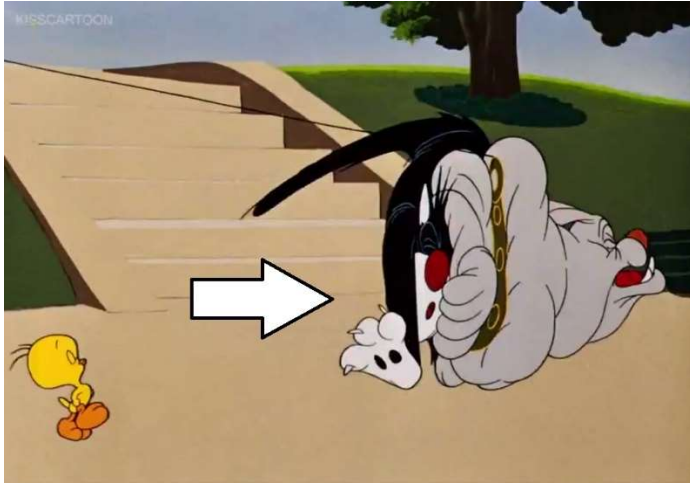


Figure 11. Sylvester bumps into the dog to the right.



Figure 12. P3-27 (NED): *(Maar die poes schiet in die riem van) die hond.*  
(ENG): *(but the cat shoots into the collar of) that dog.*

Participant 6 first points her right index finger to the right outward space, after which it makes a swinging pointing gesture to the left (figure 4). Participant 2 performs the same sort of movement, but uses her whole hand instead (figure 6). She portrays Sylvester's hopping movement from left to right (figure 5). However, Sylvester's manner is not resembled in her gesture. Her swinging motion might suggest that Sylvester swings one time from left to right, instead of making several hops to the right. The movement made by participant 4, on the other hand, involves a greater distance and takes up more gesture space, compared to participant 2 (figure 8). His right hand moves to the left, which corresponds to the direction Tweety is running to. In figure 9, two entities are illustrated that walk to the right. Participant 7 uses his index fingers in such a way that each finger resembles an entity that moves to the right (figure 10). The fingers are close to each other indicating that the distance between Tweety and Sylvester is small. She also depicts the manner of the walking by making little 'steps' with her fingers. In figure 12, participant 3 makes a pointing movement to the right, which matches Sylvester's rightward trajectory. She only depicts Sylvester's movement in her gesture and not the bulldog, but she mentions both verbally.

The binary mapping between hand and screen position, as Lausberg and Kita (2003) suggests, does not always occur. There is some variation in the handedness data. Participants may also use two hands to make one movement. In figure 14, participant 6 points her hands to the leftward space, where Tweety is located, and then both her hands move to the right space, but her right hand moves in a hopping manner, which bears some correspondence to Tweety's



jumping manner in the video. Only Tweety jumps one time in the video. Her left hand does not specify the manner, and at the end of the movement points a bit further to the right, indicating the woman's position. Both hands are used to present Tweety's movement, whereby only one hand specifies Tweety's manner.



Figure 13. Tweety jumps onto the woman's lap to the right.



Figure 14. P6-16a+b (ENG): *So Tweety went to the woman.*



Participants are inclined to use the verbs *komen* and *gaan* which only encode path, but not manner. Their gestures tend to leave out the manner component, but only portray a trajectory with a similar direction that is seen in the stimulus event. Trajectory gestures, as described in figure 3-12, are usually made with only one hand. Trajectories, nonetheless, may also involve a transfer from one hand to the other. Yet, these transfers occur seldomly.



Figure 15. P2-38 (NED): *En toen liepen ze.*  
(ENG): *And then Tweety and the bulldog walked.*



Figure 16. P2-39 (NED): *Samen.*  
(ENG): *Together.*



Figure 17. P2-41 (NED): *Bleef ie met hun meelopen.*  
(ENG): *And Sylvester walked with them.*

Figure 15 to 17 demonstrate a transfer from the left to the right hand. Participant 2 first bends her thumb and index finger to each other. The space in between her two fingers represents an entity. The metaphoric gesture in figure 16 indicates that Tweety and the bulldog are walking together and the entity framed in figure 15 actually contains two entities. In figure 10, participant 7 resembles Tweety and the bulldog each with one index finger. There is variation in how two (or more) characters are represented: participants can take up a certain amount of gesture space, or use their fingers, or hand(s) to depict a character. McNeill and Pedelty (1995) call the space (in between the hands) that represents entities a “referential regime” (p. 3). The stimulus video shows that Tweety walks together with the dog from the left side of the screen to the right. The left hand of participant 2 hops in small steps to the right, like the fingers of participant 7. The hopping manner represents the walking. This gesture suddenly stops in figure 16, but is continued by the right hand in the same manner. The space in between the hands has seemed to increase to also include Sylvester, who has ‘joined’ Tweety and the bulldog in their walk to the right. The hands may depict entities differently, through gesture space, or the hands and fingers, and furthermore, the hands may cooperate to depict a translocational motion from one side of the screen to the other.

The hands also depict the camera’s horizontal portrayal of the scene, suggesting that the camera movement may also affect the trajectory of the hands. The stimulus video first shows Tweety bathing in a bird’s fountain. The camera zooms in on Tweety, after which it zooms out, and moves to the left (figure 17). Then, from right to left, three men appear sitting on a bench and the camera stops when Sylvester is shown as the last character on the bench.

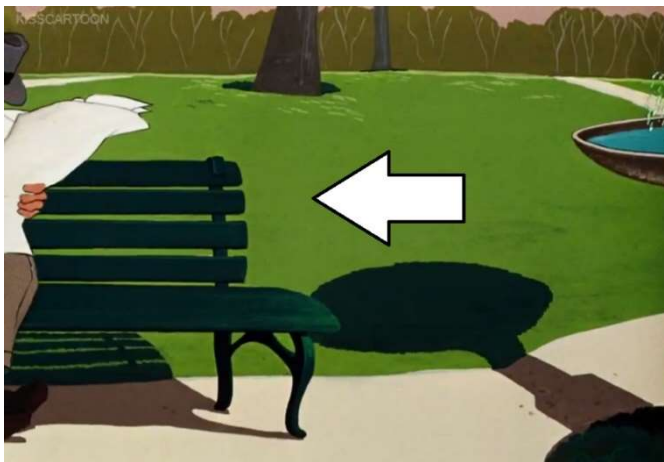


Figure 18. Camera movement from left to right.



Figure 19. P1-4 (NED): *Naast het badje is een bankje.*  
(ENG): *Next to the fountain is a bench.*



Figure 20. P4-9 (NED): *Vervolgens gaat het shot naar een bankje.*  
(ENG): *Then the camera moves to the bench.*



Figure 21. P4-10 (NED): *En dan zit er een man.*  
(ENG): *And then there's a man.*



Figure 22. P4-11 (NED): *En dan zie je nog een man zitten.*  
(ENG): *And then you see another man.*



Figure 23. P4-12 (NED): *En nog een man zitten.*  
(ENG): *And another man.*



Figure 24. P4-13 (NED): *En dan zie je Sylvester zitten.*  
(ENG): *And then you see Sylvester*

Two out of seven participants have incorporated the camera movement in their gestures. Participant 1 uses her right hand to locate both the bird's fountain (on the right side of the screen) and the bench (on the left) (figure 19). Her right hand swings twice from right to left, while it remains in the same position. The first time it swings she locates the object *badje* and the second time she mentions *bankje*. No swinging movement is apparent when the hands of participant 4 are considered that portray the same scene. His hands do also not remain in the same position, but start in the centre space and then move in one motion to the left (figure 20-24). Participant 4 takes up more gesture space than participant 1, who makes two small hand movements. However, both participants portray a trajectory from right to left that corresponds to the movement of the camera. Furthermore, both are framing an entity. Participant 1



identifies two entities, i.e. *badje* and *bankje*, with one hand. Participant 4, on the other hand, uses both his hands to ‘hold’ one invisible object. From the word *shot* in his verbal expression, it can be inferred that he is ‘holding’ a camera. The camera is not physically present on screen, and thus, the gesture involves a metaphoric component. Participant 4 continues his movement further towards the left of him. His gesture contains a beat every time he identifies a man separately and then finally Sylvester. Those beats can also be interpreted as a character frame, that is, each character sitting on the bench. These examples have shown that when participants spatially organise inanimate objects and animate characters, their hands may follow the camera trajectory.

#### 4.1.2 Vertical Trajectory

Similar to horizontal trajectories, gestures that encode vertical movements correspond to their trajectories of the stimulus animation. Whereas horizontal path from observer viewpoint tends to be binary mapped onto a particular hand, no such pattern can be detected for vertical trajectories. The participants differ greatly individually in hand choice. This means that the screen only has an effect on the portrayal of the vertical path, but not on *which* hand is used. Examples from the data set are provided to illustrate how participants differ in handedness:



Figure 25. P1-56 (NED): *Dan zie je zo die kat opstijgen.*  
(ENG): *Then you see the cat rising up.*



Figure 26. P1-57 (NED): *Zo'n grote kauwgombal.*  
(ENG): *A big balloon like this.*



Figure 27. P1-58 (NED): *Tweety prikt dan zo die bel lek.*  
(ENG): *Tweety pricks the balloon.*



Figure 28. P1-59 (NED): *En dan valt die kat zo naar beneden.*  
(ENG): *And the cat falls down like this.*

Participant 1 presents Sylvester's up- and downward trajectory with her dominant hand. In figure 25, her right hand makes a rising movement from observer perspective. The shape of



her hand indicates that Sylvester is represented by the space in between her thumb and the other fingers. The balloon which Sylvester is holding onto is getting higher and higher. The iconic gesture in figure 26 shows the balloon. The fingers of her hand are bent to form a balloon. They iconically mark the shape of the balloon, and open to demonstrate that the balloon is getting bigger and bigger. This gesture shows a description of an inanimate object. The right hand is again preferred in the gesture that follows, where she makes a pricking motion to the front gesture space. This gesture is portrayed from Tweety's character viewpoint. The gesture in figure 28 presents a falling motion from observer viewpoint. As can be seen, these four gestures are made with the right hand, which are part of one gesture unit (McNeill, 2005). In between the four successive gestures, the hand does not return to its resting position on the legs. Furthermore, the right hand may demonstrate different viewpoints from different characters within one interval. Participant 3 and 5, like participant 1, demonstrate a similar dominant hand pattern (Note: I asked these participants about their dominant hand. However, I did not ask any other participants about their hand dominance, as Dr. Geenen informed me afterwards that it did not matter for the experiment).

The successive rests of the limbs may play a role in determining hand choice. The handedness pattern for participant 2 has been outlined. The three figures illustrated below are just several examples of many where the participant alters her hand preference:



Figure 29. P2-61 (NED): *Kwam die omhoog.*  
(ENG): *Sylvester went upwards*



Figure 30. P2-62 (NED): *Tweety gaf een aambeeld aan Sylvester.*  
(ENG): *Tweety gave Sylvester an anvil.*



Figure 31. P2-63 (NED): *Dus dan val je wel naar beneden.*  
(ENG): *so yeah then you will fall down.*

To characterise Sylvester's upward movement, participant 2 swings her right hand upwards. Then, her hand returns to its resting position on her leg. Her right hand remains in its resting phase, while her left hand is held up in a folded manner. A different scene is portrayed here,

and the viewpoint has altered from observer to character perspective. The video shows that Tweety is giving Sylvester an anvil. She continues to use her left hand in the gesture that follows (figure 31). The switch from right to left hand might be to introduce a new story element into the scene, or to switch from observer to character viewpoint. Her data show that her hand choice fluctuates considerably. Sometimes Sylvester's vertical trajectory is portrayed with the right hand, while at other times with the left.

Compared to participant 2, participant 4 is more consistent in his hand use. Vertical trajectories that involve Sylvester are always made with bimanual gestures. The following examples demonstrate his handedness pattern for vertical trajectories:



Figure 32. P4-133 (NED): *Die blaast een hele grote bel met die bubblegum.*  
(ENG): *Sylvester blows a very big balloon with the bubblegum.*



Figure 33. P4-134 (NED): *En die vliegt zo omhoog.*  
(ENG): *And Sylvester rises up like this.*



Figure 34. P4-132 (NED): *En dan valt Sylvester naar beneden.*  
(ENG): *And Sylvester falls.*



Figure 35. P4-139 (NED): *Vliegt hij vervolgens pijlsnel de lucht in.*  
(ENG): *And Sylvester rises up very quickly.*



Figure 36. P4-151 (NED): *Tweety vliegt weer omlaag.*  
(ENG): *Tweety goes down again.*

This stimulus event revolves around Sylvester rising upwards with the help of a balloon. He first blows up this balloon, which is represented by figure 32. The hands rise above the head and move further and further apart, indicating the balloon getting bigger and bigger. The preceding gesture has the same anatomy, but now the hands illustrate an upward trajectory, still from observer viewpoint (figure 33). The hand shape of this gesture has thus been affected by a previous gesture. Throughout the portrayal of the scene, where Sylvester makes several up- and downward movements, Sylvester is persistently characterised by the use of two hands. There is one exception to this in figure 35. At first, it seems as if the right hand encloses an entity. The verb phrase clarifies it portrays a rocket, as Sylvester's movement is 'as fast as lightning'. Thus, the hand shape has taken shape of an arrow, and not Sylvester. Also, only one left hand gesture is apparent during the depiction of this scene. The left hand portrays the Tweety's downward movement. Compared to this gesture, Sylvester's downward movements form a contrast in hand preference to Tweety's as vertical trajectories of Sylvester are made with two hands. This would suggest that participant 4 depicts trajectories from different characters in different ways with different hands.

Trajectories do not always consist of a physical gesture movement. Variation exists among participants, for example, in how they represent the concept of *up* and *down*, although many participants depict a movement that matches the screen motion. Participants may also use deictic gestures. Participant 2 slightly bends her finger and points upwards (figure 37). Metaphoricity may be included in a gesture, like in figure 38, where both thumb and pink point upwards. Participant 5, on the other hand, opens her right hand and her fingers point upwards. To represent a downward path, she turns her hand palm one hundred and eighty degrees.



Figure 37. P2-56 (NED):  
*Vloog ook omhoog.*  
(ENG): *He also flew up.*



Figure 38. P2-60 (NED):  
*Omhoog.*  
(ENG): *Up.*



Figure 39. P5-66 (NED):  
*En ging weer naar boven toe.*  
(ENG): *And he went up again.*



Figure 40. P5-74 (NED):  
*En hij viel dus zo naar beneden.*  
(ENG): *And he fell down again like this.*

To summarise, path of motion is affected by the visual experience of the stimulus animation. Participants tend to use their left hand to refer to a horizontal trajectory from observer viewpoint that occurs from left to right, and present right-to-left movements with their right hand. This suggests that handedness is influenced by their horizontal trajectories displayed on screen. Although the vertical trajectories in gesture also correspond to the movements made in the video, a clear handedness pattern that explains hand choice for every participant cannot be detected. Instead, there are great individual differences between participants: first, the successive rests of the hands may signal a change in hand choice and the introduction of a new story element. Second, some participants mainly use their dominant hand. Third, the hands used for a certain gesture may influence the hand choice for a subsequent gesture, and fourth, participants may depict the trajectories of different characters with different hand combinations. Also, not every trajectory gesture displays a physical movement. Handshape, fingers, or position of the hand(s) can be altered in order to illustrate the direction of the movement.

#### 4.1.3 Location

The hands spatially organise characters in the gesture space according to their location in the stimulus event. Participants vary in hand use when they depict a character in space. Some examples are given to illustrate this contrast:



Figure 41. The child is situated on the right of the woman.



Figure 42. P1-24 (NED): *Een klein kindje zo naast die vrouw.*  
(ENG): *a child next to that woman.*





Figure 43. P2-12 (NED): *Naast de vrouw naast het bankje zit een kindje.*  
(ENG): *Next to the woman next to the bench is a child.*



Figure 44. P4-58 (NED): *Zie je dat kindje.*  
(ENG): *You see that child.*



Figure 45. P7-20 (ENG): *The woman has a child.*

Participants describe the scene where the child is sitting on the right to the woman. All participants locate the child in their right gesture space, which corresponds to figure 41. There is some variation in how the participant use their hands to depict the location of the child. Participant 1 makes small iterated movements back and forth with her right hand when she says *een klein kindje*. Participant 4 moves both his hands to the right gestural space. Both participants are ‘holding’ the child with their hand(s). Participant 2, on the other hand, points with her index finger to a certain space that represents the child, and participant 7 also indicates the location of the child in her right gesture space with a flat hand. This flat hand could indicate the height of the child. A further examination of this particular scene reveals that the woman is not explicitly referred to in a deictic gesture, as has been done with the child. The participants had previously addressed the woman, for which a separate gesture had been used. As McNeill (1992) states, gestures only accompany speech where it is least predictable, most complex, or the most discontinuous in the discourse. Due to communicative dynamism, the woman’s location is not been displayed in gesture. Although participant 1 may be implicitly referring to the woman with her left hand, this gesture differs in quality compared to her right hand; the right hand is moving, while the left hand is held static.

Participants may also use one hand to locate two characters, while the portrayal of this hand still corresponds to the stimulus animation on screen. Figure 46 again demonstrates the child sitting next to the woman.



Figure 46. The child is situated on the right of the woman.



Figure 47. P6-15 (ENG): *And there was a woman and a child nearby.*



Figure 48. Tweety fleeing from Sylvester to the right.



Figure 49. P6-16a+b (ENG): *So Tweety went to the woman.*

Lausberg and Kita (2003) suggest that the left hand is used to refer to a character on the right side of the screen, while the left hand is used to represent a character on the left side. Yet, samples from the data also show that the hands can be used in different ways. Participant 6 portrays both the child and the woman with her right hand. She first refers to the woman and then points her hand a bit more to the rightward space, where she locates the child. The subsequent gesture depicts Tweety running to the woman in an attempt to escape from Sylvester. The participant first points both her hands to the left space, where Tweety is located. And then, to resemble Tweety's escape, she moves both hands to the right, where she had represented the woman in her previous gesture. Her right hand makes a hopping motion. Whereas the woman had been located on the left to the child in figure 46, she is now represented on the right, as Tweety's movement to the woman is to the right in figure 49. The data show that gesture 15 and 16 are coordinated in such a way that they are part of a larger discourse, where a previous gesture is integrated into a subsequent gesture. The gestures in Lausberg and Kita's (2003) study are not part of a larger discourse.

Participant 2 demonstrates a similar handedness pattern where gestures are structured around a larger discourse. To represent the dog, the participant bends the fingers of her left hand, after which she points her left hand a bit further to the left when she talks about the tree. The leftwards pointing suggests that she has taken into consideration what she has seen in the video, where the tree is located on the left to the dog.



Figure 50. The tree is located on the left of the dog.



Figure 51. P2-78 (NED): *Bulldog eraan* (want die wilde aan die boom gaan ruiken. (ENG): *Bulldog was approaching* (because he wanted to have a sniff at the tree).



Figure 52. P2-79 (NED): *(Bulldog eraan want die wilde aan) die boom (gaan ruiken).*  
(ENG): *(Bulldog was approaching because he wanted to have a sniff at) the tree.*



Figure 53. P2-80 (NED): *Sprayde Sylvester.*  
(ENG): *Sylvester sprinkled.*



Figure 54. P2-81 (NED): *Bulldog rende weg.*  
(ENG): *Bulldog ran away.*

*Bulldog* and *tree* are part of the same utterance for which the participant only uses her left hand. The left hand does not return to its resting position on her leg in between gesture 78, 79, and 80. Although the participant has phrased a new utterance in figure 53, the same left hand is still used. The sprinkling gesture, which is viewed from character viewpoint, is made towards the right space, where the participant had initially located the dog with her left hand. After this gesture, the left hand is placed on the leg, and the right hand is used to portray a movement away from the body. The participant indicates that the dog is running *away* and has left the scene. Although two characters are presented with the same hand, their location aligns with the spatial location of the characters of the stimulus event.

Unimanual gestures may also temporarily organise two entities. The animation video shows that Tweety is walking alongside the bulldog. Sylvester is running after them, but then bumps into the dog and the dog's collar flies around his neck. Instead of the dog, Sylvester now walks with Tweety to the right, as demonstrated in the gesture of participant 2 in figure 56:



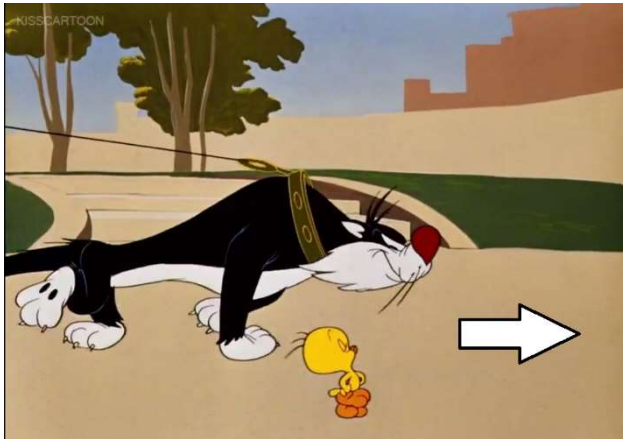


Figure 55. Sylvester walking together with Tweety towards the right.



Figure 56. P2-45 (NED):  
(*Sylvester die*) *daar liep*.  
(ENG): (*Sylvester who was*)  
*walking there*.

The right hand continues the movement made by the left hand towards the right gesture space. While Sylvester appears later on in this fragment, the subject first mentions Sylvester when she says *Sylvester in plaats van die bulldog* (ENG: *Sylvester instead of the bulldog*). Her left hand is closed when she depicts Sylvester, but opens when she mentions the dog, which appeared first in this scene, as demonstrated in figure 57.



Figure 57. P2-44a+b (NED): *Sylvester in plaats van die bulldog daar liep*.  
(ENG): *Sylvester instead of the bulldog was walking there*.

Since these two characters are portrayed with the same hand in the same position in one gesture, this suggests that they appear at the same location on the screen, but at different times. Gestures might organise the temporal properties of speech.

Bodies of participants can also function as a deixis reference point to locate entities on the body. Figure 58 shows Tweety sitting on Sylvester's head. All participants provide

information on Tweety's location by portraying the scene from a character viewpoint. Participant 2 and 5 point to their own head, while the other participants (1, 3, 4, 6, and 7) are more explicit to the spatial location of Tweety. Participant 6 and 7 lay their hand on their head.



Figure 58. Tweety on Sylvester's head.



Figure 59. P2-24 (NED): *Toen zat Tweety op Sylvester's hoofd.*

(ENG): *Then Tweety was on Sylvester's head.*



Figure 60. P5-38 (NED): *Toen stond Tweety al op het hoofdje.*

(ENG): *Then Tweety was standing on Sylvester's head.*



Figure 61. P6-33 (ENG): *Tweety was on top (of his head).*



Figure 62. P7-33 (ENG): *And sits on the cat's head.*

Since the participants provide information on the scene from character viewpoint, this suggests that their perspective of the video as seen from observer viewpoint has been altered. Participant 1, 3, and 4 do not only present the scene from character viewpoint, but their hand is located on the head and also shaped to frame Tweety. This hand represents Tweety from

observer viewpoint. The animation video may thus be presented from more than one viewpoint, which McNeill (1992) characterises as dual viewpoint. Furthermore, both viewpoints correspond to what participants have seen in the video.



Figure 63. P1-37 (NED): *Maar Tweety springt dan vanuit die boom op het hoofd van die kat.*  
(ENG): *But Tweety then jumps from the tree onto the head of that cat.*



Figure 64. P4-88 (NED): *Zit Tweety op zijn hoofd.*  
(ENG): *Tweety sits on his head.*



Figure 65. P3-45 (NED): *Zit Tweety al op zijn hoofd.*  
(ENG): *Tweety is already on his head.*

Furthermore, participants may alter the location of an attribute on the body because of hand efficiency. The following example in figures 67 and 68 illustrate this:



Figure 66. A water gun is located in Sylvester's left foot.



Figure 67. P1-74 (NED): *(Die kat die verkleedt is als boom) die heeft dan hieronder heeft ie zo'n waterpistool zitten).*  
(ENG): *(the cat which has disguised himself as a tree) has a water pistol located on his ankle.*



Figure 68. P1-75 (ENG): *Dan schiet hij.*  
(ENG): *Then he shoots.*



Participant 1 first moves her hand to her ankle to locate the position of the water pistol on her body. She positions herself inside the story from the character viewpoint of Sylvester. She locates the water pistol on her left ankle, which corresponds to the location of the water pistol on Sylvester's leg. No screen influence can be found here. Then she uses her right hand to perform the spraying motion, which is not how the action is performed on screen. It can be clarified by hand efficiency as she is likely to be more practised with her right hand. She routinely uses her right hand to perform character viewpoint actions. This also explains the great frequency with which she uses her right hand in the data.

The way in which different hands locate characters may reveal how participants structure a stimulus event as corresponding to the screen, but in different ways among participants. This becomes clear when more than two characters are spatially organised in the gesture space. In the first scene, from left to right (not corresponding to the camera movement), Sylvester appears, then the three men, and Tweety is the last character. Sylvester and the three men are sitting on a bench, while Tweety is bathing in a fountain some metres away from the bench, as shown in figure 69:



Figure 69. From left to right: Sylvester, then the three men, and then Tweety appears.

To characterise the entities on the bench, participant 3 makes three small hops with her right hand in her right space. Each hop moving further to her right side and identifying each of the three men separately, but as one gesture. In figure 70, she has not yet indicated Sylvester's position, but in the upcoming gesture, her right hand with which she represents Sylvester's hopping motion is moved from the gestural front space to the rightward space. These two gestures make clear that the subject has remembered Sylvester implicitly as located to the left of the three men. Participant 3 does not explicitly locate Tweety.



Figure 70. P3-2 (NED): *En daar zitten andere mannen langs.*  
(ENG): *And three men are sitting there.*



Figure 71. P2-4 (NED): *Steeds meer op de bank verschuiven.*  
(ENG): *Moves further and further on the bench.*



Figure 72. P4-10+11+12+13 (NED): *En dan zit er een man. En dan zie je nog een man zitten. En nog een man zitten. En dan zie je Sylvester zitten.*  
(ENG): *And then there's a man. And then you see another man. And another man. And then you see Sylvester.*



Figure 73. P4-17 (NED): *Vervolgens weet ie natuurlijk dat Tweety in het vogelfonteintje zit.*  
(ENG): *Sylvester knows Tweety is in the fountain.*

Figure 72 demonstrates that participant 4 moves both his hands to the left space of him. He makes four big hops to his left and first mentions the three men separately, after which he refers to Sylvester as the last character sitting on the bench. These four big hops are part of one gesticulation. The movement that is made maps onto the camera's horizontal movement. Participant 4, like participant 3, locates Sylvester to the left of the men. The location of each character by these two participants matches their spatial location on screen. However, the gesticulation is occurring in the opposite direction: participant 3 moves her hands further to

the right, whereas the hands of participant 4 are directed towards the left. Furthermore, their hand choice differs, which suggests that the participants may have remembered the exact same scene differently. A schematic overview is provided of how participant 3 and 4 might have remembered the same scene in figure 74 and 75:

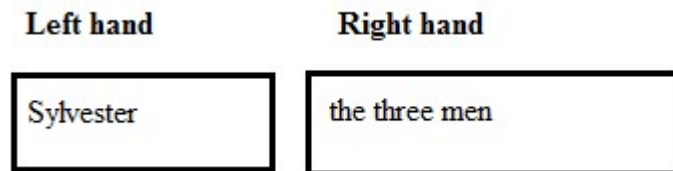


Figure 74. The location of Sylvester and the three men by participant 3.

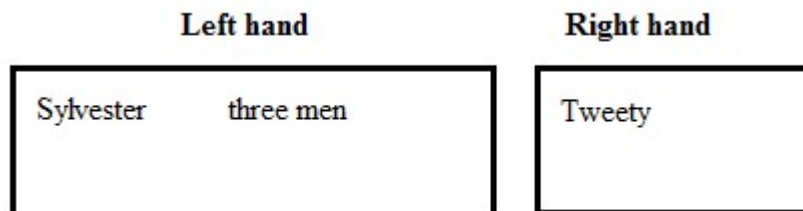


Figure 75. The location of Sylvester and the three men by participant 4.

The gesture in figure 73 indicates that participant 3 might have remembered Sylvester as separate from the three men. Only the three men are mentioned in a gesture, while Sylvester has been left out in this gesticulation. Participant 4, on the other hand, refers to the three men as well as Sylvester in a single gesture. Tweety is referred to in a different gesture. This suggests that participant 4 might have remembered Sylvester as being part of the same group as the three men. All four characters are sitting on a bench. The variation in hand choice to organise characters in the gesture space, which at the same time corresponds to the spatial location of the entities in the video, shows that participants may memorise the exact same scene differently.

The hands can organise entities spatially by referring to their spatial location from the stimulus video. Participants can ‘hold’ or point to a certain gesture space where the character is located. They can use one or two hands to represent one entity, or they might use one hand to locate two characters in space. The hands can also temporarily organise characters by changing their shape. When subjects have to locate an entity on the protagonist’s body, they tend to use their own body as a reference point. Another finding is that when a scene involves

more than two characters, participants tend to use their gesture space and hands differently to locate these entities in space. Their overall portrayal of the scene, however, displays the exact same stimulus event from the video. The different hand preferences for the location of entities suggest that participants have memorised the exact same scene in a different way.

#### 4.2 The Screen Influence on Character and Dual Viewpoint Gestures

Character viewpoint gestures, like gestures from observer perspective, may be influenced by what participants have seen in the stimulus animation. From character perspective, the character's body is mapped onto the speaker's body, and the motion is made from the perspective of the protagonist (Parrill, 2011). Observer viewpoint gestures, on the other hand, tend to follow the character's direction from the video. This means that character viewpoint gestures portray the opposite direction from gestures from third person perspective (ovpt). Some examples have been drawn upon to exemplify the direction of the movement for viewpoints:



Figure 76. Sylvester hopping to the right.



Figure 77. P3-4 (NED): *Steeds meer op de bank verschuiven.*  
(ENG): *Moves further and further on the bench.*



Figure 78. P3-3 (NED): *Stiekem gaat ie zo.*  
(ENG): *He goes like this in a sneaky way.*

When subjects take an event-internal perspective (i.e. cvpt), participants tend to follow the path (and manner) of the character. In other words, they do not encode the direction from observer viewpoint. In figure 77, participant 3 portrays the scene from observer perspective. Only her right hand moves to the right – the direction corresponds to the trajectory on screen here. From character perspective, it is expected that this movement would be in the opposite direction. However, figure 78 shows that the character viewpoint depicts the direction from

observer viewpoint. The participant moves with her entire body to the right. Both figure 77 and 78 depict the exact same scene, but from different perspectives. The character viewpoint gesture maps onto the observer viewpoint trajectory, which indicates that the screen has affected on this gesture. Furthermore, although viewpoint has changed, manner has not altered. The participant performs the hopping motion with her right hand from observer perspective. Her right hand performs a wiggling motion in three steps to the right, while her entire body is used to make these steps from character perspective. Although character viewpoint can be altered by the screen, viewpoint does not affect manner.

Not only character viewpoint gestures with a trajectory are affected by the visual experience of the stimulus event, character viewpoint gestures in general may be influenced too. Data samples are provided to illustrate this:



Figure 79. The woman gives Tweety to her left (cvpt).



Figure 80. P1-29  
(NED): *Die vrouw geeft dan Tweety zo van aan die baby van houd je mond.*  
(ENG): *The woman gives Tweety to the baby like keep your mouth shut.*



Figure 81. P5-24  
(NED): *Weet je wel ik geef Tweety wel.*  
(ENG): *you know I just give Tweety.*

From observer viewpoint, Sylvester is located on the right side of the woman, but the woman gives the bird to the cat on her left from character perspective. Participant 1 portrays a similar action from an event-internal perspective. She gives Tweety to an invisible character on her left. Participant 5 also demonstrates the scene from character viewpoint, but the direction of this motion corresponds to an observer viewpoint gesture. She gives the bird to her right



space. She continues to make use of her right space in figure 83, where her right hand makes a grabbing motion to the right.



Figure 82. The woman grabs Sylvester from her left (cvpt).



Figure 83. P5-25 (NED): *Ze pakte die kat.*  
(ENG): *She grabbed the cat.*



Figure 84. P7-26 (ENG): *So she picks up the cat.*



Figure 85. The woman hits Sylvester with her right hand.



Figure 86. P5-27 (NED): *Sloeg die kat.*  
(ENG): *She hit the cat.*



Figure 87. P7-27 (ENG): *She starts banging him.*

Participant 7 shows, like participant 5 does, a handedness pattern that is influenced by the observer perspective. She moves both her hands to the right gesture space to grab Sylvester. In figure 85, the woman hits Sylvester with her right hand, but both participant 5 and 7 use their left hand to perform this action. Their hand choice corresponds to an observer viewpoint gesture.

Dual viewpoints may also be affected by the on-screen stimulus animation. As has been explained, narrators can simultaneously take up more than one spatial perspective on a scene. The video can only show an observer viewpoint perspective. Some data samples are provided:



Figure 88. Tweety flies to the right (ovpt).



Figure 89. P1-73 (NED): En Tweety die gaat zo in die hand zitten.  
(ENG): And Tweety is sitting in his hand like this.



Figure 90. P4-173 (ENG): *Loopt ie zo heel langzaam richting Tweety en de vrouw.*  
(ENG): (Sylvester) walks very slowly towards Tweety and the woman.

Participant 1 and 4 both illustrate two viewpoints in one gesture. They are similar in that they display an observer viewpoint and a character viewpoint. Yet, there is also a contrast in the way they portray these viewpoints. Participant 1, like the other participants do, depicts Sylvester from character viewpoint; like Sylvester in the video, the bird's nest can be found in the right hand. With her left hand, she portrays Tweety's path from left to right from observer viewpoint. This trajectory is similar to the one in the stimulus event. Participant 4 also demonstrates a trajectory, but this trajectory is made by Sylvester, who moves from the right side of the screen to the left. The participant performs the same right-to-left motion with his right hand. The other hand is taken in by a bird's nest. From character viewpoint, the nest should have been located in the right hand, rather than the left. His viewpoint may not correspond, because the right hand is already taken in. Therefore, a different hand is used. Another explanation might be that the left hand may be influenced by the screen, as from observer viewpoint, the nest is located to the left of Sylvester.

The data show that character and dual viewpoint gestures may also be influenced by the visual experience of the stimulus event from observer viewpoint, although no consistent handedness pattern can be observed in all character and dual viewpoint gestures.

#### 4.3 No Screen Influence on the Description of Entities

There is no effect of the spatial location of entities on the gestural description of objects and animate characters. Participants zoom in on the entity they want to describe. Their gestures express the most salient features of the entity. Similarity in the description among participants indicates that they have remembered the same feature of an event. The first occurrence of an entity description is a fountain, in which Tweety is taking a bath.



Figure 91. Tweety taking a bath in a fountain.



Figure 92. P1-3 (NED): *In een badje (in het park).*  
(ENG): *In a bath (in the park).*



Figure 93. P7-2 (ENG):  
*Which is in a pool.*



Figure 94. P5-1 (NED): *Zo'n vogelbadje.*  
(ENG): *A bird's fountain like this.*



Figure 95. P4-6 (NED): *Zo'n vogelfonteintje.*  
(ENG): *A bird's fountain like this.*



Participants vary in how they describe the bird's fountain. Participant 2 and 3 do not refer to this event. Participant 1, 4, 6, and 7 all gesticulate the round shape of the fountain. The iconic shape of the fountain is not mentioned in their verbal expression. Participant 1 (and 6) represent the iconic shape with both hands, while participant 7 (as well as 4) trace the path of a circle with the right hand. Participant 4 provides more semantic information about the depth of the fountain. His hands are cupped and move from centre space to the sides. Participant 5, uses what appears to be a deictic gesture that indicates the presence of a fountain. No more semantic information is given. Most participants have kept the fountain's circular shape in memory.

Hand choice also varies in describing objects that involve several components. Figure 96 presents Sylvester who is setting up a trap in an attempt to catch Tweety. The trap consists of a box, a stick, a rope, and a corn. Some different examples of the description of this object are given:



Figure 96. Sylvester setting up a trap.



Figure 97. P3-44 (NED): *Waarbij de poes probeert een val te maken.*  
(ENG): *The cat is trying to set up a trap.*



Figure 98. P1-34 (NED): *Zo 'n grote steen.*  
(ENG): *A big stone like this.*



Figure 99. P1-35 (NED): *Met zo'n stok.*  
(ENG): *With a stick.*



Figure 100. P1-36 (NED): *Met zo'n touw eraan.*  
(ENG): *With a rope attached to it.*

The data show that the trap can either be characterised in its entirety, or each component of the trip can be separated into their own gesture. Participant 3 gesticulates the stick with her left hand, while her right hand simultaneously moves from the top of her left hand in an oblique angle to her right. She portrays the trap in a single gesture that iconically marks the shape of the trap. In contrast to participant 3, participant 1 shows three gestures that present each component of the trap separately. To depict the box, her hands form a square. For the subsequent gesture, her right hand makes a straight downward movement, indicating the length of the stick. And finally, her right hand depicts the rope by making a wavy movement downwards. From these gestures, it is clear not clear how the stick and the rope are fabricated onto the box.

The portrayal of animate characters does not always involve a deictic reference to a spatial location. Animate characters can be described from observer or character perspective. Some examples are provided of the description of the bulldog in figure 101:

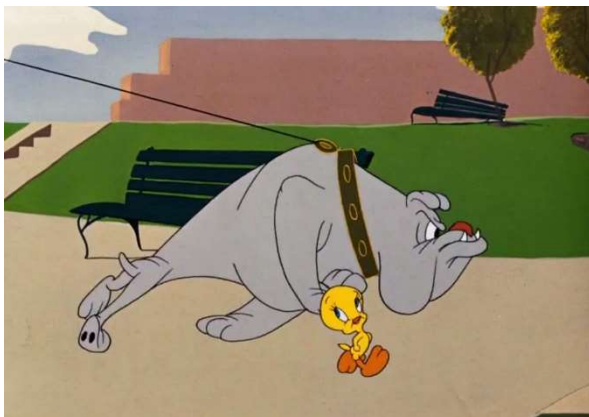


Figure 101. The bulldog walking alongside Tweety.



Figure 102. P1-46 (NED): *Zo'n grote hond.*  
(ENG): *A big dog like this.*



Figure 103. P2-35a+b (NED): *(Tweety liep naast een hele grote bulldog.*  
(ENG): *(Tweety walked alongside) a very big bulldog.*



Figure 104. P4-102 (NED): *dan hoor je ook zo'n muziekje van het is een bulldog.*  
(ENG): *Then you hear music resembling the bulldog.*



Figure 105. P4-104 (NED): *die hond had ook zo'n spiked collar om.*  
(ENG): *the dog was wearing a spiked collar.*

Participants particularly remember the size of the dog. Their utterances also refer to this size. Participant 1 characterises the dog as *zo 'n grote hond* (ENG: *such a big dog*) and participant 2 says *een hele grote hond* (ENG: *a very big dog*). This iconic feature is also represented in their gesture. The space beneath her hands indicates the size of the dog for participant 1. Participant 2, on the other hand, alters her hand shape to illustrate a contrast in size. Her hand is closed when she depicts Tweety, but opens when she mentions the dog. These illustrations are depicted from observer viewpoint. Participant 4 portrays two other features of the bulldog: its walking motion and its collar. His arms rhythmically move up and down in an iterated fashion, and they are timed with the accompanying speech, when he says *homhomhom*. This feature as well as the deictic reference to the collar around his neck are portrayed from character viewpoint. Also, there is variation in which hands are used. There are similarities and differences in the way that entities are depicted, considering the described features, hand choice, and viewpoint.

To summarise, how participants describe objects and animate characters is not influenced by their location of the entities on screen. Participants tend to remember the same salient feature of an entity, which they then depict in their gesture. Participants may vary in which features they present in gesture, their viewpoint, and hand choice.

#### 4.4 No Screen Influence on the Manner of Motion

Manner of motion is not influenced by the location or trajectory that is performed in the stimulus video. In other words, the direction of some manner gestures does not correspond to the path that is taken on screen. Some samples from the data are provided to illustrate this pattern:

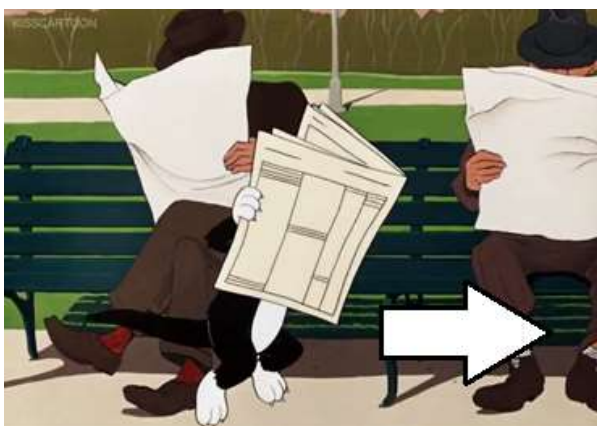


Figure 106. Sylvester hopping to the right.



Figure 107. P1-9 (NED):  
(*Die kat*) *zo een plek omschuiven tussen*.  
(ENG): (*The cat*) *is changing places between those men*.





Figure 108. Tweety jumps to the right onto the woman's shoulder.



Figure 109. P4-50 (NED): *Dan komt Tweety dus aan bij die vrouw.*  
(ENG): *Then Tweety arrives at the woman.*

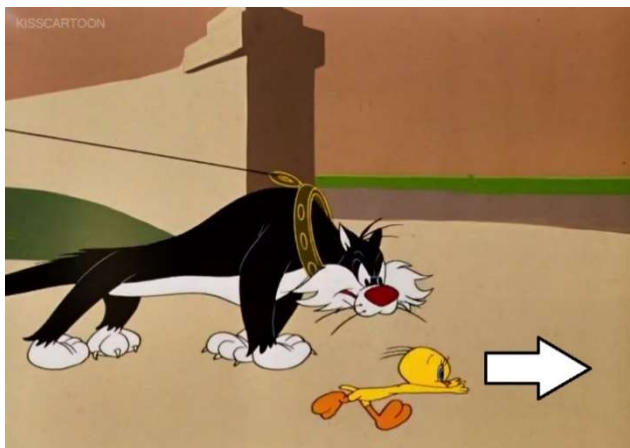


Figure 110. Tweety runs from Sylvester towards the right.



Figure 111. P6-52 (ENG): *so he managed to get away from it.*

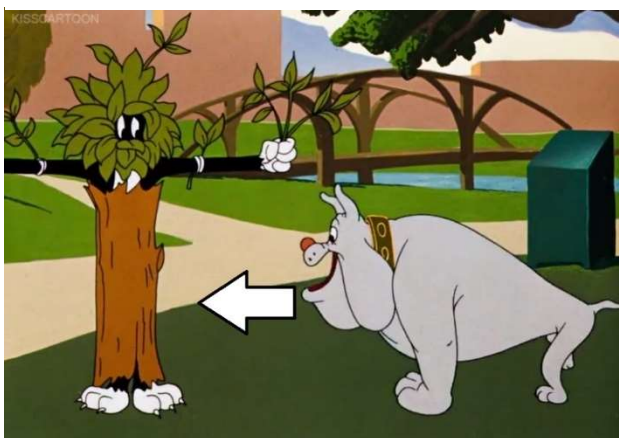


Figure 112. The dog is approaching the tree from the right.



Figure 113. P7-93 (ENG): *Then the dog shows off sniffing to the three.*

In figure 106, Sylvester hops from left to right. Instead of using her left hand, as Lausberg and Kita (2003)'s findings would predict, participant 1 performs Sylvester's action with her right hand. Her right hand moves to the left. Her left hand is also occupied as her two fingers enclose a space, which refers to the noun phrase *een plekje* (ENG: *places*). The verb phrase *opschuiven* (ENG: *changing places*) encodes path and manner. Despite the opposite direction of the trajectory, the participant does illustrate the hopping manner, which corresponds to the manner of motion on screen. Participant 4, in figure 109, also demonstrates the exact opposite direction from the trajectory made by Tweety in figure 108. Tweety runs very fast to the right. The right hand, however, performs a small wavy iterated motion to the left. This manner does not correspond to the manner of motion that is portrayed in the video. However, this wavy manner might have been influenced by Tweety's jumping up and down movement in the next scene. The participant might have remembered the jumping motion and incorporated it into a gesture. Participant 6 also portrays a scene where Tweety is running away from Sylvester in figure 110. Tweety runs towards the right, but both the participant's hands are directed in the opposite way. Moreover, her right hand performs several hopping motions to the left. This hand movement involves a metaphoric component, which involves a movement away from the body as the verb phrase indicates *so he managed to get away from it*. Participants in general tend to illustrate a hopping manner to characterise Tweety, and they therefore do not always portray the on-screen manner. The last example shows that the dog is moving to the left towards the tree. Participant 7 uses her left hand to portray a movement to the right, which does not match its trajectory in the video. Her left hand moves in a wavy manner. Her right hand resembles the nest. She is thus portraying the scene from a character viewpoint (the cat) and observer viewpoint (the dog). This suggests that participants tend to remember manner first for these examples.

Participants may know the direction of the trajectory from the stimulus video, but portray a different trajectory that prioritises manner. Participant 4 depicts Sylvester's hopping motion from right to left, as can be seen in figure 115. This gesture is followed by a gesture where the path of motion differs. The participant performs a hand motion that moves in a fast manner to the front gesture space in figure 116. This gesture is not represented by a particular scene, but from figure 115 it can be inferred that the subject knows that Sylvester is located on the left and Tweety on the right.



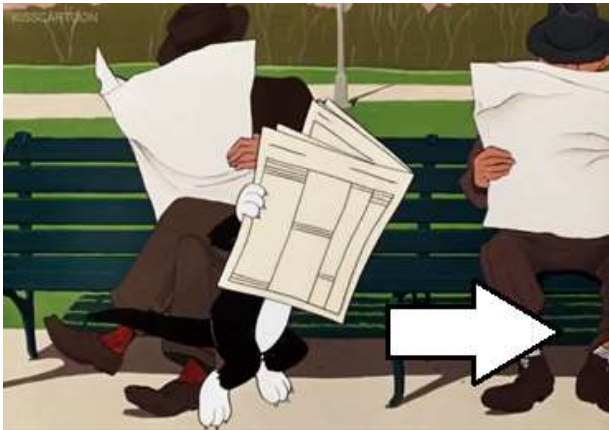


Figure 114. Sylvester hopping to the right.



Figure 115. P4-21 (NED):  
*Per man gaat ie zo tussendoor.*  
(ENG): *Sylvester moves in between the men.*



Figure 116. P4-22 (NED):  
*Dan rent ie naar Tweety toe.*  
(ENG): *Sylvester runs towards Tweety.*

Manner gestures can also consist of other iconic components that may have an effect on the portrayal of the gesture. Manner of motion may involve a second internal component, which is typically an iterated action (Parrill, 2011).



Figure 117. Sylvester chasing Tweety clockwise around the fountain.



Figure 118. P4-39 (NED): *Daar rennen ze in rondjes achter elkaar om die fontein heen.*  
(ENG): *there they run around in circles around the fountain*



Figure 119. P7-12 (ENG):  
*Around the fountain.*



Figure 120. P6-14 (ENG): *He is chasing him around the fountain.*

Figure 117 demonstrates Sylvester chasing Tweety around the fountain in a clockwise motion because of the shape of the fountain. The hand repeatedly moves in a clockwise motion, until the participant has made clear that Tweety has walked away from the scene. The data samples above all illustrate this repeated motion with their entire hand (participant 4, and 6), or just their finger (participant 7). However, the trajectory does not correspond to the direction of the chase. The participants all make a counter clockwise movement. This suggests that they have remembered the iterated iconic manner of the movement, but not its direction.

Manner gestures may also involve an object that is essential to the understanding of the plot development. The following examples will elucidate this:

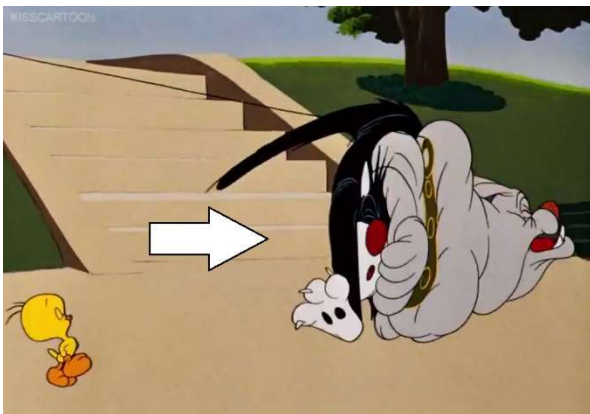


Figure 121. Sylvester bumps into the dog towards the right.



Figure 122. P4-112 (NED): *En die rent zo hard tegen het achterste van die hond.*  
(ENG): *And Sylvester is running so fast towards the back of that dog.*



Figure 123. P4-113 (NED): *Dat die hond door de halsband vliegt.*  
(ENG): *The dog is flying through the collar.*

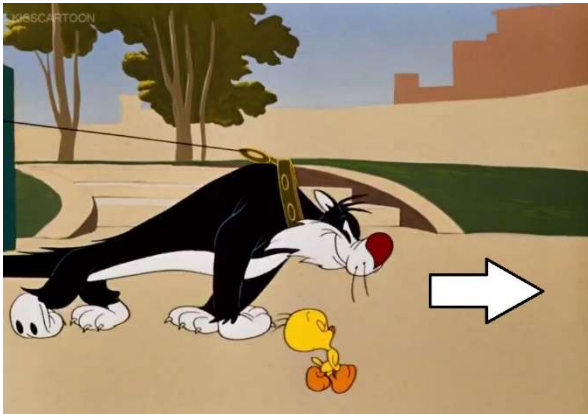


Figure 124. Sylvester walking alongside Tweety to the right.



Figure 125. P7-57 (ENG): *But he hits the dog and gets into the collar of the dog.*



Figure 126. P7-58 (ENG): *Then he's pretending to be the dog.*

Participant 4 and 7 both portray the direction of the trajectory differently. Furthermore, the directions of their hand movements are not similar to the ones portrayed in the video.

Participant 4 first moves his right hand very fast to the front gesture space, which indicates that the cat is running in a fast manner. He then pulls back his right hand, after which this hand moves quickly through an open left hand, as seen in figure 123. The shape of the left hand could be interpreted as the dog's collar. Participant 7 performs a similar action. Her right hand moves in a fast manner through an open hand (figure 125). The movement is thus made to the left, while Sylvester's on-screen motion is towards the right. The fast manner as well as the collar are essential to the interpretation of the plotline, since if the movement is not fast enough, Sylvester will not fly through the collar. In the next scene, both participant 4 and 7 depict Sylvester walking as the dog in the collar (e.g. figure 126).

Thus, manner gestures from observer viewpoint may have a trajectory which does not correspond to the one in the stimulus video. An opposite direction, or a trajectory towards the front gesture space can be depicted instead. Furthermore, participants are likely to portray the iconic components of manner, such as its iterated action, shape, or object that play a pivotal role in the plot sequence. The data also show that participants may know the direction of the movement, but still portray a manner gesture that is different from the animation event. This indicates that they prioritise manner over the direction of the trajectory in gesture.

### *Summary*

The trajectory and location of the hands in the gesture space indicate that these two motion features are influenced by the visual experience of the stimulus video. Participants tend to use their left hand to refer to an entity that moves from left to right on screen in a

horizontal line, and present a right-to-left movement with their right hand. Vertical trajectories represented in gesture also correspond to their trajectories in the video, but no clear handedness pattern can be detected here. Participants differ greatly in their hand choice for vertical movements. The analysis has pointed out four handedness patterns, specifically for vertical trajectories: (1) the successive rest of the hand may signal a switch to the other hand, (2) participants may perform the vertical trajectory with their dominant hand as they are more efficient with it, (3) hand choice is influenced by a preceding gesture, and (4) participants may use different hand combinations to depict the trajectories of different characters. Although participants typically perform a physical movement to depict a trajectory, path may also be portrayed otherwise by changing the shape, or position of the hand or fingers.

The hands may spatially organise characters and objects according to their spatial location in the video. Participants may ‘hold’ or point to a certain gesture space where the entity is located. One or two hands may be used to portray one entity, or a single hand can be presented to locate two characters in space. The hands may also temporarily organise characters by changing its shape. Moreover, participants may use their own body as a deixis reference point to locate entities on the body. The hands also reveal how participants have memorised the exact same scene differently. Participants can use different hands to locate characters, while their location still corresponds to the overall spatial location of the characters in the stimulus event.

Not only observer viewpoint gestures are influenced by the screen, character and dual viewpoint gestures are too. The description of entities, on the other hand, is not affected by what participants have seen in the animation video. Participants tend to describe the same salient features of a particular character or object, but may use different hands to do so. The depiction of entities may also be described from different viewpoints.

The data have shown that manner gestures may have a trajectory which is not similar to the one depicted on screen. Although participant may know the direction of the trajectory from the stimulus event, they sometimes subordinate the direction so that manner has more prominence. Manner gestures also involve other iconic components, such as an iterated action, shape, or object that may influence the portrayal of the manner gesture.



## 5. Discussion

The previous section has demonstrated different handedness patterns. There can be three major findings reported: (1) character and dual viewpoint gestures are sometimes narrated from observer perspective, (2) the location and trajectory of the hands tends to be similar to the spatial location and path of the protagonist on screen, and (3) manner gestures from observer viewpoint sometimes have a trajectory that does not depict the trajectory from the stimulus video. These findings will be discussed here, and linked to Kita and Özyürek's (2003) Interface Hypothesis in order to provide a deeper understanding of the cognitive processes that generate gestures and speech.

### 5.1 The Screen Influence on Character and Dual Viewpoint Gestures

Character and dual viewpoint gestures can be narrated from observer perspective, which is influenced by the screen. This means that a first person perspective is seen from a third person perspective, as illustrated in figure 129:



Figure 127. The woman gives Tweety to her left (cvpt).



Figure 128. P1-29 (NED):  
*Die vrouw geeft dan Tweety  
zo van aan die baby van houd  
je mond.*  
(ENG): *The woman gives  
Tweety to the baby like keep  
your mouth shut.*



Figure 129. P5-24  
(NED): *Weet je wel ik  
geef Tweety wel.*  
(ENG): *you know I just  
give Tweety.*

From character viewpoint, the woman gives Tweety to Sylvester who is located on her left. Participant 1 depicts Sylvester in the same gesture space as the woman does. However, participant 5 portrays a different picture where she illustrates a giving motion to her right gesture space. Character viewpoint gestures are more complex than observer viewpoint

gestures, as Cartmill et al. (2012) allege. The complex nature of character viewpoint gestures may explain why participant 5 does not allocate Tweety to the same space as the woman does. Narrators have to imagine an object (i.e. Tweety) as well as an action (i.e. giving Tweety to Sylvester), while simultaneously simulating the perspective of the protagonist. The observer perspective, however, is already readily available in memory, as figure 129 demonstrates. The participant has seen the video from observer viewpoint. The character perspective, on the other hand, might be more difficult to memorise. The Action Generator of Kita and Özyürek's (2003) Interface Model (see figure 130) may have access to information about viewpoints in memory. It is selective to what components of an action are to be represented in gesture. Since participant 5 illustrates the scene from observer viewpoint, this may suggest that the Action Generator cannot select a character viewpoint gesture. The character viewpoint gesture is not available in memory. This may also indicate that the Action Generator first selects the object and action, after which it selects a certain viewpoint. The length of the stimulus video might have had an effect on the memorisation of this scene. Participants cannot simply remember everything they have seen. Yet, the scene has to be depicted from a certain viewpoint, and therefore, the observer perspective might have been selected instead. Participant 1, on the other hand, does illustrate a character viewpoint gesture. This could mean that the Action Generator has access to two viewpoints for its selection process of this specific scene. This selection process does not always rule out one of the two viewpoints, as McNeill (1992) describes that a scene may also be narrated from dual viewpoint, when two viewpoints are presented at the same time in gesture.

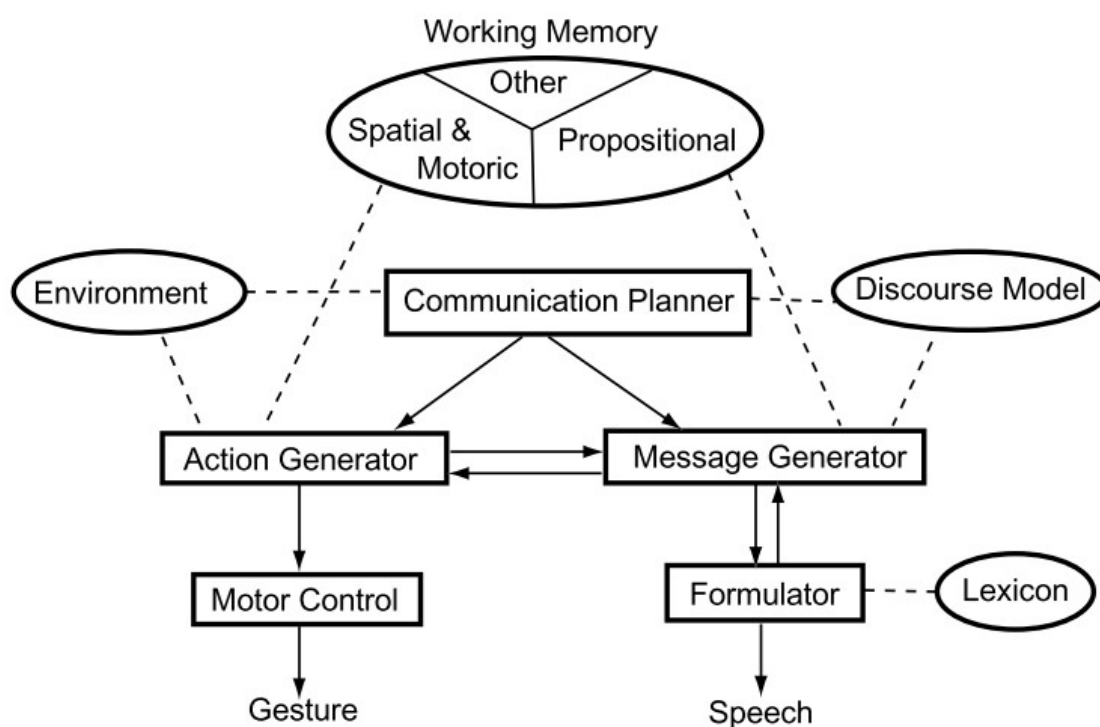


Figure 130. The Interface Hypothesis

## 5.2 The Screen Influence on the Trajectory and Location of the Hands

The findings indicate that many observer viewpoint gestures that depict the path and spatial location of entities are influenced by the participant's visual experience of the stimulus event in the video. These results support the hypothesis that the screen has an effect on the trajectory and spatial location of the hand(s) of observer viewpoint gestures of locomotion of animate characters. As mentioned, the motion and location of characters on the left and right side of the screen also affect hand choice, which is in line with the findings from Lausberg and Kita (2003). Participants tend to use their left hand to illustrate an object or character on the left side of the screen, and an entity on the right side is referred to with the right hand. However, the right and left hand are not always binary mapped onto the right and left side of the screen respectively. There is some variation in handedness in the data. Participants might, for example, use both hands to refer to an entity in space (figure 131), or one hand to refer to two entities (figure 132 and 133), while the hands still portray a location in gesture that still corresponds to the spatial location of the character on screen.



Figure 131. P4-13 (NED): *En dan zie je Sylvester zitten.*  
(ENG): *And then you see Sylvester.*



Figure 132. P2-78 (NED): *Bulldog eraan*  
(ENG): *Bulldog was approaching*



Figure 133. P2-79 (NED): *(Bulldog eraan want die wilde aan) die boom (gaan ruiken).*  
(ENG): *(Bulldog was approaching because he wanted to take a sniff at) the tree.*



Figure 134. P2-80 (NED):  
*Sprayde Sylvester.*  
(ENG): *Sylvester sprinkled.*



Figure 135. P2-81 (NED):  
*Bulldog rende weg.*  
(ENG): *Bulldog ran away.*

Participant 4 depicts Sylvester with both his hands in the leftmost gestural space. This depiction does not correspond to Sylvester's location in the animation video. Participant 2, on the other hand, uses both her hands separately to depict different entities. Her hand use might be structured around a larger discourse. She first uses her left hand to refer to the dog and then moves it slightly further to the left to present the tree. Her right hand is eventually used to portray a movement away from the body, indicating that the dog has run away. These illustrations show that the right and left hand work together to convey semantic meaning. Moreover, it may be argued that the right hand is used to reduce the cognitive load of sentence processing. If the *away*-movement had been portrayed with the left hand, the participant would first have had to refer back again to the dog with this hand after she had referred to the tree. Only then the *away*-movement could have been made. This would have been inefficient as it requires an additional gesture, which is unnecessary as the right hand demonstrates in figure 135. Hand choice might be efficiently organised to minimise the cognitive load of sentence processing.

Lausberg and Kita's (2003) study may clarify the hand choice for location and horizontal movements, but it cannot explain the handedness patterns for vertical trajectories. Their experiment only depicts a geometrical object on a horizontal line. Although the hands depict the same vertical trajectory as the one presented in the video, participants differ greatly individually in which hand, or hands they use to portray this vertical trajectory. The literature on trajectory (e.g. McNeill (1992); Parrill (2011) does not make an explicit division between



horizontal and vertical trajectories, since their focus is not on handedness. The analysis, however, has detected four different handedness patterns for vertical movements. First, participants may consistently use their dominant hand as they are more efficient with this hand. Second, different hand combinations are used to illustrate the trajectories of different characters. For example, participant 4 portrays Sylvester's vertical trajectories with both hands, but Tweety is presented with the left hand. Third, the same hands may be used for a subsequent gesture, and fourth, the successive rests of the hand may signal a switch to another hand, while simultaneously introducing a new narrative element into the story.

The correspondence between the trajectory and spatial location of characters in the video and their depiction by the hands indicates that there is a strong visual component in memory. The spatio-motoric information of the stimulus video might directly interact with the way participants gesture, without the interference of any linguistic segments. When the Action Generator activates the spatio-motoric information in memory, "certain features of the event, such as the direction of the motion, have to be specified regardless of their significance in the discourse" (Kita & Özyürek, 2003, p. 11). This means that thinking about a translocational motion, or location, involves the specification of directionality and location. These can be obtained from the stimulus video. This is not to say that the gesture always depict the same physical movement as the one portrayed on screen. The data have shown that directionality can be portrayed, while the physical movement of the character is left out of the gesture. For example, by using a metaphoric gesture, the participant can point a finger to the ground to indicate a downward movement. Also, Kita and Özyürek (2003) write that "directionality comes 'for free' in the process of activating the spatial imagery of the event" (p. 36), which is why it is not expressed in speech. This suggests that directionality is always activated, even when it contributes no significant information to the discourse. Therefore, directionality could be categorised as one of Holler and Beattie's (2012) semantic features that adds redundant information, and is not found in both modalities simultaneously. This view does not concur with McNeill's (1992) argument that gestures always encode essential information.

### 5.3 No Screen Influence on the Manner of Motion

Several different clarifications for the prioritisation of manner over direction in gesture are proposed here. The section then discusses the manner finding according to the Interface Hypothesis.

#### 5.3.1 Clarifications for the Prioritisation of Manner over Direction in Gesture

The main finding of this study is that manner of motion is sometimes prioritised over the direction of the trajectory in gesture. This means that the hand sometimes portrays a direction of motion that differs from the one depicted on screen. Therefore, *not all* observer viewpoint gestures that illustrate a trajectory of an animate character are affected by the stimulus animation in the video, and hence, the finding does not support the hypothesis. This result suggests that participants have remembered manner better than directionality. Yet, the question is why. No claims can be made about attention, awareness, or salience, since it is unknown to which features of the motion event participants attributed more importance or attention. Transitivity or viewpoint do not play a pivotal role either. McNeill (1992) has postulated that transitivity correlates with viewpoint. The data show that trajectory gestures, where path corresponds to screen, are narrated from observer viewpoint and also occur with intransitive sentences. For example, *Sylvester rent naar die hond toe* (P4-39 ENG: *Sylvester runs to the dog*). However, manner-trajectory conflating gestures, where manner is prioritised over direction, are also viewed from observer viewpoint and appear with intransitive sentences. This does not make them any different from trajectory gestures in general. Neither transitivity or viewpoint can clarify the difference in direction between manner gestures and trajectory only gestures.

The verb phrase might alter the direction of the trajectory. Participant 3 and 4 both display a gesture where the movement is made towards the front gesture space.

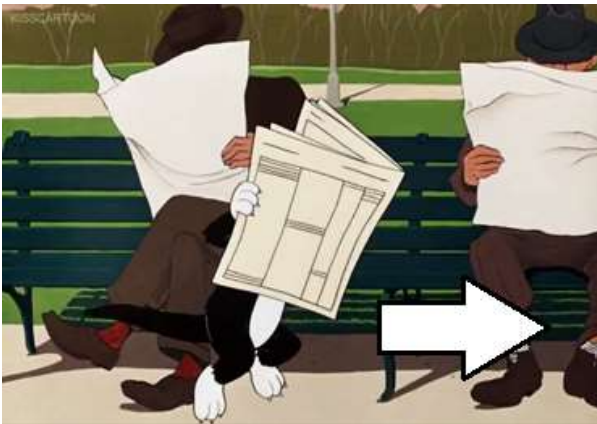


Figure 136. Sylvester hopping to the right.



Figure 137. P4-21 (NED): *Per man gaat ie zo tussendoor.*  
(ENG): *Sylvester moves in between the men.*



Figure 138. P4-22 (NED): *Dan rent ie naar Tweety toe.*  
(ENG): *Then Sylvester runs to Tweety.*



Figure 139. Tweety jumps to the right onto the woman's shoulder.



Figure 140. P3-14 (NED): *En die rent naar die vrouw.*  
(ENG): *And Tweety runs towards the woman.*



Figure 141. P3-18 (NED): *(Die ziet dan) die poes.*  
(ENG): *(The woman sees) the cat.*

Figure 136 shows that Sylvester is hopping to the right. Participant 4 gestures the exact same motion in figure 137, but then continues with a different gesture in figure 138. Participant 3 does not depict the same motion event from the video either. Whereas Tweety is running to the woman on the right, the participant portrays a gesture towards the front gesture space. Both participants thus illustrate a similar movement to the front which is accompanied by the verb phrase *rennen* (ENG: *run*). This verb phrase might have had an influence on the direction of the trajectory. Yet, the gesture's quality of these two participants differs. Participant 4 moves his entire arm in a fast manner to the front gesture space, while his hand

encloses an invisible entity. Participant 3, on the other hand, swings her hand to the front. Her hand is flat and the movement does not involve a fast motion. This gesture shows some resemblance to another gesticulation in her data. In figure 141, participant 3 portrays a similar swinging motion to the front. The gesture is not accompanied by the verb phrase *rennen*. The gesture in figure 141 bears some deictic quality. The gesture in figure 140 might be of the same quality and could refer back to *de vrouw* (ENG: *the woman*). The gesture may thus precede the lexical affiliate *de vrouw*, and therefore, may not correspond to the verb phrase *rennen*. The quality of a gesture is sometimes hard to determine, as McNeill (1992) argues, because gestures are not categorical, but dimensional. This specific gesture might also have a beat quality as well as a deictic reference. Moreover, another example from the data suggests that the verb phrase *rennen* may not have an influence on the direction.



Figure 142. Sylvester runs towards the right.



Figure 143. P4-111 (NED): *Sylvester die rent naar die hond toe.*  
(ENG): *Sylvester runs towards the dog.*

The participant depicts a movement towards the right, which corresponds to the motion on screen. Furthermore, the gesture is accompanied by the verb phrase *rennen*. The direction of the gesture and the motion event are similar, suggesting that the verb phrase *rennen* may not have an effect on the trajectory and cannot clarify why the direction of manner gestures has been altered.

Perhaps the answer can be found in the participant's past experience with motion events, since bodily experiences are integral to cognition. Participant 1 portrays a hopping manner, as illustrated in figure 145, from right to left. The same motion is directed in the opposite way in the animation video (figure 144). The direction of the movements of the

gesture and the motion event do both not correspond. The hopping manner is not a movement that is regularly seen or performed in daily life. It might therefore have been kept in memory and portrayed first in gesture.

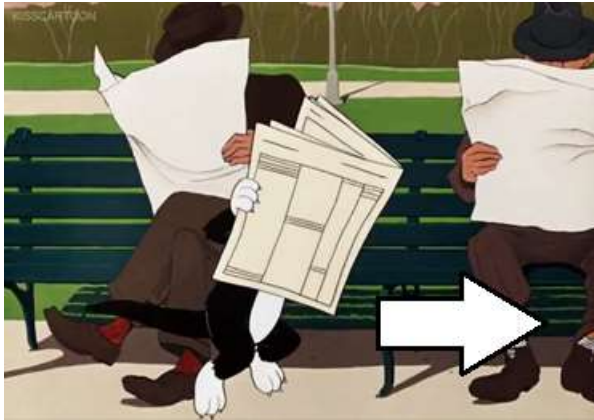


Figure 144. Sylvester hopping to the right.



Figure 145. P1-9 (NED): *(Die kat) zo een plek omschuiven tussen.*  
(ENG): *(The cat) is changing places between those men.*



Figure 146. P4-22 (NED): *Dan rent ie naar Tweety toe.*  
(ENG): *Then Sylvester runs to Tweety.*

It could be argued that it is the infrequency of a visual experience or past performance of an action that participants tend to remember first. Yet, figure 146 shows a regularly experienced motion, i.e. fast manner, where the trajectory also does not map onto its depiction in the video. The direction of the motion is made towards the front gesture space, while Sylvester runs towards the right on screen.

Manner of motion typically involves an iterated action that may have mnemonic benefits, and therefore, could clarify the prioritisation of manner in gesture. Figure 147 illustrates Sylvester continually chasing Tweety around the fountain. The participant is repeating a circular motion that depicts this movement. Yet, not all manner gestures from observer viewpoint carry such an internal repeated structure. The gesture in figure 149 is only presented once.



Figure 147. Sylvester chasing Tweety clockwise around the fountain.



Figure 148. P6-14 (ENG): *He is chasing him around the fountain.*



Figure 149. P4-22 (NED): *Dan rent ie naar Tweety toe.*  
(ENG): *Then Sylvester runs to Tweety.*



Hence, Iterated actions of manner cannot explain the difference between manner and trajectory gestures without manner. Manner gestures can also consist of abstract concepts, like the circular shape of the chase around the fountain (figure 147). The circular form can be made by gesturing a circle in space with one hand, or two hands, or with one finger. The movement that takes the shape of the circle can be clockwise, or counter clockwise. The direction of this movement and its place in the gestural space are irrelevant, because its iconic shape is what makes the circle a circle. Iconicity, like abstractness, is not spatially bounded. Manner is iconic as it embodies a picturable aspect of the stimulus event or speech (McNeill, 1992). Trajectory, on the other hand, has a deictic quality. It can also be referred to as “translocational” motion (Kita & Özyürek, 2003, p. 11), where a character moves from one location to another. Unlike manner, the direction of this trajectory is location-bounded. For example, when the hands portray a downward movement to depict Sylvester’s falling motion, a different scene is illustrated than when Sylvester is running from left to right. The location-bounded quality of trajectory gestures, without manner, cannot clarify why the trajectory of manner-trajectory conflating gestures is not spatially constrained to their trajectory on screen.

How motion event features are encoded in different languages might contribute to clarifying why the direction of manner gestures does not correspond to the character’s trajectory. Manner and trajectory have been compared cross-linguistically (e.g. Slobin, 1987; Özyürek & Ozcaliskan, 2000; Kita & Özyürek, 2003). Slobin (1987) has found that discourse is organised according to how speakers encode path and manner in their language. Speakers of verb-framed languages tend to refer more to path verbs than speakers of satellite-framed languages. They tend to subordinate manner in the main verb. More manner verbs than path verbs can be found in satellite-framed languages. These languages omit path in the main verb (qtd. in Özyürek & Ozcaliskan, 2000). As the satellite-languages in our data set (i.e. Dutch and English) have the tendency to prefer manner in the main verb, they may also choose to portray this aspect in manner over trajectory. This might explain the manner pattern in the data.

Some of these clarifications might reasonably contribute to the explanation of why manner is prioritised over the direction of the trajectory in gesture. However, Kita and Özyürek’s (2003) Interface Hypothesis might provide a clearer understanding of how the retrieval of spatio-motoric information from memory works and why mental representations give rise to such remarkable manner patterns in co-speech gesture. Different components of the Interface Hypothesis are described in order to localise where in this speech-gesture model the direction of manner gestures alters.

### 5.3.2 The Interface Hypothesis: a Cognitive Interpretation of Manner

The mismatched trajectory of manner gestures suggests that there is some cognitive process that impedes the influence of the screen on this kind of gesture. This cognitive process has not been specifically integrated in the Interface Hypothesis, but it could be taken up somewhere in Kita and Özyürek (2003)'s speech production model. Kita and Özyürek (2003) write that the online feedback from the Formulator via the Message Generator establishes some of the content that is presented in gesture. This process could therefore be a reason for the alteration of direction in manner gestures. The Message Generator produces a linguistic unit to be expressed in speech based on the spatio-motoric information from the Action Generator. This information (i.e. the message) is then send to the Formulator, which evaluates whether the message fits within a processing unit. If the message is not verbalizable within a processing unit, it is send back to the Message Generator and adjusted. There is a possibility that the on-screen trajectory information, which should appear in manner gestures, is discarded from the message and left out in gesture. Kita and Özyürek (2003) argue that the on-screen trajectory information is dropped in languages like Turkish and Japanese. Both are verb-framed languages. The languages in our data set (i.e. Dutch and English), however, encompass a greater processing unit that is able to encode trajectory as well as manner. This feedback process therefore cannot explain the manner pattern found in our data. Furthermore, this processing unit implies that gesture does not directly interact with gesture, but is always interfered by a linguistic process. This argues against what has been put forward earlier that there is a direct interplay between speech and gesture.

The Communication Planner might be prioritising manner because of its consequentiality for the plot development. It knows which messages have been conveyed so far and plans the information that has yet to come in order to contribute to the global goal of the discourse. During this process, it might attribute more prominence to narrative features, such as manner (Kita and Özyürek, 2003). The fast manner and collar, as depicted in figure 150, are essential to the plot sequence.



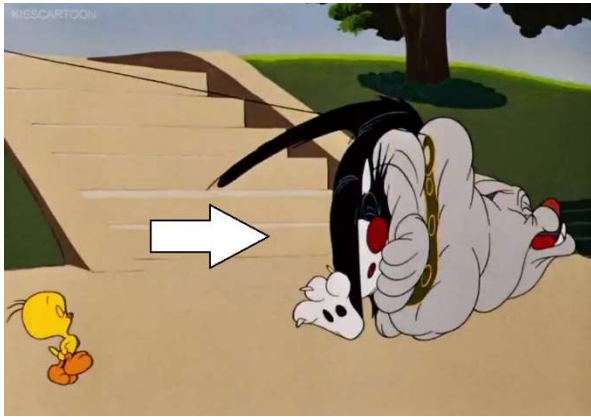


Figure 150. Sylvester bumps into the dog towards the right.



Figure 151. P4-113 (NED): *Dat die hond door de halsband vliegt.*  
(ENG): *The dog is flying through the collar.*



Figure 152. P4-115 (NED): *En dan komt Sylvester in die halsband.*  
(ENG): *And the collar is around Sylvester's neck.*

The participant's direction of the motion does not correspond to Sylvester's rightward trajectory. Participant 4 makes a movement to the front gesture space. This movement is fast as Sylvester has to run fast enough to get into the collar. His gesture might minimise the cognitive load for the next scene, where Sylvester walks like the dog in the collar of the dog. The dog's collar is depicted in figure 152. The rheme of the utterance, that is (theme: *the dog is*) *flying through the collar*, now functions as the theme for the next utterance, in which *the collar is around Sylvester's neck*. However, not every manner gesture from observer viewpoint seems to be consequential for the plotline, as illustrated in the following figures:

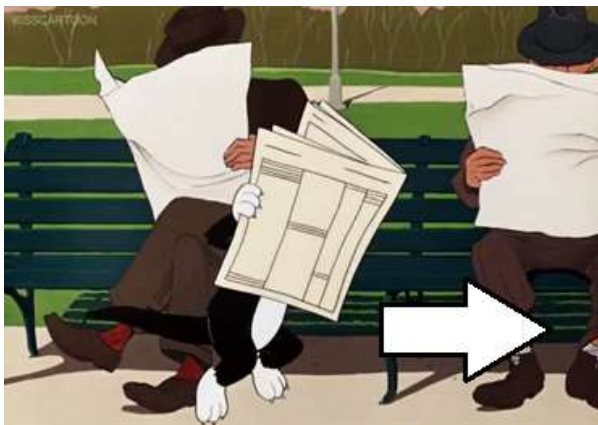


Figure 153. Sylvester hopping to the right.



Figure 154. P1-9 (NED): *(Die kat) zo een plek omschuiven tussen.*  
(ENG): *(The cat) is changing places between those men.*



Figure 155. P4-22 (NED): *Dan rent ie naar Tweety toe.*  
(ENG): *Sylvester runs towards Tweety.*

The participants illustrate the beginning scene where Sylvester is approaching Tweety. Participants vary in their manner gestures of this scene. Participant 1 depicts the same hopping manner as in figure 153, but in the opposite direction. Participant 4 portrays the exact same hopping manner in gesture, as portrayed in figure 153, but this gesture is followed by the gesture depicted in figure 155. He makes a fast moving gesture to the front gesture space, which is completely different from the gesture of participant 1. This suggests that the manner in which Sylvester is approaching Tweety is not of importance for the next scene where Tweety is having a bath. Some other cognitive process other than the Communication Planner might explain the manner results.

The Action Generator might be responsible for the observed manner pattern. This is where spatio-motoric representations are generated, and information on directionality can be found. As has been mentioned, Kita and Özyürek (2003) have claimed that the “directionality comes ‘for free’ in the process of activating the spatial imagery of the event” (p. 36). They further add that since participants have watched a stimulus video, it is likely that the direction can be obtained from the screen. However, the direction might not always come ‘for free’, as the data have shown that directionality is obstructed in some way. I suggest that there are at least three possible ways how direction can be cognitively obstructed. The first one is that manner is remembered better than the directionality of the same gesture. Participants are selective in what they memorise due to their short working memory and brain capacity. Not every feature of the six-minute video can be remembered. Trajectory might be regarded as redundant information, and therefore, have been left out of memory. This limits the selection process of the Action Generator, as it has no access to that kind of information. Yet the data show that participants do remember the direction of the trajectory when their previous gestures are taken into consideration:

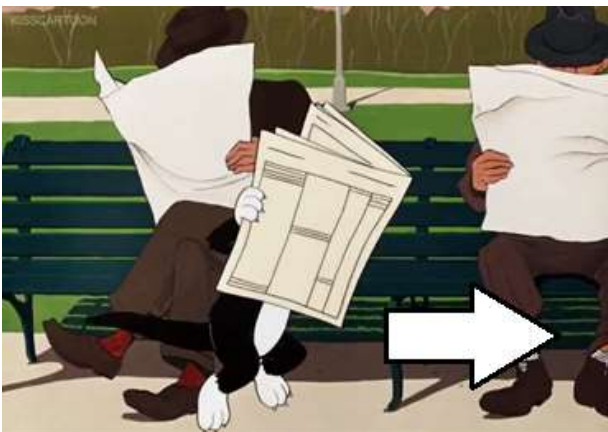


Figure 156. Sylvester hopping to the right.



Figure 157. P4-21 (NED):  
*Per man gaat ie zo  
tussendoor.*  
(ENG): *Sylvester moves in  
between the men.*



Figure 158. P4-22 (NED):  
*Dan rent ie naar Tweety toe.*  
(ENG): *Sylvester runs towards  
Tweety.*

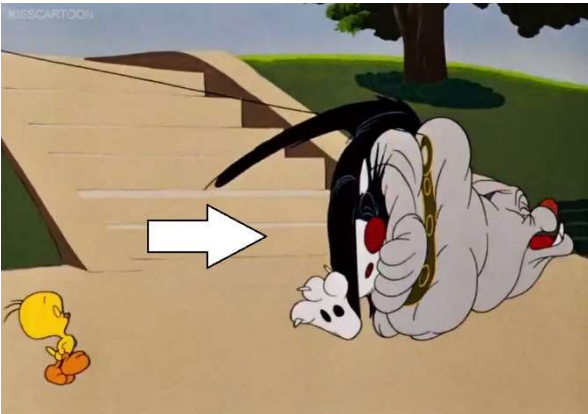


Figure 159. Sylvester bumps into the dog towards the right.



Figure 160. P7-54 (ENG): *So now the cat has an opportunity to getting to the bird.*



Figure 161. P7-57 (ENG): *But he hits the dog and gets into the collar of the dog.*

In figure 156, Sylvester hops from left to right. Participant 4 demonstrates a similar movement to the right in figure 157. Yet, the gesture that follows in figure 158 shows that the direction has been altered to the front gesture space. Similar to participant 4, participant 7 portrays a movement towards the right in figure 160, as Sylvester is moving to the right. However, the subsequent gesture demonstrates a hand movement to the left (figure 161). From this information, it can be inferred that participants have remembered the corresponding direction of the on-screen trajectory, but somehow it is not presented in the subsequent gesture. The first explanation might not hold.

Because of its autonomy, the Action Generator might select manner over trajectory. This may result in a gesture in which the path does not depict the exact same direction as portrayed in the stimulus video. Kita and Özyürek (2003) write that the Action Generator is selective to what features of the stimulus action are to be mimicked in gesture. Manner does not always have a direction. For example, wiggling fingers might portray a fast manner, but no direction. However, when manner does have a direction, the Action Generator needs to specify the direction. The Action Generator might take the direction from the stimulus video, or it may select a trajectory different from the screen in order to give more prominence to manner. This suggests that manner is not location-bounded. When prioritising manner, the Action Generator might constrain the ‘for free’ direction of manner gestures. This second explanation could be considered a preventive action. The third way to obstruct the direction of the stimulus event is to alter its direction. The data, unfortunately, do not provide any clues as

to which of these cognitive processes impedes the direction of the stimulus event. I can only conclude that some cognitive process, as part of the Action Generator, has an influence on the direction of manner, which might not have anything to do with how much participants are able to memorise. Furthermore, it is questionable whether Kita and Özyürek's (2003) term 'for free' is entirely appropriate, since it has just been explained that the direction does not always come for free.

The returning question of *why* participants would prioritise manner at all has been left unanswered so far. The task of the experiment plays a crucial role in providing an answer to this question. Participants were expected to be cooperative in that they did what they were told to do. They retold the events of the cartoon video to someone else. As they watched the cartoon video, they memorised the event sequences of the stimulus animation. Almost all of these events describe how Sylvester is chasing Tweety, and they do so in all kinds of different ways. The chase is repetitive, but the manner is not. In order to memorise the scenes, participants might be prioritising manner over the direction of the trajectory. Hence, they do not only remember the cartoon video as chase one, chase two, chase three etcetera. After the first chase, the second chase becomes given information, while the manner, which happens in all sorts of different ways, is still regarded as new info. This new information serves to separate each event from one another, and to memorise the entire story better. Thus, manner might be seen as a mnemonic device that facilitates the cognitive organisation of the speaker's narrative. What can also be concluded is that directionality should not be regarded as non-redundant information, which argues against Holler and Beattie (2012). The analysis of direction of motion has provided further insight into how participants cognitively structure their narrative retelling. I agree with McNeill (1992), when he argues, every "gesture is necessary to provide a complete insight into the scene the narrator has in mind" (Holler & Beattie, 2003, p. 110).

## 6. Conclusion

This study investigated how spatio-motoric information of a cartoon video was depicted by the hands, and why a particular hand, or hands, were used in order to provide more insight into the cognitive processes that underlie gesture and speech. Thus, it examined which motion properties influence hand choice. The research questions phrased were: how is spatio-motoric information of the stimulus video represented in gesture? Which hands are used to depict the video's motion properties? And furthermore, why do the hands depict the spatial features in this way? These research questions were inspired by Lausberg and Kita's (2003) study. They found that hand choice was influenced by the spatial location of the geometrical object on screen. When the object appeared on the left side of the screen, the left hand was used, and the right hand referred to the object on the right side. This paper conducted an experiment that tested Lausberg and Kita's (2003) findings in a less controlled, more naturalistic, and communicative setting. Participants were asked to retell the cartoon video *Home Tweety Home*, where Sylvester chases Tweety, to a recipient. The cartoon video consisted of components that could complicate the handedness question. It revolved around Sylvester and Tweety's actions, their attributes, and events. Moreover, the video also showed motion properties of the stimulus events, which were location, trajectory, manner, and viewpoint. Viewpoint could be narrated from three different viewpoints: observer, character, or dual viewpoint. A detailed qualitative analysis of handedness was carried out in relation to the following motion properties: location, trajectory, manner, and viewpoint. The results were interpreted according to Kita and Özyürek's (2003) Interface Hypothesis, which states that spatial imagery give rise to co-speech gestures. This hypothesis provided a profound understanding of how gestures are generated based on the participant's visual experience of the stimulus video.

Several handedness patterns have emerged during the analysis. The findings have shown that character and dual viewpoint gestures were sometimes influenced by what participants had seen in the stimulus video from observer perspective. The Action Generator, as part of the Interface Hypothesis, might play a role in this. Character viewpoint might not be available during the selection process of the Action Generator due to the short remembrance of the specific fragment. This result does not argue against the hypothesis that the spatial location and trajectory of the hand(s) of observer viewpoint gestures of locomotion of animate characters is influenced by the screen. It rather shows that the hypothesis can be extended to include character viewpoint gestures as well.

The second finding has indicated that the screen influences the trajectory and location of the hands. The hands depicted the path and spatial location of the entities in the animation video. This result is in line with Lausberg and Kita's (2003) findings and with the hypothesis. However, there was also variation in hand use, which suggests that the spatial location of an entity is not always binary mapped onto a particular hand. Lausberg and Kita (2003) do not clarify the handedness pattern for vertical movements in their study as their geometrical objects moves on a horizontal line, and not vertical. Their findings therefore only support the screen influence on the horizontal movements and location of the hands. The individual differences in hand choice in this study have shown that different factors influenced hand choice for vertical trajectories: (1) some participants mainly used their dominant hand as they can act more efficiently with it, (2) participants used different hand combinations to depict the vertical trajectories of different characters, (3) hand choice was influenced by a preceding gesture, and (4) the return of the hand to its resting position indicated a switch from one hand to the other, and the introduction of a new story element in the discourse. These trajectories did not always involve a physical movement. There was also variation in hand choice when portraying the location of characters, but which simultaneously corresponded to their spatial location on screen. This suggests that participants may remember the exact same scene in different ways. These findings may also imply that a strong visual component is present in memory. For directionality, Kita and Özyürek (2003) have proposed that the Action Generator has to specify direction due to the imagistic nature of gestures.

An unexpected finding of this study is that manner gestures from observer viewpoint tended to have a trajectory that did not match their path in the stimulus video. Thus, manner was sometimes prioritised over the direction of path in gesture. Instead of directionality coming 'for free', as suggested by Kita and Özyürek (2003), the direction is obstructed cognitively. The Action Generator might select manner over direction, and constrain or alter the 'for free' direction of manner gestures. The direction might be obstructed due to the task of the experiment. Participants were asked to retell a cartoon video to someone else, and in order to do so, they needed to memorise what they had seen. These manner gestures show how they have memorised the event sequences of the video. Although the chasing is repetitive, the manner is not as it happens in all kinds of forms. Manner gestures provide extra information that serves as a mnemonic device to distinguish the event sequences from each other and to cognitively structure the story of the narrator.

This study is limited in that not all participants were recorded in the same testing room due to their geographical distance. Since the previous experiment resulted in a failed attempt,



new participants had to be recruited in a short time frame at different places. The data therefore were complemented by participants of Dr. Geenen's data. Another limitation of the data is that some participants were seated in a chair with arm rests. There was one participant who leaned with her arm on one arm rest the entire time during the experiment. This affected her hand choice; she only used one hand to gesture, and hence, was discarded from the data. The other two participants also sat in a chair with arm rests, but did vary in hand choice. They were considered in the analysis. For future research, participants should be tested in the same testing room in a chair without arm rests so that all conditions are the same. This study also encountered some difficulties during the testing phase. Participants indicated that they were nervous. Some tried too hard to remember the narrative, even when I told them detail was not important. Others gave a brief retelling of the cartoon video. Both situations resulted in a very low gesture frequency. This is odd, since the instructions remained the same throughout the testing of all participants. The laptop screen might have had an effect on gesture rate. Participants were not directly facing the screen, but the screen was on the table next to them in order to provide a clear view of the participant. It was perhaps too close. A camera further removed from the participants, as in Dr. Geenen's data, might have been more suitable.

This study tested the effect of the screen on short term memory, as participants watched the stimulus video only twice. Future research could study the long-term effects of the screen on hand choice. Participants, for example, could watch the video every day, and at the end of the week a testing phase may take place. A long-term effect study would find out whether the findings of this study would change, which suggests more cognitive alterations may be taking place. Another possibility for future research is to include verb-framed languages as well. This study only considered seven participants, who were either native speakers of Dutch or non-native speakers of English. Thus, only satellite-framed languages were subjected to an analysis. Kita and Özyürek (2003) have examined the information packaging of gesture and speech across these types of languages, but there was no mentioning of this unexpected manner pattern. Thus, a future large-scale study would find out whether verb-framed languages display a similar manner pattern as satellite-framed languages do. Any more differences across these types of languages could indicate that cognitive alterations are specific to the type of language.

The analysis of this study has shown how spatio-motoric information of the stimulus video is represented in gesture. It has found that the screen influences the hand choice for trajectory and location gestures, similar to what Lausberg and Kita (2003) and Kita and Özyürek (2003) have observed. Nevertheless, it has also observed that direction is sometimes

subordinated to manner in order to give manner more prominence in gesture. This suggests that manner might serve as a mnemonic device which enables speakers to cognitively structure their narrative. Thus, people do not exactly replicate what they see, but cognitively alter the presented information for the purpose of a certain task.

## 7. References

- Alibali, M. W., Heath, D. C., & Myers, H. J. (2001). Effects of visibility between speaker and listener on gesture production: Some gestures are meant to be seen. *Journal of Memory and Language*, 44: 169–188.
- Allen, G. L. (2003). Gestures accompanying verbal route directions: Do they point to a new avenue for examining spatial representations? *Spatial Cognition and Computation*, 3: 259–268.
- Beattie, G., & Sale, L. (2012). Do metaphoric gestures influence how a message is perceived? The effects of metaphoric gesture-speech matches and mismatches on semantic communication and social judgment. *Semiotica* 192: 77-98.
- Beattie, G., & Shovelton, H. (2002). What properties of talk are associated with the generation of spontaneous iconic hand gestures? *British Journal of Psychology*, 41: 403-417.
- Beilock, S. L., & Holt, L. E. (2007). Embodied preference judgments: Can likeability be driven by the motor system? *Psychological Science*, 18(1): 51-57.
- Butterworth, B., & Beattie, G. (1978). Gesture and silence as indicators of planning in speech. In: Campbell, R. N., & Smith, P. T. (Eds.), *Recent Advances in the Psychology of Language*. New York and London: Plenum Press, 347-360.
- Butterworth, B., & Hadar, U. (1989). Gesture, speech, and computational stages: a reply to McNeill. *Psychological Review*, 96: 168–174.
- Cartmill, E. A., Beilock, S., & Goldin-Meadow, S. (2012). A word in the hand: action, gesture and mental representation in humans and nonhuman primates. *Philosophical Transactions of The Royal Society B* 367: 129-143.
- Casasanto, D. (2009). Embodiment of abstract concepts: good and bad in right-and left-handers. *Journal of Experimental Psychology: General*, 138(3): 351-367.
- Casasanto, D., & Jasmin, K. (2010). Good and bad in the hands of politicians: Spontaneous gestures during positive and negative speech. *Plos One*, 5(7), e11805.
- Cassel, J., McNeill, D., & McCullough, K. (1999). Speech-gesture mismatched: Evidence for one underlying representation of linguistic and nonlinguistic information. *Pragmatics and Cognition* 7(1): 1-34.
- Cienki, A., & Müller, C. (2008). Metaphor, gesture, and thought. In: R.W. Gibbs (Ed.), *The Cambridge Handbook of Metaphor and Thought*. Cambridge: Cambridge University Press: 483-501.

- Cook, S.W., & Tanenhaus, M.K. (2009). Embodied communication: Speakers' gestures affect listeners' actions. *Cognition*, 113: 98–104.
- Crooks, R. L., & Baur, K. (2010). *Our Sexuality*. Boston: Cengage Learning.
- Dalby, J. T., Gibson, D., Grossi, V., & Schneider, R. D. (1980). Lateralized hand gesture during speech. *Journal of Motor Behavior*, 12(4): 292–297.
- Efron, D. (1941). *Gesture and Environment*. New York: King's Crown.
- Ekman, P., & Friesen, W. (1969). The repertoire of nonverbal behaviour: Categories, origins, usage, and coding. *Semiotica*, 1: 49-98.
- Foundas, A. L., Macauley, B. L., Raymer, A. M., Maher, L. M., Heilman, K. M., & Rothi, L. J. G. (1995). Gesture laterality in aphasic and apraxic stroke patients. *Brain and Cognition*, 29(2), 204–213.
- Goldin-Meadow, S., & Beilock, S. L. (2010). Action's influence on thought: The case of gesture. *Perspectives on Psychological Science*, 5(6): 664-674.
- Goldin-Meadow, S., Nusbaum, H., Kelly, S. D., & Wagner, S. (2001). Explaining math: Gesturing lightens the load. *Psychological Science*, 12(6): 516-522.
- Graham, J. A., & Argyle, M. (1975). A cross-cultural study of the communication of extra verbal meaning by gestures. *International Journal of Psychology*, 10: 57–67.
- Hadar, U. (1989). Two types of gesture and their role in speech production. *Journal of Language and Social Psychology*, 8(3-4): 221-228.
- Hadar, U., Wenkert-Olenik, D., Krauss, R., & Soroker, N. (1998). Gesture and the processing of speech: Neuropsychological evidence. *Brain and language*, 62(1): 107-126.
- Hampson, E., & Kimura, D. (1984). Hand movement asymmetries during verbal and nonverbal tasks. *Canadian Journal of Psychology*, 38: 102–125.
- Holler, J., & Beattie, G. (2003). How iconic gestures and speech interact in the representation of meaning: are both aspects really integral to the process? *Semiotica*, 146: 81-116.
- Holler, J., & Wilkin, K. (2011). Co-speech gesture mimicry in the process of collaborative referring during face-to-face dialogue. *Journal of Nonverbal Behavior*, 35(2): 133-153.
- Hostetter, A. B., & Alibali, M. W. (2008). Visible embodiment: Gestures as simulated action. *Psychonomic Bulletin and Review*, 15(3): 495-514.
- Iverson, J. M., & Goldin-Meadow, S. (1998). Why people gesture when they speak. *Nature*, 396(6708): 228-228.
- Iverson, J. M., & Thelen, E. (1999). Hand, mouth and brain: The dynamic emergence of speech and gesture. *Journal of Consciousness Studies*, 6(11-12): 19-40.

- Kimura, D. (1973a). Manual activity during speaking – I. right-handers. *Neuropsychologia*, 11(1): 45-50.
- Kimura, D. (1973b). Manual activity during speaking – II. left-handers. *Neuropsychologia*, 11(1): 51-55.
- Kita, S., de Condappa, O., & Mohr, C. (2007). Metaphor explanation attenuates the right-hand preference for depictive co-speech gestures that imitate actions. *Brain and Language*, 101(3): 185-197.
- Kita, S., & Özyürek, A. (2003). What does cross-linguistic variation in semantic coordination of speech and gesture reveal? Evidence for an interface representation of spatial thinking and speaking. *Journal of Memory and Language* 48: 16-32.
- Krauss, R. M. (1998). Why do we gesture when we speak? Current Directions in *Psychological Science*, 7: 54-60.
- Krauss, R. M., Chen, Y., & Gottesman, R. F. (2000). Lexical gestures and lexical access: a process model. In: D. McNeill (Ed.), *Language and Gesture*. Cambridge: Cambridge University Press: 261-283.
- Krauss, R. M., & Hadar, U. (1999). The role of speech-related arm/hand gestures in word retrieval. *Gesture, Speech, and Sign*, 93.
- Lausberg, H., & Kita, S. (2003). The content of the message influences the hand preference in co-speech gestures and in gesturing without speaking. *Brain and Language*, 86: 57-69.
- Lausberg, H., Zaidel, E., Cruz, R. F., & Ptito, A. (2007). Speech-independent production of communicative gestures: Evidence from patients with complete callosal disconnection. *Neuropsychologia*, 45(13): 3092-3104.
- Lavergne, J., & Kimura, D. (1987). Hand movement asymmetry during speech: No effect of speaking topic. *Neuropsychologia*, 25: 689–693.
- Levelt, W. J. M. (1989). *Speaking: from intention to articulation*. London: The MIT Press.
- Levelt, W.J.M., Richardson, G., and La Heij, W. (1985). Pointing and voicing in deictic expressions. *Journal of Memory and Language*, 24: 133–64
- Lüke, C., & Ritterfeld, U. (2014). The influence of iconic and arbitrary gestures on novel word learning in children with and without SLI. *Gesture* 14(2): 203-224.
- McCullough, K.E. (1993). Spatial information and cohesion in the gesticulation of English and Chinese speakers. A paper presented at the annual meeting of American Psychological Society. Chicago.
- McNeill, D. (1992). *Hand and mind*. London: The University of Chicago Press.

- McNeill, D. (2005). *Gesture and thought*. London: The University of Chicago Press.
- McNeill, D., & Pedelty, L. L. (1995). Right brain and gesture. In: J. K. R. Emmorey (Ed.), *Language, Gesture, and Space*. New Jersey: Lawrence Erlbaum Associates, 63-85.
- McNeill, D., & Levy, T. E. (1993). Cohesion and gesture. *Discourse Processes* 16(4): 363-386.
- Mol, L., & Kita, S. (2012). Gesture structure affects syntactic structure in speech. *Proceedings of the Cognitive Science Society*, 34(34): 761-766.
- Ortega, G., & Morgan, G. (2015). Input processing at first exposure to a sign language. *Second Language Research* 19(10): 443-463.
- Ozcaliskan, S., & Slobin, D. I. (1999). Learning how to search for the frog: Expression of manner of motion in English, Spanish, and Turkish. In *Proceedings of the 23rd Annual Boston University Conference on Language Development*. Sommerville, MA: Cascadilla Press: 541-552.
- Papadatou-Pastou, M. (2011). Handedness and language lateralization: why are we right-handed and left-brained. *Hellenic Journal of Psychology*, 8: 248-265.
- Parrill, F. (2010). Viewpoint in speech–gesture integration: Linguistic structure, discourse structure, and event structure. *Language and Cognitive Processes*, 25(5), 650-668.
- Parrill, F. (2011). The relation between the encoding of motion event information and viewpoint in English-accompanying gestures. *Gesture*, 11(1), 61-80.
- Rauscher, F. H., Krauss, R. M., & Chen, Y. (1996). Gesture, speech, and lexical access: the role of lexical movements in speech production. *Psychological Science*, 7: 226–231.
- Selzer, E. (Executive Producer). (1950, January 14). *Home Tweet Home*. [Television Broadcast]. California, CA: Warnerbros Pictures.
- Seyfeddinipur, M., & Kita, S. (2001). Gesture and dysfluencies in speech. In: C. Cavé, I. Guaïtella & S. Santi (Eds.), *Oralité et gestualité: Interactions et comportements multimodaux dans la communication [Orality and gestuality: Multimodal interaction and behavior in communication]*. Actes du colloque [Proceedings of the meeting of ORAGE 2001]. Paris, France: L'Harmattan: 266–270.
- Slobin, D. 1987. Thinking for speaking. In J. Aske, N. Beery, L. Michaelis, H. Filip (eds.), *Proceedings of the 13th Annual Meeting of the Berkeley Linguistic Society Meeting*: 435-445.
- Sousa-Poza, J. F., Rohrberg, R., & Mercure, A. (1979). Effects of type of information (abstract-concrete) and field-dependence on asymmetry of hand movements during speech. *Perceptual and Motor Skills*, 48(3): 1323–1330.



- Stephens, D. (1983). *Hemispheric language dominance and gesture hand preference*.  
University of Chicago, Department of Behavioural Sciences.
- Wagner, S. M., Nusbaum, H., & Goldin-Meadow, S. (2004). Probing the mental representation of gesture: Is handwaving spatial?. *Journal of Memory and Language*, 50(4): 395-407.
- Winkielman, P., Schwarz, N., Fazendeiro, T., & Reber, R. (2003). The hedonic marking of processing fluency: Implications for evaluative judgment. In: J. Musch & K. C. Klauer (Eds.), *The psychology of Evaluation: Affective Processes in Cognition and Emotion* New Jersey: Lawrence Erlbaum Association: 189-217.
- Wilkins, D. (2003). Why pointing with the index finger is not a universal (in sociocultural and semiotic terms). In: S. Kita (Ed.), *Pointing: Where Language, Culture, and Cognition Meet*. New Jersey: Erlbaum: 171-215.

## **8. Appendix (USB)**