Patterns of gesture in conversations involving adults with acquired hearing impairment and their frequent communication partners

By

Karen Margrethe Sparrow

Thesis
Submitted to Flinders University
for the degree of

Doctor of Philosophy

College of Nursing and Health Sciences
February 13th 2023

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SUMMARY

Adults with acquired hearing impairment commonly experience speech perception difficulties despite the use of hearing technology, particularly in the presence of background noise. It is well recognised that the addition of visual information provided by the articulators (lipreading) tends to improve speech perception. However, little is known about other sources of visual information, including the patterns of hand and arm gestures, arising in conversations. The aim of the present research was to explore the influence of acquired hearing impairment on patterns of co-speech gesture produced by frequent (normally hearing) communication partners during face-to-face dyadic interactions in quiet and in background noise during different conversational tasks.

This thesis presents results regarding the patterns of gesture occurring in an initial exploratory case study followed by a series of six case studies. Each case study comprised two normally hearing adult frequent communication partners and one with hearing impairment. The focus of the study was the patterns of gestures produced by the normally hearing principal communication partner in each case study when interacting with their communication partner with hearing impairment and subsequently in interaction with their normally hearing communication partner. Each dyad participated in a free conversation and a short film narration. Audio-visual recordings were sampled and underwent systematic multi-layered transcription. The dependent variables examined were gesture frequency, gesture type, imagistic gesture size and gaze direction during imagistic gesture production.

Quantitative analysis revealed several trends in the gesture production of the principal communication partners, specifically:

- there was a trend towards a higher gesture rate with communication partners with hearing impairment than with normally hearing communication partners in quiet conversation. The effect of noise was to increase gesture rate regardless of hearing status.
- imagistic and interactive gestures were the predominant types of gesture. Proportions of imagistic gestures were higher in narrative than in conversation and proportions of interactive gestures were higher in conversation than narrative in most cases. Gesture rates were also higher in narrative than in conversation in most cases.
- in analysis of gesture size, there was a trend for larger gestures to be produced in quiet interactions with the communication partner with hearing impairment.. An effect of hearing impairment was also found in two cases, in which higher proportions of large imagistic

gestures were produced with the communication partner with hearing impairment in noise and quiet conditions.
- the predominant gaze direction while gesturing was toward the communication partner across all interactions. The proportion of gaze toward the communication partner increased in noise but no effect of hearing impairment was found.

Overall, the results show considerable variability across the participants and provide limited support for a substantial effect of hearing impairment on gesture characteristics in quiet or in noise. Qualitative observations revealed some distinct patterns of gesture use arising during instances of communication breakdown and repair, which warrant future study. The successful methods of gesture elicitation and analysis together with the findings present an opportunity for ongoing investigation of gesture to further develop approaches to hearing rehabilitation and communication partner training.

DECLARATION

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university: and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Signed ....Karen M Sparrow........
Date........13/02/2023..................

The guidelines of the American Psychological Association 7th edition along with Flinders University HDR thesis guidelines have been used in the preparation of this thesis.

No editor has been employed for the preparation of this thesis.

ACKNOWLEDGEMENTS

Foremost, I wish to thank Associate Professor Christopher Lind, my primary supervisor, and Dr Willem van Steenbrugge, my associate supervisor, for their guidance and advice throughout my candidature. I am extremely grateful to them for their encouragement and support, without which I could not have undertaken this project.

I acknowledge that this research was supported by a fee offset Australian Government Research Training Program (RTP) Scholarship.

Special thanks to Associate Professor Nicola Daly, as advisor, for her valuable feedback on the final draft thesis. I also wish to thank Karinna Hall, Gemma Elliott, and Jessica Young for their invaluable assistance with transcription and inter-rater reliability coding. Thanks also go to David Heinrich for his graphic design advice and assistance.

I am also grateful to Kathleen Holland at Flinders Medical Centre and Nina Swiderski at the South Australian Cochlear Implant Centre for their assistance in recruiting participants for this project. Thanks also go to the twenty-one participants for their cooperation and without whom this research would not have been possible

I would like to acknowledge my colleagues in Speech Pathology and Audiology for their support, especially Dr Sarosh Kapadia and Ms. Fleur Golder and over the past 18 months Professor Raj Shekhawat.

Finally, I would like to recognize my husband Juan and my mother for their patience, understanding and constant support throughout this journey.

PUBLICATIONS BY THE CANDIDATE RELEVANT TO THE THESIS

Sparrow, K., Lind, C., van Steenbrugge, W. (2020) Gesture, communication, and adult acquired hearing loss. *Journal of Communication Disorders,* 87, 106030. https://doi.org/10.1016/j.jcomdis.2020.106030[1]

Sparrow, K., Lind, C., van Steenbrugge. (2018, July 4–8). *Patterns of gesture in conversations involving hearing impaired adults and their frequent communication partners.* [Paper presentation]. 8th Conference of the International Society for Gesture Studies, Cape Town, South Africa.

Sparrow, K., Lind, C., van Steenbrugge, W. (2016, July 18–22) *Patterns of co-speech gesture in conversations involving hearing impaired adults and their frequent communication partners: A preliminary case study.* [Poster presentation]. 7th Conference of the International Society for Gesture Studies, Paris.

[1] Chapters 1 and 2 of this thesis include text from this journal article

ABBREVIATIONS

HI	hearing impairment/ hearing impaired
CP	communication partner
PCP	principal communication partner
CPHI	communication partner/s with hearing impairment
CPNH	communication partner/s with normal hearing
CI	cochlear implant
dB	decibel
dB(A)	decibel measured on an A weighted scale
PTA	pure tone average

1 INTRODUCTION

The production of gesture by communication partners (CP) when interacting with individuals with hearing impairment (HI) is the focus of this thesis. The use of gesture is universal in human communication (Gullberg, 2013b; McNeill, 2000). Participants in everyday face-to-face communication use gestures embedded in their own or their partner's communication to augment, contextualize, clarify, or otherwise support the spoken word (Church & Goldin-Meadow, 2017; Wagner et al., 2014). Typically, gestures are closely linked to the speech they accompany and may be described by their form and function. They may be differentiated as gestures marking word and phrasal meaning, object or action attributes, metaphorical characteristics of a spoken turn, temporal stress patterns in interaction, or as carrying interactional purpose (Kendon, 2004)

In the context of communication disorders, individuals often show reduced ability to plan or execute the spoken message or to access the content or meaning of another person's talk. This may increase the value of and the reliance placed on gestures by the individual (Eggenberger et al., 2016; Rose, 2013; Sekine & Rose, 2013). This is typically the case for an individual who has HI (Erber, 1988; Tye-Murray et al., 2007). Despite ongoing improvements in technology, neither hearing aids nor cochlear implants can fully restore hearing abilities sufficiently for successful everyday interaction in many adults with HI, particularly under adverse listening conditions (Lesica, 2018). Thus, the acquired HI may lead to greater reliance on visual information to enhance the comprehension of spoken messages (Tye-Murray et al., 2007).

This additional visual information can be split into two types. The first group comprises visual speech perception cues known as *lipreading* or *speechreading* (which typically focus on the movement of the articulators to aid speech reception). Lipreading has been the subject of much investigation and clinical activity in adult hearing rehabilitation (Erber, 1975, 1979; Kaplan et al., 1985; Lansing, 2013; Tye-Murray, 2020). The second group comprises extra-verbal visual communication cues that include hand and arm gestures, facial expression, gaze, and body posture. These visual communication cues have received less research attention to date within the context of conversations involving participants with HI.

Current hearing rehabilitation focuses on ways of assisting CPs to enhance conversational fluency in the presence of the difficulties imposed by HI (Erber, 1996; Erber & Lind, 1994; Lind, 2009; Montano, 2013). Prior to this work, hearing rehabilitation has concentrated on the benefits of using lip-reading cues. Questions addressing the role gesture plays during interactions, and how gestures might assist in reducing or resolving communication difficulties, remain largely unaddressed.

Hand and arm gestures, produced in the context of communication with individuals who have HI, are the central theme of this thesis. This chapter provides a synopsis of the key background issues which underpin this study and research directions addressed in the subsequent review of the literature in Chapter 2. The current chapter outlines the rationale, significance of the study and the overarching research questions followed by an overview of the subsequent chapters.

1.1 Background

The term *gesture* may be used broadly to refer to body movements, facial expression as well as hand and arm movements undertaken in the context of spoken communication, often referred to as *co-speech gesture* (Kendon, 2004; Wagner et al., 2014). These gestures are noted to occur spontaneously, often without conscious awareness, and are typically closely associated with the spoken content (Kendon, 2004). The use of gesture begins from an early age (Capone & McGregor, 2004) and has been observed to follow an identifiable pattern of development closely linked with spoken communication (Capone & McGregor, 2004; Goldin-Meadow, 2003). Gestures are produced universally but have been found to differ across cultures and are reflected in the culturally specific repertoires of conventionalised gestures (emblems and pointing gestures). Gesture form varies with differences in spoken language structure (lexical and syntactic) and spatial cognition (see Kita, 2009 for a review).

1.1.1 Gesture Studies

The history of the study of gesture has its beginnings in Roman times in connection with oratorical technique. The work of Quintilian on rhetoric from approximately AD 100 became particularly influential toward the end of 16th century. During the 17th to 19th centuries, scholarly discussions developed about gesture as the basis of a universal language and as the source of the natural origin of language (Kendon, 2004). Interest declined during the 19th century but began to revive in the mid-20th century. The evolution of recording technology underlies increasingly detailed descriptions of gestures and efforts to develop typologies of gesture. A variety of gesture categories have been identified and described (Efron, 1972; Ekman & Friesen, 1969; Freedman & Hoffman, 1967; McNeill, 1992). McNeill’s (1992) widely used typology has its basis in gesture function or meaning within the context in which it occurs and is the typology chosen in the current investigation.

1.1.2 Gesture Form and Function

Gestures typically have an observable physical structure (Kendon, 2004; McNeill, 1992). However, the nature of the movement of the hands in relation to one another, the forms produced, the movement trajectory, distance between the hands, and relationship to the spoken content may all vary greatly. Such gesture characteristics may be used to identify specific interactional function or meaning content that the speaker is conveying (McNeill, 2016). While the over-arching purpose of co-speech gesture remains a source of discussion, several theories and related computational models have been outlined in attempts to explain the function and process of gesture production and their relationship to spoken language. Speaker-related hypotheses suggest that gestures are produced to assist the speaker in speech production and word finding (Krauss et al., 2000) while listener-driven approaches support the theoretical construct of *communicative intent* that gestures are intended to provide a listener with information together with the spoken content (de Ruiter, 2000; Hostetter & Alibali, 2008, 2010; Kendon, 1994; Kita & Özyürek, 2003; McNeill, 1992; McNeill & Duncan, 2000).

Despite the differing perspectives, there seems to be a consensus amongst researchers that gesture and speech are part of one integrated system and may serve more than one function simultaneously (Wagner et al., 2014). They may serve an overt communicative function in interaction, which include providing information, clarifying, and/or highlighting aspects of the spoken utterance. They may also be a function which helps a speaker's verbal expression and the organization of thoughts (Gullberg, 2006a; McNeill, 2005). These theoretical models will be discussed in Chapter 2.

1.1.3 Acquired Adult Hearing Impairment

Hearing impairment is a common sensory disorder. Worldwide hearing impairment is estimated to affect over 1.5 billion individuals (Wilson, 2017). A reduction in hearing acuity may involve different components of the ear and hearing mechanism/sensory organ. A *conductive* hearing loss refers to a deficit of the outer or middle ear inhibiting the transmission of sound and damage to the sensory organ of the inner ear termed cochlea results in a *sensorineural* hearing loss (WHO, 2021). A mixed hearing loss refers to combination of both conductive and sensorineural site of lesion (Sheffield & Smith, 2019)

Hearing Impairment may be present from birth or infancy caused by genetic or environmental factors and may have a significant impact on speech and language acquisition (Wilson et al, 2017). By contrast, acquired HI refers to the postlingual onset of hearing loss. Among the causes are age-related decline, noise exposure as well as other diseases, viral infections, ototoxic agents or a combination of factors (Sheffield & Smith, 2019). Many of these aetiologies result in irreversible sensorineural HI which affects the ability of the inner ear to detect and transmit sound to the auditory centres of the brain (Lesica, 2018).

The degree of HI may be described as mild, moderate, severe or, profound based on audiometric test findings which measure the hearing threshold for pure tones across a range of frequencies (WHO, 2021). The WHO defines a disabling hearing loss in adults as a pure tone average of 40 decibels (moderate HI) or greater in the better ear in adults (Sheffield & Smith, 2019). However, sensorineural HI will not only impact hearing sensitivity, as measured using a standard audiometric test, but maybe associated with a reduction in loudness tolerance and an increase in distortion resulting in reduced speech discrimination ability (Lesica, 2018). Hence, it is recognised that the negative influence of acquired sensorineural HI on an individual's everyday communication may be greater than reflected by the pure tone hearing test (WHO, 2021)

Adults with acquired HI will typically seek assistance when functional communication difficulties in their participation in daily and social interactions become noticeable to the individual with HI and/or their significant others (Erber, 1988). With an increasing aging population and aging as a major cause of sensor-neural hearing loss (Bowl & Dawson, 2018), the importance of effective intervention for adults with acquired HI and their CPs to address their real-life communication difficulties becomes apparent. The focus of this thesis is on the influence of adults acquired sensorineural HI on communication behaviours, specifically gesture, used by their frequent CPs.

1.1.4 Gesture as a Compensatory Device

Gesture has long been recognized and explored as a potential compensatory device when either expression or comprehension of speech is hindered (Sekine et al., 2013). This has been particularly the case in research addressing neurologically-based language disorders (known as aphasia) resulting from stroke or other acquired brain impairments, which may impact on language production and/or reception (Sekine et al., 2013). Aphasia research has explored the communicative use of gesture including patterns of gesture production and perception. Findings suggest that individuals with aphasia gesture more frequently than individuals who do not have aphasia while specific gesture patterns are associated with aphasia type and severity (e.g., Sekine & Rose, 2013; Cocks et al, 2013). In addition, there is evidence to suggest that gesture can be used to supplement or replace a spoken message for individuals with aphasia that affects the individual's ability to receive and interpret another's talk (Eggenberger et al., 2016).

Hearing impairment presents primarily as a receptive communication disorder. Often, the acquisition of HI will significantly reduce the ability of an individual to perceive speech accurately and hence result in an increased likelihood of breakdown in communication potentially leading to reduced conversational fluency and success (Hetu et al., 1993; Lind et al., 2006). Two early studies in the 1970s demonstrated that meaningful gestures enhanced the visual speech perception performance (lip-reading/speech reading) of normally hearing adults (Berger & Popelka, 1971; Popelka et al., 1971). However, it is only in recent years that experimental studies have begun to create challenging listening situations and explore the potential complimentary benefits of gesture in greater depth. The above studies and those discussed in detail in Chapter 2 provide evidence for the role of gesture as a source of semantic and interactional information which may compliment auditory information when access to the spoken message is limited (Drijvers & Özyürek, 2017; Holle et al., 2010; Obermeier et al., 2012). These studies have primarily recruited subjects without reference to their hearing, and there is a need for further research to determine what role gesture might play in communication and aural rehabilitation efforts involving adults with HI.

1.1.5 History of Aural Rehabilitation

Early models of aural rehabilitation arose from the efforts to rehabilitate the many World War 2 returned servicemen suffering from noise induced HI (Alpiner & McCarthy, 2014). Approaches in the 1950s and 60s centred on direct intervention including hearing aid fitting and speech perception training, designed to directly address the loss of auditory information and to enhance the individual's ability to comprehend the speech signal (Montano, 2013). Speech perception training focused on the individual's auditory only (known as *auditory training*) and/or audio-visual (lipreading) perception of individual speech sounds (phonemes) or nonsense syllables (Rubenstein & Boothroyd, 1987).

The 1970s and 80s saw a move away from analytic approaches and the use of non-meaningful stimuli to more emphasis on (a) contextual sematic and syntactic information (Jeffers & Barley, 1979) and (b) extraverbal visual cues, including, facial expression, and head or body movements, and gesture (Kaplan et al., 1985). The use of sentence-based materials recognised the importance of communication as the transfer of a message as a whole and the ability to predict meaning rather than the perception of single sounds or syllables (Erber & Lind, 1994). During the 1990s intervention approaches further evolved to focus on the conduct of everyday conversation. These conversational intervention models emphasised the importance of individuals with HI making use of all sources of available information to facilitate comprehension (Erber, 1996, 2002; Erber & Lind, 1994).

1.1.6 Conversation and Hearing Impairment

Interest in the analysis of face-to-face conversations involving adults with HI has been fostered by advances in recording technology with the underlying aim of developing clinical assessment tools and targeted interventions (Lind et al., 2009). The work of Lind and colleagues (Lind et al., 2006; Lind et al., 2009), Ekberg et al. (2016), and Pajo (2012, 2013) has provided functional insights into the influence of HI on the conduct of everyday talk. Further, Skelt's (2006, 2010) analysis of the impact of HI on gaze cues in dyadic conversations has revealed atypical patterns of speaker gaze whereby speakers direct their gaze almost constantly at their CP with HI.

The development of more conversation orientated research and intervention has led to greater attention to the role of the CP, in particular family members, spouses, friends who are in regular interaction with the individual with HI, referred to as frequent or familiar CP (Preminger & Lind, 2012). Thus, the spotlight moves to include the CPs' ability to facilitate communication and increase redundancy in their message. It follows that an important consideration in the study of everyday interactions is the way in which CPs adapt or change their communication behaviours to enhance the fluency of the interaction. Both the conversation analytic term *recipient design* (Sacks et al., 1974) and the broader psycholinguistic term *audience design* (Bell, 1984; Clark & Murphy, 1983) are used to refer to communication modification in response to the characteristics of a listener or situation. A similar concept underlies Communication Accommodation Theory (CAT; Simmons-Mackie, 2018). The theory provides a framework for understanding the way in which individual and social contextual factors may influence the characteristics of a conversation (Gallois & Giles, 2015; Giles & Ogay, 2006). To date there has been limited consideration of gesture within the context of CAT (Tellier et al., 2021).

1.1.7 Audience Design and Accommodation

There is evidence that adult speakers modify not only their speech production as a marker of audience design but also their gestures in response to their perceptions and the particular needs and characteristics of an interaction (Holler & Bavelas, 2017). Also, researchers have explored the impact on gesture of variables such as spatial location of CPs relative to one another as well as shared knowledge and characteristics of the listener such as attentiveness or age. Such variables have been found to impact on gesture characteristics such as gesture rates, size and precision (Holler & Bavelas, 2017). It might be inferred that in the presence of significant hearing loss audience design may affect the quantity and quality of nonverbal behaviours, including gesture, exhibited by a frequent CP. It follows then that a familiar or frequent CP may endeavour to tailor their communication, both verbal and nonverbal, to the listening needs of the individual.

1.2 Study Aim

The overall objective of the current study is to determine whether CPs adapt their use of gesture in everyday conversations in response to the knowledge that their frequent CP has hearing loss, and if so, how they do this. The main aim of the research is to examine the patterns of gestures, their interactional and physical characteristics, used by normally hearing CPs in recorded dyadic interactions involving participants with and without. Hence, the investigation explores the gesture behaviours during face-to-face interaction between adults and their frequent CPs who have HI and compares them with gesture production involving the same adults in interaction with frequent CPs without HI.

The primary research question addressed is as follows: Do gesture behaviours differ in interactions involving adults with acquired HI and their frequent CPs by contrast with interactions between adults who do not have HI? This may be more operationally framed as: Do gestures differ with respect to rate of production, form, function, and associated patterns of gaze?

In addition, the research seeks to study the impact of interactional task types and increasing listening difficulty (via the introduction of background noise) on gesture production. The additional research questions address whether patterns of gesture behaviour differ in the presence of background noise and between conversational task types.

1.3 Study Significance

The central issue underpinning this thesis is to consider whether and how CPs' patterns of multimodal communication change in the presence of the knowledge of their partner's hearing status. More generally, the question whether gesture may prove to be an appropriate candidate for intervention in adult aural rehabilitation remains open. The aim of much current hearing rehabilitation is to find ways of assisting CPs to enhance their conversational fluency and in particular their interactional redundancy in the presence of the difficulties imposed by HI (Erber, 1996; Montano, 2014). Given the limitations of hearing devices in fully restoring normal hearing acuity and auditory comprehension, particularly under more adverse listening situations, it is important to explore additional ways by which conversational fluency might be enhanced. Strategies might include nonverbal strategies such as gesture as a target behaviour for aural rehabilitation. While gesture has received substantial research attention across a broad range of disciplines, it has received limited investigation in the context of HI. Results from the current study aims to provide some insights into the influence of HI on everyday conversation and how gesture may reduce or resolve communication difficulties involving adults with HI. Consequently, these findings have the potential to inform aural rehabilitative practices and further research into gesture intervention strategies for both adults with HI and CPs.

The next chapter provides a description and overview of the physical and functional properties of gesture, the methods of observation, and models of gesture function and production that have been proposed. This is followed by a review of research into patterns of gesture and gaze when the conversation includes a person with HI.

The methodology and method used in the current study are outlined in Chapter 3. The findings are presented in the following four chapters: Chapter 4 presents the results of a preliminary proof-of-method case study, Chapter 5 presents the results from Case studies 2–7 for the independent variable of HI, Chapter 6 presents the results for the same case studies regarding the independent variable of background noise and finally, Chapter 7 presents the results for the independent variable of interactional task type. The thesis concludes with a general discussion in Chapter 8.

Clinical implications, theoretical models, and future research directions are also addressed in light of the current findings.

2 REVIEW OF THE LITERATURE

The use of gestures is a communication behaviour that individuals commonly engage in while they speak. Research endeavours across disciplines have sought to describe, explain and theorise about gesture and its form and function across the fields of linguistics (e.g., McNeill, 2000; Gullberg, 2013a), anthropology (e.g., Haviland, 2004), and psychology (e.g., Holler et al., 2018; Schubotz et al., 2019). Gestures have also been explored in the context of communication disorders as a compensatory device in the expression or reception of spoken language (e.g., Cocks et al., 2018; Rose et al., 2017). Research in adult HI, however, is yet to turn its attention to the production of gestures to support or elaborate spoken communication.

Hearing impairment as a receptive communication disorder frequently results in a reduced ability to follow conversation, resulting in conversation disfluency and breakdown in communication. Gesture as a potential source of additional visual information, however, has not been explored in the context of conversations involving individuals with HI. Greater understanding of the role played by gesture in interactions in which HI is a factor will increase knowledge of potentially atypical interactions and how CPs manage these interactions (see also Ekberg et al., 2016; Lind et al., 2010; Skelt, 2010). Furthermore, it will provide a basis from which to explore modifications or additions to communication therapy and aural rehabilitation approaches for individuals with HI and their significant others.

2.1 Defining Gesture

Commonly when individuals speak, their hands and arms move in accompaniment with their speech. This is broadly referred to as *co-speech gesture* (McNeill, 1992). Kendon's Continuum[2] (see Figure 2.1) was proposed by McNeill (1992, 2016) to clarify the distinctions among types of nonverbal communication. Co-speech gesture (also called *gesticulation*) sits at one end of the continuum, followed by (from left to right) *language-like gestures*, *pantomime*, and *emblems* with *sign language* at the other end of the continuum.

[2] named in honour of Adam Kendon

Figure 2.1

"Kendon's Continuum" adapted from McNeill (1992, 2005)

	GESTICULATION (Co-speech Gestures)	LANGUAGE-LIKE GESTURES	PANTOMIMES [a]	EMBLEMS [b]	SIGN LANGUAGES
Definition	accompany speech	grammatically integrated with speech	depiction of objects & actions speech not obligatory	standard form culturally specific	a complete linguistic system
Example	"I made a cake" while using two hands to form a round shape	"She was very small but her sister was (gesture)"	A series of gestures demonstrating making a cup of coffee	OK sign	ASL [c]

Relationship to Speech	used with speech	→	not typically with speech
Degree of linguistic Organisation	little structural organisation	→	high degree of structural organisation
Conventionalised Behaviour	spontaneous idiosyncratic	→	highly conventionalised signs
Representation of meaning	highly contexualised	→	largely context-independent meaning

Note. [a b] On McNeill's (2005) revised continuum representing the relationship to speech, emblems are repositioned to the left of pantomimes as pantomimes are performed without speech while emblems may be accompanied by speech. See McNeill (2005, p 6-12) for further explanation of the continua.
[c] American Sign Language.

From Sparrow, K., Lind, C., van Steenbrugge, W. (2020) Gesture, communication, and adult acquired hearing loss. *Journal of Communication Disorders,* 87, 106030. https://doi.org/10.1016 /j.jcomdis 2020.106030

By McNeill's definition, co-speech gestures are produced spontaneously with minimal awareness of the speaker and typically in close temporal and semantic association with speech (Kendon, 2004). Each co-speech gesture has a unique presentation which is particular to the local instance and context in which it arises i.e., a gesture for the same purpose may be presented differently each time it is produced (Kendon, 1972; McNeill, 1979, 1985). Language-like gestures have the same physical form as co-speech gestures but replace a spoken word or phrase within the grammatical structure of a sentence. Pantomimes represent objects or actions but may be produced without speech whereas emblems have a standard form that is culturally specific and may or may not accompany speech. For example, the "OK" or the thumbs-up signal (McNeill, 2005; see Figure 2.1 for examples).

Sign languages within the Deaf community are typically not accompanied by speech (but for the simultaneous use of speech and sign see for example Bishop, 2010). The hand movements of sign language have the structure, sequential organisation, and semiotic conventions that identify them as a language. McNeill (2000) has further proposed that several continua are required within each gesture type to better identify the differences in the features and function. Gesticulation, pantomime, emblems, and sign language contrast with one another in terms of the manner in which they relate to speech, the degree of their linguistic properties, the degree to which they have been conventionalised and their representation of meaning/semiotic properties (see Figure 2.1). Co-speech gesture, the primary focus of this review, is thus considered distinct from natural sign language in Deaf communities which will not be addressed here.

2.2 Gesture Studies

The study of gesture has a long history with its beginnings in Greek and Roman times in connection with the art of oratory. The comprehensive work of Quintilian *(Institutio oratoria)* on the art of rhetoric from approximately AD 100 describes both voice and body movements as important components of oratorical technique. A small section on movement includes comments on head, body, facial eye movements as well as hand gestures although the detail is focussed on the latter. Towards the end of 16th century, Quintilian's treatise became particularly influential as the art of public speaking and learning conversation style became a desirable skill across Europe (Kendon, 2004). The late 16th century and early 17th century saw gesture taken up as a topic of broader scholarly and scientific interest. Through the 17th century, discussions emerged about gesture as the basis of a universal language. In the 18th and 19th centuries there was debate about gesture as the source of the natural origin of language which was informed by the study of gesture, language and sign languages, (see also Kendon, 2004 for a comprehensive discussion).

There was a decline in interest in gesture by the end of the 19th century followed by a revival of interest during the mid-20th century driven by an increasing interest within psychology and linguistics in cognitive processes underlying language (Kendon, 2004). Since then gesture has emerged as a topic of interest across a diverse range of disciplines; including anthropology (e.g., Haviland, 2004), information technology (e.g., Quek et al., 2002), bilingualism and second language acquisition (e.g., Gullberg, 2006b, 2013b; Stam & Tellier, 2017), problem solving and cognition (e.g., Kita, 2000; Alibali et al., 2011), speech and language development (e.g., Blackwell & Baker, 2002; Capone & McGregor, 2004), sign languages and gesture (e.g., Brentari & Goldin-Meadow, 2017) and communication disorders (e.g., Rose, 2006a; Sekine et al., 2013; Pritchard et al., 2015). These areas of research will be used to address more general issues and methodological considerations of the communicative value of gestures and the theoretical models that underpin them.

2.2.1 Classifying Gestures

In the early 20th century further efforts were made to describe and classify gestures. Efron (1941;1972) published a comprehensive summary of the different uses of gesture in relation to speech. Efron's work focussed on comparisons of gesture used by new and long term "assimilated" migrants from Italian and Jewish communities living in New York (Efron, 1941;1972). He used various data collection methods, primarily field observations. He was also one of the first in gesture research to use film to analyse interactions. His analysis described gestures in terms of movement characteristics, semantic meaning, interactional functions, and the ways in which they are conveyed. His detailed summary has been used as the basis for subsequent classification systems (Ekman & Friesen, 1969; Freedman & Hoffman, 1967; McNeill, 1992) (see Table 2.1).

Ekman and Friesen (1969) developed a categorisation scheme, based largely on their work with psychiatric patients, in which they described a typology of *non-verbal* behaviour, including movements of face or body important in interaction. They used the term *emblems* defined as "those nonverbal acts which have a direct verbal translation or dictionary definition" (p. 63). In addition, they described six types of *illustrators* defined as "movements which are directly tied to speech, serving to illustrate what is being said verbally" (Ekman & Friesen, 1969, p. 68) for example, making a round shape with the hands while talking about a ball.

More recently, McNeill (1992) described a classification system, which focuses specifically on co-speech gesture function. McNeill's typology makes a distinction between *imagistic* and *non-imagistic* gestures. Imagistic gestures portray an action, object shape, movement, or abstract idea and include both *iconic* (i.e., those that portray a concrete image or action) and *metaphoric* (i.e., those that represent an abstract idea). Non-imagistic gestures include pointing (or *deictic*) gestures and simple rhythmic movements, which follow the rhythmic structure of speech, referred to as *beats* (e.g., short up and down flicks of a hand; McNeill, 1992, 2005).

Classifications of gesture have included two general domains of analysis:[3] (a) in terms of the physical, temporal patterns of how they are performed (i.e., etic), and (b) the linguistic meaning or function they carry (i.e., emic). From an etic perspective, the term gesture may be used to refer to hand and arm movements, and less frequently to body movements (e.g., raising an eyebrow) and changes in posture (e.g., leaning forward). While gestures are commonly performed without "props", they may include manipulation of concrete objects (e.g., playing with a pen or necklace), body-touching (e.g., flicking back hair, scratching, crossing, or uncrossing legs), facial expressions (e.g., frowning, smiling).

From an emic perspective, a distinction may be drawn between the linguistic (particularly, semantic) meanings of gestures such as those described in McNeill's typology (1992) and those that have an interactional purpose. Bavelas et al. (1992) identified a group of gestures as interactive, defining them as those that assist participants to guide a conversation as a social activity. For example, a speaker may move a hand palm up outward in a half circle to acknowledge what the listener said earlier (see Table 2.1 for further examples). It should be noted that the classification of gestures by their meaning and purpose is embedded in the context in which they occur, and that any particular instance of gesture often carries more than one meaning or function for the participants (McNeill, 2005). For example, a pointing gesture indicating a location in space might incorporate the iconic feature of movement, or a beat might be superimposed for emphasis on an iconic gesture representing an object (Austin & Sweller, 2018; McNeill, 2016).

Despite the limitations of applying a rigid typology, McNeill's (1992) classification is recognised as a useful tool by which to characterise gesture function for analysis and therefore has been adopted and adapted by researchers across many fields of research (Austin & Sweller, 2018; Bavelas & Gerwing, 2010; Gawne & Kelly, 2014; Stam & Ishino, 2011). In the study of interactions involving adults with HI, the framework provides a practical basis for (a) the differentiation of gesture functions and the role each might play in communication, and (b) comparisons of the varied functions of gesture and their relative frequency between interactions involving different CPs and/or contexts.

[3] For the purposes of this essay, a distinction is drawn between *etic* and *emic* analyses of gesture. Following the use of these as suffixes in the two terms *phonetic* and *phonemic*, etic analysis refers to the physical, temporal, and bodily aspects of gesture, and emic analysis refers to the meaning of gestures, locally within the conversation in which they occur and more broadly in the language system of the interlocutors.

Table 2.1

Gesture Types and Their Key Characteristics

Gesture Type (following McNeill, 1992)	Subcategory	Alternative Name	Definition/Characteristics	Example
Imagistic	Iconic	Physiographics/kinetographics (Efron, 1972) Literal reproductive (Freedman & Hoffman, 1967) Kinetographs/pictographs (Ekman & Friesen, 1969)	Portray a concrete image or action	Using the hands to form a shape of a ball
	Metaphoric	Ideographics (Efron, 1972) Concretization (Freedman & Hoffman, 1967) Ideographs/underliners (Ekman & Friesen, 1969)	Portray as pictorial content an abstract idea or concept such as knowledge, language itself, the genre of the narrative etc.	"He had one idea, but she had another" while cupping one hand and then the other to represent the concept of an idea
Non Imagistic	Deictic	Pointing gesture: concrete or abstract	To direct a hand and/or finger/s at a concrete object or person or at a point in space	"I was referring to that book" while pointing toward a particular book " I went over to her house" while pointing a the index finger to a point in space
	Beat	Baton (Efron, 1972) Batons/rhythmics (Ekman & Friesen, 1969) Punctuating (Freedman & Hoffman, 1967)	Follow speech rhythm with a consistent form; may indicate the significance of a specific phrase	Short quick flicks of hand or fingers back and forth or up and down while speaking

Gesture Type (following McNeill, 1992)	Subcategory	Alternative Name	Definition/Characteristics	Example
Cohesive	Any of the above types		Repeated G used to connect content related parts of talk spoken at different times. i.e. indicates a reoccurring or continuing theme	"We saw a ball under a bush in the park and." using two hands to make a ball shape. Then the speaker breaks off to explain which park. The iconic G is then repeated to connect back to the theme/story of the ball
Emblem		Italianate Gesture	Culturally specific, can be used without speech; have names or standard paraphrases	OK sign - putting index finger and thumb together to form an O shape
Butterworth		Speech failure (Freedman & Hoffman, 1967)	Occur in response to speech failure	A hand opening and closing as the speaker tries to remember a particular word or name.
Interactive (Bavelas, 1994)	Turn		Perform a regulatory function within conversation. Contain no topic information	Holding up a hand to indicate a continuing turn
	Citing			Moving a hand palm up outward in a half circle to acknowledge what the listener said earlier
	Seeking			Making a circular motion with a hand to seek help with word finding
	Delivery of information			Moving an arm & hand palm up toward the listener to indicate shared information

2.3 Co-speech Gesture Structure and Execution

In etic terms, the production of co-speech gestures has been described with reference to their structure and the area or location in which they are typically performed (known as the *gesture space*) as well as to their temporal patterns in relation to co-occurring speech. This structural aspect describes the gesture's physical form. Its annotation may include detail, for instance, about the hand/s used, hand shape, palm/finger orientation, the trajectory, place and direction of movement and position, all identified via a systematic partitioning of the gesture space into concentric areas (McNeill, 1992; see Figure 2).

Gestures' etic characteristics have also been described in terms of their temporal patterns in relation to co-occurring speech. With the exception of beats (which are rapid biphasic movements), speech-synchronised gestures typically comprise: (a) a *preparation phase* when the arm/s moves from the rest position (e.g., the arm of a chair or the individual's lap) to the point in space at which the *stroke* begins; (b) a stroke is the peak of effort in the gesture through which the meaning of the gesture is expressed; the stroke is typically synchronized in time and meaning with the accompanying talk; and (c) the *retraction phase* when the hand/s return to the *rest position* (Kendon, 1972; McNeill, 1992). The physical form of gestures is influenced by the context in which they occur. For example, gesture size has been found to increase during face-to-face interaction when compared to gesture size during telephone dialogue (Bavelas et al., 2008). Other influences on gesture include increases in size when listeners request clarification (Holler & Wilkin, 2011), when motivation to convey information to the listener is high (Hostetter et al., 2011), and when new rather than shared information is revealed (Gerwing & Bavelas, 2004).

Gesture in a particular context may be best understood and explored from both structural or etic and functional or emic perspectives (Wagner et al., 2014). Indeed, many gesture annotation systems now incorporate elements of both gesture form and function or meaning (Wagner et al., 2014). The definitive purpose of gesture is still a matter of ongoing discussion and debate and has led to the development of several theories and models. These different viewpoints and theoretical positions are discussed in the next section.

2.4 Theoretical Models

There is consensus among researchers that co-speech gestures and the speech they accompany are part of one integrated system. However, the cognitive and interactional purpose(s) of co-speech gesture is still a source of some debate (Pritchard et al., 2015). Researchers' viewpoints about the various function(s) of co-speech gestures include emphasis on speaker- versus listener-focussed approaches.

Researchers who focus on speaker-driven models of gesture suggest that gestures act to assist a speaker's verbal expression (Hadar & Butterworth, 1997; Krauss et al., 1996). Others suggest that some gestures play a role in assisting the cognitive organisation of the speaker's thoughts (Goldin-Meadow, 2003; Kita, 2000; Kita & Özyürek, 2003) or in cognitive discourse planning (Jenkins et al., 2017). On the other hand, listener-focused researchers suggest co-speech gestures provide information, clarify, and/or highlight aspects of the spoken utterance to assist the listener's perception of the message (de Ruiter, 2000; Kendon, 1994) in the clearest and most efficient way given the context of the interaction (Kelly et al., 2011). A listener-focused interpretation of gesture stipulates that gestures are intended to provide the listener with content and interactionally relevant information, together with the spoken message (de Ruiter, 2000; Kendon, 1994; McNeill, 1992). The models imply that recipients may benefit from the addition of gesture as a clarification of the conversation partner's talk. This in turn has particular relevance for the notion that gesture may be used to enhance communication with adults who have HI.

This section outlines some major theories and models concerning the purpose and conduct of co-speech gestures with particular emphasis on their speaker or listener focus. These theories include the speaker-focused *Lexical Retrieval Hypothesis*[4] (Hadar & Butterworth, 1997; Krauss & Hadar, 1999), the listener-focused approaches the *Communicative Intent Hypothesis* (de Ruiter, 2000; Kendon, 1994; McNeill, 1992, *Growth Point* (GP) *theory* (McNeill, 1992; McNeill & Duncan, 2000), the *Sketch Model* (de Ruiter, 2000), and finally those that incorporate both listener and cognitive functions, the *Information Packaging Hypothesis* (Kita, 2000) *Interface Model* (Kita & Özyurek, 2003) and the *Gesture as Simulated Action Framework* (GSA) (Hostetter & Alibali, 2008, 2010, 2019).

The Lexical Retrieval Hypothesis (Hadar & Butterworth, 1997; Krauss & Hadar, 1999) postulates that gestures are produced by the speaker to assist in resolution of local difficulties (e.g., word-finding difficulty) in speech production. This is supported by Morrel-Samuels and Krauss (1992) who found that during narrative descriptions, gestures tended to be used in association with words that were rated as less familiar to the speaker. Others have reported that natural speech disfluencies increase when subjects are not permitted to gesture (Rauscher et al., 1996). Krauss et al. (2000) propose that the primary function of iconic gestures is to assist in the speaker's internal processes of finding spoken words. They suggest that a motor program for a particular gesture of a particular visual-spatial representation has a "priming" effect across modalities such that performing the gesture facilitates spoken word retrieval.

[4] Capitalisation is used for the names of the theories and models to reflect presentation in current literature, despite APA 7th edition guidelines not to capitalize.

By contrast, the listener-focused Communicative Intent Hypothesis proposes that gestures play a role in and are intended to provide the listener with information together with the spoken content (de Ruiter, 2000; Kendon, 1994; McNeill, 1992). This view is supported by early experimental studies showing that gestures can benefit listener comprehension. For example, recipients were able to understand the meaning of gestures when presented in isolation (e.g., Feyereisen et al., 1988) and listeners were able to produce more accurate abstract line drawing from descriptions which included gesture (Graham & Argyle, 1975). In one series of experiments, no beneficial effect of gesture was found in listener object selection based on object descriptions (Krauss et al., 1995). However, others have shown that correct objects were determined more rapidly when (iconic) gestures were part of the verbal description (Riseborough, 1981) and listeners answered questions more accurately when gesture and speech were used during the narration of cartoon stories (Beattie & Shovelton, 1999b).

Numerous investigations have shown that gesture patterns alter in response to the physical and social-interactional environment in which talk takes place, and also that the recipients of another's gestures perform better in interactional tasks when gestures are used (Alibali et al., 2001; Bavelas et al., 2008; Beattie & Shovelton, 1999a, 1999b; Graham & Argyle, 1975). Models adopting a listener-focused view include GP theory (McNeill, 1992; McNeill & Duncan, 2000), the Sketch Model (de Ruiter, 2000), the Interface Model (Kita & Özyürek, 2003), and the GSA (Hostetter & Alibali, 2008, 2010, 2019).

Growth Point theory (McNeill, 1992; McNeill & Duncan, 2000) suggests that there is a cognitive starting point, a *growth point* (GP) from which an utterance emerges. The GP contains symbolic and imagistic information. The theory follows Vygotsky's concept of a minimal psychological unit and incorporates gesture. McNeill proposes that the growth point is the smallest unit of thought which encompasses the dual characteristics of an image and its associated semantic meaning. A GP is a minimal unit and thus cannot be divided into smaller elements. McNeill considers a growth point to be comparable to the notion of a *psychological predicate,* proposed by Vygotsky (1986). In Vygotsky's terms, psychological predicates are dependent on the context and evolve in a dynamic process to highlight and differentiate salient aspects of content in speech. In a similar dynamic manner, the linguistic content and imagery of a growth point interact and influence one another (McNeill, 2016). During speech production, a GP evolves into two synchronised components the symbolic part becoming speech and the imagistic part manifesting as gesture (McNeill, 2000; McNeill, 2016).

In this view images do not simply translate into language rather the growth point is "the mediating link between individual cognition and the language system" (p146, McNeill, 2000). Gesture-speech synchrony is considered intrinsic. The existence of a GP is supported by the synchrony of a gesture stroke phase and a spoken utterance co-expressing a semantically associated/related content (McNeill, 2000).

The Sketch Model (de Ruiter, 2000) assumes speech and gesture have a shared communicative function both stemming from a common *communicative intent*. It follows Levelt's (1993) model of speech production in which the communicative intent precedes a *preverbal message* which leads to the speech signal. In parallel, a separate *sketch*, the gestural equivalent of a preverbal message, arises and the formation of a gesture follows (de Ruiter, 2000). The sketch model also assumes speech and gesture have a communicative function and that they both stem from the same communicative intent. The sketch is an abstract form, which includes information about spatial temporal features but without specifics regarding characteristics such as size, speed, or location. The *conceptualiser* is described as sharing the communicative load across both speech and gesture channels. If it is hindered in the formation of a preverbal message or sketch it will compensate by adjusting the cognitive load between channels. After the sketch and preverbal message are formed, the sketch moves to a *gesture planner.* Once a motor plan for gesture execution is complete a signal is sent back to the conceptualiser and the preverbal message is transferred to the *formulator*, which then operates independently. In the formulator, preverbal messages are encoded grammatically and then phonologically (de Ruiter, 2000). The model includes not only iconic gestures but also deictic, emblems, and pantomimes (but excludes beats). In a revision of the original model, the function of the conceptualiser is redefined. In the *Asymmetric Redundancy* (AR) Sketch Model, iconic gestures are not considered to compensate for limitations of spoken language but to provide redundant information (de Ruiter, 2017).

In his Information Packaging Hypothesis, Kita (2000) has argued that gesture and language together assist the formulation of thought. This follows the suggestion that gesture plays a role in cognition function in spoken language organisation as well as having a listener-focused communicative function (Hadar & Butterworth, 1997; Kita, 2000). In Kita's view language influences gesture and gesture influences language and this implies that gesture might help with word retrieval. The Interface Model (Kita & Özyürek, 2003) is based on the differences in the gesture used across languages. According to the model, negotiation takes place during speech and gesture production to coordinate both outputs to provide similar information. The way in which a particular language expresses an action, event, or idea will impact the content of the accompanying gesture (Kita & Özyürek, 2003). This model supports the notion that both the lexical as well as the grammatical features of a language influence the gestures that are produced in other words, the "nature of speech at least partially determines the nature of gesture" (de Ruiter & de Beer, 2013, p 1025).

The Gesture as Simulated Action Framework (Hostetter & Alibali, 2008, 2010, 2019) considers the cognitive system to include mental imagery, concrete perceptual and action simulations of perception and action, and language production. When speakers imagine an action (*simulation*), this is considered to activate motor areas of the brain and may (dependent upon certain factors) result in the production of a (iconic) gesture.

The models of gesture production outlined here differ in several key aspects. They differ in the type of representation which underlie gesture from visuo-spatial images (Sketch Model, AR Sketch Model, Interface Model, GSA), elementary spatial features (Lexical Retrieval), or imagery that is linguistically categorised and not solely visuospatial (GP theory) and whether linguistic factors play a role in their production Interface model, GP theory, GSA) or not (Sketch Model, AR Sketch Model, Lexical Retrieval). The Lexical Retrieval Hypothesis places most gestures outside the communicative process in the visuospatial working memory.

All other models described here consider gestures to be communicatively intended. The Sketch Model does not address the issue of speech facilitation, but all others incorporate varying methods of speech production facilitation and hence a speaker-focused function. The integration of speech and gesture is another point of difference. The Sketch Model, AR Sketch Model, Lexical Retrieval and the Interface models divide gesture and speech into two systems that overlap or interact while GP theory and the GSA place that gesture and speech into one system (Hostetter & Alibali, 2008).

Despite efforts to explain the relationship between gesture and speech, agreement on the underlying mechanisms and purposes of gesture has yet to be reached. It may be surmised that gestures have multiple functions, including communicative/listener-focussed functions, (e.g., conveying information, directing attention, regulating turns, and indicating agreement) as well as speaker-focused functions (e.g., facilitating speech production and supporting thought processes; Gullberg, 2006a; Kendon, 2004; Wagner et al., 2014).

The models mentioned above are based on observations and experimental data obtained in the main from everyday conversation by individuals without explicit communication impairment. Investigations into the production of gesture when one partner in the interaction has a speech and/or language disorder have also added to the understanding and highlighted the importance of exploring the role of gesture in atypical conversational interactions.

2.5 Gesture and Communication Disorders

When an individual's ability to formulate, perceive, produce, or comprehend spoken language is reduced or impaired, therapy is often driven by a need to explore alternative and/or complementary means of communication. In this context, gesture may present as a valuable alternative communication channel (Sekine et al., 2013). Research suggests that gesture may be used by individuals who have expressive communication difficulties, for example expressive aphasia, to enhance (limited) speech or as an alternative to spoken communication (Cocks et al., 2013; Goodwin, 2000; Rose, 2006b; Sekine & Rose, 2013; Sekine et al., 2013). By contrast in receptive communication disorders, the focus moves towards able partners' ability to increase communicative redundancy in their turns at talk to support the individual whose receptive abilities have been compromised (Caute et al., 2013; Pashek & DiVenere, 2006).

Findings of the benefit of gesture use in communication disorders are varied. For instance, aphasic adults with severe auditory comprehension deficits did not benefit from additional redundant pantomime or emblems when comprehending simple verbal messages (Venus & Canter, 1987). However, comprehension of spoken instruction has been found to be enhanced by the use of pantomime gestures when presented to adults with mild to moderate degrees of Alzheimer's disease (Pashek & DiVenere, 2006) or to adults with aphasia (Yorkston et al., 1979).

Yorkston et al. (1979) used three methods of instruction (verbal, pantomime or combined) to obtain responses to short instructions The authors reported that combined verbal redundant pantomime resulted in more accurate and faster responses. Similarly, Eggenberger et al. (2016) found that speech combined with redundant (congruent iconic) gestures enhanced decision task accuracy when compared to a baseline condition of speech and meaningless gesture. The production of incongruent gestures decreased decision task accuracy in both the participants with aphasia and the control group. A greater reliance on visual information provided by gesture has been demonstrated with an increase in the ambiguity of a speech signal when aphasic listeners responded using a pointing action (including arm/finger point, head turn and eye gaze) to visual only, auditory only and audio-visual stimuli. The use of visual information was found to increase as the auditory comprehension decreased (Records, 1994).

More recently, Preisig et al. (2018) found that participants with aphasia attended to co-speech gestures more frequently than controls during short conversational tasks. Gestures that they visually attended to were more likely to be the gestures representing semantic meaning rather than the more abstract concepts. This supports the notion that individuals with receptive aphasia may benefit from co-speech gestures portraying concrete meaning (iconic, concrete deictic, emblems, and pantomimes).

It follows then that some gestures or gesture types may be valuable alternatives or complementary sources of information. The findings show that gesture has an important but varied role in supporting, clarifying, and informing interactions between adults with communication difficulties and their CPs. Perhaps not surprisingly, the impact of expressive communication disorders on interaction seem to support more speaker-focussed and/or cognitive planning models of gesture, while receptive communication disorders suggest that listener- or interaction-based models may apply.

The existing theoretical models described have been used to explain research findings in speech and language disorders (de Beer et al., 2020; de Ruiter & de Beer, 2013). Similarly, testing these models against research data in adult HI may contribute to better understanding of the influence of hearing status on the nature of gesture in interaction. The next section explores the role of gesture in adult acquired HI as a receptive communication problem.

2.6 Gesture, Speech Perception and Acquired Hearing Impairment

As mentioned previously, HI presents primarily as a receptive communication disorder and many adults with significant HI will struggle to understand spoken conversation, particularly in the presence of background noise (Picou et al., 2013; Pryce & Gooberman-Hill, 2012). Despite advances in hearing technology, hearing device users frequently report persisting difficulties with speech reception, which in turn influence their abilities to participate in everyday conversation. Few studies have addressed gesture as a possible visual compliment to CPs' spoken communication to assist with the receptive communication difficulties following adult-onset HI.

In a series of early studies, Berger and colleagues (Berger & Popelka, 1971; Popelka et al., 1971) investigated the enhancement of visual speech perception by gesture. They showed that when spoken sentences were presented with visual speech cues only gestures congruous with the content enhanced the speech perception scores of normally hearing adult participants, whereas gestures unrelated to the semantic meaning of the spoken utterance reduced performance. It was concluded that CPs' use of gesture should be encouraged and that "Hearing impaired individuals should be alerted to the communicative value of watching gestures" (Popelka et al., 1971, p. 436).

Rogers (1978) explored the effect of both presentation modality and signal-to-noise ratio on comprehension during the presentation of videoed sentences to normally hearing adults. Comprehension was determined by their accuracy in answering multiple-choice questions about the content and was greater both in the normal audio-visual condition and in the audio-visual condition with lip and facial information obscured, than when content was presented in the audio-only condition. This effect increased in the presence of background noise suggesting that visual information including gesture is more important for comprehension as the listening environment becomes more demanding and the auditory signal degrades.

Co-speech gesture in the context of adult HI or difficult listening conditions received little research attention in the next 30 years. More recently, Holle et al. (2010) demonstrated that co-speech gesture enhances message reception particularly under difficult listening conditions. The authors reported that the addition of iconic gesture during videoed sentence presentations (with masks to exclude facial or visual speech cues) led to a significant increase in verb recognition among normally hearing young adults compared to the auditory alone condition. While the benefit of gesture was found across a range of signal-to-noise (multi-speaker babble) ratios (SNRs), the greatest increase in speech comprehension was at moderate (-6dB) SNR. Studies using neuroimaging techniques have also showed that neural activity increased when a gesture was produced together with the spoken message in the presence of background noise (Holle et al., 2010; Özyürek, 2014). Furthermore, it was found that simultaneous processing and integration of speech and gesture resulted in increased neural activity and greater improvements in comprehension than the linear sum of separate auditory and visual stimuli (Holle et al., 2010; Özyürek, 2014). These findings not only support speech-gesture neural integration, but also suggest that this integration enhances comprehension under difficult listening conditions.

Neuroimaging studies using fMRI techniques have identified the brain areas involved in speech-gesture integration as the inferior frontal and posterior middle temporal regions (Dick et al., 2014; Holle et al., 2010; Straube et al., 2012; Straube et al., 2018; Zhao et al., 2018). While these studies use short linguistic segments, often word-in-isolation stimuli. Cuevas et al. (2019) also used fMRI to measure responses during the presentation of longer speech segments (with and without co-speech gestures) in videoed narratives. The authors found evidence in the recorded brain activity that gesture had a complementary effect on speech processing and greater benefit with increased language complexity (Cuevas et al., 2019).

Electroencephalogram (EEG) studies have further added to the understanding of underlying processes and temporal correlates. Obermeier et al. (2012) used EEG recordings to investigate the integration of auditory speech and gesture in neural processing among participants with or without HI. The authors suggested that individuals with HI may attend to and integrate iconic gestures to enhance their reception of an auditory speech message. In contrast, those with normal hearing do so only when a speech signal is degraded (Obermeier et al., 2012). In addition, EEG and magnetoencephalography (MEG) studies have measured the temporal dimension of speech-gesture integration (He et al., 2015; He et al., 2018) and been able to predict the individual benefit of gestures particularly in the presence of degraded speech (Drijvers et al., 2018a, 2018b; Drijvers et al., 2019).

Cocks et al. (2009) developed another measure of integration termed *multi-modal gain* (MMG) which quantifies an individual's ability to integrate speech and supplementary or *additive* iconic gestures. Additive iconic gestures represent semantic content not included in a spoken utterance (Kita & Özyürek, 2003). Full comprehension of a message comprising a spoken utterance accompanied by additive gesture requires successful integration of both verbal and gesture information (Hostetter, 2011). For example, if the verbal message is “Mary went home” and the associated gesture portrays the grasping of a steering wheel, to understand the complete message i.e., *Mary drove home,* speech and gesture must be integrated.

The *multi-modal gain* (MMG) method uses response patterns in a picture- sentence matching task to calculate the MMG score. The MMG score represents the probability of accurate message comprehension using multimodal components compared to individual sources of input i.e., gesture or speech alone. In other words, MMG indicates how well “two modalities mutually enhance their informativeness” (Cocks et al 2009, p797). Cocks et al. (2009, 2018) found that individuals with aphasia had lower MMG scores than control participants. This suggested that individuals with aphasia had greater difficulty understanding a target message when presented with both gesture and speech than when presented with either gesture or speech alone. These findings are consistent with the notion that the individuals with aphasia may not have the resources to attend to and/or process both visual and auditory information sources simultaneously (Cocks, et al, 2018).

Interestingly, Cocks et al. (2009) and Cocks et al. (2018) found one control participant who achieved a low MMG score. This suggests that not all “healthy” individuals will benefit from gesture which compliments spoken content (Cocks et al., 2018) and that individual factors which may influence speech-gesture integration need to be explored. For instance, age has been identified as a potential influencing factor on integration and production (Özer & Göksun, 2020).

Early reports suggested that redundant iconic gestures assisted younger but not older adults in a sentence recall task (Thompson, 1995) and under challenging listening conditions (i.e., dichotic shadowing task; Thompson & Guzman, 1999). More recently, Cocks et al. (2011) used MMG analysis to compare the performance of older adults with younger participants in message comprehension under three conditions: speech only, speech and iconic gesture containing supplementary information, *a*nd gesture alone. No age differences were found in participants’ ability to understand gestures in isolation. However, the older participant group demonstrated less benefit from combined speech-gesture than the younger group. Furthermore, older adults were more likely to disregard the supplementary information provided by the gesture (Cocks et al., 2011). Such age variation has been attributed to age-related decline in working memory and consequent reduction in cognitive resources. Cocks and colleagues hypothesise that the processing of speech may expend considerable resources and leave insufficient capacity for gesture perception therefore leading to greater reliance on the verbal message (Cocks, 2011; Thompson, 1995; Thompson & Guzman, 1999).

Other findings in relation age-related changes in gesture production have also been ascribed to decline in cognitive skills (Göskun et a.,2022). Two early studies showed overall gesture rates were similar for older and younger adults (Cohen & Borsoi, 1996; Feyereisen & Havard, 1999).

Older participants, however, produced a lower proportion of representational gestures (iconic, metaphoric & deictic). A possible reason proposed was an age-related decline in working memory and/or or mental imagery processing (Cohen and Borsoi, 1996; Feyereisen & Havard, 1999). In a more recent study, Schubotz et al. (2019) also found that gesture rates were comparable between younger and older participants but that older adults did not demonstrate the same adaptation of gesture. Younger adults decreased their gesture frequency (and verbal content) when narrating shared semantic content, but older adults did not. The differences, however, were not associated with age-related differences found in cognitive skills, including verbal and visuospatial working memory as well as executive function.

Arslan and Göksun (2021) explored the influence of not only working memory but also mental imagery processing skills on gesture production. Similar representational gesture rates were found when younger and older participants described an activity or completed a story but that older adults produced fewer representational gestures than younger adults during a spatial description task. This difference was associated with mental imagery ability but not with working memory (Arslan & Göksun, 2021). Taken together these findings suggest that age should be considered as potential source of variability which may influence an individual's ability to process, benefit from and/or produce gesture.

Much of the research discussed above is focused on gesture in isolation by removing or obscuring other visual information. By contrast, Drijvers and Özyürek (2017) examined both the separate and combined effects of visual speech cues and iconic gestures on speech perception. They presented subjects with speech signals degraded by altering the spectral and temporal characteristics of the signal (*noise-vocoding*). Results indicated that listeners gained greater benefit from iconic gestures combined with visual speech cues than from either visual speech or gesture presented in isolation. Importantly, the strength of the combined or multimodal effect was greatest when the degraded speech still allowed the detection of limited spoken sounds. The authors concluded that limited access to spoken information is complemented by semantic information provided by iconic gestures.

In summary, these studies show that adults' focus on gesture enhanced their speech comprehension, particularly when presented with degraded perceptual conditions. Taken together, these experimental studies support a listener-focused and communicative intent view of gesture production. They suggest that gestures add complementary information which may be used by listeners to enhance comprehension, particularly in the presence of a degraded message or background noise. The questions remain as to (a) how gestures are implemented by speakers for the listener's benefit in challenging listening situations during everyday interactions and (b) what impact HI has on patterns of multimodal communication implemented in natural face-to-face conversations.

2.7 Analysis of Conversations

There has been an increasing interest in the analysis of conversations involving HI adults over recent years. This reflects the move from a focus on sensory-perceptual views towards the analysis of conversation as the focal impact of HI (Lind, 2014). The research has included audio and video recording of dyadic conversations (Caissie et al., 1998; Caissie & Rockwell, 1993; Gibson & Caissie, 1994; Sparrow & Hird, 2010; Tye-Murray & Witt, 1996) in the analysis of verbal (Lind et al., 2004, 2006) and nonverbal behaviours including gaze (Pajo & Klippi, 2013; Skelt, 2010). With this change has come a renewed interest in the role of nonverbal behaviour in interactions. For example, Skelt (2010) analysed the impact of HI on gaze cues in dyadic conversations. She found patterns of speaker gaze which were atypical when compared with the patterns reported in individuals with normal hearing. Kendon (1967) observed that both listeners and speakers use gaze to monitor one another's turn-taking intentions and to indicate their own. Listeners maintain their gaze towards the speaker, while speakers move their gaze towards and away from the listener. By contrast, Skelt (2010) identified that listeners with HI overwhelmingly directed their gaze towards the speaker. If they withdrew their gaze, familiar CPs stopped talking until the adult with HI returned their gaze to their partner. Hence, the significance of gaze as a social, nonverbal behaviour suggests that it could also be an important component of analysis in the context of gesture and HI.

The desire to address the communication difficulties of individuals with acquired HI and their frequent CPs within a real-life context implies the need to explore natural interactions. Investigations involving everyday conversations in a non-experimental setting promote greater face and ecological validity for participants (Wagner, 2014). This in turn is likely to result in a more accurate reflection of everyday multimodal communication behaviours. Access to digital recording of data and versatile analytic software permit greater ease of the systematic analysis of nonverbal behaviours in a qualitative and/or quantitative manner (Gullberg, 2010; Wagner et al., 2014).

Conversation analysis (CA) in particular has proven to be a useful data-driven method by which to investigate the characteristics and organisation of everyday conversation (Sacks et al., 1974; Schegloff & Sacks, 1977). Conversation analysis is both a method of analysis and a sampling method for conversational behaviour and sequential organisation, and has been used widely, including in communication disorders research (Goodwin, 2003). CA-based studies have informed clinical practice in a range of communication disorders, for instance in aphasia (Damico et al., 1999; Ferguson, 1998; Lindsay & Wilkinson, 1999), dementia (Guendouzi & Mueller, 2002; Orange et al., 1996; Young et al., 2016), and intellectual disability (Brinton & Fujiki, 1998). The CA methodology proposes certain principles by which everyday talk is co-constructed by CPs. Among these principles are the two concepts of *intersubjectivity* and *recipient design* which have particular relevance for the research presented in this thesis.

2.8 Intersubjectivity, Recipient Design, HI and Gesture

The CA methodology places importance on examining data obtained from natural interactions and concentrates on observable sequences of behaviour including turn taking, overlapping talk, and repair sequences (Sacks et al., 1974; Schegloff & Sacks, 1977). It eschews inference about the intentions or motivation of communication participants. Intersubjectivity or shared understanding is the fundamental principle by which conversation is constructed. Psycholinguists use a similar term, *common ground* to refer to CPs' shared knowledge and beliefs about one another that may inform their communicative behaviour (Clark, 1996; Isaacs & Clark, 1987; Nadig & Sedivy, 2002). The term *recipient design*, coined by CA researchers, refers to the ways in which participants individualise or adjust their conversation response to their understanding of the situational context and CP characteristics (Garfinkel, 1967; Sacks et al., 1974). This concept has also been referred to as *audience design* (Clark & Murphy, 1983) or *message tailoring* (Tye-Murray & Schum, 1994). Communication Accommodation Theory (CAT) is based on a comparable concept describing the ways in which interlocuters modify their communication in interaction (Gallois & Giles, 2015).

Communication Accommodation Theory, as an example of audience design, proposes that speakers adjust aspects of their communication according to individual needs of a listener or the broader context of group or social identity. Thus, the characteristics of an interlocuter's communication are shaped by their experiences and sociocultural background (Gallois & Giles, 2015; Giles & Ogay, 2006). In this view, speakers observe and assess their CP and aspects of their communication such as accent, volume, language, and body language. Speakers will adapt to the listener "to accommodate" their talk according to the listener's perceived perspective, sociocultural identity or status (e.g., a university lecturer speaking with a student).

The *approximation strategies* of *convergence* and *divergence* are central to the theory. Convergence refers to speaker modifications which increase the similarities with the communication style of the listener. On the other hand, divergent communication highlights differences between interlocuters such as social or knowledge status (Giles & Ogay, 2006). Listeners have been shown to have positive regard for communication styles that resemble their own (Giles et al., 1973; Simard et al., 1976) but to view divergence negatively as suggesting a reluctance towards communicative collaboration/cooperation (Simard et al.,1976; Street, 1982).

The theory has expanded to include *non-approximation* strategies including *interpretability strategy.* This refers to accommodations that seek to address the perceived individual needs of the listener in relation message reception, and/or comprehension, or shared knowledge. Such needs might be due to sensory challenges such as reduced vision or HI (Gallios & Giles, 2015). There has also been a move to incorporate nonverbal behaviours, such as gaze, body posture and smiles (Giles et al., 1991; Gallios & Giles, 2015). However, little mention is made of hand and arm gestures (Tellier et al., 2021). The few attempts to embed findings from gesture research into CAT include studies of interactions between native and non-native speakers of French (Tellier et al., 2021) and in relation to communication training in individuals with aphasia and their CPs (Simmons-Mackie, 2018).

The current investigation did not implement CA as its method of analysis but rather uses aspects of the CA transcription system while focusing on the (normally hearing) frequent CPs' talk and behaviour. The principle of interpretability strategy in CAT and recipient design, (henceforth referred with the broader term *audience design*) in relation to the viewpoint of the individual with HI's frequent CP is a central theme in this thesis.

There is considerable evidence of the impact of audience design on different aspects of spoken interaction, e.g., the number of words used, details or events included, duration of turns, and word selection (Galati & Brennan, 2010; Isaacs & Clark, 1987; Kuhlen & Brennan, 2010; Stoll et al., 2009). Together the findings suggest that individuals modify their spoken language in varying ways to accommodate the perceived knowledge and shared understanding of the CP.

Audience design has also been the topic of interest in gesture studies (Campisi & Özyürek, 2013). For instance, findings suggest that gestures may be modified in response to the spatial location (Furuyama, 2000; Özyürek, 2002) and/or the relative visibility of the listener. Several investigations have indicated that speakers use gesture less frequently when speaker and listener are not visible to each other than when speaker and addressee are face to face (Alibali et al., 2001; Bavelas et al., 2008; Bavelas, Kenwood, et al., 2002; Mol et al., 2011; Mol et al., 2009). However, this effect has not been demonstrated in investigations of free dyadic conversations (Bavelas & Healing, 2013).

There is evidence that gesture production is influenced by CPs' shared knowledge such that speakers adjust their gestures to their perceived needs of a listener. The more common ground interlocutors share the less information tends to be portrayed in gesture (Gerwing & Bavelas, 2004; Holler & Stevens, 2007). Further, a higher rate of gesturing has been associated with reduced common ground between interlocutors in narrative tasks, when listeners were perceived to be more attentive (Jacobs & Garnham, 2007), or when information conveyed to the listener was of high importance (Kelly et al., 2011).

Several studies have demonstrated that interlocutors will modify the etic characteristics of their gestures under varying circumstances. For example, Galati and Brennan (2014) reported that more precise gestures were produced during the first narration of a story compared to retelling the same story to the same listener. Holler and Wilkin (2011) found that in response to requests for clarification, participant speakers produced larger and more precise iconic gestures. Similarly, larger gestures were implemented when motivation was high for speakers to assist listeners, rather than actively compete with them, (Hostetter et al., 2011). Participants reduced the speed and increased precision of deictic gestures during a pointing task when guiding listeners to identify a specific target shape within a collection of shapes (Peeters et al., 2015). Hilliard and Wagner Cook (2016) found that speakers altered the position of their instructional gestures within the gesture space in response to a manipulation of shared knowledge in a problem-solving task. When gestures were intended for children, instead of adults, the rate of iconic gestures was found to increase and become more detailed and larger (Campisi & Özyürek, 2013). Furthermore, when student French teachers explained words to non-native and native speakers of French, Tellier at al. (2021) established that gesture rate, duration, and size increased while iconic and deictic gestures were more frequent in the non-native than the native-speaker condition.

Overall, it is evident that interlocutors modify both their verbal behaviours and their gestures in response to perceptions of the specific characteristics of an interaction. The question then arises whether familiar CPs of individuals with HI modify their communication behaviours as a consequence of their familiarity with the negative impact of HI on speech perception? More specifically, do CPs alter the frequency or rate of their gesture production when speaking to their CP with HI by contrast with when they speak to a CP without HI?

A common measure of gesture frequency is gestures per unit of speech (rather than per unit time) expressed as the gesture rate per 100 spoken words (Holler & Bavelas, 2017). However, analysis of the emic nature of changes in gesture in the presence of a HI may be more revealing than measures of overall gesture rate. That is, an additional question of interest is whether gestures with particular functions (e.g., iconic versus non-iconic) are produced more frequently or in higher proportions than others.

It is evident from the research reviewed above that the etic features of gestures may alter dependent upon context. Addressing the emic features of gesture, Skelt (2006) commented on the use of “highly illustrative” iconic gestures by CPs when conversing with adults with HI. (p. 268). She observed that iconic gestures were commonly produced by normally hearing CPs in conversations involving adults with severe to profound HI. She noted that these gestures “seem to occupy the middle ground between talk linked gesture and formal signing in that they appear designed to enhance understanding” (p. 268). This leads to the question of whether the physical characteristics, for example size of gestures, are altered and how they are altered as a result of a CP's awareness of their CP's HI.

As mentioned earlier, gesture researchers have explored gesture size and have found that speakers may modify the size of their gestures dependent upon the context or characteristics of a listener or interaction as part of their audience design of listener-focused activity. Several methods have been proposed to evaluate the size of a gesture. These have included observers using a five- or seven-point observer rating (Campisi & Özyürek, 2013; Mol et al., 2011) or coding into categories according to the primary body part involved in the movement, i.e., fingers, wrist, forearm, or full arm and elbow (Chu et al., 2014; de Marchena et al., 2018). Others have used judgements based on the largest movement of one hand or in two-handed gestures the amount of space between hands (Galati & Brennan, 2014) or on the span of the gesture movement within the gesture space (Holler & Wilkin, 2011). Beattie and Shovelton (2005) and (Hostetter et al., 2011) mapped the trajectory of each gesture on the McNeill (1992) gesture space diagram to determine the number of spatial borders crossed during the stroke as a measure of size. Tellier et al. (2021) identified gesture size based on the location of the hands within the gesture space using an adapted profile version of the McNeill (1992) diagram. They identified gestures produced close to the body as small and those produced in the periphery as large (Tellier et al., 2021). Motion capture technology has also been implemented to measure gesture movements known as *kinematics* (Pouw et al., 2020; Trujillo et al., 2018). Trujillo et al. (2021) found that the introduction of background noise was associated with an enhancement of gesture movements.

As described above, it has been suggested that visual information may be of greater benefit in noisy or difficult listening situations. Whether or not changes in the etic and/or emic nature of CP gesture result from increasingly difficult listening conditions for adults with HI (e.g., with the introduction of background noise) are key questions explored as part of the current investigation.

It is important to note that gesture studies have explored other aspects of the manual-visual modality as well, such as facial expressions and eye movement and gaze direction. Gaze has also been the subject of a CA-based exploration of conversations involving adults with acquired HI (Skelt, 2010) and is discussed in the next section.

2.9 Gesture and Gaze

The analysis of patterns of gesture implies analysis of patterns of gaze and attention. Skelt (2006, 2010) found it necessary to assess the direction of both the speaker's and the listener's gaze as critical elements in understanding the impact of HI in the context of conversations involving adults with acquired HI. The findings revealed that in contrast to typical patterns of speaker gaze, CPs looked at their partners with HI for substantial proportions of time when they were speaking.

Furthermore, the CPs tended to talk only when the individual with HI's gaze was directed towards them and ceased talking when gaze was averted away from them (Skelt, 2006, 2010). The results are a strong indication that while CPs are speaking, they are monitoring their listener with HI's attention to their turn-at-talk presumably as a marker of their uptake and understanding (Skelt, 2006). Skelt also postulates that these atypical patterns of gaze highlight the possibility that CPs shape their conversational behaviours to meet the perceived needs of their CP with HI demonstrating the impact of audience design (see also Ekberg et al., 2016; Lawrence et al., 2016).

Investigations have endeavoured to systematically describe the ways in which gaze is sought or solicited by conversation partners and synchronised with one another's speech (Goodwin, 1980; Stivers & Rossano, 2010). It has been suggested that gaze direction is used by interlocutors as a systematic cue in managing turn-taking or content during dyadic conversations (Bavelas, Coates, et al., 2002; Ford et al., 1996; Goodwin, 1980; Ho et al., 2015).

Instances arise in which gaze is also used by the speaker to direct the listener to a gesture the speaker is performing. In general conversation, gesture may be used as the primary (Goodwin, 1986) or secondary method, after an unsuccessful verbal attempt (Heath, 1984), by which a speaker redirects the gaze or orientation of a disengaged non-attentive conversation partner. In addition, gaze is used to link units of speech and gesture (Streeck, 1994). It has been observed that a speaker may direct their own gaze towards a gesture as they perform it so as to draw attention to and highlight the importance of the content of their gesture (Streeck, 1993). Gullberg and Kita (2009) found that a listener's uptake of a gesture's content increased when the speaker turned their gaze toward their own gesture suggesting that this may serve as an important speaker strategy to facilitate CP comprehension.

While speakers vary their gaze at a listener, listeners may spend most of their time looking at the speaker's face and look directly at only a few gestures (Gullberg & Holmqvist, 2006). Gullberg and colleagues reported that visual attention to gesture is more likely under some circumstances, such as when a speaker directs gaze at their own gesture or when the hands/arms are held in position following a gesture stroke in a *gesture hold*. Results have suggested that it may be that listeners' uptake of a gesture's meaning occurs irrespective of whether they focus their gaze directly at a gesture or perceive the gesture in their peripheral view (Gullberg & Kita, 2009). Thus, gaze may serve multiple functions in addition to regulating turn-taking behaviour, for example monitoring the attention and the feedback of a CP (Argyle & Dean, 1965; Kendon, 1967). The question addressed in this thesis is whether CPs direct their gaze more frequently *at their own gesture* when conversing with a CP with HI compared to interaction with a CP who is normally hearing, and if so, under what circumstances does this behaviour occur. The central issue underpinning the current study was to consider whether CPs' patterns of gesture and associated gaze direction differ according to their CP's hearing status, and if so, how they differ. Investigation into patterns of gesture and gaze in conversations with adults who have HI may inform the development of new approaches of improving communication and find application in aural rehabilitation settings.

2.10 Co-speech Gesture in Aural Rehabilitation

As outlined in Chapter 1, aural rehabilitation programs traditionally encourage clients with HI to use hearing and communication strategies in addition to hearing aids or cochlear implants to increase the availability and use of visual cues as a means to improve speech reception and consequently improve access to daily conversation (Hickson et al., 2007; Hull, 2010; Kaplan et al., 1985; Tye-Murray, 2009; Wayner & Abrahamson, 1996). The move towards interactional and conversation-based approaches to intervention has prompted an increase in the involvement of familiar CPs. The cooperation and engagement of the CPs is considered critical to enable adults with HI to implement hearing strategies and to achieve successful communication in everyday activities (Preminger & Lind, 2012).

Programs involving familiar CPs typically address how verbal and nonverbal behaviours (including gesture) might be most effectively implemented to convey information to their significant other with HI. In addition, intervention might focus on the interpretation of frequently occurring non-verbal behaviours including hand and arm movements, facial expressions as well as body language and movements like head nodding. For instance, Kaplan et al. (1985) indicate that hand and arm gestures are a significant component of speechreading and that "Most gestures are used to supplement speech" (p.1). Wayner and Abrahamson (1996) emphasize the importance of gestures in the rehabilitative program "Learning to Hear Again", in addition to the importance of facial expression and body movements, as a source of visual information for adults with HI. They include a list of primarily emblematic gestures such as holding a finger to closed lips to mean "be quiet". Exercises for adults with HI include deliberate observation of such gestures, recall of visual features of gestures implemented by frequent CPs, and structured practice using gestures, each designed to raise awareness of the way in which they enhance speech. Despite the face validity of such intervention there has been, to this point, little evidence for the content and structure of the target behaviours.

A key consideration in the involvement of CPs in aural rehabilitation is the variability in communication styles, skills, and in the awareness of communication behaviours (Erber, 1996; Tye-Murray & Schum, 1994; Tye-Murray & Witt, 1996). Some CPs may not be aware of the adverse impact of specific communication behaviours on the understanding of the person with HI, such as speaking quickly, slurring words together, or not facing the speaker. Other partners, however, may have adopted strategies that address the needs of the person with HI without any intervention (Erber, 1996). The question then arises as to whether a CP's communication behaviours, including speech and nonverbal behaviours, can be modified to improve speech intelligibility.

Early research identified the characteristics of *clear speech* compared to conversational speech and found that clear speech improved intelligibility for listeners (Picheny et al., 1986). Training in clear speech has been found to successfully result in changes in some speakers' verbal skills and has been associated with higher speech intelligibility scores for individuals with HI (Caissie et al., 2005; Caissie & Tranquilla, 2010). If it is possible for a speaker to change their speaking technique, then might it be possible for individuals to learn to increase their gesture production and/or change the characteristics of their gestures if there is a need to do so?

Limited research has addressed this question. In one study six junior high school teachers received brief instruction about the benefits of incorporating gestures into a lesson (Hostetter et al., 2006). They were all subsequently found to be able to increase (or reduce) their use of gesture when requested to do so (specifically pointing gestures) during a mathematics lesson (Hostetter et al., 2006).

The creation of an evidence base for aural rehabilitative intervention may facilitate the development of more specific CP intervention focused on the use and comprehension of non-verbal behaviours, including co-speech gesture. The investigation presented in this thesis aims to contribute to the development of such an evidence base.

2.11 Study Design

Conversation is considered the primary activity impacted and limited by a significant acquired hearing loss (Lind, 2009). It follows that it is critical to evaluate communication behaviours within as realistic as possible research task and context to understand how individuals communicate with their familiar CPs and to address their real-life communication needs (Lind, 2009). Participation in naturally occurring conversations offers greater face and ecological validity than do tasks with greater manipulation of experimenter variables, as it more closely approximates their everyday activities/interactions (Trujillo et al., 2021; Wagner et al., 2014).

Conversation, particularly dialogue is considered the fundamental form of language use (Clark, 1996) during which individuals collaborate to achieve goals specific to the context. The functions of social conversation have been described as both *transactional* and *interactional.* The transactional function refers to the transmission of content while the interactional function includes the maintenance of interpersonal and social connections (Brown & Yule, 1983). Hearing impairment may impact both functions dependent on the context, degree of listening difficulty, and the communication goals of the interlocuters (Pichora-Fuller et al., 1998). Reduced auditory information may impact the reception of content by the individual with HI and thus the transactional communication goals. The disruption to message understanding may influence conversational fluency and as a result compromise the interactional communication goal/s (Pichora-Fuller et al., 1998).

Gesture studies frequently involve face-to-face interaction during experimental referential tasks, semi-structured interviews, or narratives. Face-to-face dialogues in experimental gesture research typically involve interaction in controlled settings with specified tasks and rigorous quantitative analysis (Bavelas & Chovil, 2006). However, other researchers have chosen to record unplanned, non-experimental conversations between CPs. For example, McNeill's work has typically involved participants watching a short cartoon film or a full length black and white film and narrating the story of the film or cartoon to a listener immediately after the viewing. This is a form of relatively uncontrolled face-to-face interaction involving a monologue rather than a dialogue. The cartoon stimuli were chosen because of their simple, concrete form and limited dialogue which increased the likelihood of particularly iconic gesture production (McNeill, 1992; McNeill & Levy, 1982). Streeck (1993, 1994) studied gaze and gesture during naturalistic interactions involving spontaneous and unplanned conversations usually amongst friends or family members. The dialogues took place in a range of everyday contexts without specific instructions.

For these reasons, a prime study objective of the current investigation is to capture the characteristics that may mirror aspects of real-life interaction. Hence, both unstructured conversation and semi-structured narrative task were selected. Data gathered from seven case studies will allow consideration of individual variability of the way in which gesture is produced, with each primary participant acting as their own control. Audio-visual recordings include dyadic conversations involving individuals without HI interacting with (a) a frequent CP with HI and (b) a frequent CP without HI. Comparisons drawn between interactions will provide insights into the ways in which CPs may tailor their gesture in response to the presence of a HI. Comprehensive analysis of the recordings will allow consideration of both the emic and etic characteristics of gesture and address research questions raised in this chapter.

2.12 Research Aims and Objectives

This chapter has highlighted the need for research into the hitherto untapped visual resource of co-speech gesture in the context of everyday interactions involving adults with acquired HI. The objective of the research described in this thesis is to investigate how the use of co-speech gesture may reflect the atypical nature of the interaction imposed by HI, that is, how it might differ from the way gesture is used in everyday conversations involving adults who do not have HI. The broad aim is to explore whether patterns of co-speech gesture differ between conversations involving adults with HI and interactions in which HI is not a factor.

Specifically, the research aims are to investigate co-speech gesture produced by normally hearing CPs during dyadic natural conversations involving HI adults, to make comparisons with conversations when HI is not a factor and to determine how their use may reflect whether a speaker may alter their gesture patterns based on the hearing status of their interlocutor (i.e., their audience design). The independent variables are (a) hearing status (i.e., HI versus normal hearing), (b) presence versus absence of background noise, and (c) conversation type (free conversation and narrative). Operationally, the aim is to compare gesture characteristics in terms of (a) frequency of gestures; (b) emic characteristics of gesture, specifically gesture function; and c) the etic characteristics of gesture, specifically, size and gaze direction. A series of specific research questions arising from these research aims are addressed.

2.13 Research Questions

The primary research question of this investigation is, whether gesture production of an individual (PCP) are influenced by the presence of a familiar CP with HI (CPHI) by comparison with a CP without HI (CPNH) in everyday conversation or while narrating a story. Chapter 4 presents the first exploratory case addressing the primary research question. In the following chapters specific research questions address the independent variables (Chapter 5, HI; Chapter 6, background noise; Chapter 7, conversation type) in reference to the use and attention to gestures by PCPs 2–7.

The first exploratory case presented in Chapter 4 addresses the following specific research questions in relation to the interactions with PCP1:

1.(a) How frequently are gestures produced?
1.(b) Do gesture rates differ between interactions with the CPHI and interactions with the CPNH?
2.(a) What types of gesture can be observed?
2.(b) Are some gesture types produced more frequently than others?
2.(c) Does the frequency of different gesture types differ between conversation and narrative?
2.(d) Do the proportions of different gesture types differ between interactions with the CPHI and interactions with the CPNH?
3. Does the size of imagistic gestures differ between interactions with the CPHI and interactions with the CPNH?
4.(a) Where does the PCP direct their gaze during imagistic gesture production?
4.(b) Do gaze direction patterns during imagistic gesture production differ between interactions with the CPHI and interactions with the CPNH?

The first overarching research question, whether patterns of gesture change based on the hearing status of the CP, is addressed in Chapter 5 with the specific research questions:

1.1.(a) How frequently is gesture produced?

1.1.(b) Do gesture rates differ between interactions with CPHI and interactions with CPNH?

1.2.(a) Are some gesture types produced more frequently than others?

1.2.(b) Do the proportions of different gesture types differ between interactions with CPHI and interactions with CPNH?

1.3. Does the size of imagistic (iconic and metaphoric) gestures differ between interactions with CPHI and interactions with CPNH?

1.4.(a) Where do PCPs as speakers direct their gaze during imagistic gesture production?

1.5.(b) Do gaze direction patterns during imagistic gesture production differ between interactions with CPHI and interactions with CPNH?

The second overarching research question, namely whether patterns of gesture change because of the presence of background noise, is addressed in Chapter 6 with the specific research questions:

2.1.(a) How frequently is gesture produced in the presence of background noise?

2.1.(b) Do gesture rates differ between interactions in background noise and in quiet with CPHI and/or with CPNH?

2.1.(c) Do gestures rates differ between interactions with CPHI and interactions with CPNH in the presence of background noise?

2.2.(a) Are some gesture types produced more frequently than others in the presence of background noise?

2.2.(b) Do the proportions of different gesture types differ between interactions with CPHI and interactions with CPNH?

2.2.(c) Do the proportions of different gesture types differ between interactions in background noise and quiet with CPHI and/or with CPNH?

2.3.(a) Does the size of imagistic gestures differ between quiet and noise with CPHN and /or with CPHI?

2.3.(b) Does the size of imagistic (iconic and metaphoric) gestures differ between interactions with CPHI and interactions with CPNH in the presence of background noise?

2.4.(a) Where do PCPs as speakers direct gaze during imagistic gesture production in the presence of background noise?

2.4.(b) Do gaze patterns during imagistic gesture production differ between quiet and noise with CPHN and /or with CPHI?

2.4.(c) Do gaze direction patterns during imagistic gesture production differ between interactions with CPHI and interactions with CPNH in the presence of background noise?

The final overarching research question, namely whether patterns of gesture change based on the conversation type, is addressed in Chapter 7 with the specific research questions:

3.1.(a) Do gesture rates differ between conversation and narrative in quiet with CPHI and/or CPHN?
3.1.(b) Do gesture rates differ between conversation and narrative in the presence of background noise with CPHI and/or CPHN?
3.2.(a) Do the proportions of different gesture types differ between conversation and narrative in quiet?
3.2.(b) Do the proportions of different gesture types differ between conversation and narrative in the presence of background noise?
3.3.(a) Does the size of imagistic (iconic and metaphoric) gestures differ between conversation and narrative in quiet?
3.3.(b) Does the size of imagistic (iconic and metaphoric) gestures differ between conversation and narrative in the presence of background noise?
3.4.(a) Do gaze direction patterns during imagistic gesture production differ between conversation and narrative in quiet?
3.3.(b) Do gaze direction patterns during imagistic gesture production differ between conversation and narrative in the presence of background noise?

The literature review presented in this chapter presents the theoretical perspectives that have informed the current investigation while highlighting the need for research into the visual resource of co-speech gesture in the context of everyday interactions involving adults with acquired HI. The next chapter presents specific data collection methods and methodological considerations; participant characteristics; transcription, multimodal coding, and analysis techniques.

3 METHODOLOGY AND METHODS

This chapter presents the principal issues in the methodology and methods used to address the questions posed at the end of Chapter 2 and reported in the results chapters that follow (Chapters 4–7). The methodology guiding the research in this thesis, based on the work of Kendon (2004), McNeill (1992, 2005), Bavelas et al. (1992), Bavelas et al. (1995), and Skelt (2006) is an analysis of instances of gesture undertaken by frequent CPs of adults with HI across varying conditions. The focus on the CPs of adults with HI gives recognition to the key role they play in the management of HI (see Chapter 2 Section 2.11).

The current investigation was undertaken as a multiple case study design (Mills et al., 2012) to explore the form and function of co-speech gestures occurring during face-to-face dyadic conversations. Each case study triad consisted of three frequent CPs (one adult with HI and two CPs without HI) interacting in dyads. The first dyad included one normally hearing adult, the principal CP (PCP)[5] and one adult with HI (CPHI) and the second dyad included the same normally hearing adult (PCP) and a second normally hearing adult (CPNH). Each dyad participated in a free conversation and the narration of a short film. The focus of the analysis was the gestures produced by PCPs 1–7. Each participant group (i.e., PCP, CPHI, and CPNH) was handled as a single case (Cocks et al., 2007) such that each principal familiar CP (PCP) acted as their own control.

Each interaction was video recorded and underwent systematic multi-layered transcription and analysis of the speech-accompanying gesture produced. The analysis focuses on several key issues of gesture outlined in the literature review in Chapter 2. Analyses address both emic (meaning-based) and etic (physical/temporal) aspects of gesture. From an emic perspective, analysis is based on McNeill's typology of co-speech gestures which provides a series of gesture categories by which to describe the meaning or function of a gesture (McNeill, 1992). The gesture categories included in the analysis were iconic, metaphoric, and deictic (both concrete and abstract), in addition to emblems (Kendon, 2004; McNeill, 2005) and interactive gestures as described by Bavelas (1992) (see coding guidelines Section 3.6). Beats were included in the initial Case 1 analysis but excluded in Case 2–7 analyses. Quantitative analysis was undertaken to determine total gesture numbers, gesture proportion by type, and gesture rates and was complimented with qualitative descriptions and observations addressing gesture function.

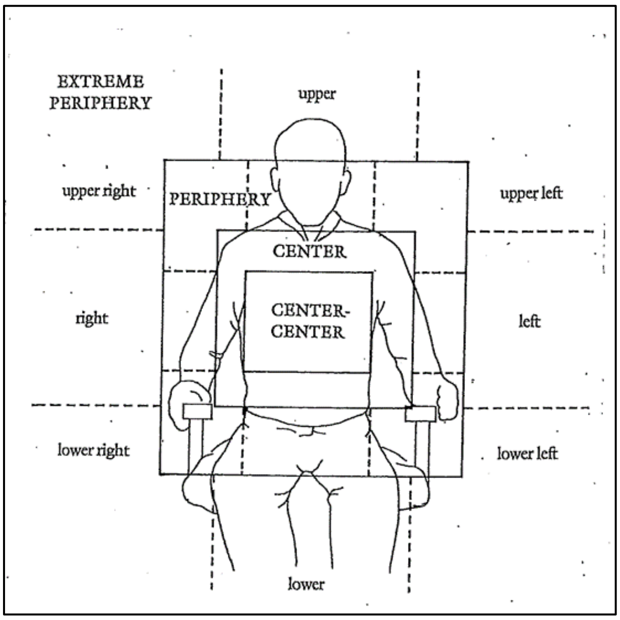
[5] For the purposes of this study the participant of primary interest in each triad, the frequent CP of the adult with HI, is labelled as the principal CP, or PCP.

From an etic viewpoint, an adapted version of McNeill's (1992) division of gesture space (the area in front of a speaker) facilitated the description of the physical form of gestures (see Section 3.5.2.1). The McNeill gesture space is marked by boundaries which divide the area in front of the speaker into concentric squares (see Figure 3.1). The areas are labelled centre-centre, centre, periphery, and extreme periphery The current analysis focuses on the size of a subset of gestures that portray semantic content, iconic and metaphoric gestures, by determining the number of boundaries crossed by hands/arms during the production of a gesture stroke (Beattie & Shovelton, 2005; Hostetter et al., 2011). A profile view of the gesture space diagram was also created to enable size analysis and illustration of gestures extending into the front peripheral areas (see Section 3.5.4.2).

As discussed in Chapter 2 (see Section 2.9), the gaze direction and movement of interlocuters has been identified as an important social, nonverbal behaviour (Gullberg & Holmqvist, 2006; Skelt, 2006; Streeck, 1993, 1994). Hence CP gaze direction as the speaker during gesture production is considered an important variable for analysis in the context of gesture and HI. The present study therefore includes an analysis of gaze movement by PCPs during iconic and metaphoric gesture production.

Figure 3.1

McNeill's (1992,p 378) Gesture Space Diagram



Reprinted from Hand and Mind, McNeill, Division of the typical adult gesture space for transcription purposes, Appendix, page 378, (1992) with permission from University of Chicago Press.

3.1 Research Design

3.1.1 Multiple Case Study

Case studies have been used across many disciplines to explore specific issues or phenomena in detail in a natural rather than in a controlled experimental setting (Crowe et al., 2011). For instance, single case studies may be used to explore specific disorders and treatments in a clinical setting or to investigate an organisation, such as a hospital or industrial setting (Nelson & Gilbert, 2020). Multiple case study research involves in-depth study of several individual cases and data collection and analysis may include qualitative and/or or quantitative methods (Hancock & Algozzine, 2011; Zainal, 2007). This approach allows the description of individual behaviours as well as comparisons and the identification of trends across cases (Mills et al., 2012; Robinson & McAdams, 2015).

Efforts to define the case study have proven challenging and there is no one formula by which to conduct or analyse single or multiple case studies (Taylor, 2013). Neither does the broader literature define case numbers required for a valid a multiple case study, although one review of the medical literature suggests that a case study series should consist of more than four participants and fewer than ten (Abu-Zidan et al., 2012).

In the current study, in depth discourse transcription, annotation, and analysis of multiple variables was undertaken. Multilayered transcription and annotation is an intensive and time consuming activity (Müller et al., 2006). Orthographic transcription of spoken interactions alone may take one hour per minute of talk for the transcription of talk alone (Müller et al., 2006). Hence considering the time constraints and scope of this thesis the numbers in the current study were limited to the seven cases.

The conventional research views are that cases studies are of limited value because the small numbers prevent the use of inferential statistics and because findings cannot be generalised to the wider population (Taylor, 2013; Yin, 2011; Flyvbjerg, 2011). Their sole role is frequently considered as a preliminary phase preceding the development of ideas towards more experimental methods with larger numbers (Taylor, 2013; Yin, 2011; Flyvbjerg, 2011). Critics of this view contend that this stance is no longer current (Yin, 2003). They propose that case study research has benefits beyond initial exploration or generation of ideas in its ability to implement in-depth analysis of individuals to identify patterns and complexities that may not be captured when studying groups and averaging data (Tetnowski et al., 2020).

Physical gesture characteristics and rates differ from individual to individual and such variations may also be influenced by personal factors such as nervousness, and social/linguistic factors such as the content or the context in which an interaction occurs, inter alia (Gullberg, 2010). The multiple case study approach used in this investigation allowed individual variation to be considered in detail as each PCP served as their own control. Case-by-case analyses enabled examination of a specific context and/or circumstance arising within each interaction and avoided over-generalisation of results (Gullberg, 2010). Comparisons were also made across conditions and communication tasks for each case along with *cross case* examination which facilitated the search for common patterns (Robinson & McAdams, 2015). The implementation of both qualitative and quantitative analyses, as advocated by Gullberg (2010), facilitated a multi-faceted view of patterns of conversational gesture behaviour.

3.1.2 Gesture Elicitation

Everyday communication tasks were used in this study as they provide increased face and ecological validity (McNeill & Levy, 1982; Wagner et al., 2014) and allow greater insight into individual communication behaviours as they are less controlled than in structured experimental tasks or interviews. The conversation and narration interactions in this investigation allowed free and unstructured talk to unfold in a spontaneous manner within the constraints of the study context and tasks.

3.2 Participants

3.2.1 Recruitment

Four South Australian-based adult hearing clinics, comprising one public and one private adult cochlear implant program and two private hearing aid rehabilitation clinics, agreed to identify potential participants with HI from their clinical databases and forward them a letter of introduction with the Participant Information Sheet enclosed (see Appendix A). This information included the request that the potential participant with HI identify two frequent CPs (without identified HI) willing to take part in the study. Participants were asked to express their willingness to participate by returning a response form containing their contact details (by mail or email) to the chief investigator (see Appendix A). Once contact was made, the investigator confirmed that the participant was able to recruit two familiar CPs without HI and arrangements were made for the three participants to attend Flinders University together for data collection.

3.2.2 Inclusion and Exclusion Criteria

The following criteria were applied in the selection of participants with HI (CPHI) and their frequent CPs without HI. A frequent CP was defined as a spouse or partner, family member, or friend with whom both the participant with HI (CPHI) and the PCP communicated regularly.

3.2.2.1 Hearing Status

Participants with HI had a (measured) acquired (moderate to profound) HI of greater than a pure tone hearing threshold average (PTA) of 50dB in the better ear for a period of at least 5 years. The PCP and CPNH were assessed to have a PTA of 30dB (measured via standard audiometric techniques; Martin & Clark, 2015) or better, no self-reported communication difficulties, and were not fitted with a hearing aid/s or cochlear implants.

Participants with a moderate or greater degree of HI are at increased risk of conversational difficulties, particularly in the presence of background noise even with the use of hearing aids or cochlear implants (Lesica, 2018; Pryce & Gooberman-Hill, 2012). Participants were required to have a HI of primarily sensorineural nature. A sensorineural HI involves impairment of inner ear function resulting in deficits of frequency and temporal resolution as well as of volume, commonly leading to distortion of speech and loss of speech discrimination (Lesica, 2018). Individuals with this type of HI will typically experience greater speech comprehension difficulties (despite the use of amplification) than an individual with a similar degree of conductive (or outer/middle ear) HI.

3.2.2.2 Language

Eligible participants had post-lingually acquired HI (i.e., with onset at or after 16 years of age) and English was their prime means of communication. Participants had English as their first or dominant language and conversed in English for all recorded interactions. Sign language users were excluded as they may have an enhanced awareness of visual information and therefore possibly an increased use of gesture and/or sign (Emmorey et al., 2005).

3.2.2.3 Vision

All participants had normal uncorrected or corrected vision (by prescription glasses or contact lenses) to ensure that they would be able to observe gestures and other visual cues produced by their CP without difficulty. This removed the potential impact on a PCP's gesture production of an impairment of CPNH's or CPHI's vision or as a consequence of their own visual impairment (Frame, 2000; Sharkey et al., 2000).

3.2.2.4 Age and Cognitive Assessment

It is well accepted that aging is associated with cognitive decline (Salthouse, 2004).To reduce the likelihood of recruiting participants with significant cognitive decline an upper age limit of 70 years was selected. The Raven's Coloured Progressive Matrices test of cognitive function was administered to exclude potential participants with impaired cognitive function (Raven & Court, 1998).

3.2.2.5 Neurological Impairment

Neurological deficits or acquired speech and language problems may also impact the individual's ability to communicate verbally and nonverbally (e.g.,Hogrefe et al., 2013; Mol et al., 2013; Preisig et al., 2018). It follows that these deficits may specifically affect the ability of CPs to produce and/or to perceive gesture. To exclude this possible prospect (Hogrefe et al., 2013; Schubotz et al., 2019) potential participants with reported neurological deficits or an acquired speech and language impairment were also excluded.

3.2.2.6 Hand and Arm Mobility

Absence or immobility of a hand or arm was also an exclusion criterion. Such physical factors may result in alteration (permanent or temporary) of the typical characteristics of a gesture's physical form. It was surmised that this would have resulted in adaptations or compensatory adjustments involving verbal or other non-verbal cues, such as facial expressions.

Based on the rationale discussed in the preceding sections, study participants (PCP, CPHI and CPNH) met the following inclusion criteria:

- hearing status CPHI acquired moderate to profound HI; PCP and CPNH normal hearing/ mild HI and no reported hearing difficulties
- age between 18-70 years (male or female)
- English dominant or first language
- no sign language use for communication
- normal corrected visual acuity (better than 6/12 or 20/40).
- no cognitive difficulties - a score on The Raven's Coloured Progressive Matrices (RCPM) cognitive assessment at or above the 25^{th} percentile (Raven & Court, 1998)
- no reported neurological impairment
- normal hand and arm mobility

As seen in Table 3.1, Case Study 1 participants were a 59-year-old normally hearing female (PCP1), her husband, a monaural CI user (CPHI), and PCP1's normally hearing stepdaughter (CPNH). The PCPs 2–7 comprised two males and four females, aged 45–69 years. The CPHI comprised five partners of the PCPs and one was a close friend. Three were hearing aid users, one a monaural CI user, one wore a right HA and a left CI, and one wore no devices. The CPNH comprised three daughters, a stepdaughter, and two friends of the PCP. The CPHI and CPNH participants were aged between 24 years and 69 years.

3.2.3 Consent and Withdrawal Criteria

Individual signed consent of each participant was sought before participation (see Appendices A and B) and for future use of the film material in presentations of the research or for teaching purposes (see Appendix C). Each participant received a gift voucher valued at $25 AUD and a reimbursement for any parking costs incurred.

Participants were informed prior to the commencement of data collection, both verbally and in written form, that they were free to withdraw from the study at any point without any adverse consequences on the access to care and services provided by Flinders Medical Centre or Flinders University

Table 3.1

Participant Information for Case Studies 1–7

Case	Participant	Gender	Age (years)	Relationship to PCP	CPHI Devices[a] Left/Right
1	PCP	F	69		
	CPHI	M	69	husband	CI
	CPNH	F	42	stepdaughter	
2	PCP	M	56		
	CPHI	F	59	wife	CI/HA
	CPNH	F	31	stepdaughter	
3	PCP	F	61		
	CPHI	F	57	friend	HA/HA
	CPNH	M	58	friend	
4	PCP	M	66		
	CPHI	F	66	wife	HA/HA
	CPNH	F	31	daughter	
5	PCP	F	45		
	CPHI	M	46	partner	None
	CPNH	F	47	friend	
6	PCP	F	59		
	CPHI	M	61	husband	HA/HA
	CPNH	F	37	daughter	
7	PCP	F	57		
	CPHI	M	57	husband	CI/none
	CPNH	F	24	daughter	

Note. PCP = principal CP without HI; CPHI = CP with HI; CPNH = CP with normal hearing; F = female; M = male; Devices refers to amplification devices: CI = cochlear implant; HA = hearing aid.

3.2.4 Data Storage

Research data and materials have been stored in accordance with the Flinders University policy on the management of research data. Clinical results sheets have been kept in hard copy in a secure locked location within Flinders Medical Centre/ Flinders University Speech Pathology & Audiology. Hard copies were scanned and kept on a Flinders University server. All digital films and transcription files have been stored on a dedicated external hard drive and backed up on the Flinders University server. Both electronic and paper data and digital files will be kept for a period of at least five years following completion of the project and publication of the results. These remain in a confidential and secure environment. All participants were de-identified in the analyses, articles, reports, correspondence, and presentations associated with this study.

3.3 Ethical Considerations

This study was approved by the Southern Adelaide Clinical Human Research Ethics Committee (SAC HREC EC00188 (see Appendices D to F).

3.4 Procedure

The methods and procedures as outlined in this chapter apply in the main throughout this thesis. Any change or modification is addressed in the relevant chapter.

3.4.1 Clinical Assessment

At the initial session of each case study triad, the requirements of the study, per the Participant Information Sheet, were explained to the participants and all questions were addressed prior to signed consent being obtained (see Appendix A and B). Participants underwent a short clinical interview to collect information about demographic details, hearing status, and hearing history and to confirm eligibility for participation in the study (see Appendix G and H). Participants were individually assessed in the Flinders University Audiology clinic rooms using the clinical measures described below (see Appendix I for assessment results).

Peripheral hearing test including *otoscopy* and *pure tone audiometry:* Otoscopy comprises standard visual inspection of the ear canal and ear drum to ensure that the outer ear and ear canal do not present with any conditions that might hamper the individual's hearing. Pure tone audiometry is the gold standard behavioural assessment of hearing and was used to determine hearing thresholds (the softest detectable tone) at individual frequencies across the range 250Hz to 4kHz (Martin & Clark, 2015). The results were recorded on an audiogram (see Appendix J). If the participant had undergone a hearing assessment in the previous 6 months, the results were used for the purposes of this study in lieu of an assessment at the time of the participant's attendance for data collection.

If the PCP or CPNH test results showed any degree of HI (whether or not they met the inclusion criteria of a pure tone average of 30dB or better) the results were discussed with the participant, and they were advised regarding further follow-up hearing assessments as appropriate.

Speech discrimination: The AB speech discrimination test (Travers, 1990) was administered (in quiet) to the participant with HI (wearing CI/s or hearing aids): The AB word test is a standard (Australian English) speech perception test used to assess the ability of an individual to correctly perceive 10 single words (scored by correct phonemes out of 30) presented at a comfortable listening level without visual cues (see Appendix K). If the participant had undergone a speech discrimination test in the previous 6 months, the results were used for the purpose of this study.

Speech discrimination in noise: The QuickSiN (Killion et al., 2004) speech in noise test was administered to participants (with the participant with HI wearing CI/s or hearing aids). The QuickSiN is a standard clinical speech in noise assessment designed for the assessment of adults and consists of sentences recorded in four-speaker background babble which are presented at an increasing signal-to-noise ratio (SNR). The SNR loss is the increase in signal-to-noise ratio required by an individual to understand speech in noise when compared to the normative data for performance of normally hearing individuals (Killion et al., 2004). The SNR loss score provided information (not predictable from the pure tone audiogram) about participants' ability to understand speech in noise without the use of visual cues (see Appendix L).

Snellen vision assessment: This is standard assessment of visual acuity involving the use of a chart of printed letters of decreasing size in each row. The row with the smallest text that can be read accurately indicates the visual acuity (see Appendix M). Participants in the current study were required to have vision with or without corrective lenses of better than 6/12 or 20/40.

Raven's Coloured Progressive Matrices (RCPM): This is a well validated measure of nonverbal cognitive ability and impairment. The Raven's CPM produces a single raw score that can be converted to a percentile based on normative data collected from various groups. Participants for the current study were required to have a score at or above the 25th percentile for their age norms to avoid the inclusion of participants with significantly reduced cognitive function (Raven & Court, 1998; see Appendix N).

Arm and hand mobility: An informal functional test based on an apraxia assessment (Poeck, 1986) was administered to ensure that participants were not prevented or significantly hindered in the use of arms, hands, or fingers (see Appendix O).

3.4.2 Conversation Recordings

Participants' involvement in the project was undertaken over two visits to Flinders University in most cases. Assessments set out above were administered on the first day. Filming was conducted on the second day unless participants preferred to complete both parts on the same day. Cases 1, 2, 4, and 7 completed assessments and filming on different days. Case 3, 5, and 6 participants completed both sessions on the same day. For Case 5 the first dyad (PCP and CPHI) and the second dyad (PCP and CPNH) were filmed on different days.

During the recording participants were seated face to face in a carpeted speech pathology therapy room furnished with a small coffee table and two comfortable armchairs approximately 1.5 metres apart. A large window provided good lighting. The room was made as physically comfortable as possible so that participants would feel comfortable and to reduce any perceived threat induced by the filming process. Each dyad was given approximately 5 minutes to adjust to the room prior to the commencement of filming (see Figures 3.2 and 3.3. Two Sony HDR-XR150 HDD Handycam video cameras were positioned such that each participant's face and upper body was clearly visible on one camera. The participants each wore head-worn Countryman E6i omnidirectional head worn (boom) microphones connected to a Zoom H4n Handy recorder. The room setup for Case 1 can be seen in Figures 3.2. All subsequent (Cases 2–7) recordings took place in a similar therapy room with the same set up (with the cupboard positioned on the opposite side). As pictured in Figure 3.3, a laptop and two speakers were positioned on the cupboard and used to present background noise during the interactions (see Section 3.4.2.6). To maximise gesture production there were no objects within reach of the participants in the room. This reduced visual distractions and participants' handling of objects to avoid not having their hands free to gesture.

Figure 3.2

Room Setup for Case Study 1 Recording Sessions

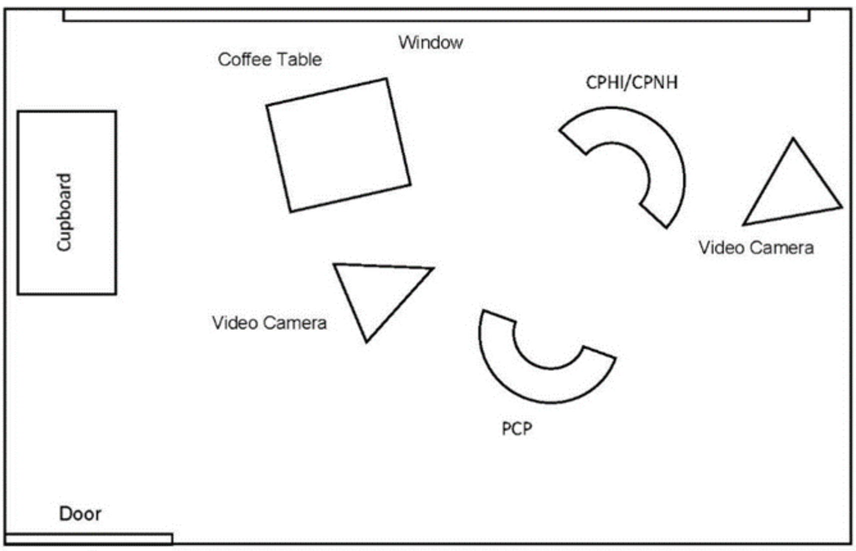
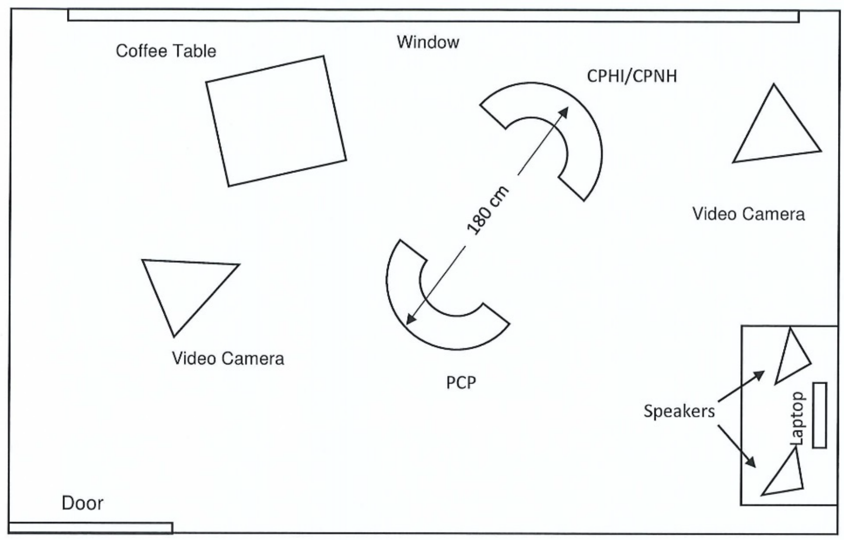


Figure 3.3

Room Setup for Cases 2-7 Recording Sessions



3.4.2.1 Ambient Noise Levels

A Quest sound level meter (SLM) 2400 was used to measure background noise levels prior to participants being seated in the room. Readings over 1 minute with a dB(A) slow setting gave peak readings ranging from 29–36 dB(A).

3.4.2.2 Conversational Tasks

To avoid an unnatural focus on gestures influencing participants' behaviour, they were told that the study aimed to investigate the way in which people communicate in different situations when one of them has HI. No specific reference was made to gestures or non-verbal behaviours. Participants were informed of the specific focus and aims of the study on completion of the recordings.

Each participant dyad was asked to take part in two conversational activities, a free conversation, and a narrative. Before each activity, the investigator provided instructions concerning the task (see Appendix P) and switched on the recording equipment before departing the room. On completion of each activity the equipment was switched off when the investigator returned.

3.4.2.3 Conversation Dyads

Each PCP was recorded interacting with their CPHI during the interactional tasks as described below. Following a short break of between 10 and 30 minutes, the PCP was recorded performing the same tasks in the same order with the second familiar CP (CPNH). Thus, Dyad A comprised the CP with the CPHI and Dyad B the PCP with the CPNH (see Figure 3.4).

3.4.2.4 Free Conversation

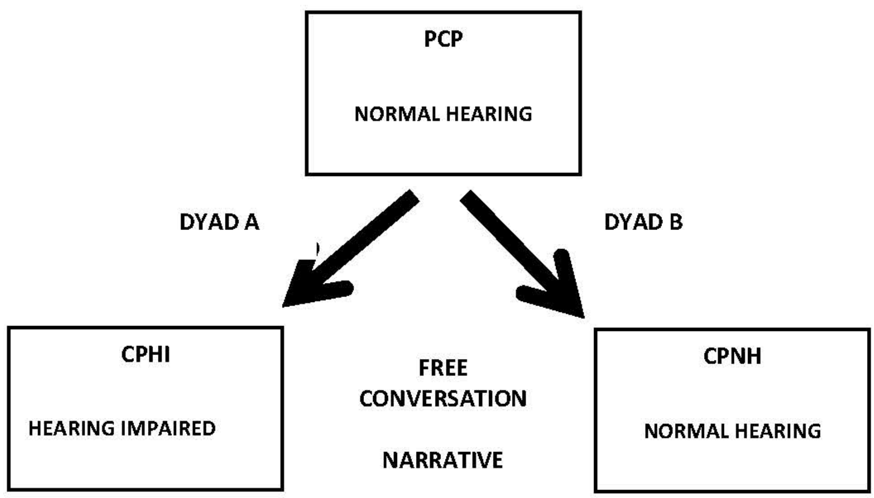
Participants were asked to talk about any topics of their choice for approximately 20 minutes. The free conversation task allowed participants to talk spontaneously on the topic of their choosing and to move between topics as would typically happen in an interaction between individuals who are known to one another. No other instruction was given about the conduct of their conversation.

3.4.2.5 Narrative

In the initial phase of the second task, the PCP was taken to a separate room to view a short seven-minute film entitled *Lamb* (Freeman, 2002). The story centered around a young blind boy and his pet lamb (see Appendix Q for film transcript). The PCPs were told that they would be asked to explain the content of this film to their CP (CPHI and CPNH) in sufficient detail so that their CP would be able to recount the story accurately.

Figure 3.4

Conversation Dyads



Others have successfully used narration of animated films to elicit gesture (McNeill, 2016). A similar approach was adopted in the current study. A short film was used that had a simple storyline featuring physical action but with limited dialogue to stimulate greater use of gesture (McNeill, 1992; McNeill & Levy, 1982).

3.4.2.6 Background Noise

Background noise was introduced during the interactions in Cases 2–7 to increase the difficulty of the listening environment (see Table 3.2). The noise levels used represent noise levels that might be typically encountered in group situations and in social gatherings (Cox & Alexander, 1994). A recording of eight speaker babble[6] was edited using Adobe Audition to create a digital file of background noise consisting of 5 minutes quiet (noise off), followed by 5 minutes of babble (referred to as *Noise level 1*), followed by 5 minutes of quiet and a further five minutes of babble (*Noise level 2*) increased by 10dB. This was used during the 20-minute free conversations.

Quiet 5 min → Noise 5 min → Quiet 5 min → Noise +10dB 5 min

Due to the shorter duration of the narrations, an additional recording was created with 2-minute intermitting periods of quiet and babble noise. The noise was increased by 10dB from Noise level 1 to Noise level 2. Background noise was introduced during narratives in Cases 3–7.

Quiet 2 min → Noise 2 min → Quiet 2 min → Noise +10dB 2 min

Table 3.2

Quiet and Background Noise During Conversations and Narratives

Case	Conversation	Narrative
1	Quiet	Quiet
2	Quiet & Noise	Quiet
3–7	Quiet & Noise	Quiet & Noise

Background noise was played via a laptop computer connected to Logitech Z520 stereo speakers. Recorded noise levels were measured using a Quest 2400 sound level meter (SLM). Noise level 1 was adjusted to 60dB(A) measured at approximate ear level at each participant chair to ensure a uniform noise level. Measurements were taken at Noise level 2 to ensure a linear (10dB) increase to 70dB(A). Two noise levels were used to ensure increased auditory difficulty at one or both levels but without making speech comprehension so difficult for the CPHI that the interaction could not continue.

[6] The babble noise is a mixture of four female and four male talkers recorded in the anechoic chamber at the National Acoustic Laboratories and available on the CD Speech and Noise for Hearing and Evaluation. The noise is filtered to match the International Long-term Average Speech Spectrum (ITLASS).

3.5 Transcription

3.5.1 Data Preparation

Video and audio files were downloaded from the recording devices. Video-editing software (Pinnacle Studio Ultimate Version 20, 2016) was used to edit and combine videos and the audio recording into a single media file.

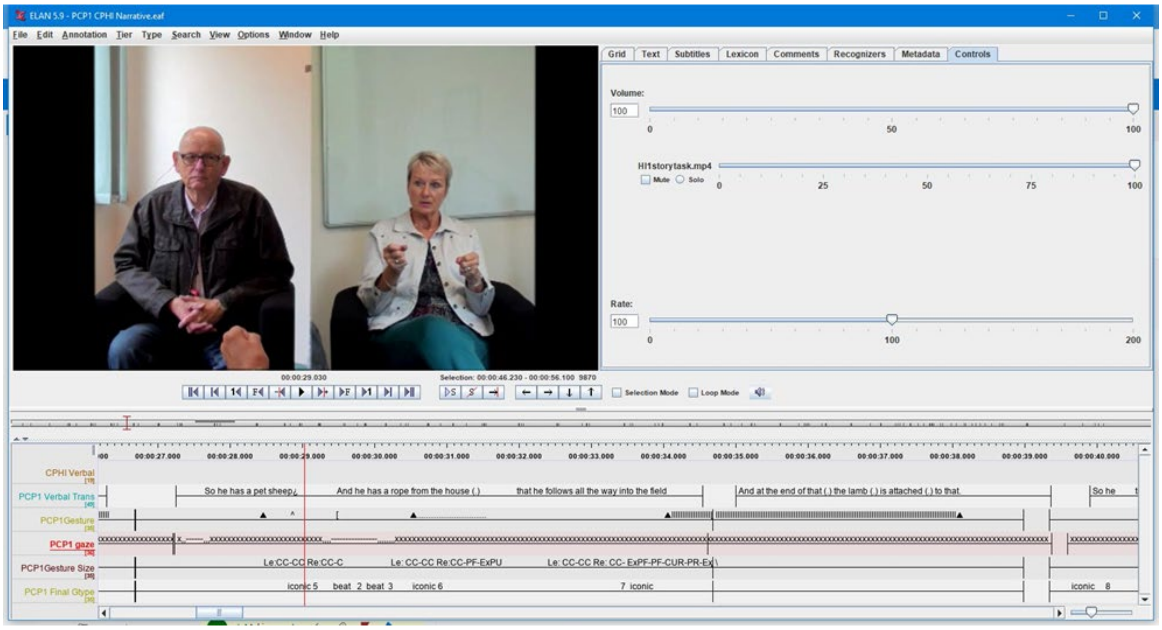
3.5.2 Multi-layered Transcription

Research into patterns of verbal and non-verbal interaction requires analyses which allow useful observations and interpretation in a systematic manner. In the present study importance was placed on observing everyday interaction. The focus of the analysis is primarily on the non-verbal behaviour of the PCPs as speakers given the hearing status of their CP. Conversation Analysis (CA) (Sacks et al., 1974) was used to inform the transcribed talk and gesture, gaze, and other relevant visual details were added as described below.

Media files of the filmed conversations and narratives were imported into the ELAN 5.9 software (Lausberg & Sloetjes, 2009) for transcription. ELAN enables the user to create annotations of a chosen type (e.g., spoken text, comments, and descriptions of visual features, such as gesture or gaze) associated with the appropriate section of a media file. These can be notated in different layers or *tiers* of transcription (Lausberg & Sloetjes, 2009). Tiers were created including one tier for the talk by each participant, and for the PCPs, one for gesture units and strokes, one for gesture categorisation, one for gesture size, and one for gaze direction of each participant (see Figure 3.5)

Figure 3.5

ELAN Media File and Multiple Annotation Tiers



A speech pathologist with CA transcription experience transcribed the interaction in Case 1 during the conversations and the narratives using CA notation. The investigator completed all gaze transcription, gesture identification and categorisation. In the subsequent cases, the investigator also identified gesture units and phrases and transcribed talk associated with PCP instances of co-speech gesture production. Ten-minute samples of each (approximately 20 minute) free conversation were transcribed. These samples consisted of the second 10 minutes of the conversation which included a 5-minute quiet period followed by 5 minutes of background noise at the higher volume (Noise level 2; at approximately 70dBA). The narratives were approximately 2.5–5 minutes in duration (see Appendix R) and the samples (Cases 3–7) that were transcribed consisted of the initial 2 minutes of quiet followed by 2 minutes of noise (at approximately 60dBA). A detailed description of the transcription and coding procedure is provided in the coding guidelines in Section 3.6.

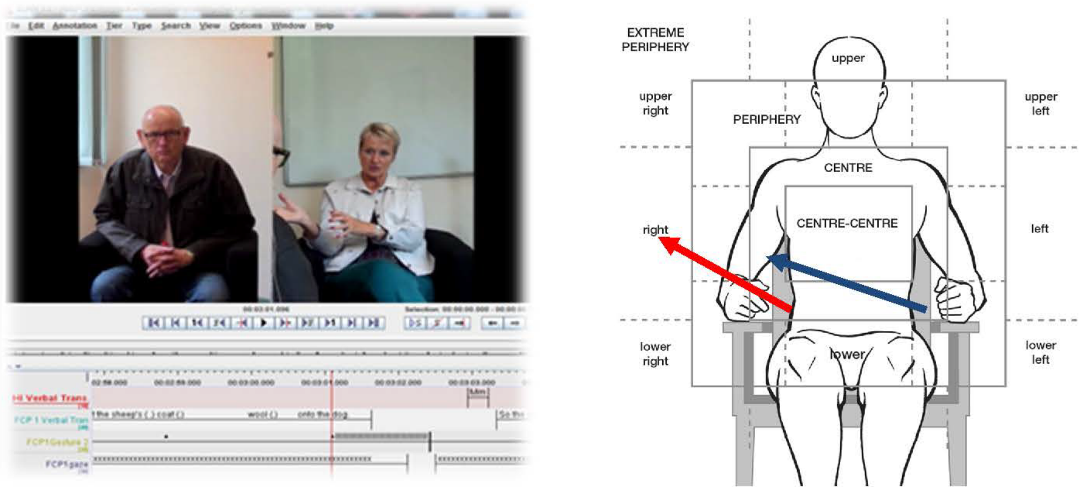
3.5.2.1 Multilayered Transcription Extracts

Sample extracts as shown in Figure 3.6 are used in the presentation of the results in Chapters 4–6. The first transcription line shows the PCP talk and immediately underneath the gesture is notated. The gaze notation appears on the next line and below the direction of the CPHI or CPNH gaze is indicated.

The gesture space diagram used for the current analysis was derived from McNeill's (1992) diagram. The diagram is used to illustrate the positioning and trajectory of the gesture in the examples. As mentioned above, a profile version of the gesture space diagram was also designed which extends into the space directly in front of the speaker. These regions have been called the *front periphery* and *extreme front periphery* (see Figure 3.7).

Figure 3.6

Sample Extract of an Iconic Gesture from Case Study 1



1 PCP1: so then. (0.3) u:m (0.5) you see the boy waking up¿
2 PCP1: he then goes outside, walks along the rope again¿
3 PCP1: and at the end of it, Is (.) you you can sort of see him feeling around

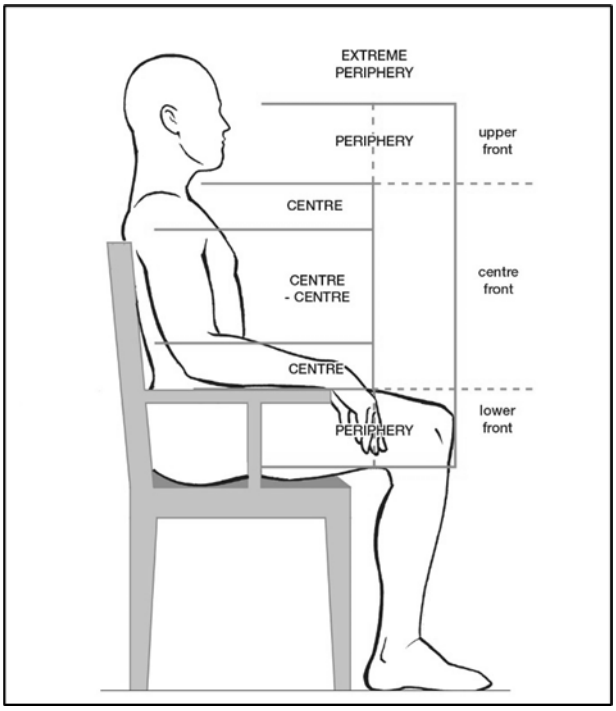
4 PCP1: and what the father has done¿ (0.3) Is put the sheep's (.) coat (.) wool (.) onto the dog
Ge: ....{ [▲............[▲......
Gz: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz:

5 CPHI: mm

Figure 3.7

Profile View of the Gesture Space Diagram



Note. adapted from McNeill (1992)

The participants in the extract seen in Figure 3.6 are from Case Study 1, therefore they are labelled PCP1 and CPHI. The image captures the peak of the gesture stroke. On the right, the gesture space diagram represents the stroke movement of the left hand with a solid blue line and the right with a solid red line. The arrow indicates the direction of the movement and the location within the gesture space boundaries. The transcription extract shows PCP1's talk before and during the gesture, and in the lines below the gesture stroke and gaze annotations are shown. The red vertical line represents the cursor position which corresponds to the ELAN image showing the peak of the gesture stroke in question. In this instance there is another gesture immediately prior to the example. The lines marked *Ge* and *Gz* indicate the gesture and gaze transcript lines respectively located below PCP1's talk. The CPHI's gaze during the gesture is notated on a separate line immediately below PCP1's gaze. The notation and symbols used in the transcript are explained in the coding guidelines (see Section 3.6).

3.5.3 Reliability Measures

In studies of gestures a second coder typically recodes between 10% to 25% of the samples to determine inter-rater reliability (Austin & Sweller, 2018; Chu et al., 2014; Jacobs & Garnham, 2007; Lanyon & Rose, 2009). In the absence of details about the process of sample selection from previous studies, the following reliability measures were undertaken.

3.5.3.1 Case 1

A speech pathologist with transcription experience (not involved in the transcription mentioned earlier) was recruited to undertake inter-rater reliability judgements. They were given training and practice in the identification of the gesture types and independently recoded 100% of gestures by type in the two narratives. Initial inter-rater agreement was 72%. Both coders then reviewed and discussed discrepancies until 100% consensus was achieved.

3.5.3.2 Cases 2–7:

The investigator identified and coded all instances of gesture. The second independent coder was another speech pathologist blinded to the prior categorisation and to the study objectives. They were trained in the categorisation of gesture by the primary investigator using written materials and examples taken from the Case 1 recordings. In line with McNeill (1992), Bavelas (1992, 1995), and Lücking et al. (2013) inter-rater reliability assessment was undertaken on approximately 10% of the data set. Random selection of conversation or narrative followed by gesture type and number was carried out using a random number generator. Twenty-five to 35 gestures of each category were identified by the investigator to achieve a balance in the number of gestures across types. However, there were few emblems (*n*=12), so, all emblems were included. Nineteen instances of beats were also included in this random selection. This resulted in a total of 170 gestures. Outcomes are presented as percentage agreement.

The initial agreement between the investigator and the second coder was 70.00%. Discussion was undertaken of each difference in the categorisation until consensus was reached and a second post-discussion agreement was calculated. The investigator classification was included in the total agreed gestures, when both coders agreed that this classification was correct. The resulting post resolution agreement was 84.00%.

Agreement for each PCP 2–7 was calculated and is presented in the Table 3.3. Rates of agreement were greater than 66% (66.67%-84.00%) for all PCPs' categories of gesture apart from PCP6 for whom the agreement was 41.67%. Following discussion, consensus was reached and approximately half of the classifications (6/14) remained in the category originally selected by the investigator. This resulted in a post-resolution agreement for PCP6 of 66.67%.

As seen in Table 3.4, agreement was calculated across all PCPs for each gesture type. Agreement on categories of deictic concrete and iconic agreement were lowest at 60.00%. However, this increased to 70.00% and 77.14% for the post-resolution discussion score.

Table 3.3

Inter-rater Agreement for Gesture Classification for Cases 2–7

Case	2	3	4	5	6	7
Agreement %	73.33	72.97	77.42	84.00	41.67	65.22
Post Agreement [a] %	86.67	83.78	87.10	92.00	66.67	82.61

Note [a] refers to total percentage agreement following discussion of interrater differences.

Table 3.4

Numbers of Randomly Selected Gestures by Category and Percentage Inter-rater Agreement

Case	2	3	4	5	6	7	Total	Agree *n*	Agree%	Post%
Metaphoric	3	8	6	4	3	3	27	18	66.67	81.48
Interactive	6	6	4	2	4	4	26	21	80.77	88.46
Iconic	2	9	6	3	7	8	35	21	60.00	77.14
Deictic C	6	4	1	4	4	1	20	12	60.00	70.00
Deictic Ab	9	6	4	5	3	4	31	20	64.52	83.87
Beat	2	3	4	4	3	3	19	15	78.95	94.94
Emblem	2	1	6	3	0	0	12	12	100	100
Total	30	37	31	25	24	23	179	119	70	

Note. Agree% = percentage agreement prior to inter-rater discussion and Post% = percentage agreement following resolution of inter-rater differences

The main point of discussion was whether a gesture directed toward the listener should be classified as a concrete pointing action or alternatively classified as having an associated pragmatic or interactive function. Discrepancies were resolved by reviewing the associated talk to determine if the gesture related to the topic of conversation or had an interactive interpretation. The form and orientation of the hand was reviewed with reference to the typical interactive gesture characteristics (see Section 3.6). As a result, the investigator reviewed concrete deictic gestures noting the context of the verbal exchange and the hand shape with reference to the typical interactive gesture form. There were several instances in which the classification was changed from metaphoric to interactive because of the discussion. The distinction between metaphoric and iconic gestures also resulted in some inter-rater differences concerning whether the concept portrayed was concrete (iconic) or more abstract (metaphoric). This prompted the investigator to review all metaphoric gestures in each instance.

3.5.4 Transcription Analysis

3.5.4.1 Gesture Rate

The gesture rate per 100 spoken words was calculated for each conversation (Holler & Bavelas, 2017). The total number of gestures and words spoken are also reported. The researcher transcribed and conducted word counts for PCP1 recordings. In subsequent cases, audio-recordings for each conversation were transcribed by a commercial transcription service. Non-words such as “um”, “ah” and fillers such as “yeah” and “you know” were removed during the transcription process.

To ensure the consistency of transcription service texts, two-minute samples from each participant dyad were assessed for accuracy. A high level of transcription accuracy was found in the extracts. In the twelve conversations sampled there were typically only one or two instances in which words were omitted or identified as inaudible. It may be taken that the word count derived from the transcripts provides a good estimate of words spoken for the gesture rate calculations.

The talk produced by PCPs 2–7 was extracted from each transcript into a Word document to perform the word count. The gesture rate per 100 words of talk for total gestures and for imagistic (iconic and metaphoric) gestures was calculated for each free conversation and each narrative sample in both quiet and noise conditions separately.

3.5.4.2 Gesture Size

As discussed in Chapter 2 (see Section 2.9), there is significant evidence that interlocuters modify their gestures in response to their perception of the specific characteristics of an interaction. Audience design has been found to include changes in the size of gestures portraying semantic content, including iconic and metaphoric gestures. (Campisi & Özyürek, 2013; Holler & Wilkin, 2011; Hostetter et al., 2011; Tellier et al., 2021). Deictic (pointing) and interactive gestures were excluded from size analysis as they show more limited variation in their form. Deictic gestures involve pointing with a finger/s or one hand extended, and interactive gestures typically involve a hand with the palm open toward the listener (Bavelas et al., 1995). Hence a subset of gestures, comprising iconic and metaphoric gestures termed imagistic gestures was selected for the size analysis.

The current project follows a method adapted from Beattie and Shovelton (2005) and Hostetter et al. (2011) in the division of gesture space (as described by McNeill,1992, 2005) to determine the size of each gesture stroke. The trajectory of each hand and/or arm involved in a gesture was observed in the recording and mapped using the derived gesture space diagram (see Figure 3.4) to determine the number of division borders crossed during the gesture stroke production. When both hands were involved, the borders crossed were summed to give a total number of borders crossed. Within boundary movements across internal dotted borders were also used to determine gesture size. A limitation of this method, however, was identified when a gesture extended out in front of the speaker (Tellier et al., 2021). When the arm/s move in a forward direction they do not cross any borders within a two-dimensional gesture space and any gesture performed in this space will be identified as a small-size gesture. Consequently, a border within three-dimensional space was added and a full arm extension in a forward motion was in the *extreme front periphery* region and a half and arm extension in the *front periphery.* Hence the profile view of the gesture space diagram enables illustration of gestures extending into the front peripheral areas (see Figure 3.7).

Gestures were allocated to one of three categories, namely (a) no borders crossed, (b) one or two borders, and (c) more than three borders crossed. The proportion of the total number of iconic and metaphoric gestures in each subcategory was calculated. A fourth category of one or more borders crossed was subsequently used in a secondary analysis in Cases 2–7.

3.5.4.3 Gaze Direction

As discussed in Chapter 2 (see Section 2.10), gaze has been identified as an important social, non-verbal behaviour. It has been reported that (normally hearing) listeners may direct overt attention to a speaker's gesture while under some circumstances a speaker may direct their gaze towards their own gestures as a marker of the perceived importance to the listener (Gullberg & Holmqvist, 2006; Streeck, 1993, 1994). As for gesture size, imagistic gestures were selected for the analysis. Gaze direction and gaze movements associated with each iconic and metaphoric gesture were annotated. Following analysis of Case 1, PCP1 gaze movements associated with gestures were grouped into three main categories. Gaze at the gesture; gaze at the CP and gaze away from CP and not at the gesture (i.e., at some other point in space). The proportion of the total number of imagistic gestures for each subcategory was calculated. The coding guidelines used for transcription and analysis are described in the next section.

3.6 Coding Guidelines

3.6.1 Transcription and Coding Procedures

ELAN *segmentation mode* was used to identify and bracket the turns at talk by each participant. The *annotation mode* was used to orthographically transcribe the talk of each filmed conversation using conventional orthographic Australian English. CA symbols were added to identify features of speech such as pause, stress, loudness, and overlapping talk in the examples presented in Chapters 4–6 (see Appendix S).

ELAN allowed several simultaneous layers of transcription time locked each in its own *tier* displayed one under the other. ELAN was used for gesture identification by the creation of a new tier. Only gestures of PCPs 1–7 were recorded and categorized in this tier. *Gesture units* were identified on the first viewing by using the segmentation mode. A gesture unit included all gestures occurring within the interval between the departure from and the return to rest positions (Kendon, 2004). Gesture units may contain more than one *gesture phrase* that typically consist of preparation, stroke, and retraction phases. One gesture phrase may also flow into the next without a clear preparation or retraction phase. On the second viewing each individual gesture was identified, and the peak of the gesture stroke was marked within the transcription tier. A slowed motion and frame-by-frame advancement of the video within ELAN facilitated this process.

3.6.2 Gesture Categorisation

During subsequent viewings of the video the primary investigator categorised each gesture following the guidelines provided McNeill (1992) and Bavelas et al. (1995). Each gesture was categorised as belonging to one of the categories iconic, metaphoric, deictic (abstract or concrete), as a beat, an interactive gesture, or an emblem (see Tables 3.5 and 3.6). Each gesture within each category was given a number to facilitate the counting of gesture types and the identification of examples.

Interactive gestures were identified following Bavelas and colleagues (Bavelas et al., 1995; Bavelas et al., 1992). Interactive gestures provide no information about the topic of conversation but where there is an inferred reference to the listener (see Table 3.7). The physical characteristics typically consist of a movement of a finger or fingers or an open palm by the speaker towards the listener. The entire movement may be very brief. By contrast, individual beats were identified (unless they appeared to be a continuous movement of the hand marking the same word or idea) but not counted in Cases 2–7.

Table 3.5

Gesture Types and Their Characteristics

Gesture Type	Characteristics/Function		Example
Iconic	Portray a concrete image or action	Placing Shaping Drawing Posturing Sizing Counting	Using both hands to form the shape of a ball
Metaphoric	Portray pictorial content for an abstract idea or concept such as knowledge or language		"He had one idea and she had another" Cupping one hand and then the other to represent the concept of an idea
Deictic - concrete	Using a finger or fingers extended as an index pointing towards an object, person, direction, or location	Accompany speech but may be used to substitute speech	"I was referring to that book" while pointing toward a particular book
Deictic - abstract	Using a finger/s extended as an index pointing towards a point in space – unseen, abstract or imaginary things		"Then we saw the policeman" while pointing a finger to a point in space
Beats	Short biphasic movement with no semantic meaning Follows speech rhythm, may indicate the significance of a specific phrase		Short flicks of the hand/s or finger/s back and forth or up and down while speaking
Emblems	Culturally specific, can be used without speech; have names or standard paraphrases		OK sign -putting index finger and thumb together to form an O shape
Interactive	Regulatory function within conversation; contain no topic information	Delivery Citing Seeking Turn	

Table 3.6

Iconic Gesture Forms (adapted from Lücking et al., 2013)

Iconic Gesture Form	Description
Placing	as if an object is placed or set down within gesture space
Shaping	as if an object's shape is contoured or sculptured in the air
Drawing	as if the hands trace the outline of an object's shape
Posturing	the hand/s form/s a static configuration to stand as a model or as a proxy for the object itself
Sizing	as if the hands or fingers indicate a specific distance or size
Counting	fingers are used to enumerate things by means of what can be construed as an iconic representation of a tally sheet

During gestures that present a certain hand shape in a hold position one or more beats may be superimposed on the original hand shape.

When a particular gesture was judged to be more than one gesture type the gesture was labelled as both gesture types and then classified as one or the other based on the context and associated talk. For example, if a pointing gesture provided information about movement in addition to direction or location, then it was labelled as both iconic and deictic but with a primary classification as iconic (Mol et al., 2009). Head movements, such as nodding and other body movements, were also noted if associated with a gesture. Movements not considered gestures included self-touching, such as scratching, flicking back hair, rubbing an eye, shifting posture, or object manipulations, such as adjusting clothing, jewellery, or glasses, and picking up an object.

When a gesture began but appeared to be aborted before the stroke phase was executed then the gesture was not categorised. When the hands remained in position following a stroke and did not immediately return to the rest position this was considered a *hold* and annotated as a dotted line.

Table 3.7

Interactive Gesture Functions (adapted from Bavelas, et al.,1995)

Interactive Gesture Type		Function	Example Analogous Verbal Paraphrase
Delivery: Refer to the delivery of information by speaker to addressee	General	The speaker metaphorically hands over information relevant to his or her main point	“Here’s what I’m telling you”
	Shared Information	Mark material that the addressee probably already knows (common ground)	“As you know”
	Digression	Mark information that should be treated as an aside from the main point	“Follow me”
	Elliptical	Mark information that the addressee should elaborate for themselves. The speaker will not provide further information	“You know the rest”
Citing: Refer to a previous contribution by the addressee	General Citing	Indicates that the point the speaker is now making has been contributed by the addressee	“As you said earlier”
	Acknowledgement	Indicates that the speaker saw or heard the addressee understood the speaker	“I see that you understood me”
Seeking: Aim to elicit a specific response from the addressee	Seeking Help	Request a word or phrase that the speaker cannot find at that moment	“Can you give me the word for….?”
	Seeking Agreement	Asks whether the addressee agrees or disagrees with the point being made	“Don’t you agree?”
	Seeking Following	Asks whether the addressee understands what is being said	“You know?”
Turn: Refer to issues around a speaking turn	Taking Turn	Accepts the turn from the other interlocutor	“OK I’ll take over”
	Giving Turn	Hands over the turn to the other interlocutor	“Your turn now”
	Turn Open	Indicates that it is anyone’s turn	“Who’s going to talk next?”

Small shifts or changes of the handshape during the hold were not annotated. When a gesture concluded with a return to the rest position and when the hands remained in a hold position before returning to the rest position this was considered a single gesture. When the hands continued after a hold to perform further movement this was considered a second gesture. When there was a repeated movement, such as continuous hammering action, waving goodbye, or drawing the same shape back and forth, this was coded as one gesture consisting of repeat movements.

3.6.3 Size

The trajectory of each hand and arm involved in the gesture was reviewed and mapped using the gesture space diagram to determine the number of spatial borders crossed during the gesture stroke production. When both hands were involved, the total borders crossed were summed to give the total number of borders crossed. The movements across borders were annotated in a dedicated ELAN tier using the notation as seen in Table 3.9. Gestures were grouped into three categories according to the numbers of borders crossed by the hand/s and/or arms involved in the movement. If hand/s and/or arm/s remained within a single gesture space area and so crossed no borders, the gesture was classified of *small* size. When one or two borders were crossed a gesture was considered *of medium* size while a *large* gesture was identified if three or more borders were involved. Gestures in the fourth category were classified as *medium-large* when one or more borders were crossed.

3.6.4 Gaze

Gaze direction and movement of the PCP were transcribed on a (Gardner, 2001) dedicated ELAN tier. Gaze transcription was carried out for the PCP gaze immediately prior to, during and immediately following a gesture or gesture phrase. Gaze patterns were identified for PCP1 and the following primary categories used for the subsequent analysis.

- Gaze at the gesture
  - during performance of the stroke
  - at the hands during the gesture *preparation phase* moving to the CP on/during/after the stroke
- Gaze at the CP: including before and during the stroke; gaze at CP but moves <u>away</u> immediately after the stroke; gaze moves to the CP as the stroke is performed; gaze moves to the CP *immediately after* the stroke is performed.
- Gaze away from CP and not at the gesture i.e., at some other point in space.

3.6.5 Notation

Notation used in the transcription of talk in the example extracts in this thesis is based on conversation analysis (CA) conventions adapted from Gardner (2001) (see Appendix S). Gesture notation is presented in Table 3.8, size notation in Table 3.9, and gaze notation in Table 3.10.

Table 3.8

Gesture Notation

Gesture Phase		Notation
Preparation	a curly bracket indicates the start of a preparation phase	**{**
Stroke	a square bracket indicates the beginning of a stroke movement following the preparation phase	**[**
Peak of a stroke	a closed triangle indicates the peak of the stroke & points upward towards the word most closely associated with the peak	▲
Repeated stroke	A closed triangle and **r** indicate a repeat of the prior stroke action	▲r
Beat gesture	An open triangle indicates a beat gesture	^
Ongoing stroke	a solid line indicates an ongoing stroke movement	____________
Stroke hold	a dotted line indicates a stroke hold	....
Return to rest position	a curly bracket indicates a return to the rest position	**}**

Table 3.9

Gesture Size Notation

Gesture Space Division	Notation
Centre-centre	CC
Centre left/right/upper/lower	CL/CR/CU/CLo
Periphery left/right	PL/PR/
Periphery upper right/left	PU/PUL/PUR
Periphery lower right/left	PLo/PLoL/PLoR
Periphery front	PF
Extreme periphery left/right	ExPL/ExPR
Extreme periphery upper left/right	ExPUL/ExPUR
Extreme periphery lower left/right	ExPLoL/ExPLoR
Extreme periphery front	ExPF
Hand/s used left/right	Le/Ri

Table 3.10

Gaze Notation (adapted from Goodwin, 1981 & Skelt, 2006)

Gaze direction		Notation
Movement	a series of commas indicates movement of gaze either toward the CP after looking away and movement away from the CP	,,,,,,,,,,,,,,,,
Continuing at CP	a series of crosses indicates continuing gaze at the CP	**xxxxxxxx**
Away from CP	a series of dashes indicates gaze is directed away another object/point in space and not at the CP	**-------------**
At gesture	a series of asterisks/stars indicates CP gaze directed at their own gesture	************
Unclear	a series of question marks indicates that gaze direction could not be determined	????????

3.7 Method Summary

This chapter presented the methodology and methods developed for the current investigation including the recording of interactions and the discourse-orientated analysis applied to gestures produced in interaction. Adults with acquired hearing impairment and their frequent CPs were recruited to participate in everyday conversational tasks. An initial exploratory case study was followed by six subsequent case studies. Each case study triad comprised two dyads: the normally hearing principal CP, the focus of the study with their CP with HI and the principal CP with their normally hearing CP. The multilayered transcription and analysis of gesture frequency and characteristics followed and adapted the work of Kendon (2004), McNeill (1992, 2005), Bavelas et al. (1995), and Skelt (2006).

In the next chapter the findings of the exploratory case study are presented. Case study 1 was designed to assess the proposed research design as a method of data collection and analysis of gestures produced in a naturalistic setting. For the first time gestures undertaken by the familiar CPs of adults with HI are the focus of analysis.

4 CASE STUDY 1

This chapter presents the results of the initial exploratory case in the investigation of the impact of adult HI on the production of gesture by PCPs in dyadic conversations. As discussed in Chapter 2, research findings support the view that hand gestures produced in association with speech provide important sources of visual information which may be used by listeners to enhance speech comprehension, particularly in difficult listening conditions (e.g., Holle et al., 2010; Obermeier et al., 2012; Riseborough, 1981; Rogers, 1978). Furthermore, it has been demonstrated that listeners obtain greater benefit during speech comprehension from iconic gestures combined with visual speech cues than from either visual speech or gesture presented alone (Drijvers & Özyürek, 2017). It follows that when individuals experience a degraded speech signal because of their HI (Picou et al., 2013) they may place greater reliance on visual information to enhance comprehension of spoken messages (Tye-Murray et al., 2007). This visual information might include gestures in addition to visual speech cues.

This gives rise to a key consideration, namely the role of the CPs of individuals with HI and how they might tailor their communication in response to difficulties imposed by HI in everyday interactions. The modification of conversation-partner behaviours based on the situational context or CP characteristics is referred to as audience design (Garfinkel, 1967; Sacks et al., 1974). As discussed in Chapter 2, key targets of audience design include gesture rates, size, precision, and informativeness (Campisi & Özyürek, 2013; Galati & Brennan, 2014; Holler & Wilkin, 2011; Hostetter et al., 2011; Jacobs & Garnham, 2007; Kelly et al., 2010). The central issue addressed in this thesis is whether CPs' gestures are affected by their partner's HI, and if so how.

4.1 Objectives

Case study 1 was designed to ascertain whether the proposed research design would result in gesture production during interactions recorded in a naturalistic setting, allowing examination of the primary research question: Is the gesture production of an individual impacted by the presence of a frequent CP with HI by comparison with a CP without HI in everyday conversation or while narrating a story? Further it may be asked, whether the presence of a CPHI impacts the frequency, types and/or the physical presentation of the gestures and associated gaze of during dyadic interactions?

The specific questions following from the above omnibus question addressed in this chapter in reference to the gesture production of PCP1 are as follows:

1.(a) How frequently are gestures produced?

1.(b) Do gesture rates differ between interactions with the CPHI and interactions with the CPNH?

2.(a) What types of gesture can be observed?
2.(b) Are some gesture types produced more frequently than others?
2.(c) Does the frequency of different gesture types differ between conversation and narrative?
2.(d) Do the proportions of different gesture types differ between interactions with the CPHI and interactions with the CPNH?
3.(a) Does the size of imagistic (iconic and metaphoric) gestures differ between interactions with the CPHI and interactions with the CPNH?
4.(a) Where does the PCP direct their gaze during imagistic (iconic and metaphoric) gesture production?
4.(b) Do gaze direction patterns during gesture production differ between interactions with the CPHI and interactions with CPNH?
The methodology and methods used in Case study 1 are summarised in the next section.

4.2 Method

Case study 1 was designed to test the methods of data collection outlined in Chapter 3 and determine whether gestures could be successfully elicited in the specific setting. The method chosen reflects the change over recent years towards analysis of interaction to investigate the primary impact of HI (Lind, 2014). Addressing the communication difficulties of individuals with HI within a real-life context implies the need to explore natural conversations rather than measure speech perception using clinical tests (Preminger & Lind, 2012).

Participation in naturally occurring conversations represents everyday interactions more closely and thus offers greater face validity (Wagner et al., 2014). By contrast, behaviours produced under conditions with greater experimental manipulation may not be typical of those found in more spontaneous natural interactions. As far as the investigator is aware, the current study is the first to record and examine the impact of HI on gesture production of a CP in natural conversations. The conversation tasks selected in the current study were a free conversation and a narrative task.

4.2.1 Participants

Participant information is shown in Table 3.1.(see also Appendix I for clinical assessment results). Case study 1 participants consisted of an adult male with HI (69 years; CPHI) and two familiar CPs (PCP1 & CPNH). At the time of recording, the CPHI had a severe to profound bilateral acquired hearing loss and was a unilateral cochlea implant user. Neither PCP1 nor CPNH reported hearing difficulties and audiometric testing revealed pure-tone average hearing thresholds better than 30dBHL. PCP1 (69 years) was the CPHI’s wife and CPNH (42 years) was the couple’s daughter. All participants met the inclusion criteria and were fluent speakers of Australian English. Both CPHI and CPNH were native speakers and PCP1 had spoken English as her dominant language for 50 years.

The methods and methodology used to generate the data and examples in this chapter were described in detail in Chapter 3 and are summarised below.

4.2.2 Procedure

Clinical interviews and assessments were followed by the recording sessions. As illustrated in Figure 3.3, the first dyad consisted of PCP1 and CPHI and the second of PCP1 and CPNH. Each dyad participated in two conversation activities. The first was free conversation during which they conversed about topic or topics of choice for 20 minutes. The second activity involved PCP1 watching a 7-minute film and narrating the story as depicted in the film to their CPHI/CPNH. All interactions took place in a quiet environment.

4.2.3 Transcription and Analysis

A speech pathologist with transcription experience transcribed the participants' talk during conversations and narratives using CA notation in the multilayer transcription software ELAN (Lausberg & Sloetjes, 2009). Individual layers known as *tiers* were created for the talk of each participant and for PCP1 gesture units and strokes, gesture categorisation and gaze direction. The investigator completed all gaze transcription, gesture identification and categorisation. The focus of the analysis was on the characteristics of PCP1's gesture production as described in the following sections.

4.2.3.1 Gesture Frequency

As a measure of gesture frequency, the number of gestures produced per 100 spoken words was calculated for the total gestures and additionally for imagistic gestures (including iconic and metaphoric gestures). The results are presented as gesture rates in Section 4.3.1.

4.2.3.2 Gesture Type

McNeill's (1992) typology of gesture function was used as the basis for gesture categorisation. Gesture types (defined in Section 3.6.2) identified were *iconic, metaphoric, deictic* (*abstract* or *concrete*), in addition to *interactive* Bavelas (1995) and *emblems* (Kendon, 2004). *Beats* produced in isolation or superimposed on another gesture were also identified. The findings regarding gesture function are presented in Section 4.3.2. Each gesture type is depicted in examples presented in the sample extracts. Due to the considerable variation in total gesture numbers produced by PCP1 across interactions, gesture type proportions were calculated for each interaction. The results are presented in Section 4.3.3. A subset of gestures namely imagistic gestures (iconic and metaphoric) was chosen for the analysis of gesture size and associated gaze direction.

4.2.3.3 Gesture Size

Gesture size was determined using the gesture space diagrams (front view and profile view) derived from McNeill (1992; see Section 3.6.3) following a method adapted from Beattie and Shovelton (2005) and Hostetter et al. (2011). The diagrams were used as a representation of size by identifying the number of gesture space division borders crossed by hands and/or arms during gesture production. Movements across borders were annotated for each imagistic gesture in ELAN using the notation system presented in the coding guidelines (see Section 3.6.5). Gesture sizes were assigned to one of three categories: small (no borders crossed), medium (one to two borders), and large (more than three borders crossed). The proportion of the total number of imagistic (iconic and metaphoric) gestures for each category was calculated. The results are presented in Section 4.3.4.

4.2.3.4 Gaze Direction

Gaze movements associated with each imagistic gesture were annotated in ELAN using the notation system described in the coding guidelines (see Section 3.6.5). Typically occurring patterns were identified and subsequently grouped into three main categories: gaze at the gesture, gaze at the CP and gaze away from CP and not directed at the gesture (but at some other object or point in space). The proportion of the total number of gestures for each subcategory was calculated. The results are presented in Section 4.3.5.

4.3 Results

Case study 1 was designed to assess the method of eliciting gestures and to determine whether gestures would be observable during both conversational activities. Gestures were produced by PCP1 in the conversations and the narratives with the CPHI and the CPNH.

All results reported here refer to PCP1’s gestures when conversing either with their CPHI or their CPNH. Quantitative data of gesture size categories and gaze movement patterns are complemented with qualitative descriptions and with excerpts illustrating specific examples.

4.3.1 Gesture Frequency

The research questions addressed in this section are:

1.(a) How frequently are gestures produced?

1.(b) Do gesture rates differ between interactions with the CPHI and interactions with the CPNH?

Gesture rates were calculated for total gestures including beats, for total gestures excluding beats, and for imagistic gestures. As seen in Table 4.1, all gesture rates were higher in narrative than in conversation. Gestures rates were similar with the CPHI and the CPNH in free conversation with respect to total gesture rate (CPNH 7.8; CPHI 8.3), total gesture rate excluding beats (CPNH 5.06;

CPHI 4.38), and imagistic gesture rate (CPNH 3.16; CPHI 2.28). Similar gesture rates were also found with both CPs in the narrative with respect to total gesture rate (CPNH 12.68; CPHI 12.66), total gesture rate excluding beats (CPNH 7.97; CP HI 8.59) and imagistic gesture rate (CPNH 7.19; CPHI 7.34).

Table 4.1

PCP1 Gesture Rates per 100 Spoken Words in Conversations and Narratives With CPNH (NH) and CPHI (HI)

	Conversation		Narrative	
	NH	HI	NH	HI
Total gestures	223	91	97	81
Total gesture Rate	7.83	8.3	12.68	12.66
Total gestures (excl. beats)	144	98	61	55
Gesture rate (excl. beats)	5.06	4.38	7.97	8.59
Total imagistic gestures	90	25	55	47
Imagistic gesture Rate	3.16	2.28	7.19	7.34

Table 4.2 presents the total number of words spoken by PCP1 in each interaction. While conversing with the CPNH (stepdaughter) PCP1 spoke over twice as many words than with the CPHI (husband). This reflected the fact that the CPHI was observed to hold the conversation floor for substantial periods in the 20-minute conversation. By contrast, PCP1 used approximately the same number of words in the narrative task when retelling the story to the CPNH and the CPHI. The duration of the narrations were 4 minutes 20 seconds and 4 minutes 58 seconds with the CPHI and the CPNH respectively.

As illustrated in Figure 4.1 these findings indicate that PCP1 did not alter the overall frequency of gestures when communicating with the CPHI compared to the CPNH. This suggests that the presence of a CP with HI did not influence PCP1's rate of gesture production.

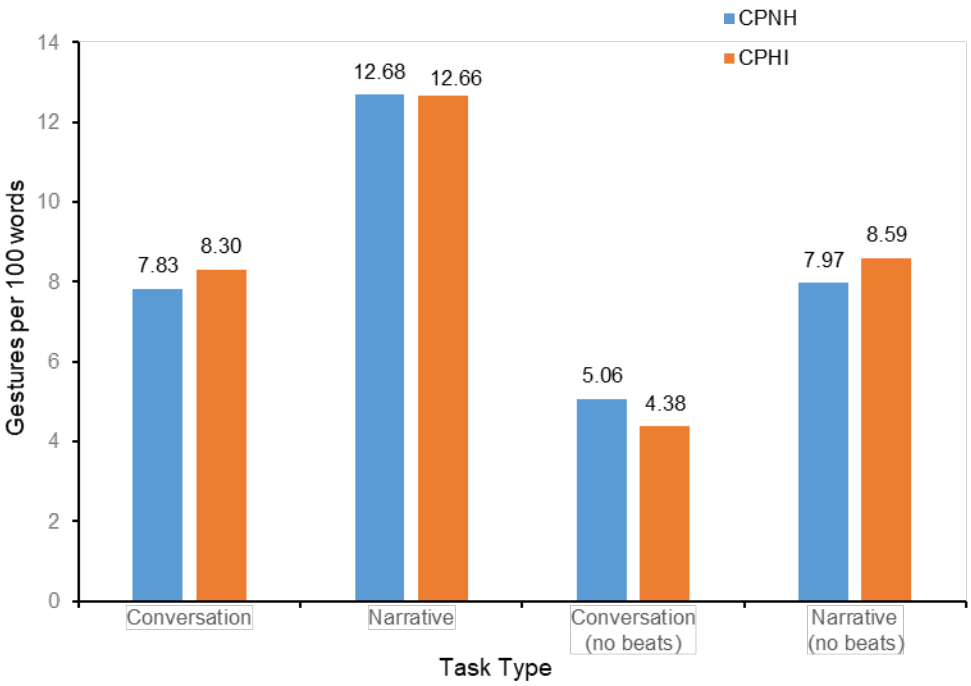
Table 4.2

Total Words Spoken by PCP1 in Conversation and Narrative with CPNH (NH) and CPHI (HI)

	Conversation		Narrative	
Hearing status	NH	HI	NH	HI
Total words	2847	1096	765	640

Figure 4.1

PCP1 Total Gesture Rates in Conversation and Narrative With CPNH and CPHI



4.3.2 Gesture Form

The research question addressed in this section is:

2.(a) What types of gesture can be observed?

Each gesture was allocated to one of six categories described in the coding guidelines (see Section 3.6.2). Five of the six gesture types were used consistently by PCP1, namely iconic, metaphoric, deictic (abstract & concrete), interactive, and beats. Three emblems only were identified across all interactions. Examples of each type are presented below.

Each example comprises an image from ELAN, a transcript and a gesture space diagram. The blue (left) and red (right) arrows represent the trajectory of the hands during the gesture stroke. The vertical red line in the transcript indicates the position of the cursor in the ELAN image. The stroke commencement is indicated by a square bracket ([) and the peak of the stroke is indicated by the symbol ▲ (refer also to Section 3.5.2.1 & Section 3.6).

4.3.2.1 Iconic Gesture

Figure 4.2 shows an iconic gesture from the narrative representing a sheep's fleece spread out on the floor. This gesture is classified as an iconic gesture as it represents the form of a concrete object. The sheepskin is portrayed as a flat form spread out in front of PCP1. The gesture is interpreted with reference to the associated talk. PCP1 refers to the "sheep's coat" spread out on the floor as she performs the gesture. To begin PCP1's hands are palms face down and move to overlap in the lower periphery (preparation) then right and left hands move outward to the centre right and centre left (stroke). In the gesture space diagram, the stroke movement is represented with the arrows (blue for the left and red for the right hand). This gesture is held in this form and the hands do not return to the rest position during the utterance. The image on the left shows the peak of the stroke as the hands move to their final position which remains in a post-stroke hold.

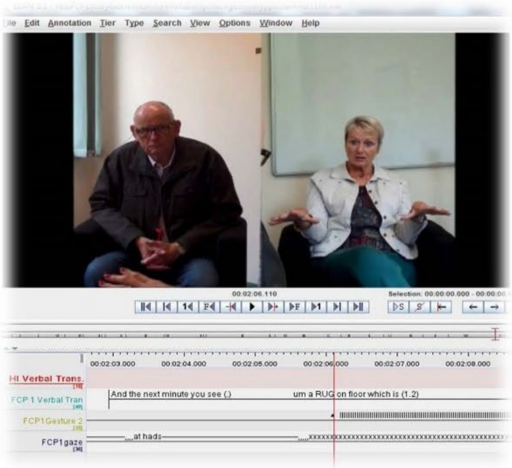
Another example of iconic gesture is presented in the second extract (Figure 4.3). A concrete action is represented in this instance. Both hands have fingers loosely clasped in front of PCP1 in the centre-centre space (rest position). Her hands unclasp and move outward, the right into the right and left into the left front periphery (preparation). Both hands/arms move to the left front periphery then the left hand/arm moves to the left periphery and the right to the left centre. While the arms move, the palms are facing down, and the hands make small up and down movements. In her talk PCP1 refers to the boy in the film as "feeling like this". She appears to be demonstrating the physical movement of the blind boy feeling his way as if she is the boy. As in the previous example it is only possible to understand the semantic meaning of the gesture by putting it into context of the talk. This is considered an iconic gesture as it represents a concrete representation of the action of "feeling". The gesture space diagram used for this example presents the profile perspective as during the performance of this gesture PCP1 extends her arms forward (elbows still bent).

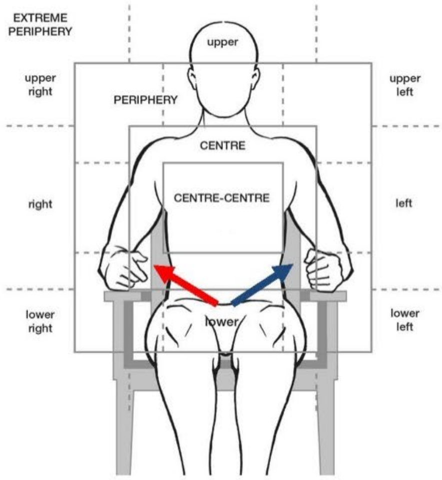
4.3.2.2 Metaphoric Gesture

Figure 4.4 shows a metaphoric gesture representing the idea of "change". This gesture is classified as a metaphoric gesture as it represents an abstract concept. Once again it is interpreted with reference to PCP1's associated talk. Her right hand moves from her leg (rest position) to the centre right (preparation). She rotates her hand palm down into the periphery and continues to roll her hand forwards repeatedly, palm facing her body, while moving her arm outward to the right extreme periphery. Her hand then moves back to the chair arm (retraction to rest position).

Figure 4.2

Example of an Iconic Gesture





1 PCP1: he (0.9) he takes the: (0.4) all: the wool off because it's a beautiful looking lamb with quite (0.7) thick wool

2 PCP1: and the next minute you see (.) um a RUG on floor which is (1.2) the sheep's (0.5) coat¿

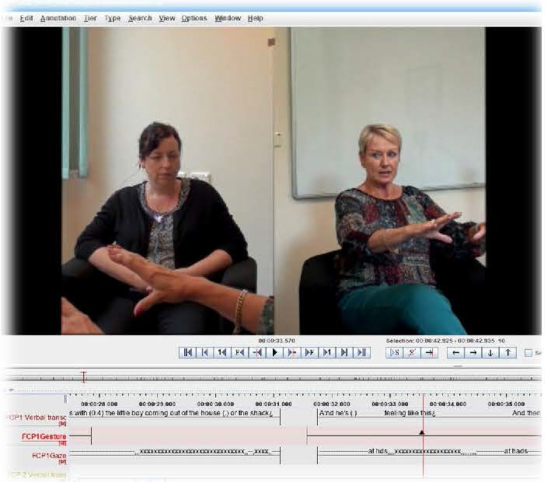
Ge { [▲...

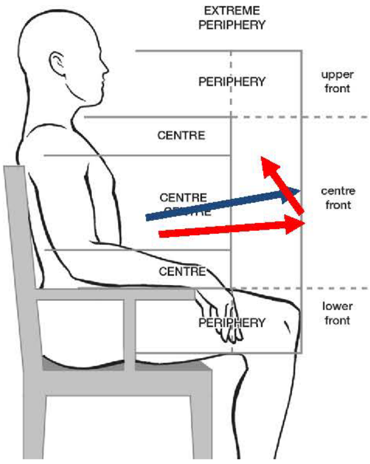
Gz -----,,,,*******---------------------- ,,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

Figure 4.3

Example of an Iconic Gesture





1 PCP1: it's starts with (0.4) the little boy coming out of the house (.) or the shack¿

2 PCP1: a:nd he's (.) feeling like this¿
Ge { [▲.......}
Gz -------,,,,,*********,,,,xxxxxxxx,,,,--

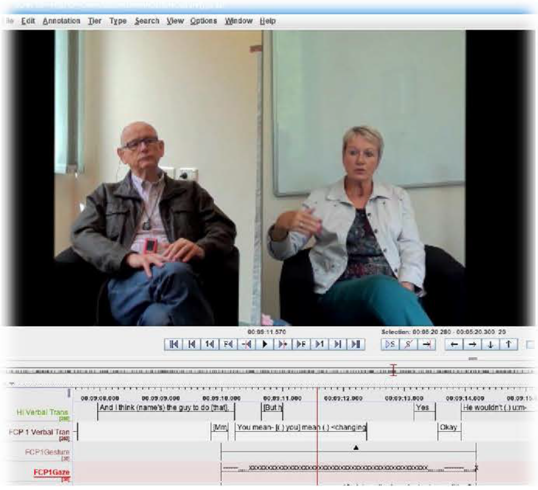
CPNH: xxxxx,,***,,xxxxxxxxxxxxxxxxxxxxx
Gz

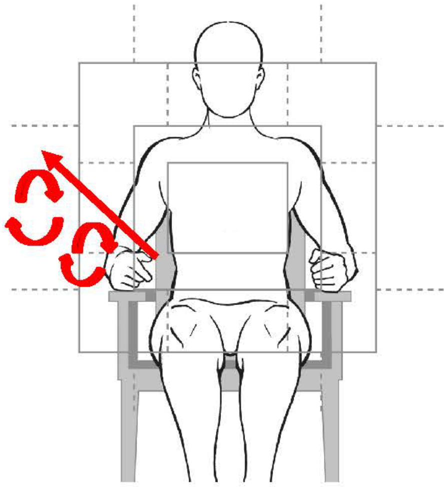
3 PCP1: and then he finds a POle, that has a rope on it¿ so he follows the rope all along.

4 PCP1: so from that (0.3) before I saw his eyes, (0.3) I gathered that he's blind.

Figure 4.4

Example of a Metaphoric Gesture





1 CPHI: but apart from anything else I need to have some (0.7) training on (.) how to w- (.) U:SE those.
2 CPHI: how to [(0.4)] keep them interesting and [so on].
3 PCP1: [Right]
4 PCP1: [Yep] yep
5 CPHI: and I think (name's) the guy to do [that],
6 PCP1: [Mm]

7 PCP1: you mean- [(.) you] mean (.) <changing>
Ge { [▲___________
Gz ----,,,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

8 CPHI: [but he-]
9 CPHI: yes
10 PCP1: okay
11 CPHI: he wouldn't (.) u:m-
12 CPHI: <he> certainly wouldn't (1.4) for a website for ME: = [it] wouldn't be an interactive website like the j[ohn LOgan website]

PCP1 begins the rolling action as she appears to search for the appropriate word and continues the movement as she utters “changing” referring to the updating of a website. The rolling action is interpreted as a physical action used to portray the abstract concept of change or renewal. By contrast, in different context for example, if a ball was described as “rolling down the hill”, then the same action would be classified as an iconic gesture representing the concrete action of rolling.

4.3.2.3 Deictic Gesture

Figure 4.5 shows an example of a *concrete* deictic gesture labelled as such because the pointing action is directed toward a concrete entity (with verbal reference to that entity). The entity in this example is PCP1 herself. She indexes herself as she refers to herself in her talk. She says “I have to make sure” while pointing her hands towards her torso. Both hands are in front with palms facing out in the lower centre (left hand) and centre-centre (right hand) with index fingers raised. She points towards herself with both hands, the right to the centre-centre and the left to lower centre (stroke). She begins to clasp her hands together and return to a rest position but instead then moves immediately into another gesture.

Deictic gestures can also be abstract in nature and used to set up a scene or location in space. Reference to one or more points in space may be used to represent locations, times, objects, or persons who are not present but are referred to in the conversation. Figure 4.6. shows an abstract deictic gesture indicating a time point in the future. This gesture is classified as abstract deictic because the index finger is directed at a point in space to represents a point in time referenced in PCP1’s talk as “the week after next”. In this example, PCP1’s right hand moves from the lower periphery (finger resting on her knee after previous gesture) up and to the right with the index finger pointing forward (preparation) then in towards the centre-centre and outward again in a half circle motion to the right periphery (stroke). Her hand then returns to her lap (retraction to rest position).

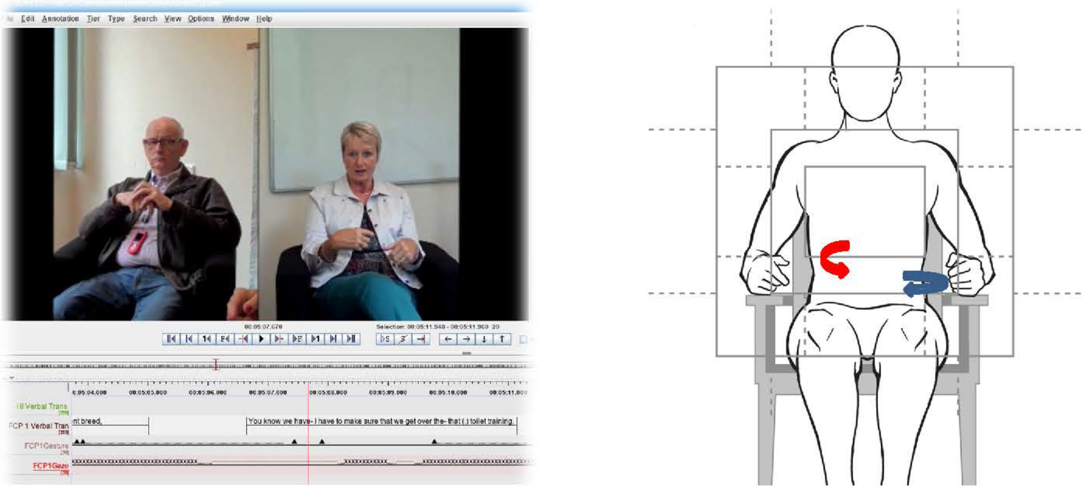
4.3.2.4 Interactive Gesture

Figure 4.7 shows an interactive gesture. It is classified as interactive as the gesture does not represent the semantic content of the talk but appears to reference the CPNH using the characteristic interactive handshape. Both hands are clasped in the centre-centre space (rest position). The right-hand separates from the left (preparation) and moves to centre right with the palm upwards and fingers pointing at CPNH as she makes an aside from the main topic of her talk (stroke) “while the filming is happening”. The characteristic hand shape is seen with the open palm with hand and fingers directed towards CPNH. as if to say “you know what I am talking about” referring to CPNH knowing about the “filming” PCP1 refers to in her talk.

.

Figure 4.5

Example of a Deictic Concrete Gesture



1 CPHI: she seems to be- she seems to be↓ (.) a very very happy (0.8) little [(0.5) dog]
2 PCP1: [which is aMAzing] (.) the beginning that they've had
3 CPHI: yeah it is=
4 PCP1: =but because the bREEd (.) is an intelligent breed

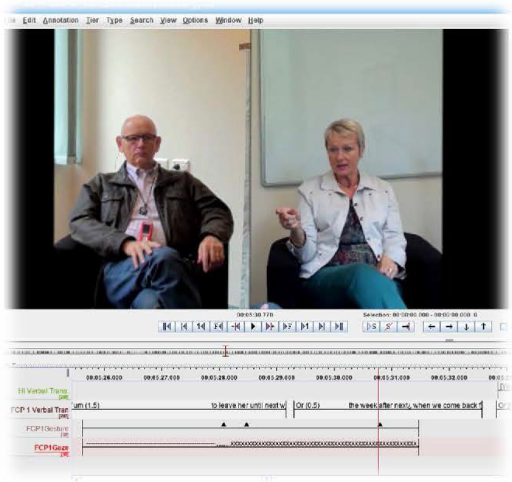
5 PCP1: you know we have- I have to make sure that we get over the- that (.) toilet training
Ge .... ^ { ▲.......................} { ▲.................................. }
Gz --------------------------------,,,,xxxxxxxxxxxx,,,,,-------,,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

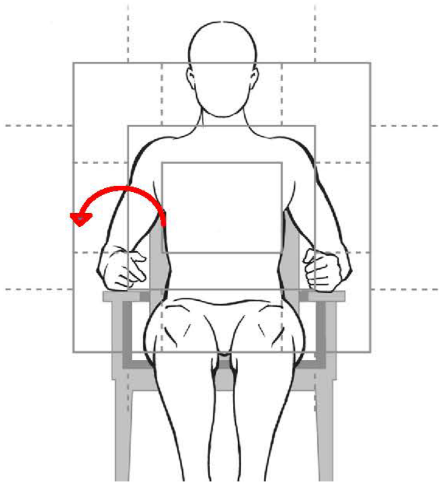
CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

6 CPHI: yes
7 PCP1: and that's why I think if we see [name] today If we go there today
8 CPHI: yeah
9 PCP1: we'll say to him look we'd prefer to (0.7) [you know]

Figure 4.6

Example of a Deictic Abstract Gesture





1 PCP1: we'll say to him look we'd prefer to (0.7) [you know]
2 CPHI: [look at] the behavioural thing I was changing my (.) (h) (h) (.) (h)
3 PCP1: ………………………………………………………(laughter)
4 PCP1: if um (1.5) to leave her until next week?

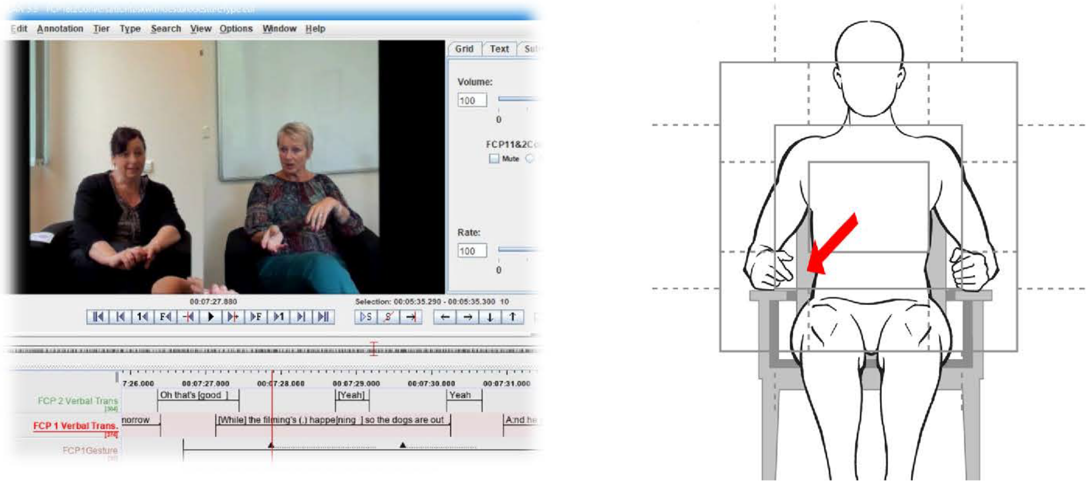
5 PCP1: or (0.5) the week after next¿ when we come back from Ballarat?
Ge { [▲ }
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

5 PCP1: or [Mel]bourne?
6 CPHI: [yeah]

Figure 4.7

Example of an Interactive Gesture



1 PCP1: so::(0.6) the arrangement is um if we've got time today we'll go back & have another loo¿=
2 CPNH: =yeah
3 PCP1: but the arrangement is that I take our dogs tomorrow morning¿
4 CPNH: oh that's [good]

5 PCP1: [while] the filming's (.) happe[ning] so the dogs are out of the house
Ge { ▲.....................................{ ▲...
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx,,,,,,,,,,----

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

6 CPNH: [yeah]
7 CPNH: yeah
8 PCP1: a:nd he said (.) bring them in (.) we'll put them all into a kennel and see how they go
9 CPNH: that's fanTAStic [I didn't realise they do that]

A further interactive gesture is shown in Figure 4.8. Both PCP1's hands move to the centre-centre space, palms facing toward CPNH (preparation) then both hands move downwards palms down and fingers directed at CPNH (stroke). The stroke is completed with the left hand in the centre-centre and the right in the right periphery. When PCP1 asks CPNH if she remembers a previous pet dog of theirs, she relates this memory to the current situation. The utterance "well she was like that" coincides with the gesture that can be paraphrased as "so you know what I mean or that's my point"

Beat

The example in Figure 4.8 also shows beats superimposed on the interactive gesture hold. These are identified as beats by the short sharp biphasic movement. The hands remain in a hold of the previous gesture and a beat is superimposed as she repeats "it was like that" Thus, she appears to be reinforcing her previous point about a dog having similar fur to a previous pet dog "well, she was like that". Beats are indicated in the extract by the symbol ^. Beats do not represent semantic content but are used to provide emphasis and/or follow the rhythm of speech.

4.3.2.5 Emblem

Three gestures were classified as emblems. In the narration with both her CPs, PCP1 used an emblem identifiable as representing quotation marks when talking about the food prepared as "stew". This is classified as an emblem as it is a has a recognisable form and meaning which can be understood without speech within a particular cultural context. The second emblem was used in PCP1's narration to CPNH. As her talk refers to the dog in the story refusing to eat the soup, she holds her right hand, palm at a 30-degree angle, fingers facing to her left indicating rejection/stop. This occurs as she pulls down the corners of her mouth in a facial expression suggesting disgust. She pauses her talk during the gesture.

4.3.3 Gesture Type Frequency

The research questions addressed in this section are:

2.(b) Are some gesture types produced more frequently than others?

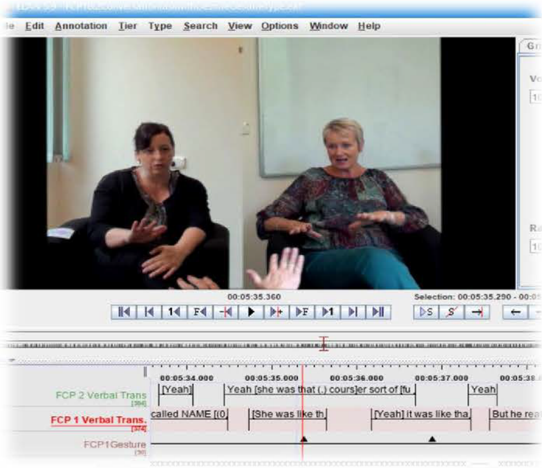
2.(c) Does the frequency of different gesture types differ between conversation and narrative?

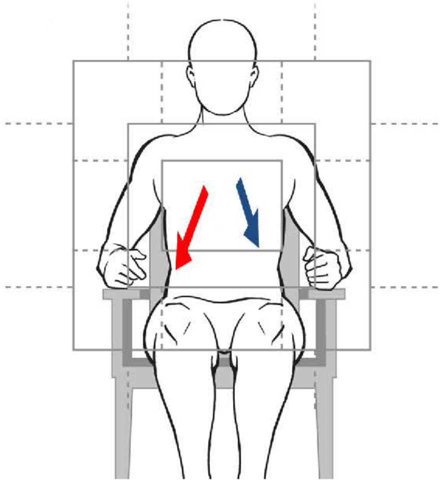
2.(d) Do the proportions of different gesture types differ between interactions with the CPHI and interactions with the CPNH?

Due to the substantial variation in total gesture numbers produced by PCP1 between interactions, gesture type proportions were calculated and are presented in Table 4.3 and Table 4.4.

Figure 4.8

Example of an Interactive Gesture





1 PCP1: do you remember we had a dog called (name) [(0.3)] years ago
2 CPHI: [yeah]
3 CPHI: yeah [she was that (.) cours]er sort of [fur].

4 PCP1: [well she was like that] [yeah] it was like that
Ge { [▲.......................................^............
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx,,----------------,,xxx
Gz

5 CPHI: yeah
6 PCP1: but he really looked (0.8) it's supposed to be cross but he really looked VEry much like a pure dachsy.

In the free conversation the highest proportion of gestures produced by PCP1 was beats with both CPs (CPNH 35.43%; CPHI 47.25%) followed by iconic gestures (CPNH 25.56%; CPHI 18.68%). No emblems were observed. The other gesture types were found in small numbers with proportions ranging between 8.07% and 16.14%. In the narrative PCP1 produced considerably higher proportion of iconic gestures compared to other gesture types with both CPs (CPNH 45.36%; CPHI 51.85%). This was followed by beats (CPNH 37.11%; CPHI 32.10%). Other gesture types were observed in small numbers of less than 12%.

Table 4.3

Gesture Type as a Proportion of the Total Number of Gestures in PCP1 Interactions With CPNH (NH) and CPHI (HI)

	Conversation		Narrative	
	NH %(*n*)	HI %(*n*)	NH %(*n*)	HI%(*n*)
Iconic	25.56 (57)	18.68 (17)	45.36 (44)	51.85 (42)
Metaphoric	14.80 (33)	8.79 (8)	11.34 (11)	6.17 (5)
Deictic	16.14 (36)	13.19 (12)	2.06 (2)	4.94 (4)
Interactive	8.07 (18)	12.09 (11)	2.06 (2)	3.70 (3)
Beat	35.43 (79)	47.25 (43)	37.11 (36)	32.10 (26)
Emblem	0.00 (0)	0.00 (0)	2.06 (2)	1.23 (1)
Total	223	91	97	81

Following the exclusion of beats, as illustrated in Figure 4.9, iconic gestures made up the highest proportion in the conversation task with both CPs (CPNH 39.58%; CP HI 35.42%), followed by deictic (CPNH & CPHI 25.00%) and metaphoric gestures (CPNH 22.92%; CPHI 16.67%). In the narrative task, as illustrated in Figure 4.10, iconic gestures again made up the highest proportion with both CPs (CPNH 72.13%; CPHI 76.36%). Smaller numbers of metaphoric gestures were observed (CPNH 18.03%; CPHI 9.09%) while negligible numbers of the remaining gestures categories were found. Table 4.4 shows the gesture type proportions when beats were excluded from the analysis.

Table 4.4

Gesture Type as a Proportion of the Total Number of Gestures (Excluding Beats) in Conversations and Narratives with CPNH (NH) and CPHI (HI)

	Conversation		Narrative	
	NH %(*n*)	HI %(*n*)	NH % (*n*)	HI %(*n*)
Iconic	39.58 (57)	35.42 (17)	72.13 (44)	76.36 (42)
Metaphoric	22.92 (33)	16.67 (8)	18.03 (11)	9.09 (5)
Deictic	25.00 (36)	25.00 (12)	3.28 (2)	7.27 (4)
Interactive	12.50 (18)	22.92 (11)	3.28 (2)	5.45 (3)
Emblems	0.00 (0)	0.00 (0)	3.28 (2)	1.82 (1)
Total	144	48	61	55

Figure 4.9

Proportions of Gestures by Type in Conversation Produced by PCP1 With CPNH and CPHI

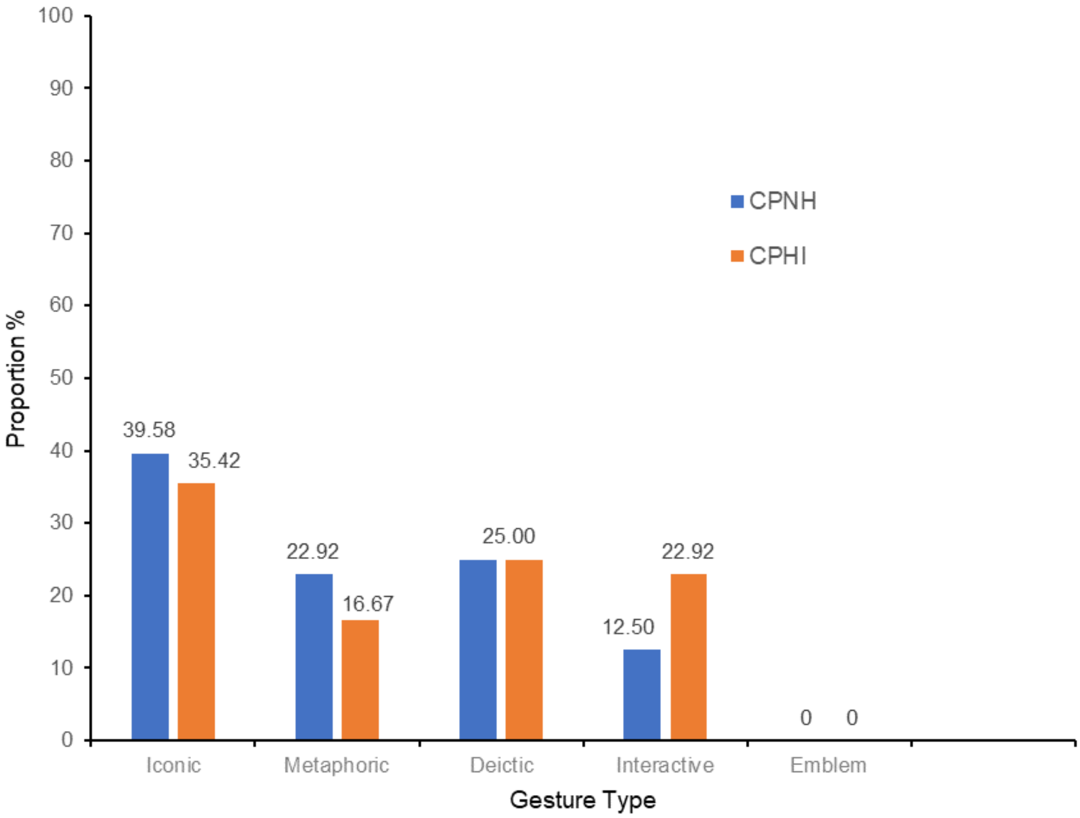
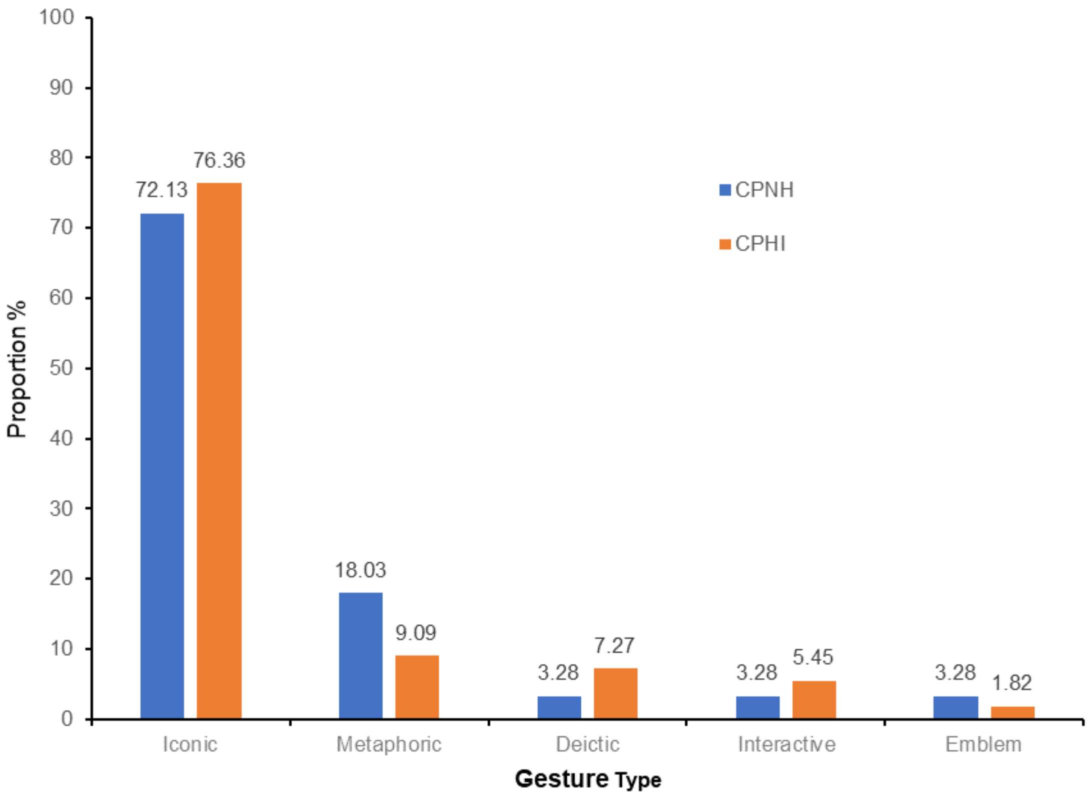


Figure 4.10

Proportions of Gestures by Type in Narrative Produced by PCP1 With CPNH and CPHI



Proportions of gesture types did not differ substantially between interactions with the CPHI and those with the CPNH. The differences in proportions ranged between 1.46% and 8.94% in the narrative and between 0% and 10.42% in the conversation. In narrative, PCP1 produced 8.94% or six more metaphoric gestures with the CPNH than the CPHI. In conversation PCP1 produced 10.42% more interactive gestures with the CPHI than with the CPNH. This consisted of 18 out of 144 versus seven out of 48 resulting in a difference of 11 gestures.

4.3.4 Gesture Characteristics – Size

The research question addressed in this section is:

3. Does the size of imagistic gestures differ gestures differ between interactions with the CPHI and interactions with the CPNH?

Each gesture was categorised according to the number of borders crossed during the stroke performance. As seen in Table 4.5 the highest proportions by size were the medium-size category (one to two borders crossed). In the conversation PCP1 produced 47.78% medium-size gestures with the CPNH and 48% with the CPHI. In the narrative task PCP1 produced 41.82% medium-size gestures with the CPNH and 42.55% with the CPHI. The differences in gesture size proportions between CPNH and CPHI in the narrative and in conversation were no more than 10%. These results suggest that PCP1 did not substantively alter the size of her gestures with the CPHI.

Table 4.5

Percentage of Imagistic Gestures by Size in PCP1 Interactions With CPNH (NH) and CPHI (HI)

Borders	Conversation		Narrative	
	NH % (*n* = 90)	HI % (*n* = 25)	NH % (*n* = 55)	HI % (*n* = 47)
<1	30.00	40.00	25.45	31.91
1-2	47.78	48.00	41.82	42.55
3+	22.22	12.00	32.73	25.53

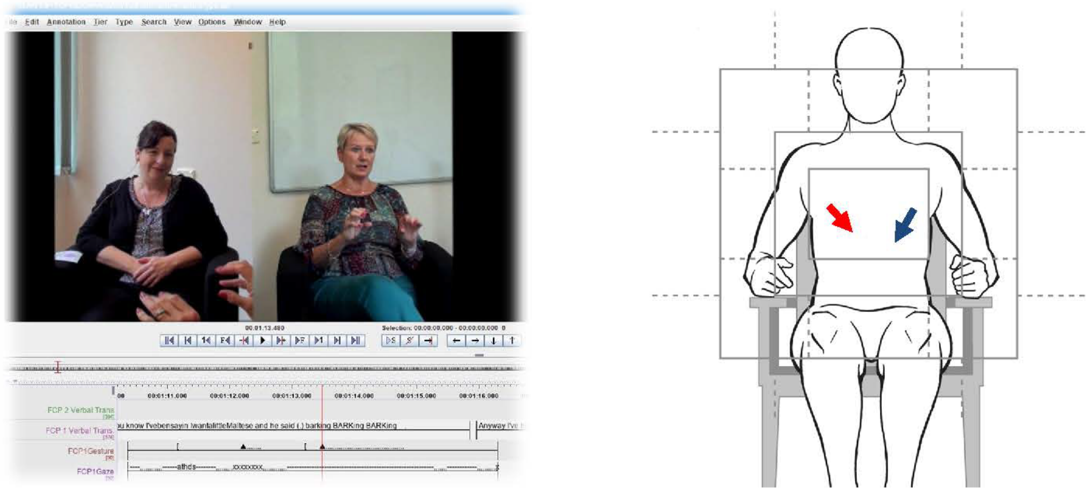
Note. Size was determined by the number of gesture space borders crossed by hands/arms during the stroke.

Large gestures comprised the lowest proportion in conversation, but in narrative were produced in similar proportions to small gestures. Further analysis of the gestures crossing three or more borders revealed that a number of these either involved two hands in a repeated movement, in some cases a small movement moving in and out of the same gesture space division, or one movement of one or both hands and arms moving across gesture space divisions.

Figure 4.11 provides an example of the small-size category. In her talk to CPNH, PCP1 expresses her desire to get a new dog. The fingers of both PCP1's hands are curled with palms facing down. In an opening and closing motion the fingers touch the thumb in a repeated action as PCP1 repeats the word "barking". This action was taken to represent the movement of the dog's mouth during barking and is thus considered an iconic gesture. The repeated action of the stroke phase consists only of finger movement and takes place within the centre-centre division. No borders are crossed during the action and therefore this gesture is classified as small.

Figure 4.11

Example of a Small Size Iconic Gesture



```
1  PCP1:   and you know we had a special collar for him (.) which (name) now wears [because she]
2  CPNH:                                                                          [does it work] the collar
3  PCP1:   it does (.) absolutely abso[LUtely]
4  CPNH:   [okay  ]
5  PCP1:   and (name) just- when she has the collar on (.) doesn't bark at All [(.)  ] which is great,
6  CPNH:                                                                       [Mm]
7  PCP1:   I mean she's <no where NEAR> as bad a (name) w[as]¿
8  CPNH:                                                 [Mm]
9  PCP1:   so (0.4) your father been you know

10 PCP1:   I've been sayin I want a little Maltese and he said (.) barking BARKing BARKing
     Ge              [                      ▲........  {          [    ▲________________}
     Gz     ,,,,,,,*****************,,,,,,,,,, xxxxxxxx,,,,,,,,,,,,,,,,----------------------------------------------

   CPNH:   xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
     Gz
```

Note. No gesture space borders were crossed by the hands during gesture production, so the gesture was categorised as small.

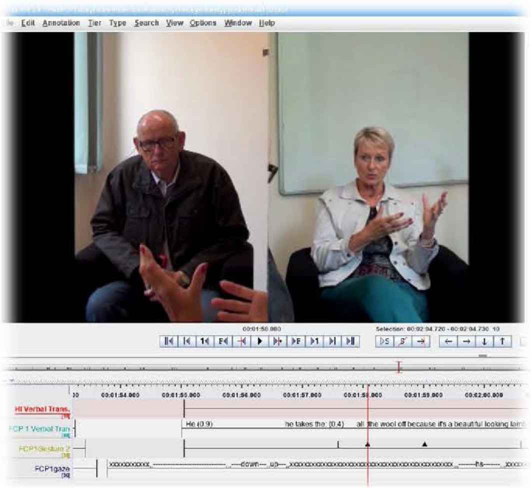
Figure 4.12 provides an example of a medium-size gesture. During PCP1's narration to the CPHI her talk describes the father taking "all the wool off" (a lamb) as she performs this iconic gesture. Her hands are in a hold following previous gesture, the right in the centre left and the left hand in the lower centre left. Both hands move inward and then up and outward (preparation) and remain in a hold during an initial pause (0.9) in her talk. As she resumes speaking, her right hand moves in a sweeping motion from the right upper periphery to the centre-centre (stroke) with palm up and fingers extended. The right-hand crosses two solid borders while the left hand remains in a hold position throughout in the upper periphery left.

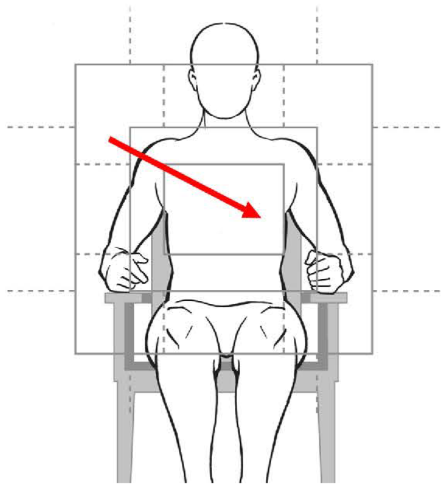
Figure 4.13 provides an example of the large size category. In PCP1's narration to the CPNH her talk describes the father banging his hands on the table and she uses both hands to perform an iconic gesture. She clasps her hands as fists and lifts them to the upper periphery above either shoulder (preparation) and then lowers them in a fast abrupt stroke downwards to the lower periphery, moving through the centre space (left and right) from top to bottom. The gesture replicates the father's action of banging on the table. During the downward movement each hand crosses two borders making a total of four borders crossed. Following the stroke, the hands remain in a hold, and two beats are produced before the hands move to the lower centre and clasp together (rest position).

Figure 4.14 provides another example of a large-size gesture. In PCP1's narration to CPNH her talk describes the lambskin being removed from the lamb and spread out in front of the father. She performs an iconic gesture with a repeated action which represent the spreading out of the lambskin. She moves both hands outward, fingers pointing inward and palms down, from the centre-centre outward to the periphery front where her hands overlap (preparation). She extends her arms outwards into the extreme periphery front and sweeps each hand around to the sides and back to the centre-centre. The arms and hands subsequently follow the reverse trajectory in a circular motion to the sides and around to the extreme periphery front and once again the original movement is repeated. Figure 4.15 shows the profile view of one performance of the stroke in the repeated series. Each hand crosses three borders during each circular movement making a total of more than six borders crossed.

Figure 4.12

Example of a Medium Size Iconic Gesture



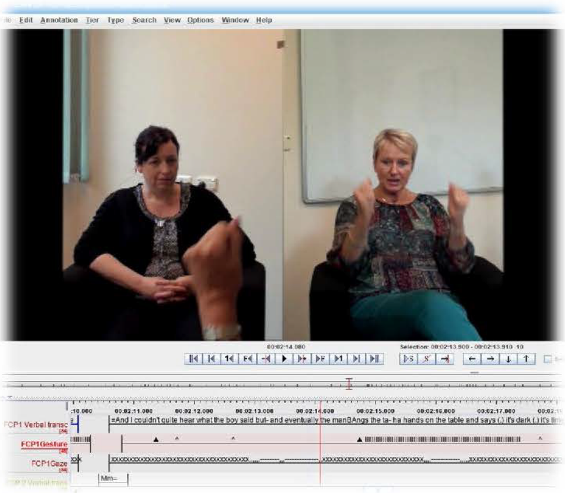


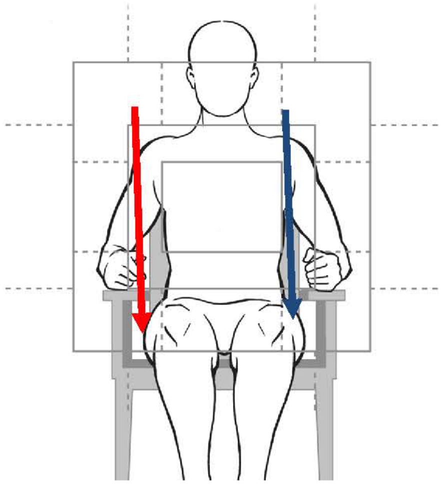
```
1  PCP1:  and you don't SEE it of course but he has the lamb in front of him, (   )   across the throat¿

2  PCP1:  he (0.9) he takes the:(0.4) all :the wool off because it's a beautiful looking lamb with quite (0.7) thick wool
     Ge    {                          [   ▲............. }    ^                ^                  {   ▲________________
     Gz    -------------,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx,,,****,,,,xxxxxxxxxxxxxxxxxxxxx,,,--

   CPHI:  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
     Gz

3  PCP1:  and the next minute you see (.) um a RUG on floor which is (1.2) the sheep's (0.5) coat¿
4  PCP1:  [for wa]nt of a better word¿
5  CPHI:   [uhm]
```

Note. Two gesture space borders were crossed by the right-hand during gesture production, so the gesture was categorised as medium size.

Figure 4.13

Example of a Large Size Iconic Gesture





1 PCP1: and then the man says (0.7) we should pray for rain tonight.
2 PCP1: then the boy obviously goes outside¿ He's comes back in again, a:nd he's told to go to bed.
3 PCP1: =and I couldn't quite hear what the boy said

4 PCP1: but and eventually the man BAngs the ta- ha hands on the table
Ge { [▲ ....
Gz ,------,,,,,,----down--------,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx,,

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

5 PCP1: and said (.) it's dark (.) it's time to go to bed
Ge ....^ ^ }
Gz ,,,,----------,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

6 PCP1: because obviously the boy doesn- (0.4) can't [defe-] [(0.3)] diferentiate betwe[en li]ght and dark
7 CPNH: [its-] [yeah] [yeah]

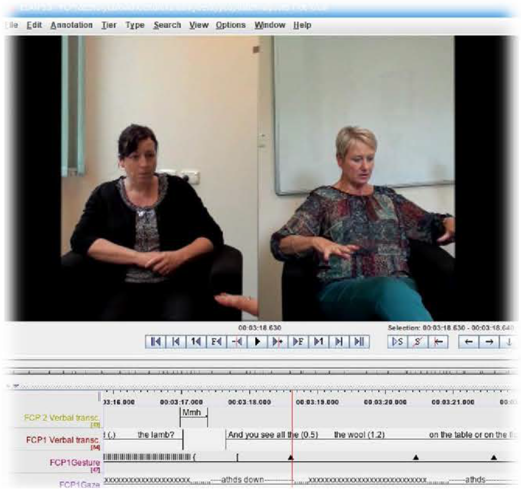
Note. Two gesture space borders were crossed by each hand making a total of 4 borders crossed so the gesture was categorised as large size.

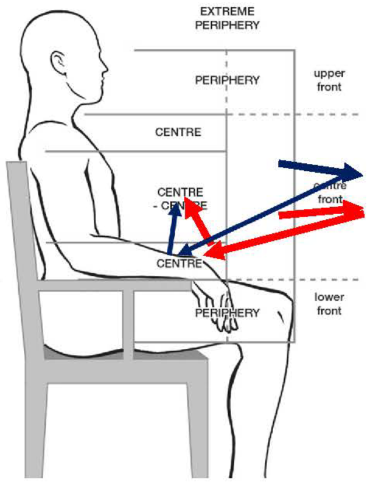
Figure 4.14

First and Second Phase of a Large Repeated Movement Gesture Representing a Lambskin

Figure 4.15

Example of a Large Size Iconic Gesture With Repeated Movement





1 PCP1: and then he has he lights an oil lamp¿
2 PCP1: and then you see the sheep (0.8)he's obviously (0.9) sheared (.) the lamb?
3 CPNH: mmhm

4 PCP1: and you see all the (0.5) the wool (1.2) on the table or on the floor
Ge { [▲________________________▲________________▲_____________________}
Gz ,,,,,**************,,,,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx,,,,,,,******************,,,,,,,,--------------------

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

4.3.5 Gaze Direction

The research questions addressed in this section are:

4.(a) Where does PCP1 direct their gaze during imagistic gesture production?

4.(b) Do gaze direction patterns during gesture production differ between interactions with the CPHI and interactions with CPNH?

The following eight initial categories of gaze and gesture were identified.

- gaze at gesture during the stroke
- gaze at gesture during the preparation phase (moves to the CP *on or after* the stroke)
- gaze continuously directed at the CP during gesture production
- gaze moves from CP to another point in space or object (not the gesture) *on* the stroke,
- gaze moves from CP to another point in space or object (not the gesture) *after* the stroke
- gaze moves from a point in space or object (not the gesture) to the CP *on* the stroke
- gaze moves from a point in space or object (not the gesture) to the CP *after* the stroke
- gaze is directed at an object or a point in space (not the gesture) during gesture production.

Due to the small number of gestures in several categories these were reduced to three broad categories including PCP1's (a) *gaze at CP*, (b) *gaze at gesture* directly during the preparation and/or stroke, and (c) *gaze away* from both the CP and the gesture (i.e., at some other point in the room or space). These categories are discussed in the following sections (see Table 4.6).

4.3.5.1 Gaze at CP

Gestures demonstrating gaze at CP involve PCP1 directing their gaze at the listener (CPHI or CPHN) during the production of a gesture, suggesting that PCP1 is monitoring the attention of the listener. Gaze at CP included five identifiable patterns:(a) gaze continuously toward the CP, (b) gaze movement to the CP during the stroke, (c) gaze movement to the CP immediately after the stroke, (d) gaze at the CP during the stroke but away to another point in the room after the stroke, and (e) gaze at the CP prior to the stroke but looking away as the stroke was performed.

Most gazes were found to be in the first two patterns with PCP1 either looking at the CPNH or CPHI continuously during gesture production or moving her gaze to look at the CPNH or CPHI during the stroke. Few instances of the three remaining patterns were found, so the five patterns were combined into one category named gaze at CP. As seen in Table 4.6, PCP1's gaze was directed at the CP for over 60% of gestures. This was observed across both conversation and narrative and with both the CPHI and the CPNH.

Table 4.6

***Gaze** Direction by Proportion of Total Imagistic Gestures in PCP1 Interactions With CPNH (NH) and CPHI (HI)*

Gaze direction	Conversation		Narrative	
	NH % (*n*)	HI % (*n*)	NH% (*n*)	HI% (*n*)
At gesture				
On stroke	8.89 (8)	4.00 (1)	10.91(6)	10.64 (5)
On preparation	14.44 (13)	12.00 (3)	20.00 (11)	21.28 (5)
At gesture total	23.33	16.00	30.91	31.91
Away	14.44 (13)	12.00 (1)	5.45 (3)	0.00
At CP	62.22 (56)	64.00 (16)	61.82 (34)	68.09 (32)

Figure 4.16 provides an example of the gaze-at-CP category as PCP1 performs an iconic gesture which is taken to depict the shape of a dog ‘s nose. She moves her right-hand outward with fingers pinched together suggesting the shape of a pointy nose. During the stroke phase her right hand remains within the upper periphery space. Her gaze is directed at the CPHI throughout this gesture and the following gesture. This is shown in the transcript by the series of crosses in the PCP1 gaze line.

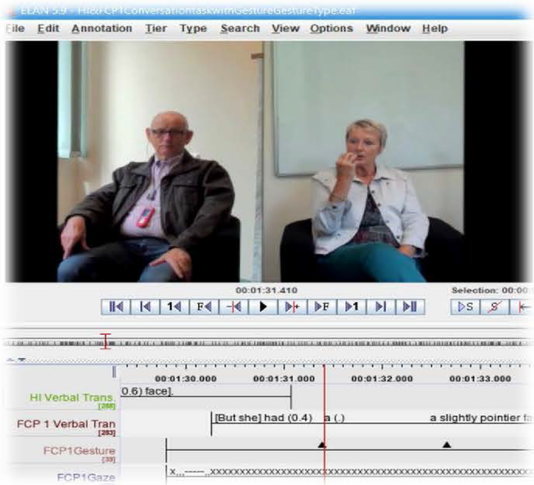
4.3.5.2 Gaze at Gesture

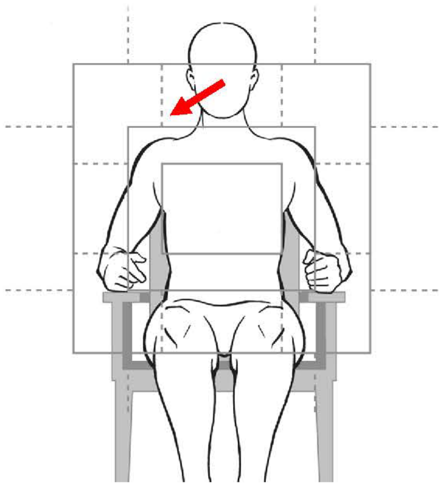
Gestures demonstrating gaze at gesture involve PCP1 directing her gaze at her own hands during the production of a gesture. Gaze toward gesture was found to take one of two forms. Before moving to fixate the CPNH or CPHI during the stroke, PCP1’s gaze was directed at her own gesture (a) during the preparation phase or (b) during the stroke phase. The proportion of gestures in the gaze-at-gesture category was similar in interaction with the CPNH and the CPHI. As seen in Table 4.6, PCP1 directed her gaze during conversation toward her own gesture with the CPNH for 23.33% and with the CPHI for 16.00% of imagistic gestures. In narrative PCP1 directed gaze at her own gesture with both her CPs for 31.91% of gestures.

Figure 4.17 provides an example of gaze at gesture. At first PCP1’s hands move from pointing at her eyes (on completion of the previous gesture) to the upper centre with the thumb and forefinger of each hand pointing toward the CPNH (preparation).

Figure.4.16

Example of Gaze at CP During an Iconic Gesture





1 CPHI: whether (0.8) (name) in fact had Japanese [(1.2) um (.)] Chin [(.) in] her

2 PCP1: [could have had yeah could have had] [Japanese Chin]

3 CPHI: be[cause] she (0.4) didn't have a dissimilar [(0.6) face.]

4 PCP1: [yes]

5 PCP1: [but she] had (0.4) a (.) a slightly pointier face

Ge { [▲ [▲ ▲ }

Gz x,,,-----,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

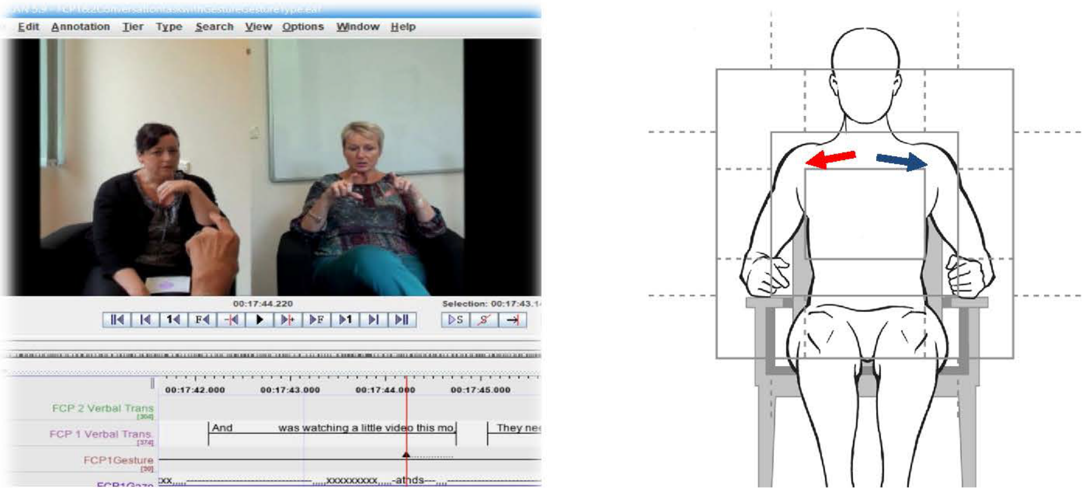
Gz

6 CPHI: it was a slightly pointer [face] but she had the wide set eyes [and th]e wide forehead,=

7 PCP1: [yeah] [yes]

Figure 4.17

Example of Gaze at Gesture During an Iconic Gesture



1 PCP1: oh God I [HAte to think] HAte to think.=
2 CPNH: =Yeah you don't know what sort of cages they're living in or with [how many other] [(0.7) dogs so]
3 PCP1: [<no no>] [she: tends to have]-
4 PCP1 or the bree:d tends to have weepy eyes,
4. CPNH: mm

4 PCP1: and (0.3) was watching a little video this morning¿
Ge { [▲..................... }
Gz -------------------,,,,,xxxxxxxxx,,,,,,*****---,,,,-------------

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

5 PCP1: they need to be brushed probably only twice a week¿
6 CPNH: oh that's not too bad.

Her gaze moves to the CPNH during this preparation, and both hands then move outward forming the shape of a small rectangle. As she says, “watching a little video”, her gaze moves to her hands performing the stroke. This is seen in Figure 4.17 transcript as a line of asterisks (******). Following the gesture PCP1’s gaze moves away and then returns to the CPNH as she performs the subsequent gesture.

Figures 4.18 and 4.19 provide examples of the gaze at gesture category as PCP1 performs a metaphoric gesture. In this example PCP1’s gaze is directed at the gesture during the preparation phase before moving to the CPHI during the stroke. Gaze is directed down at her hands as she moves both hands into the centre-centre (preparation). She moves her hands outwards in a stroke (the right hand to the centre right and the left to the centre left) as her talk refers to an “easing in” of a new dog to the family. Her gaze moves from her hands up to the CPHI as she reaches the stroke peak. Following the stroke, she moves her gaze briefly away and then back to the CPHI as she repeats the outward movement during a pause in her talk.

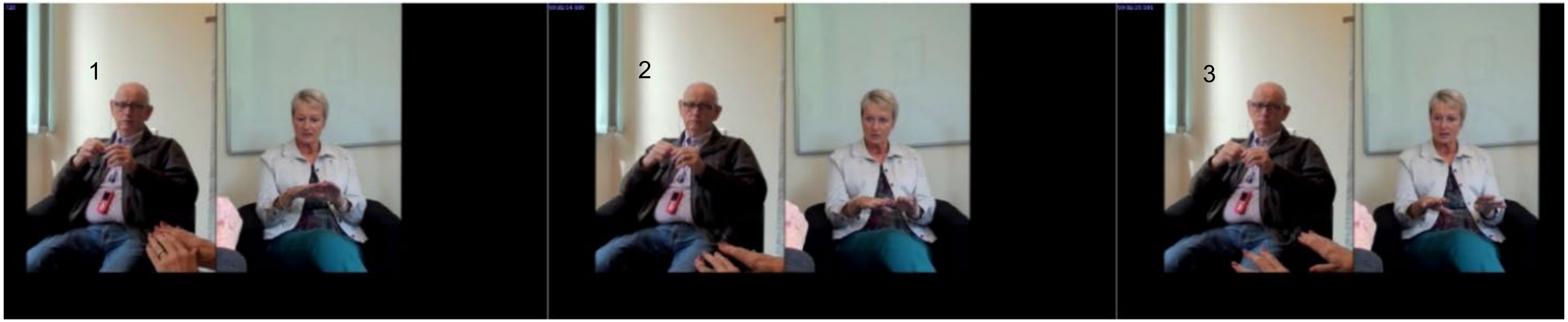
4.3.5.3 Gaze Away

Gestures during gaze away involve PCP1 directing her gaze away from the listener to some other object or point in space (not at her own hands) during gesture production. The lowest gesture proportions with respect to gaze direction were found in this third category. As seen in Table 4.6, PCP1 directed her gaze away in conversation with the CPNH for 14.44% and with the CPHI for 12.00% of imagistic gestures. In narrative, PCP1 directed gaze at her gaze away with the CPNH for 5.35% and with CPHI for no imagistic gestures.

Figure 4.20 provides an example of the gaze away category during an iconic gesture representing the action of the young blind boy touching the dog. In this example, during a gesture hold, PCP1 turns her head and moves her gaze away from the CPNH to her left. She moves her right hand (no preparation) from the periphery right to the upper periphery right with her palm facing close to the side of her head (stroke). Her left hand moves from the hold position in the upper centre right to the upper periphery palm facing toward her right. Her gaze remains directed away from the CPNH until she begins the preparation phase for the subsequent gesture when she moves gaze to the gesture. In the transcript gaze directed away from the CPNH is seen as the dashed line. The square bracket ([) in the line 6-*Ge* of the transcript indicates the start of the next stroke phase. As the stroke peak is reached PCP1 moves her gaze (indicated by the line of commas) and redirects it briefly towards her gesture and then towards the CPNH (indicated by the line of crosses). Her gaze remains directed at the CPNH until the end of the utterance. The gaze direction of the CPNH is shown in the line below and remains continuously directed toward PCP.

Figure 4.18

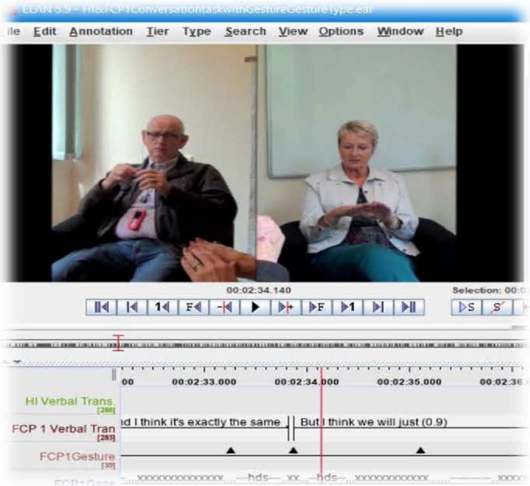
Example of Gaze at Gesture During Preparation Phase of a Metaphoric Gesture

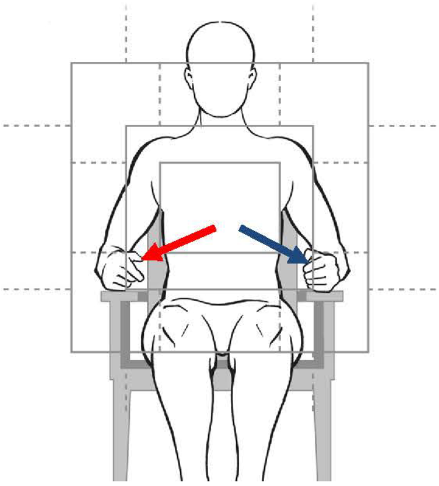


Note. Image 1 shows PCP1's gaze directed at the hands (gesture preparation). Images 2 and 3 during the stroke show PCP1's gaze at CPHI. See also Fig 4.19.

Figure 4.19

Example of Gaze at Gesture During Preparation Phase of a Metaphoric Gesture





1 CPHI: and we haven't looked into that yet in South Australia [as to whe]ther we can even DO: it?
2 PCP1: [no but-]
3 PCP1: we cAn [we cAn].
4 CPHI: [we can] (.) o[kay].
5 PCP1: [becau]se do you remember before we mo:ved, (name) looked into it
6 CPHI: oh that's [right].
7 PCP1: [through] the Onkaparinga Council and I think it's exactly the same as Geelong.

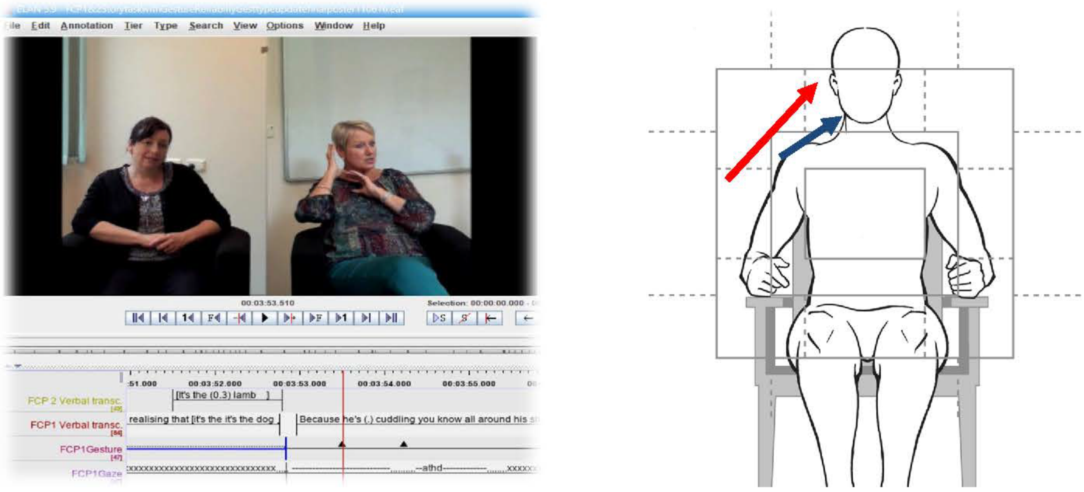
8 PCP1: but I think we will just (0.9) ea:se her in first before we get that done.
Ge { [▲ ▲r } { ▲
Gz - ***--,,,xxxxxxxxxxxx,,,,,,,----------,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

9 CPHI: ah yes absolute[ly].
10 PCP1: [be]cause if it happens to be where it JUST isn't going to work with our dogs

Figure 4.20

Example of Gaze Away During an Iconic Gesture




```
1  PCP1:  and (.) then you see (1.0) his hands on the sheep's coat¿
2  PCP1:  and it's on the dog.
3  CPNH:  aw
4  PCP1:  so then he cuddles the dog not realising that [it's the it's the dog],
5  CPNH:                                                [it's the (0.3) lamb ]

6  PCP1:  because he's (.) cuddling you know all around his shoulder and all around his back.
   Ge     {        ▲ {    [       ▲                                 ▲                      }
   Gz     ----------------,,,,,*******************,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

  CPNH:   xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   Gz
```

4.4 Discussion

The findings in this chapter show how the use of everyday interactions by adults in both conversation and narrative provide opportunities to observe and analyse gesture behaviour under a research method designed to provide an ecologically valid context. The results demonstrate that the proposed method of gesture elicitation provided a rich source of data.

A range of gesture types were identified, with iconic gestures the most frequently occurring in all interactions regardless of the hearing status of the CP. Free conversation has to date and to the author's knowledge not been analysed in terms of frequency of gesture type. The findings regarding the narrative task, however, are comparable with those in McNeill's (1992) analysis of cartoon-narrative tasks performed by young English-speaking university students. McNeill identified that iconic gestures were used in substantial numbers during storytelling to describe events and actions. Other gesture types such as metaphoric and deictic gestures appeared in smaller numbers and serve other *extra narrative* functions (McNeill, 1992).

The status of the participant's HI was not found to impact the measures investigated in the current study. Gesture rates per spoken word were not substantially different with the CPHI compared with the CPNH. Gesture size was not found to increase when PCP1 conversed with the CPHI compared with the CPNH. Furthermore, there was no evidence to suggest that patterns of gaze associated with gesture altered when PCP1 conversed with the CPHI compared with the CPNH. Gaze was most frequently directed by PCP1 at the listener during imagistic gesture production with both the CPNH and the CPHI. Thus, this case study shows that PCP1's gesture type, gesture rate, gesture size, and patterns of gaze did not differ substantially between interactions with the CPHI and the CPNH.

4.4.1 Reflections on Method

Participants sat face to face in a quiet environment to simulate a natural conversation between partners or family members. It was evident in the interactions that the CPHI did not signal difficulties hearing or understanding PCP1. There was little to no evidence of misunderstandings or the need for repair or requests for repeats, and the one request for repetition was repaired by PCP1 without the use of gesture. This suggests that there may have been no perceived need for PCP1 to modify their use of gesture or use more gestures with the CPHI. This lends support for the view that audience design occurs only as perceived need arises during an interaction (Horton & Keysar, 1996; Newman-Norlund et al., 2009).

Under more challenging listening conditions, more specifically in the presence of background noise, an individual with HI will typically experience greater difficulties understanding speech (Picou et al., 2013). Conversation will become less fluent with increased instances of breakdown and repair. In the second phase of this investigation periods of background noise will be added into the interactions to determine whether more demanding listening conditions influence the frequency and characteristics of gesture and patterns of gaze produced by PCPs with CPNH and/or with CPHI.

The next chapter presents the results of a series of case studies further examining the impact of HI on gesture production. This is followed by Chapter 6 which presents the results associated with the impact of background noise on gesture production with CPNH and with CPHI. Finally, Chapter 7 presents the results associated with the impact of interaction type (free conversation and narrative) on gesture production.

5 HEARING IMPAIRMENT AND GESTURE PRODUCTION

This chapter presents the results from the series of case studies (Cases 2–7) concerning the impact of HI on the production of gesture by PCPs in dyadic interactions. These findings follow on from the initial case study presented in the previous chapter. Although this introductory analysis did not show an effect of HI on the behaviours analysed, it demonstrated that a range of gesture types were able to be identified in the conversation and narrative samples. The gesture types that were observed comprised iconic, metaphoric, deictic abstract and concrete gestures, as well as interactive gestures, beats, and emblems. With the exclusion of beats, iconic gestures were the most frequently occurring gestures in all interactions regardless of the hearing status of the CP. As reported in Chapter 4, gesture rates per 100 words were not substantially different when PCP1 interacted with her CPHI and CPNH, nor was the size of PCP1's imagistic gestures found to differ when in interaction with her CPHI compared with her CPNH. The greatest proportion of gestures by gesture size in both conversation and narrative was the medium-size gestures. Large gestures were the lowest proportion in conversation but were produced in approximately equal proportions to the small gestures in narrative. Furthermore, there was no evidence to suggest that gaze direction associated with gesture differed when PCP1 conversed with the CPHI or the CPNH. During imagistic gesture production PCP1's gaze was most frequently directed at her CP regardless of the CP's hearing status.

Case study 1 showed that the method set out in Chapter 3 allowed the elicitation and analysis of gesture behaviour by the participants. Hence, the method was deemed to be a suitable technique to use in the following series of case studies. It was also observed that there were few instances during the interactions with the CPHI (or CPNH) where there was evidence of communication difficulties or misperceptions, which might have been attributed to the HI. Consequently, modifications were made to the procedure to increase the difficulty of the listening environment, specifically with the introduction of periods of background noise during the interactions, as described in Section 3.4.2.6. The results presented in this chapter from Cases 2–7 focus on the independent variable of HI using the same conversational activities, free conversation and narrative. Gesture patterns for PCPs 2–7 were analysed in terms of; (a) how frequently gestures occur (b) the emic characteristics of gestures' function or meaning and c) the etic or physical qualities of imagistic gestures' size, and (d) the gaze direction during imagistic gesture production.

To address the initial overarching research question, whether patterns of gesture change based on the hearing status of the CP as listener, the specific research questions addressed in this chapter in reference to the use of and attention to gestures produced by PCPs 2–7 are:

1.1.(a) How frequently is gesture produced?

1.1.(b) Do gesture rates differ between interactions with CPHI and interactions with CPNH?

1.2.(a) Are some gesture types produced more frequently than others?

1.2.(b) Do the proportions of different gesture types differ between interactions with CPHI and interactions with CPNH?

1.3. Does the size of imagistic (iconic and metaphoric) gestures differ between interactions with CPHI and interactions with CPNH?

1.4.(a) Where do PCPs as speakers direct their gaze during imagistic gesture production?

1.4.(b) Do gaze direction patterns during imagistic gesture production differ between interactions with CPHI and interactions with CPNH?

The next section of this chapter reviews the methodology and methods as they are applied to Cases 2–7. The results from the analysis of the quiet samples from free conversations and narratives are presented in Section 5.2. The chapter concludes with a discussion of the case findings regarding the influence of HI on patterns of normally hearing PCP gesture and the reasons behind the introduction of background noise as a second independent variable are outlined.

5.1 Method

The methods and methodology were the same as those used in Case Study 1, with the addition of periods of background noise during the two tasks.

5.1.1 Participants

Participants were recruited for six single case studies. Each case study triad comprised the participant with HI and their two normally hearing CPs. One normally hearing CP was identified as the principal CP (PCP) and the second as CPNH. The participants (PCP2–7) were the focus of the analysis and comprised two males and four females. The CPs with HI (CPHI) comprised five partners of the PCPs and one a close friend. The CPNH comprised three daughters, a stepdaughter, and two friends (see also Table 3.1 for further details). All participants met the inclusion criteria for hearing, vision, cognition,[7] and hand and arm mobility (see Section 3.2.2 & Appendix H for clinical assessment results). Participants were aged between 18 and 70 years, were speakers of Australian English, and none used sign language as a means of communication. The Case 2 CPHI reported having attended lipreading classes many years previously. The Case 2 CPNH and CPHI had also attended basic signing classes. No participants reported attending an

[7] Participant RPCM scores were above the 50th percentile based on normative data (Ravens & Ravens, 1998, Table CPM25). The one exception was Case 2 CPHI with a score at the 25th percentile. The PCP2 recordings with CPHI were reviewed and no difficulties understanding the requirements of the tasks were observed.

aural rehabilitation course. None of the participants reported significant speech or language deficits. Details of the procedures used to generate and analyse the data are summarised below.

5.1.2 Procedure

In each of Case Studies 2–7 clinical interview and assessments were followed by the filming sessions. Within each case study triad there were two dyads. The first dyad consisted of the PCP and their CPHI and the second, PCP and their CPNH (see Figure 3.3). As for Case Study 1, each dyad participated in two interactional tasks. All dyads undertook the tasks in the same order. The first task was free conversation during which the two participants were invited to converse about any topic or topics they wished. The second task involved PCP watching a short seven-minute film and narrating the story to the CPHI and separately to the CPNH. Each PCP watched the film twice, i.e., once before each narration. During both tasks, periods of quiet were interspersed with periods of background multi-speaker babble (see Section 3.4.2.6). The results presented in this chapter concern the findings regarding samples of interactions during *periods of quiet* only. The influence of background noise is addressed in the Chapter 6.

5.1.3 Transcription and Analysis

The investigator completed the transcriptions and annotations using the multilayer transcription software ELAN (Lausberg & Sloetjes, 2009) and following the coding and annotation guidelines (see Section 3.6). Layers known as tiers were created for each participant's talk and gaze. Additional individual tiers were created for PCP gesture units and strokes, gesture categorisation, size, and gaze direction annotations. The focus of the analysis was on the characteristics of PCPs (2–7) gesture production including gesture frequency, type, imagistic gesture size, and associated gaze direction during the portions of interaction occurring in quiet as summarised in the following sections.

5.1.3.1 *Gesture Frequency*

As a measure of gesture frequency, the number of gestures produced per 100 spoken words was calculated for the total gestures (excluding beats) and for iconic and metaphoric gestures combined (imagistic gestures) produced in each sample period of quiet for each conversation and narrative. The results are presented as gesture rates in Section 5.2.1.

5.1.3.2 *Gesture Type*

Gestures were allocated to the six categories as described in the coding guidelines (see Section 3.6.2). Gesture types identified were iconic, metaphoric, deictic (abstract or concrete) (McNeill, 1992), interactive (Bavelas, 1995), and emblems (Kendon, 2004). The first level of analysis was the total number of each type of gesture. Due to the considerable variation in total gesture numbers produced by PCPs 2–7, gesture type proportions were calculated for each interaction.

The results are presented in Section 5.2.2. The next sections of the chapter present the findings of the analysis of the emic or physical features of gesture size and of the gaze movements associated with the gestures produced by PCPs 2–7. A subset of gestures comprising imagistic gestures, including iconic and metaphoric gestures, was used, as discussed in Chapter 3, for the analysis of size and associated gaze direction (see Section 3.5.4).

5.1.3.3 ***Gesture Characteristics: Size***

An adapted version of McNeill's (1992) gesture space diagram was used to determine gesture size. Movements across borders were annotated for each imagistic gesture in ELAN using the notation system described in the coding guidelines (see Section 3.3.4.2). Operationally, gesture size was identified as the number of division borders crossed during gesture production. Gestures were categorized in two ways: (a) each gesture was assigned to one of three categories; small (i.e., no borders crossed), medium (i.e., one to two borders crossed), and large (i.e., more than three borders crossed) and (b) each gesture was assigned to one of two categories; small (i.e., no borders crossed) and medium-large (i.e., one or more border crossed). The proportion of the total number of imagistic gestures for each subcategory was calculated. The results are presented in Section 5.2.3.

5.1.3.4 ***Gaze Direction***

Gaze movements associated with each imagistic gesture produced by PCPs 2–7 were annotated in ELAN using the notation system described in the coding guidelines (see Section 3.6.5). Based on the Case 1 gaze analysis each gesture was assigned to one of three primary categories; gaze at the gesture; gaze at the CP, and gaze away from CP (at some other point in space). Gaze at gesture included (a) gestures at which gaze was directed during the stroke phase and (b) gestures at which gaze was directed during the preparation phase but that moved to the listener (CPHN or CPHI) during the stroke performance. The proportion of the total number of gestures in each subcategory was calculated. The results are presented in Section 5.2.4.

5.2 Results

The research questions and results presented in this section refer to the gesture production of PCPs 2–7 when interacting with CPNH and with CPHI in quiet conditions.

5.2.1 Gesture Frequency

The research questions addressed in this section are:

1.1.(a) How frequently is gesture produced?

1.1.(b) Do gestures rates differ between interactions with CPHI and interactions with CPNH?

The number of gestures produced per 100 spoken words was determined for PCPs 2–7 for total gestures (excluding beats) and for imagistic gestures. Table 5.1 shows the total gestures rates and imagistic gesture rates for PCPs 2–7 in conversation and in narrative with CPNH and CPHI. The highlighted rows show the gesture rates in quiet which are the focus of this chapter.

5.2.1.1 ***Gesture Rates in Conversation***

As seen in Table 5.1, total gesture rates in conversations with CPNH ranged from 2.00 (Case 2) to 8.54 gestures per 100 words (Case 6) and with CPHI from 1.08 (Case 7) to 9.85 gestures (Case 4). Imagistic gesture rates with CPNH ranged from 0.56 (Case 7) to 5.69 (Case 6) and with CPHI from 0.65 (Case 7) to 3.90 (Case 4).

To investigate the effect of HI on the total as well as the imagistic gesture rates, differences in rates of each PCP between interactions with the CPHI and the CPHI were calculated. The results are shown in Table 5.2. Higher total gestures rates were found in conversation with the CPHI than with the CPNH in Case 2, Case 3, and Case 4 (range 2.72–7.85). The largest difference in total gesture rates was 7.85 (Case 4). That is, in quiet PCP4 produced 7.85 more gestures per 100 words with the CPHI than with the CPNH. By contrast, in Cases 5, Case 6, and Case 7 higher total gesture rates were found with the CPNH than with the CPHI (range of differences 1.44 - 3.84). The largest difference was 3.84 (Case 6). That is, PCP6 produced 3.84 more gestures per 100 words with their CPNH than with their CPHI. Differences found in Cases 5 and Case 7 were less than two gestures per 100 words.

Higher imagistic gesture rates were also found in Case 3, Case 4, Case 5, and Case 7 in conversation with the CPHI than the CPNH (range of differences 0.30–3.05). The largest difference between imagistic gesture rates was 3.05 (Case 4). That is, PCP4 produced 3.05 more imagistic gestures per 100 words with their CPHI than with their CPNH. Differences in gesture rates of less than 1.00 were found in Case 5 and Case 7. By contrast, in Case 2 and Case 6 higher imagistic gesture rates (2.44 & 0.97) were found with the CPNH than with the CPHI.

In the Case 5 conversation, the CPHI produces long periods of talk during which PCP5 occasionally asks a question or makes a brief comment without using gesture. For much of the time PCP5 sits on her hands. By contrast, in conversation with the CPNH (a friend) PCP5 leads the conversation (also using gesture) while talking about the experiences of some friends.

Table 5.1

Total Words, Gesture (G) Numbers and Total and Imagistic (IM) Gesture Rates for Conversations (C) and Narratives (Na) With CPNHI (NH)and CPHI (HI) in Quiet (Q) and in Noise (N)

Case		*2*				*3*				*4*				*5*				*6*				*7*			
	Task	C		Na		C		Na		C		Na		C		Na		C		Na		C		Na	
		NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI
Total words	Q	421	256	511	328	330	592	278	303	350	538	269	223	449	188	304	299	492	277	248	225	356	461	241	265
	N	344	325	-	-	412	515	277	351	394	377	273	234	379	352	339	277	298	250	263	234	353	466	194	202
Total G	Q	18	18	66	44	15	43	24	23	7	53	23	23	29	9	31	35	42	13	39	36	9	5	9	9
	N	10	34	-	-	12	52	28	27	32	23	32	34	37	26	53	49	31	13	43	38	15	34	11	11
Total G rate	Q	**4.28**	**7.03**	**12.92**	**13.41**	**4.55**	**7.26**	**8.63**	**7.59**	**2.00**	**9.85**	**8.55**	**10.31**	**6.46**	**4.79**	**10.20**	**11.71**	**8.54**	**4.69**	**15.73**	**16.00**	**2.53**	**1.08**	**3.73**	**3.40**
	N	2.91	10.46	-	-	2.91	10.10	10.11	7.69	8.12	6.10	11.72	14.53	9.76	7.39	15.63	17.69	10.40	5.20	16.35	16.24	4.25	7.30	5.67	5.45
Total IM	Q	9	3	41	22	6	20	17	18	3	21	17	10	13	6	26	19	28	9	16	17	2	3	6	7
	N	5	16	-	-	6	22	20	22	11	8	22	16	26	15	30	29	17	4	25	23	8	15	8	7
Total IM Rate	Q	**2.14**	**1.17**	**8.02**	**6.71**	**1.82**	**3.38**	**6.12**	**5.94**	**0.86**	**3.90**	**6.32**	**4.48**	**2.90**	**3.19**	**8.55**	**6.35**	**5.69**	**3.25**	**6.45**	**7.56**	**0.56**	**0.65**	**2.49**	**2.64**
	N	1.45	4.92	-	-	1.46	4.27	7.22	6.27	2.79	2.12	8.06	6.84	6.86	4.26	8.85	10.47	5.70	1.60	9.51	9.83	2.27	3.22	4.12	3.47

Note. Highlighted rows show the results for the quiet samples.

Table 5.2

Differences in PCP Gesture Rates in Conversation (C) and Narrative (Na) Between CPHI and CPNH in Quiet (Q) and in Noise (N)

Case		2		3		4		5		6		7	
	Task	C	Na	C	Na	C	Na	C	Na	C	Na	C	Na
Total G-rate	**Q**	2.76	0.50	2.72	-1.04	7.85	1.76	-1.67	1.51	-3.84	0.27	-1.44	-0.30
	N	**7.55**	**-**	**7.18**	**-2.42**	**-2.02**	**2.81**	**-2.38**	**2.06**	**-5.20**	**-0.11**	**3.05**	**-0.22**
Imagistic G-rate	**Q**	**-0.97**	**-1.32**	**1.56**	**-0.17**	**3.05**	**-1.84**	**0.30**	**-2.20**	**-2.44**	**1.10**	**0.09**	**0.15**
	N	3.47	-	2.82	-0.95	-0.67	-1.22	-2.60	1.62	-4.10	0.32	0.95	-0.66

Note. G-rate = gesture rate. Differences were calculated by subtracting the CPNH rate from the CPHI rate. A negative difference indicates that the gesture rate was higher when the PCP was in interaction with the CPNH. Highlighted rows show the results for the quiet samples.

In the Case 6 conversation with the CPHI, PCP6 has her hands clasped on her lap for much of the time producing only the occasional gesture. Notably short comments are exchanged between PCP6 and her CPHI without detailed descriptions of events. Similarly, in conversation with her CPNH, PCP6's hands are clasped resting on her knee for extended periods during her own talk and during CPNH's talk. However, as she relates a story about an incident with her dog, she produces a series of gestures, describing the events and behaviour of the dog over the period of one minute (see Figure 5.1). During the storytelling PCP6's gesture production was observed to increase (14 gestures including nine imagistic gestures). Hence the narrative content in PCP6's conversation with her CPHN may have resulted in the increased total gesture rate in comparison with the conversation with her CPHI.

As illustrated in Figure 5.2, higher total gesture rates were found in Case 2, Case 3, and Case 4 in conversations with the CPHI than with the CPNH. suggesting that some PCPs, but not others, may be expressing their sensitivity to the hearing status of their listeners by producing a relatively larger number of gestures when talking to their CPHI.

Figure 5.1

Example of a Series of Gestures Produced by PCP6 in Conversation With the CPNH While Telling a Story About her Dog

Note. *The numbers 1–8 indicate each gesture stroke and are referenced in the transcript below*

1 PCP6: you know (0.5) I caught her on the couch¿=

2 CPNH: =hhhh

3 PCP6: I (h)(h)(h)(h) I'd just gone to bed (0.3) and I'd remembered ↑oh I need to get (0.6) something

Ge { [▲1.............................▲2 [▲3__________ ▲4 }

Gz -------------,,xx,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx,,,,,------,,,xxxxxxxxxxxxxxxxx,,,,,,,---,,------------,,,,,--

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

4 PCP6: (0.2) and I came back out and put the light on and I think ↑oh where's (Name) (0.3)

Ge [▲5 ^6...

Gz ---,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx,,,,,---*head side to side*------,,xxxxxxxxxxxxxxxx,,,,,---

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

5 PCP6: and she's like on the couch like this I think she's thinking (0.6) [don't come over here] don't [come over here]

Ge [▲7.. }

Gz ----,,,,,,xxxxxxxxxxxxxxxx,,,,-----,,,,,,,,,,,xxxxxxxxxxxxxxxxxxx,,,,,------------*eyes closed*------------------,,,,,,xxxxxxxxxxxx

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

6 CPNH: [yeah]

7 PCP6: [(h)(h)(h)(h) (h) ofcourse what I was looking for was on the ta[ble]¿

Ge { [▲8 }

Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

8 CPNH: [(laughter)] [yea::]h

Note. Gesture strokes are numbered 1–8 in the transcript and are referenced in the image above

5.2.1.2 ***Gesture Rates in Narrative***

Total gesture rates were higher in narrative than in conversation. As seen in Table 5.1, total gesture rates in narrative with CPNH ranged from 3.73 (Case 7) to 15.73 gestures per 100 words (Case 6). In Cases 2–6 the total gesture rate was greater than 8.55 gestures per 100 words. Total gesture rates with CPHI ranged from 3.40 (Case 7) to 16.00 (Case 6). In Cases 2–6 the total gesture rates were greater than 7.50.

Imagistic gesture rates in narrative with CPNH ranged from 2.49 (Case 7) to 8.02 (Case 2). In Cases 2–6 the imagistic gesture rates were higher than 6.00 gestures per 100 words. Imagistic gesture rates with CPHI imagistic gesture rate ranged from 2.64 (Case 7) to 7.56 (Case 6). In Cases 2–6 imagistic gesture rates were greater than 4.48.

To investigate the effect of HI on the total and imagistic gesture rates, differences between rates with CPHI and CPNH were calculated. The results are shown in Table 5.2. Higher total gesture rates were found in narrative with the CPHI than with the CPNH in Case 4 and Case 5. The largest differences in total gesture rates were 1.76 (Case 4) and 1.50 (Case 5). That is, PCP4 produced 1.76 and PCP5 1.51 more gestures per 100 words when narrating with their CPHI than with their CPNH. By contrast, in Case 3 a higher gesture rate (1.04) was found with the CPNH than with the CPHI. Differences in gesture rates were 0.50 or lower in Case 2, Case 6, and Case 7, suggesting that the hearing status of the listener had limited or no impact on the total gesture rates in narrative.

A higher imagistic gesture rate was found in Case 6 in narrative with the CPHI than with the CPNH (1.10). By contrast, in Case 2, Case 4, and Case 5 higher imagistic gesture rates were found in narrative with the CPNH than with the CPHI (range of differences 1.32 – 2.20). The largest difference in imagistic gesture rates was 2.20 (Case 5). That is, PCP5 produced 2.20 more imagistic gestures when narrating with their CPNH than with their CPHI. Differences in imagistic gesture rates in Case 3 and Case 7 were 0.17 and 0.15 respectively suggesting that the hearing status of the listener had no impact on the imagistic gesture rates.

The lowest total gesture rates were found in the Case 7 narratives. When narrating PCP7 produces some gesture but tells other aspects of the story without gestures. At the beginning of the narration with her CPHI and with her CPNH, PCP7 indicates a dislike of the film and comments that she did not think the story was “very nice”. This sentiment may have impacted her overall gesture production.

As seen in Table 5.2, overall differences in total and in imagistic gesture rates between narratives with CPNH versus CPHI were smaller than differences in rates between conversations. In several cases these differences were less than a one gesture per 100 words. This suggests there was little change in the relative frequency of gesture produced in narrative by PCPs in response to the hearing status of their CP (see Figure 5.3).

Figure 5.2

PCP Total Gesture Rates in Conversations With CPNH and CPHI

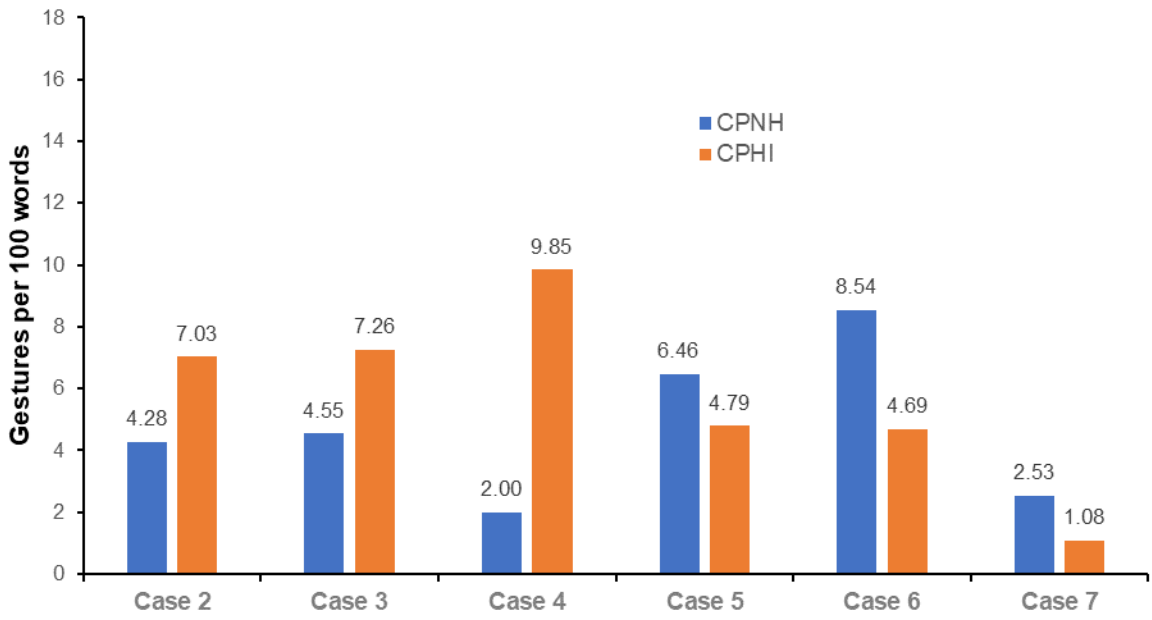
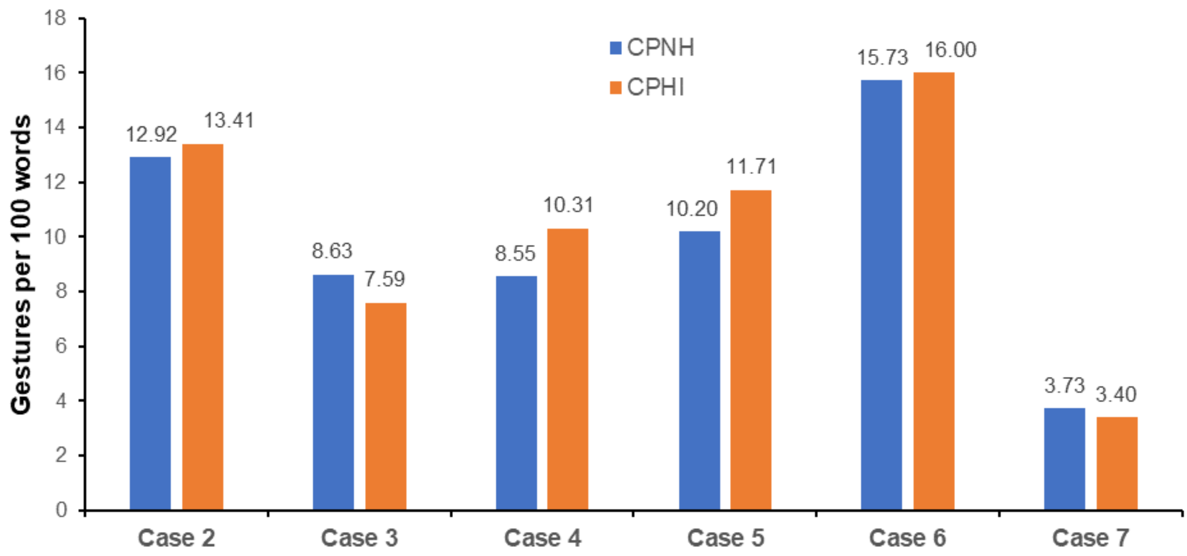


Figure 5.3

PCP Total Gesture Rates in Narratives With CPNH and CPHI



5.2.2 Gesture Type Frequency

The research questions addressed in this section are:

1.2.(a) Are some gesture types produced more frequently than others?

1.2.(b) Do the proportions of different gesture types differ between interactions with CPHI and interactions with CPNH?

Gesture type as a proportion of total gestures (excluding beats) was calculated for each of the six categories (iconic, metaphoric, deictic abstract, deictic concrete, interactive, and emblems) and for imagistic (iconic and metaphoric gestures combined). The results are presented in Table 5.3. The highlighted rows show the proportions by gesture type for PCPs 2–7 in the quiet samples, the focus of this chapter.

As seen in Table 5.3, all gesture categories including iconic, metaphoric, deictic abstract, deictic concrete, interactive, and emblems were represented. It was noted that the number of deictic concrete gestures was low across all cases. On one or two occasions a participant gestured towards the loudspeaker playing the noise or pointed at the view out of the window. The low number of deictic concrete gestures is likely due to the room setup and the absence of concrete objects. As described in Chapter 3 (Section 3.4.2), this was designed to maximise gesture production by avoiding visual distractions or participants handling objects and not having hands free to gesture. There were also few emblems produced.

In most interactions the highest proportion of gestures by type produced by PCPs was for imagistic gestures followed by interactive gestures with both the CPNH and the CPHI. Iconic gestures were typically the predominant imagistic type with relatively low proportions of metaphoric gestures. Proportions of imagistic gestures ranged from 39.62% (Case 4 conversation) to 78.26% (Case 3 narrative) with the CPHI and from 40.00% (Case 3 conversation) to 83.87% with the CPNH (Case 5 narrative). The Case 2 conversation with the CPHI was an exception with the proportion of interactive gestures (61.11%) higher than the proportion of imagistic gesture (16.67%). The Case 7 conversation with the CPNH was also an exception with the proportion of interactive gestures (55.56%) higher than the proportion of imagistic gestures (22.22%).

Imagistic gestures and interactive gestures were the predominant gesture types in the interactions with both the CPHI and the CPNH. Therefore, the next stage of the analysis focused on imagistic and interactive gestures and compared gesture type proportions produced in interactions with CPHI versus interactions with CPNH.

Table 5.3

Gesture Type Numbers and Proportions in Conversation (C) and Narrative (Na) With CPHI (HI) and CPNH (NH) in Quiet (Q) and in Noise (N)

Case		*2*				*3*				*4*				*5*				*6*				*7*			
Task		C		Na		C		Na		C		Na		C		Na		C		Na		C		Na	
Type	% (n)	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI
Iconic	Q	16.67 (3)	11.11 (2)	56.06 (19)	43.18 (37)	20.00 (3)	39.53 (17)	66.67 (16)	73.91 (17)	28.57 (2)	22.64 (12)	73.91 (17)	39.13 (9)	13.79 (4)	44.44 (4)	51.61 (16)	48.57 (17)	59.52 (25)	53.85 (7)	30.77 (12)	41.67 (15)	11.11 (1)	60.00 (3)	66.67 (6)	66.67 (6)
	N	50.00 (5)	47.06 (16)	-	-	25.00 (3)	30.77 (16)	64.29 (18)	70.37 (19)	6.25 (2)	13.04 (3)	56.25(18)	47.06 (16)	56.76 (21)	46.15 (12)	47.17 (25)	51.02 (25)	48.39 (15)	7.69 (1)	41.86 (18)	39.47 (15)	40.00 (6)	41.18 (14)	72.73 (8)	63.64 (7)
Meta [a]	Q	33.33 (6)	5.56 (1)	6.06 (4)	6.82 (3)	20.00 (3)	6.98 (3)	4.17 (1)	4.35 (1)	14.29 (1)	16.98 (9)	0.00	4.35 (1)	31.03 (9)	22.22 (2)	32.26 (10)	5.71 (2)	7.14 (3)	15.38 (2)	10.26 (4)	5.56 (2)	11.11 (1)	0.00	0.00	11.11 (1)
	N	0.00	0.00	-	-	25.00 (3)	11.54 (6)	7.14 (2)	11.11 (3)	28.13 (9)	21.74 (5)	12.50 (4)	0.00	13.51 (5)	11.54 (3)	9.43 (5)	8.16 (4)	6.45 (2)	23.08 (3)	16.28 (7)	21.05 (8)	13.33 (2)	2.94 (1)	0.00	0.00
Total IM [b]	**Q**	**50.00 (9)**	**16.67 (3)**	**62.12 (41)**	**50.00 (22)**	**40.00 (6)**	**46.51 (20)**	**70.83 (17)**	**78.26 (18)**	**42.86 (3)**	**39.62 (21)**	**73.91 (17)**	**43.48 (10)**	**44.83 (13)**	**66.67 (6)**	**83.87 (26)**	**54.29 (19)**	**66.67 (28)**	**69.23 (9)**	**41.03 (16)**	**47.22 (17)**	**22.22 (2)**	**60.00 (3)**	**66.67 (6)**	**77.78 (7)**
	N	50.00 (5)	47.06 (16)	-	-	50.00 (6)	42.31 (22)	71.43 (20)	81.48 (22)	34.38 (11)	34.78 (8)	68.75(22)	47.06 (16)	70.27 (26)	57.69 (15)	56.60 (30)	59.18 (29)	54.84 (17)	30.77 (4)	58.14 (25)	60.53 (23)	53.33 (8)	44.12 (15)	72.73 (8)	63.64 (7)
Deictic Ab [c]	Q	0.00	11.11 (2)	7.58 (5)	9.09 (4)	20.00 (3)	13.95 (6)	8.33 (2)	8.70 (2)	0.00	15.09 (8)	13.04 (3)	26.09 (6)	3.45 (1)	11.11 (1)	3.24 (1)	14.29 (5)	9.52 (4)	0.00	17.95 (7)	8.33 (3)	22.22 (2)	20.00 (1)	33.33 (3)	22.22 (2)
	N	0.00	2.94 (1)	-	-	25.00 (3)	15.38 (8)	10.71 (3)	0.00	12.50 (4)	0.00	12.50 (4)	8.82 (3)	8.11 (3)	19.23 (5)	5.66 (3)	2.04 (1)	16.13 (5)	0.00	9.30 (4)	10.53 (4)	13.33 (2)	17.65 (6)	18.18 (2)	**9.09 (1)**
Deictic C [d]	Q	0.00	11.11 (2)	0.00	0.00	6.67 (1)	2.33 (1)	0.00	0.00	0.00	0.00	0.00	0.00	6.90 (2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**
	N	10.00 (1)	5.88 (2)	-	-	0.00	1.92 (1)	3.57 (1)	3.70 (1)	0.00	4.35 (1)	3.13 (1)	0.00	0.00	0.00	0.00	4.08 (2)	0.00	15.38 (2)	0.00	0.00	0.00	5.88 (2)	0.00	0.00
***Inter* [e]**	**Q**	**44.44 (8)**	**61.11 (11)**	**30.30 (20)**	**40.91 (18)**	**26.67 (4)**	**37.21 (16)**	**20.83 (5)**	**8.70 (2)**	**57.14 (4)**	**43.40 (23)**	**13.04 (3)**	**26.09 (6)**	**41.38 (12)**	**22.22 (2)**	**12.90 (4)**	**28.57 (10)**	**23.81 (10)**	**30.77 (4)**	**41.03 (16)**	**44.44 (16)**	**55.56 (5)**	**20.00 (1)**	**0.00**	**0.00**
	N	40.00 (4)	41.18 (14)	-	-	25.00 (3)	40.38 (21)	14.29 (4)	14.81 (4)	50.00 (16)	56.52 (13)	15.63 (5)	41.18 (14)	18.92 (7)	23.08 (6)	37.74 (20)	34.69 (17)	29.03 (9)	53.85 (7)	32.56 (14)	26.32 (10)	33.33 (5)	32.35 (11)	9.09 (1)	27.27 (3)

Case		*2*				*3*				*4*				*5*				*6*				*7*			
Task		C		Na		C		Na		C		Na		C		Na		C		Na		C		Na	
Type	% (n)	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI
Embl [f]	Q	5.56 (1)	0.00	0.00	0.00	6.67 (1)	0.00	0.00	4.35 (1)	0.00	1.89 (1)	0.00	4.35 (1)	3.45 (1)	0.00	0.00	2.86 (1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N	0..00	2.94 (1)	-	-	0.00	0.00	0.00	0.00	3.13 (1)	4.35 (1)	0.00	2.94 (1)	2.70 (1)	0.00	0.00	0.00	0.00	0.00	0.00	2.63 (1)	0.00	0.00	0.00	0.00

Note. Highlighted rows show the results for the quiet samples.

[a] Meta = metaphoric. [b] IM = iconic and metaphoric gestures = imagistic. [c] Deictic Ab= deictic abstract. [d] Deictic C = deictic concrete. [e] Inter = interactive.

[f] Embl=emblem.

5.2.2.1 ***Gesture Type in Conversation: CPHI versus CPNH***

As seen in Table 5.3, proportions of imagistic gestures produced by PCPs did not differ substantially between conversations with the CPHI and the CPNH in Cases 3, Case 4, and Case 6. The differences in proportions ranged from 2.56% to 6.52%, the proportions being higher when PCPs conversed with their CPHI than with their CPNH.

In Case 2 a similar number of gestures were produced by PCP2 with their CPNH and their CPHI (18). Interactive gestures made up the highest proportion (61.11%, 11/18) with a lower imagistic proportion (16.67%, 3/18) and deictic (abstract and concrete 4/18) produced with the CPHI. By contrast, imagistic gestures (50%, 9/18) made up the highest proportion when PCP2 conversed with their CPNH with a slightly lower proportion of interactive gestures (44.4%, 8/18).

In Cases 5 and Case 7 proportions of imagistic gesture were higher when PCPs conversed with their CPHI than with their CPNH. However, very small gesture numbers in one or both cases prevent meaningful reporting of proportions. Hence, differences may be inflated as they may only comprise a difference of one or two gestures.

5.2.2.2 ***Gesture Type in Narrative: CPHI versus CPNH***

As seen in Table 5.3, proportions of imagistic gesture produced by PCPs did not differ substantively between narratives with CPHI and CPNH in Case 2, Case 3, Case 6, or Case 7. The differences in proportions of gesture ranged from 6.19% to 12.12% the proportions being higher when PCPs narrated to their CPHI.

In Case 4 and Case 5 a similar total number of gestures was produced by PCP4 and by PCP5 with their respective CPNH and CPHI, and imagistic gestures made up the highest proportion of gestures produced by PCPs, albeit showing a higher proportion with the CPNH than the CPHI. In Case 4 the proportion of imagistic gestures was lower when PCP4 narrated to their CPHI (43.48%, 10/23) than their CPNH (73.91%, 17/23) while (equal) proportions of interactive and deictic (abstract only no concrete) gestures were higher when PCP4 narrated to their CPHI (26.09% & 26.09%) than their CPNH (13.04% & 13.04%). In Case 5 the proportion of imagistic gestures was also lower when PCP5 narrated to their CPHI (54.29, 19/35) than their CPNH (83.87%, 26/31), while proportions of interactive and deictic gestures were higher when PCP5 narrated to their CPHI (28.57% & 14.29%) than their CPNH (12.90% & 3.24%).

Overall, these results suggest that in the majority of interactions, participants did not substantively alter their various gesture types in conversation or narrative with their CPHI compared to their CPNH.

5.2.2.3 ***Qualitative Commentary: Gesture Type***

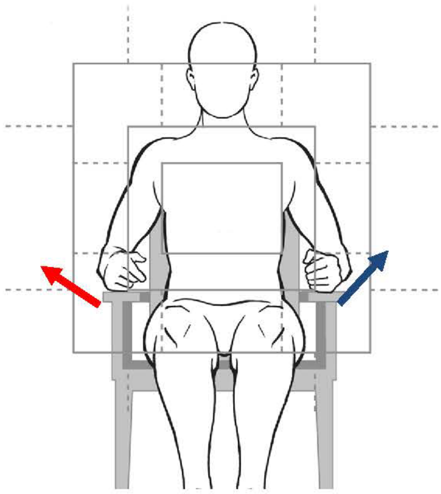
Based on the literature review in Chapter 2, the expectation was that higher proportions of imagistic gestures which provide semantic information would be produced by PCPs when interacting with their CPHI because of the impact of the hearing loss on message reception. However, substantial differences were not found in many of the interactions.

As described, there were instances where PCPs produced larger proportions of interactive gestures than imagistic gestures with their CPHI. This suggests that in some interactions with the CPHI (Case 2 conversation; Case 4 and Case 5 narratives), the balance of gesture types alters in favour of a larger proportion of interactive gestures (and deictic in Case 4 and Case 5 narratives) and a corresponding lower proportion of imagistic gestures, suggesting that for these cases the interactional or pragmatic elements of the talk were perceived to require greater support from gesture. For example, PCP2 produced 11 interactive and only three imagistic gestures in conversation with the CPHI. In the conversation, CPHI asks for PCP2's opinion about plans for a child coming to stay with them overnight, and PCP2 produces interactive gestures while providing verbal reassurance that the visit will go well. In the rest position typically adopted by PCP2 both his forearms lie on the chair armrests with hands hanging off to the sides. These gestures typically consist of raising one or both hands with palms facing the CPHI while forearms and elbows remained on the arm rests. An example is seen in Figure 5.4. As PCP2 begins his talk (line 2) he produces a gesture in the manner described above. Both hands move up and outwards and then remain in a hold. As he completes the utterance his hands move upward palms facing the CPHI in a second interactive gesture before they return to the rest position.

In the narratives PCP4 and PCP5 produced a higher proportion of imagistic gestures with the CPNH than the CPHI. Even though total gesture rates were not substantially different, imagistic gesture rates were slightly lower in interaction with the CPHI. A possible explanation for might be that PCP4 and PCP5 added more semantic details to their narration with the CPNH having noted and recalled more detail following the second viewing of the film. This is illustrated in Figures 5.5 and Figure 5.6 which show comparable extracts from the Case 4 narratives with the CPHI and CPNH. Figure 5.5 shows an extract from the narration with the CPHI in which PCP4 uses eight gestures including five imagistic gestures. Figure 5.6 shows an extract from the narration with the CPNH in PCP4 which mentions details not in his narration to the CPHI and produces 12 gestures eight of which are imagistic.

Figure 5.4

Example of an Interactive Gesture in Case 2 Narrative With the CPHI



1 PCP2: anyway I'm sure she will be fine (1.0)

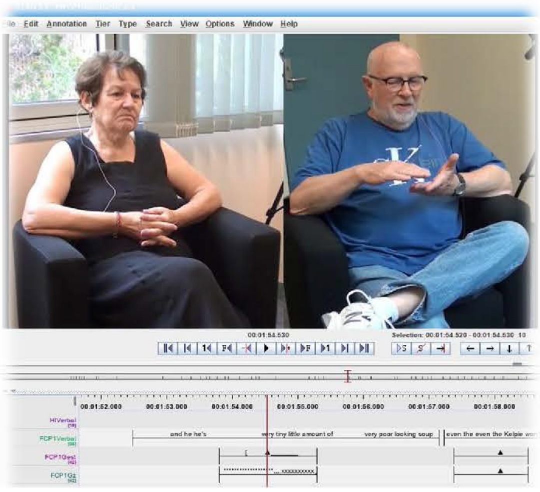
2 PCP2: (name) seems to think she will be fine¿
Ge { ▲...[▲ }
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

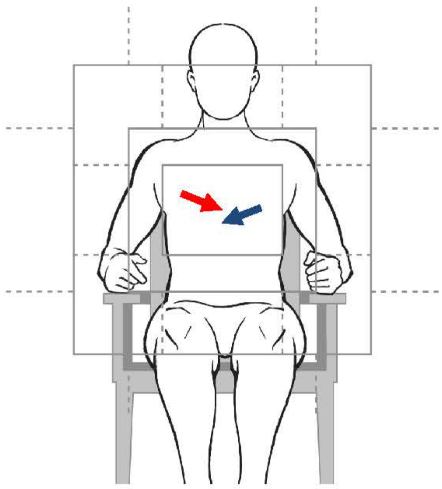
CPHI:,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

3 CPHI: does she?
4 PCP2 yeah¿ otherwise she wouldn't suggest it
5 CPHI: oh I dun know you know how quick we wanted to offload our kids¿=
6 PCP2: = (h) (h) ye[ah on]ly took about 25 years =
7 CPHI: [yeah] = yeah

Figure 5.5

Example Extract from Case 4 Narrative With the CPHI





1 PCP4: anyway the: eh (1.0) the FIRST day you see them (0.3) the kid's out there and he (0.6) PATS his lamb
Ge { ▲} { [▲M } { ▲ .▲I________________{
Gz ---------,,xxxx,,,------------------,,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

2 PCP4: then he comes home and dad says (1.1)
Ge [▲I }
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

3 PCP4: dad,s obviously distressed by being very POOR

4 PCP4: and he (.) he's (0.4) very tiny amount of (.) very poor looking soup (0.4)
Ge { [▲I_______ }
Gz ---------------,,,,,*******************,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

5 PCP4: even the even the Kelpie won't eat the soup (.) hhhh
Ge { ▲ }
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx,,,--------

CPHI : xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

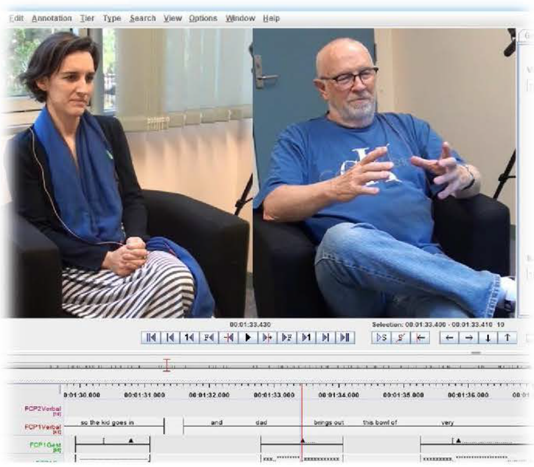
6 PCP4: and the kid has to eat his soup and then he's sent off to bed
Ge { ▲I }
Gz -- ,,,,,,xxxxxxxxxxxxxxxxxxxxxxx

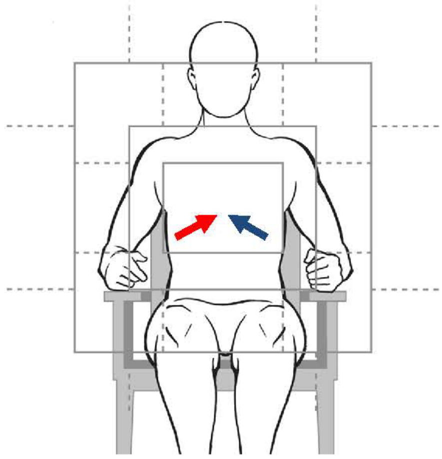
CPHI: -------------------,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

Note. Iconic gestures are indicated by the symbol ▲I and metaphoric gestures by ▲M

Figure 5.6

Example Extract from Case 4 Narrative With the CPNH





1 PCP4: and the lamb is grazing out there(.) and the lamb is (.) this kid's (0.7) pet
Ge [▲ᴵ_________ ▲_________ ▲
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPNH xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

2 PCP4 (0.3) ↑ not his pet but his favourite lamb so he (0.3) he goes out there and
Ge [▲ᴵ
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPNH :xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz:

3 PCP4: he obviously goes out there a lot (.) and he hugs the lamb and pats it (0.7) he loves the lamb (0.9)
Ge [▲ᴵ [▲ᴵ____
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

4 PCP4: and then his dad comes (0.6) opens the door of the house and it's a rea::lly (0.2) just a tin shed (0.2)
Ge ▲ ▲ [▲ᴵ
Gz --------------,,,,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx,,,,,,-----------------,,,,,,-------,,xxxxxxxxxxxxxxxxxxxx

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

5 PCP4: it's they're obviously extremely poor (0.2) it's obviously just the two of them

6 PCP4 (0.8) an:d uh: dad says: (.) says DINNER time so the kid goes in (0.7)
Ge { [▲ᴵ }
Gz --,,,xxx,,-------------------------

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

7 PCP4: an:d dad (0.8) brings out (.) this bowl of (0.3) very (0.2) hh (0.3) small amount (0.3) of what he calls STEW
Ge ▲ᴵ.... [▲ᴵ..........................
Gz xxxx,,***********,,xxxxxxxxxxxxxxxxxxxxxxxxxx,,,*************************************,,,,,,,,,,,,,,,,,,,,,,,,,xxxxxxxxxxxxxx

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

Note. iconic gestures are indicated by the symbol ▲ᴵ and metaphoric gestures by ▲ᴹ

5.2.3 Gesture Characteristics – Gesture Size

The research question addressed in this section is:

1.3. Does the size of imagistic (iconic and metaphoric) gestures differ between interactions with CPHI and interactions with CPNH?

For the analyses associated with these questions each gesture produced by PCPs 2–7 was categorised according to the number of borders crossed during stroke performance. Gesture size proportions of the total imagistic gestures were calculated for the three size categories, small, medium, and large and for the combined medium-large category (i.e., one or more gesture space borders crossed) and are presented in Table 5.4. Results obtained in the quiet samples are highlighted to distinguish them from results obtained during the noise samples.

5.2.3.1 ***Gesture Size in Quiet CPHI versus CPNH as Listeners***

Gesture size was analysed by focusing on cases in which the higher numbers of imagistic gestures were produced by PCPs with both CPHI and CPNH (range 16–41). Thus, Case 2, Case 3, Case 5, and Case 6 narratives were selected for the first analysis of small, medium, and large gesture categories, as seen in Table 5.4 and described below. The remaining interactions, Cases 2–7 conversations and Case 4 and Case 7 narratives, are not discussed here due to the low gesture numbers (≤ 10) produced by the PCP with either the CPHN or the CPHI, making comparisons less meaningful.

Case 2 Narratives: Forty-one imagistic gestures were produced by PCP2 with the CPNH and 22 with the CPHI. There were approximately equal proportions of gestures produced across the three size categories with the CPNH. By contrast, with the CPHI the highest proportion was medium-size (45.45%) followed by large (36.36%) and then small gestures (18.18%). This shows that when narrating PCP2 produced a lower proportion of small gestures and a higher proportion of medium gestures with their CPHI than their CPNH.

Case 3 Narratives: Seventeen imagistic gestures were produced by PCP3 with the CPNH and 18 with the CPHI. The highest proportion by gesture size with the CPNH was small gestures (47.06%) followed by medium (35.29%) and large gestures (17.65%.) By contrast, with the CPHI the highest proportion was medium (38.89%) followed by large (33.33%) and small gestures (27.78%). This shows that when narrating PCP3 produced a lower proportion of small gestures and a higher proportion of large gestures with their CPHI than their CPNH.

Table 5.4 *Proportions of Imagistic (IM) Gestures by Size in Conversation (C) and Narrative (Na) With CPNH (NH) and CPHI (HI) in Quiet (Q) and in Noise (N)*

Case		2				3				4				5				6				7			
Borders [a]		C		Na		C		Na		C		Na		C		Na		C		Na		C		Na	
	% (*n*)	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI
< 1	Q	44.44 (4)	33.33 (1)	36.59 (15)	18.18 (4)	0	30.00 (6)	47.06 (8)	27.78 (5)	0.00	42.86 (9)	17.65 (3)	40.00 (4)	23.08 (3)	83.33 (5)	30.77 (8)	26.32 (5)	41.38 (12)	44.44 (4)	31.25 (5)	25.00 (4)	50.00 (1)	33.33 (1)	33.33 (2)	28.57 (2)
	N	20.00 (1)	18.75 (3)	-	-	33.33 (2)	31.82 (7)	16.67 (3)	36.36 (8)	27.27 (3)	37.5 (3)	31.82 (7)	31.25 (5)	38.46 (10)	40.00 (6)	26.67 (8)	10.34 (3)	29.41 (5)	100 (4)	37.50 (9)	26.09 (6)	0.00	80.00 (12)	25.00 (2)	33.33 (2)
1-2	Q	33.33 (3)	33.33 (1)	31.71 (13)	45.45 (10)	83.33 (5)	60.00 (12)	35.29 (6)	38.89 (7)	0	33.33 (7)	58.82 (10)	30.00 (3)	53.85 (7)	0.00	46.15 (12)	57.89 (11)	37.93 (11)	44.44 (4)	56.25 (9)	50.00 (8)	50.00 (1)	66.67 (2)	33.33 (2)	57.14 (4)
	N	80.88 (4)	56.25 (9)	-	-	50.00 (3)	59.09 (13)	50.00 (9)	50.00 (11)	36.36 (4)	50.00 (4)	50.00 (11)	43.75 (7)	46.15 (12)	40.00 (6)	40.00 (12)	58.62 (17)	47.06 (8)	0.00	37.50 (9)	43.48 (10)	71.43 (5)	20.00 (3)	75.00 (6)	66.67 (4)
3+	Q	22.22 (2)	33.33 (1)	31.71 (13)	36.36 (8)	16.67 (1)	10.00 (2)	17.65 (3)	33.33 (6)	100 (3)	23.81 (5)	23.53 (4)	30.00 (3)	23.08 (3)	16.67 (1)	23.08 (6)	15.79 (3)	20.69 (6)	11.11 (1)	12.50 (2)	25.00 (4)	0.00	0.00	33.33 (2)	14.29 (1)
	N	0.00	25.00 (4)	-	-	16.67 (1)	9.09 (2)	33.33 (6)	13.64 (3)	36.36 (4)	12.50 (1)	18.18(4)	25.00 (4)	15.38 (4)	20.00 (3)	33.33 (10)	31.03 (9)	23.53 (4)	0.00	25.00 (6)	30.43 (7)	28.57 (2)	0.00	0.00	0.00
1-6+	Q	55.56 (5)	66.67 (2)	63.41 (26)	81.82	100 (6)	70.00 (14)	52.94 (9)	72.22 (13)	100 (3)	57.14 (12)	82.35 (14)	60.00 (6)	76.92 (10)	16.67 (1)	69.23 (18)	73.68 (14)	58.62 (17)	55.56 (5)	68.75 (11)	75.00 (12)	50.00 (1)	66.67 (2)	66.67 (4)	71.43 (5)
	N	80.00 (4)	81.25 (13)	-	-	66.67 (4)	68.18 (15)	83.33 (15)	63.64 (14)	36.36 (8)	62.50 (5)	68.18 (15)	68.75 (11)	61.54 (16)	60.00 (9)	73.33 (22)	89.66 (26)	70.59 (12)	0.00	62.50 (15)	73.91 (17)	100 (7)	20.00 (3)	75.00 (6)	66.67 (4)
Total IM Ge	Q	9	3	41	22	6	20	17	18	3	21	17	10	13	6	26	19	29	9	16	16	2	3	6	7
	N	5	16	-	-	6	22	18	22	11	8	22	16	26	15	30	29	17	4	24	23	7	15	8	6

Note. Highlighted rows show the results for the quiet samples. Borders = the number of borders crossed during the stroke as a measure of size.

Case 5 Narratives: Twenty-six imagistic gestures were produced by PCP5 with the CPNH and 19 with the CPHI. The highest proportion by gesture size was medium gestures with both the CPNH (46.15%) and CPHI (57.89%) followed by small then large gestures. However, the proportion of large and small gestures produced by PCP5 when narrating was slightly lower with their CPHI than their CPNH. The proportion of medium gestures (57.89%) produced by PCP5 was slightly higher with their CPHI than their CPNH (46.15%).

Case 6 Narratives: Sixteen imagistic gestures were produced by PCP6 with the CPNH and the CPHI. The highest proportion by size was medium gestures with both the CPNH (56.25%) and the CPHI (50%) followed by small and then large gestures. The proportion of large gestures produced by PCP6 when narrating was higher with their CPHI (25.00%) than their CPNH (12.50%).

The second analysis was conducted reducing size of gesture proportions to two categories: *small* and *medium-large*. The small category included gestures that crossed no borders. The medium-large category included gestures which crossed one or more borders during gesture production. The re-categorisation showed that a higher proportion of medium-large than small gestures were produced in all cases. The analysis of the Case 2, Case 3, Case 5, and Case 6 narratives based on the re-categorisation is presented below.

Case 2 Narratives: The proportion of large gestures produced by PCP2 was higher when narrating with the CPHI (81.82%) than with the CPNH (63.41%). The proportion of small gestures produced by PCP2 when narrating was lower with their CPHI (18.18%) than their CPNH (36.95%).

Case 3 Narratives: The proportion of large gestures produced by PCP3 was higher when narrating with the CPHI (72.22%) than with the CPNH (52.94%). The proportion of small gestures produced by PCP3 when narrating was lower with their CPHI (27.78%) than their CPNH (47.06%).

Case 5 Narratives: The proportion of large gestures produced by PCP5 was slightly higher when narrating with the CPHI (73.68%) than with the CPNH (69.23%). The proportion of small gestures produced by PCP5 when narrating was slightly lower with the CPHI (26.32%) than with the CPNH (30.77%).

Case 6 Narratives: The proportion of large gestures produced by PCP6 when narrating was slightly higher with their CPHI (75%) than their CPNH (68.75%). The proportion of small gestures produced by PCP6 was slightly lower with the CPHI (25.00%) than with the CPNH (31.25%).

Overall, the proportion of medium-large gestures produced by PCP2 and PCP3 when narrating was higher and the proportion of small gestures lower with their respective CPHI than their CPNH. A similar trend was found for PCP5 and PCP6 but differences between proportions were smaller.

The short film used in this investigation portrays a young blind boy following a rope out to his pet lamb, tethered some distance away in a field (see Appendix Q for the film transcript). The PCP narrations frequently included gestures using one or both arms reaching out into the extreme periphery region to portray the rope and the movement of the blind boy. Figures 5.5 and 5.6 provide sample extracts from Case 6 illustrating PCP6's portrayal of the boy's action walking along the rope, and in which PCP6 was observed to produce smaller size gestures with their CPNH than their CPHI.

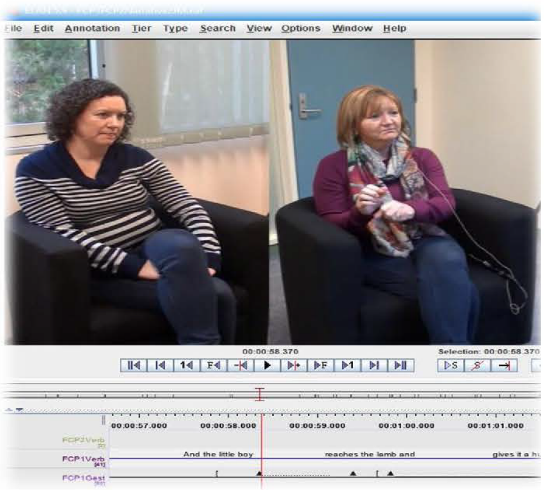
Figure 5.7 shows a series of three iconic gestures produced by PCP6 with the CPNH when narrating. The first gesture is produced with the left hand which moves across three gesture-space borders and thus was categorised as a large gesture. The other two gestures were categorised as small because in each case both hands remain within one gesture-space region during the stroke. Figure 5.8 shows a series of three iconic gestures produced by PCP6 with the CPHI when narrating. The first gesture is performed with the left hand (line 1) which moves across two borders and is thus categorised as medium size. The second gesture (line 2) is produced with the right hand (the left hand remains in a hold) which moves across three gesture space borders and thus is categorised as large. The third gesture is produced with the right hand moving across five borders and the left hand across one border thus this is also categorised as large.

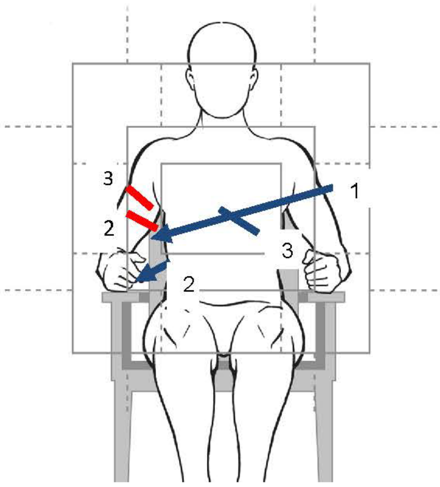
It was noted the gestures crossing the largest number of borders (six or more borders) were typically those that involved a series of movements often repeated movements crossing and re-crossing borders.

Overall, as illustrated in Figure 5.9, these results suggest a trend among PCPs in that they produced a lower proportion of small gestures within one gesture division with their CPHI compared to gestures of medium to large size. However, the results do not show a substantial increase in the number of gestures in the large category (three or more borders crossed). As illustrated in Figure 5.9, the results based on the re-classification into two categories showed that PCPs produced a higher proportion of gestures crossing one or more gesture space borders than gestures crossing no borders when narrating with either their CPNH or their CPHI. The results also suggest a trend in PCPs to produce a higher proportion of gestures that cross one or more borders with their CPHI than with their CPNH. This may be an indication that PCPs modify their gestures, by increasing the span of the stroke movement and/or the number of movements within a gesture, in response to the HI of a CP.

Figure 5.7

Series of One Large and Two Small Imagistic Gestures in Case 6 Narrative With the CPNH





1 PCP6: at the end of it is: a:: lamb: (.) that's tethered (0.8) to a post (0.6)

2 PCP6: and the little boy (0.8) reaches the lamb (0.7) and gives it a hug and a (0.3) a cuddle or whatever¿
Ge { [▲1……………▲2 [▲3____________________________________}
Gz ,,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx,,,,,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

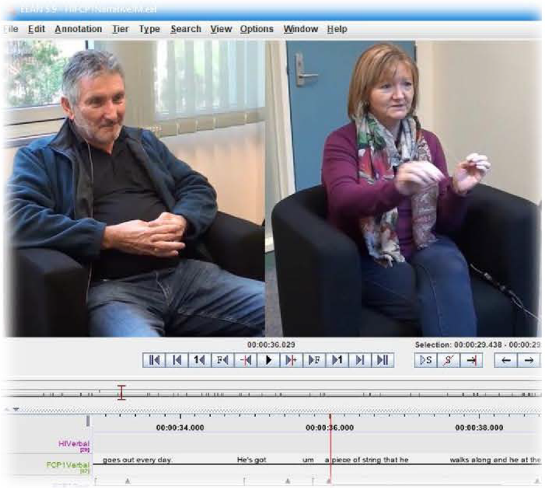
3 PCP6: so that- eh's obviously its like its his pet¿
4 PCP6: (0.7) but when: he actually turns around you realise the little boy is blind so that's why: (0.7)
5 CPNH: there;s a rope out[t to it]
6 PCP6: [there's a rope] out to the lamb

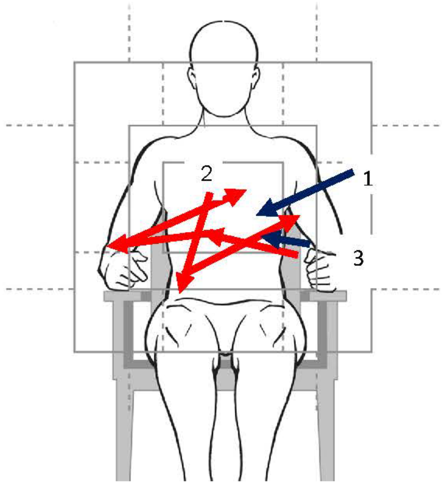
PCP6: **1** Le: C Le- CC- C Ri Hold **2** Le: C Ri-C Ri Ri: C Ri - C Ri **3** Le: CC-CC Ri: C Ri - C Ri
Size

Note. 1 is categorised as a large gesture and 2 & 3 are categorised as small gestures

Figure 5.8

Series of One Medium and Two Large Imagistic Gestures in Case 6 Narrative With the CPHI





1 PCP6: this little blind boy who goes out every day
Ge { [▲[1]{
Gz xxxxxxxxxxxxxxxx,,,-------,,,,,,xxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

2 PCP6: he's got um: (.) a piece of string¿ that he walks along and he f- at the end of it (0.3)
Ge [▲[2] [▲[3]_______________________[▲............... }
Gz **************,,,,---,,,xxxxxxxxxxxxxxxxxxxxxxxxx,,,,,,,,,****,,,,,,,xxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

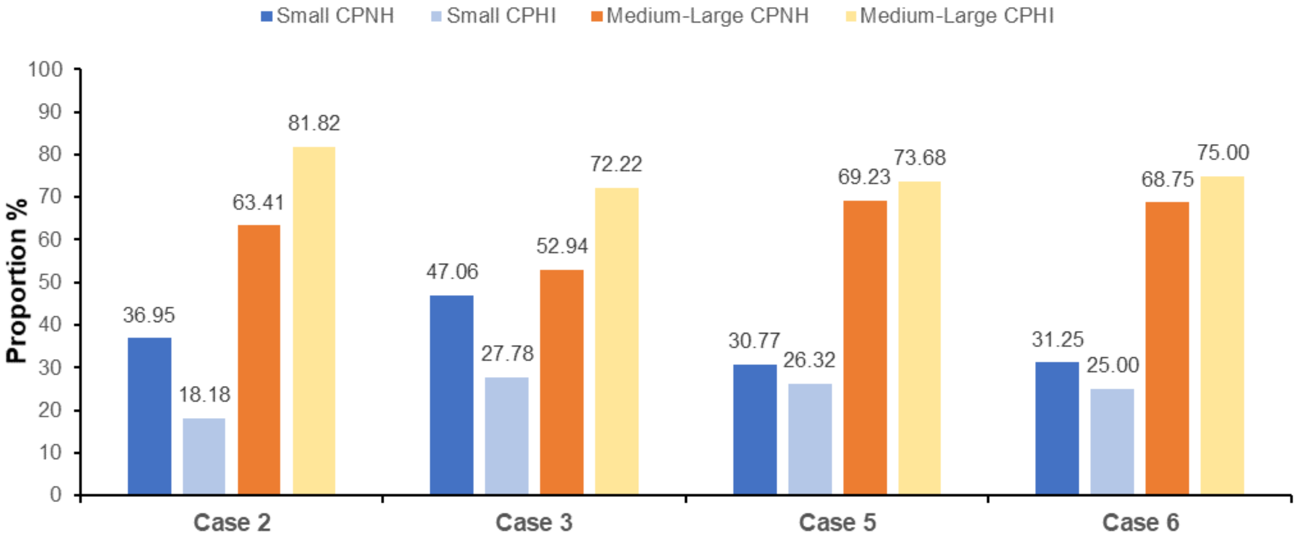
3 PCP6: there's a um: (0.3) a sheep that's (0.2) tethered to the string (.) so he goes out everyday
4 PCP6: and he pats this sheep its like it's his pet (0.6)

PCP6: **1** Le: P Le-C -CC Ri: Rest **2** Le: Hold Ri: CC- C Lo- CC-C Le **3** Le: C Le- CC -r Ri: C Le-CC- P Fr- CC
Size

Note. 1 is categorised as a medium size gesture. 2 & 3 are categorised as large gestures

Figure 5.9

Proportions of Small and Medium-Large Imagistic Gestures in Narratives (Na) With CPHI and CPNH in Quiet



Note. Results shown are based on the two-category size analysis.

5.2.4 Gaze Direction

Imagistic gestures were categorised and analysed in terms of PCP's gaze direction during their own gesture production. The research questions addressed in this section are:

1.4.(a) Where do PCPs as speakers direct their gaze during their imagistic gesture production?

1.4.(b) Do PCP speaker gaze direction patterns during imagistic gesture production differ between interactions with CPHI and interactions with CPNH?

As described in Section 3.6.4, each gesture was assigned to one of three primary categories: gaze at the gesture; gaze at the CP and gaze away from CP (at some other point in the room or space). Gaze at gesture included: (a) gestures at which gaze was directed during the stroke phase and (b) gestures at which gaze was directed during the preparation phase but that moved to the listener (CPHN or CPHI) during the stroke performance. Proportions by gaze direction of the total number of imagistic gestures were calculated and are presented in Table 5.5. Results obtained in the quiet samples are highlighted to distinguish them from results obtained during the noise samples.

The results indicate that PCPs' gaze was most frequently directed at the listener with both the CPNH and the CPHI during imagistic gesture production. In some interactions the PCP gaze was directed at the listener (CPNH or CPHI) for 100% of gestures.

Table 5.5

Gaze Direction by Proportion (%) of Total Imagistic Gestures in Conversation (C) and Narrative (Na) with CPNH (NH) and CPHI (HI) in Quiet (Q) and in Noise (N)

Case		2				3				4				5				6				7			
Task		C		Na		C		Na		C		Na		C		Na		C		Na		C		Na	
Gaze	% (n)	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI
Ge on stroke	Q	11.11 (1)	0.00	34.15 (14)	13.64 (3)	0.00	15.00 (3)	23.53 (4)	27.78 (5)	0.00	4.76 (1)	23.53 (4)	10.00 (1)	7.69 (1)	16.67 (1)	23.08 (6)	15.79 (3)	6.90 (2)	11.11 (1)	0.00	25.00 (4)	50.00 (1)	0.00	50.00 (3)	57.14 (4)
	N	40.00 (2)	6.25 (1)	-	-	16.67 (1)	0.00	22.22 (4)	27.27 (6)	0.00	0.00	13.64 (3)	6.25 (1)	3.85 (1)	0.00	16.67 (5)	10.34 (3)	5.88 (1)	.000	8.33 (2)	4.17 (1)	25.00 (2)	20.00 (3)	37.50 (3)	28.57 (2)
Ge on prep	Q	0.00	0.00	2.44 (1)	9.09 (2)	0.00	5.00 (1)	0.00	11.11 (2)	0.00	4.76 (1)	0.00	10.00 (1)	0.00	0.00	3.85 (1)	0.00	10.34 (3)	11.11 (1)	0.00	0.00	0.00	0.00	0.00	0.00
	N	0.00	0.00	-	-	0.00	9.09 (2)	0.00	0.00	0.00	0.00	0.00	12.50 (2)	0.00	0.00	6.67 (2)	3.45 (1)	23.53 (4)	0.00	4.17 (1)	8.33 (2)	0.00	0.00	0.00	14.29 (1)
At Ge total	**Q**	**11.11 (1)**	**0.00**	**36.59 (15)**	**22.73 (5)**	**0.00**	**20.00 (4)**	**23.53 (4)**	**38.89 (7)**	**0.00**	**9.52 (2)**	**23.53 (4)**	**20.00 (2)**	**7.69 (1)**	**16.67 (1)**	**26.92 (7)**	**15.79 (3)**	**17.24 (5)**	**22.22 (2)**	**0.00**	**25.00 (4)**	**50.00 (1)**	**0.00**	**50.00 (3)**	**57.14 (4)**
	N	40.00 (2)	6.25 (1)	-	-	16.27 (1)	9.09 (2)	22.22 (4)	27.27 (5)	0.00	0.00	13.64 (3)	18.75 (3)	3.85 (1)	0.00	23.33 (7)	13.79 (4)	29.41 (5)	0.00	12.50 (3)	12.50 (3)	25.00 (2)	20.00 (3)	37.50 (3)	42.86 (3)
Away	**Q**	**22.22 (2)**	**0.00**	**24.39 (10)**	**0.00**	**33.33 (2)**	**10.00 (2)**	**17.65 (3)**	**0.00**	**0.00**	**9.52 (2)**	**17.65 (3)**	**30.00 (3)**	**0.00**	**0.00**	**19.23 (5)**	**0.00**	**3.45 (1)**	**0.00**	**0.00**	**6.25 (1)**	**50.0 (1)**	**0.00**	**0.00**	**0.00**
	N	20.00 (1)	0.00	-	-	0.00	9.09 (2)	5.56 (1)	4.55 (1)	0.00	0.00	13.64 (3)	0.00	0.00	0.00	3.33 (1)	13.79 (4)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29 (1)
At CP	**Q**	**66.67 (6)**	**100 (3)**	**39.02 (16)**	**77.27 (17)**	**66.67 (4)**	**70.00 (14)**	**58.82 (10)**	**61.11 (11)**	**100 (3)**	**80.95 (17)**	**58.82 (10)**	**50.00 (5)**	**92.31 (12)**	**83.33 (5)**	**53.85 (14)**	**84.21 (16)**	**79.31 (23)**	**77.78 (7)**	**100 (16)**	**68.75 (11)**	**0.00**	**100 (3)**	**50.00 (3)**	**42.86 (3)**
	N	40.00 (2)	93.75 (15)	-	-	83.33 (5)	81.82 (18)	72.22 (13)	68.18 (15)	100 (11)	100 (8)	72.73 (16)	81.25 (13)	96.15 (25)	100 (15)	73.33 (22)	72.41 (21)	70.59 (12)	100 (4)	87.50 (21)	87.50 (21)	75.00 (6)	80.00 (12)	62.50 (5)	42.86 (3)

Note. Highlighted rows show the results for the quiet samples. Ge = gesture; CP = communication partner.

In conversation with the CPNH the proportion of gestures in the gaze at CP category ranged from 50.00% (Case 7) to 100% (Case 4) and in narrative from 39.02% (Case 2) to 100% (Case 6). In conversation with the CPHI the proportion of gestures in the gaze at CP category ranged from 42.86% (Case 7) to 100% (Case 2) and in narrative from 42.86% (Case 7) to 84.21% (Case 5).

5.2.4.1 ***Speaker Gaze Direction with CPHI versus CPNH as Listeners***

Gaze direction by PCPs during gesture production was analysed in terms of comparisons between listeners by focusing on cases in which the number of imagistic gestures was higher with both the CPHI and the CPNH. Thus, as seen in the gesture size analysis, Case 2, Case 3, Case 5, and Case 6 narratives were selected for the analysis. The findings are described below (see also Table 5.5). In each of these cases the category with the largest proportion by gaze direction was gaze at CP. The remaining interactions Cases 2–7 conversations and Case 4 and Case 7 narratives are not discussed here due to the low gesture numbers produced by the PCP with either the CPHN and/or the CPHI.

Case 2: Forty-one imagistic gestures were produced by PCP2 with their CPNH and 22 with their CPHI. There were approximately equal proportions of gestures produced across the three gaze categories with the CPNH. The highest proportion by gaze direction by a small margin was in the gaze at CP category (39.02%). The highest proportion (77.25%) was gaze at CP, followed by gaze at gesture (22.73%) with the CPHI. There were no gaze-away gestures produced by PCP2 with the CPHI and 10 (24.39%) with the CPNH.

Case 3: Seventeen imagistic gestures were produced by PCP3 with their CPNH and 18 with their CPHI. The highest proportion by gaze direction was gaze at CP with the CPNH (58.82%) and with the CPHI (61.11%). This was followed by gaze at gesture with a higher proportion with the CPHI (38.89%) than with the CPNH (23.53%). There were no gestures gaze-away gestures produced by PCP3 with their CPHI and three (17.65%) with their CPNH.

Case 5: Twenty-six imagistic gestures were produced by PCP5 with their CPNH and 19 with their CPHI. The highest proportion by gaze direction was gaze at CP with the CPHN (53.85%) and with the CPHI (84.21%; 16/19). This was followed by gaze at gesture with a higher proportion of gestures with the CPNH (26.92%) than with the CPHI (15.79%). There were no gaze-away gestures produced by PCP5 with their CPHI and five (19.23%) with their CPNH.

Case 6: Sixteen imagistic gestures were produced by PCP6 with their CPNH and their CPHI. The highest proportion by gaze direction was gaze at CP gestures with the CPNH (100%) and with the CPHI (68.75%) followed by gaze at gesture (25.00%). There were no gestures in the gaze away category with the CPHN and one gesture with the CPHI.

Overall, as illustrated in Figure 5.10, these results suggest that PCPs are frequently gazing at their CPNH or their CPHI when producing imagistic gestures rather than directing their gaze at their own gestures or away in another direction. Furthermore, in the narratives analysed here, PCPs directed gaze to the listener for a higher proportion of imagistic gestures with their CPHI than their CPNH in three cases (Case 2 and Case 5; Case 3 with minimal difference) and in two cases (Case 2 and Case 5) directed gaze at their own gestures or away (at another point in space or in the room) for a lower proportion of imagistic gestures with their CPHI than their CPNH.

Figure 5.10

Gaze Direction by Proportion (%) of Total Imagistic Gestures in Narratives) With CPHI and CPNH in Quiet

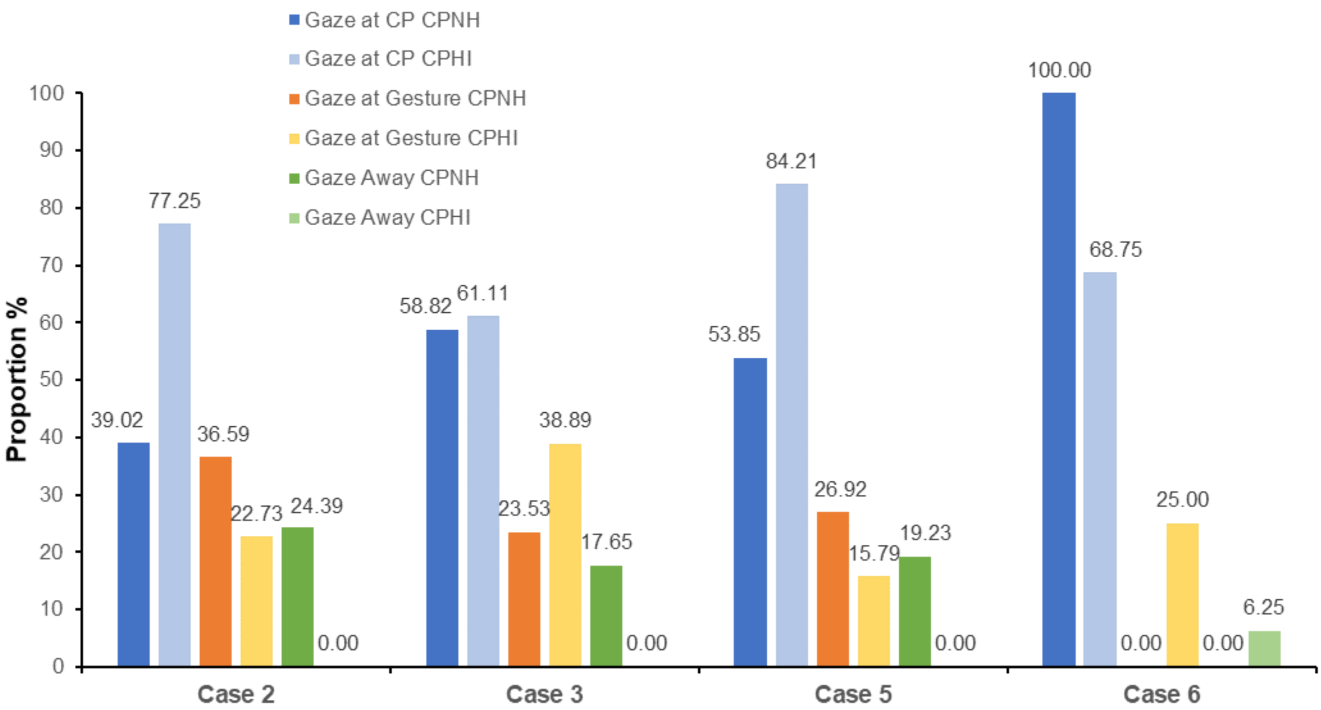
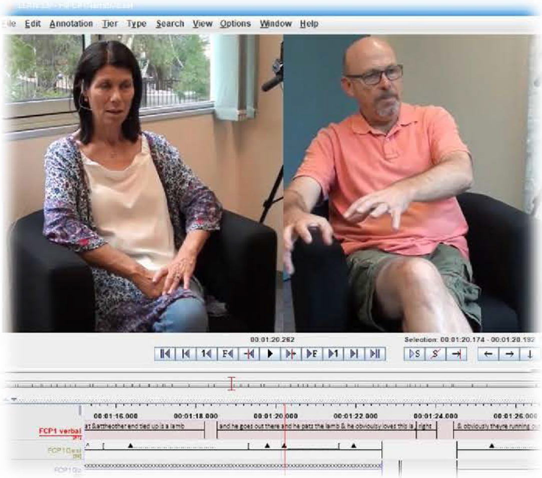
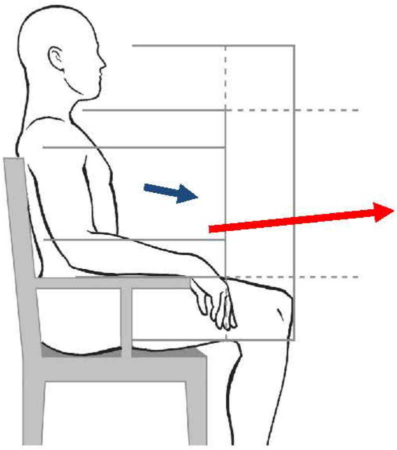


Figure 5.11 provides an example taken from the Case 2 narration with the CPHI where PCP2 has his gaze almost continuously directed at his CPHI. In line 2, PCP2 directs gaze at the preparation and stroke phase of his gesture (represented by the series of stars). Following the stroke phase, he redirects his gaze to the CPHI where it remains constantly (represented by a line of crosses) as he continues the narration while producing two (iconic) gestures, which evoke the image of the blind boy's movements along a rope to find his pet lamb.

Figure 5.11

Example of Gaze Directed at CP During Gesture Production in Case 2 Narrative With the CPHI





1 PCP2: a:nd (0.4) the boy: (0.2) eh walks (0.3) out of the (.) door of the shed (.)
2 PCP2 and then there 's a (.) a li:ne (0.2) of sort of rope made of sheep's: wool

3 PCP2:(0.6) a big thing of wool &(0.3) he walks guides himself along that and at the OTHER end (0.4) tied up is a LAMB
Ge { [▲ { [▲.........^ { [▲.......................
Gz ,,,*****,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

4 PCP2: and he goes out there and he pats the lamb [and he ob]viously loves this lamb =
5 CPHI: =hh Aaw

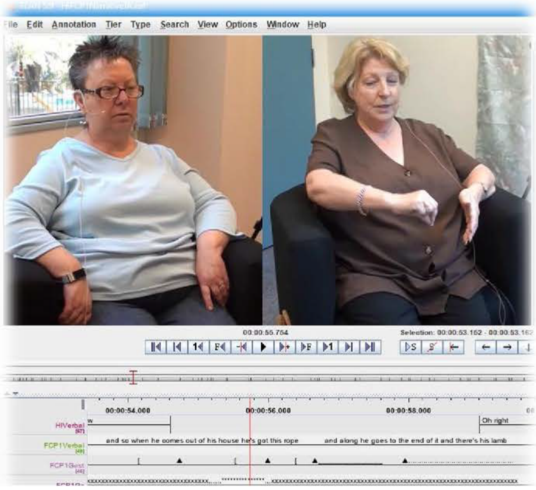
In contrast to Case Study 1, there were only a few instances in which gaze was directed at the preparation phase of the gesture. When gaze was directed at the preparation phase, it was observed that PCP's gaze frequently moved toward the listener (CPHI or CPNH) during the stroke phase. It appears that when gaze is directed at a gesture that speaker gaze will typically return to the CP rather than remain on the gesture or gesture hold. Figure 5.12 and Figure 5.13 provide examples from the Case 3 narratives with the CPHI and the CPNH.

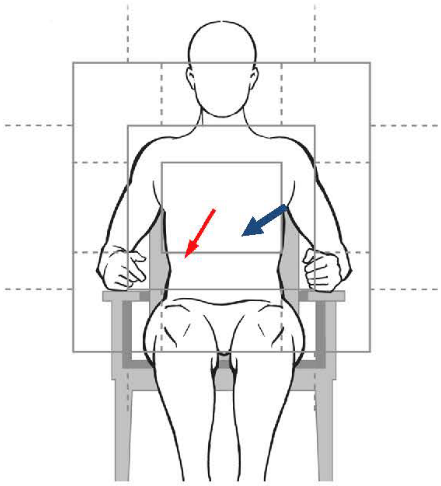
Figure 5.12 provides an example of gaze directed at the gesture preparation from the Case 3 narrative with the CPHI. In line 4, PCP4's talk refers to the blind boy coming out of the house to hold the rope (which leads to his pet lamb). Her right hand is clasped, and her arm moves from centre-centre into the extreme periphery front evoking the image of a long rope. Her gaze is directed at her hands (represented by the line of stars) from the beginning of the preparation phase until the peak of the stroke when she redirects her gaze to the CPHI (represented by a line of crosses).

Figure 5.13 provides another example of gaze directed at the gesture preparation phase from the Case 3 narrative with the CPHI. In line 3, PCP3's talk refers to a "plate". She uses both hands to depict a circular object which evokes the image of a plate. Her gaze is directed at her hands (represented by the line of stars) during the preparation and stroke phases before moving to her CPNH during a gesture hold. She maintains the gesture hold with her gaze directed at her CPNH (represented by a line of crosses) as she completes her utterance.

Figure 5.12

Example of Gaze at the Gesture Preparation Phase and Redirection to the CPHI on the Stroke in Case 3 Narrative With the CPHI





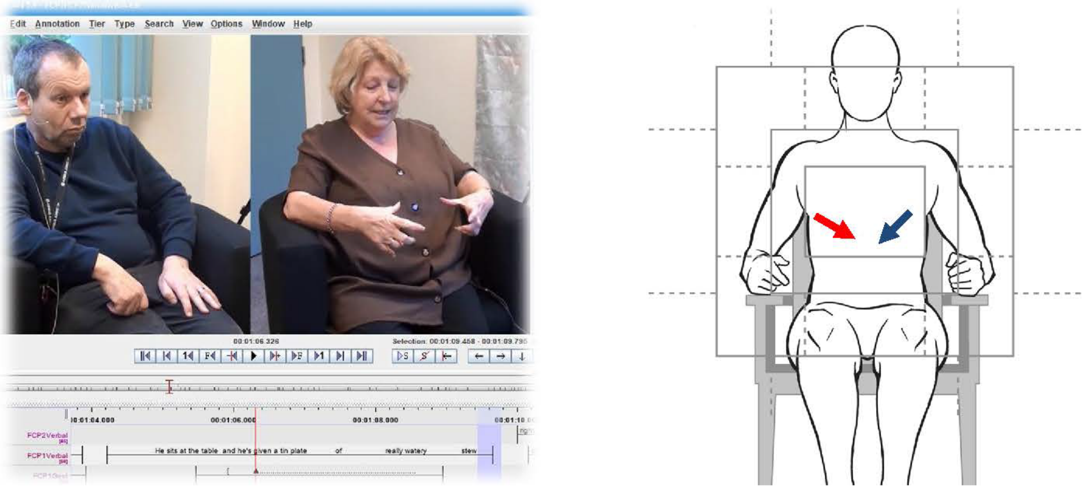
1 PCP3: and he cuddled the lamb¿(0.3) an::d (.) you↑ thought for a moment he'd been reeling this lamb in =
2 PCP3: but then you realise (0.3) that he's actually BLIND the little b[oy]
3 CPHI: ↑ O[h:::]

```
4 PCP3:  [and so wh]en he comes out of his house he's got this rope (0.4)
   Ge    {                  [               ▲            {      [          ▲
   Gz    xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx,,,,,,************,,,xxxxx

  CPHI:  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
   Gz
```

5 PCP3: and along he goes to the end of it and there's his lamb=
6 CPHI: =Oh right

Figure 5.13

Example of Gaze at the Gesture Preparation Phase and Redirection to the CPHI During a Post-Stroke Hold in Case 3 Narrative With the CPHI



1 PCP3: and things obviously aren't good¿ (0.4) a::nd (0.3) so:: (0.9)
2 PCP3: he goes out he CUDDLES the lamb he COMES back in (0.8)

3 PCP3: he sits at the table and he's given a tin plate of (0.4) really watery (.) stew =
Ge { [▲...}
Gz ----------------------,,,,**********************,,,,,,,,,,xxxxxxxxxxxxxxxxxxxxxx

CPNH: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

4 CPNH:= [right]
5 PCP3: [with which] he has a FORK to eat

5.3 Discussion

Quantitative data and qualitative commentary were presented in this chapter regarding the patterns of gestures in the conversation task and narrative task conducted in quiet conditions. The specific aim was to investigate the effect of the hearing status of the listeners in the two conversational activities on the gesture production of the normally hearing PCPs.

The results presented in this chapter showed considerable variation in the frequency of gesture produced by participants. Gestures were found to occur more frequently in conversation with the CPHI than with the CPNH in some cases. Overall, gesture rates in narrative were higher than in conversation and were similar with the CPHI and the CPNH across all cases while imagistic gesture rates were similar for all but one case.

Experimental investigations using referential communication or narrative tasks have used gesture rates per 100 words to compare across conditions. However, authors frequently do not report the mean or range of gesture rates. Exceptions include Jacobs and Garnham (2007) who in their analysis of comic strip narrations found overall mean gesture rates of 2.5 to 7.5 gestures per 100 words. During a referential communication task Hoetjes, Krahmer, et al. (2015) reported mean rates of four to five gestures per 100 words and Hoetjes, Koolen, et al. (2015) reported a mean rate of 4.9 (95% confidence intervals 3.986-5.870). It is difficult, however, to compare gesture rates across studies, including the present study due to differences in study tasks and in the content of dialogues and language spoken.

The full range of gesture types iconic, metaphoric deictic abstract and concrete, interactive, emblems and beats was observed across the participants although emblems and deictic concrete gestures were infrequent or absent across interactions. The most frequently occurring gesture types were imagistic and interactive gestures. In most cases imagistic gestures made up the highest proportion of gestures by type. The expectation was that a higher proportion of imagistic gestures providing semantic information would be produced by PCPs with their CPHI than with their CPNH. However, no substantial differences were observed between proportions of imagistic gestures produced with the CPHI and the CPNH. It appears that the presence of a HI did not have a detectable impact on the balance of gesture types produced by the (PCP) participants. This may be because the nature and requirements of the task exerted greater influence on gesture type than the hearing status of the listener.

As discussed previously, gesture size has been explored in only a few experimental studies (Beattie & Shovelton, 2005; Campisi & Özyürek, 2013; Holler & Wilkin, 2011; Hostetter et al., 2011; Tellier et al., 2021). Changes in gesture size suggest that gestures may increase as a marker of audience design for some listeners. Hence, the current investigation sought to determine whether the presence of HI would lead to an increase in gesture size. The presumption was that a larger gesture could potentially provide more pronounced semantic information for the listener and thereby enhance communication.

The proportion of large gestures (when more than three gesture space borders were crossed) produced by PCPs with their CPHI was not substantially higher than that produced with their CPNH. However, in a number of cases, a lower proportion of gestures within a single gesture space division were produced by PCPs with their CPHI in favour of gestures crossing one or more borders. This suggests that only some individuals may implement modifications in the size of their imagistic gestures when speaking with their CPHI.

The final questions addressed in this chapter was determining where PCPs directed their gaze during gesture production, and whether patterns may differ when communicating with their CPHI. The analysis showed that the predominant gaze direction in all interactions was toward the CP during imagistic gesture production regardless of whether the PCPs interacted with their CPNH or their CPHI. In two of the cases analysed, PCPs directed gaze to their gestures while speaking with their CPHI for a lower proportion of imagistic gestures than with their CPNH.

Previous investigations suggest that speakers will frequently direct gaze at their own gestures to highlight the importance of the information provided by a gesture. Streeck (1993) observed that the gestures looked at in this way tend to contribute semantic detail to the talk and thus are typically imagistic or deictic gestures rather than interactive gestures.

The current findings show that only a low proportion of imagistic gesture involved speaker gaze at their own gesture and a lower proportion tended to be produced by PCPs with their CPHI than their CPNH. These findings align with previous research which indicates that CPs will consistently monitor their CPHI directing gaze toward them while conversing (Skelt, 2006, 2010). This is one possible explanation for the current findings, that even when producing gesture, PCPs frequently continued to observe their CPHI. It may be hypothesised that they did so to check signs of mishearing or difficulty hearing (Ekberg et al., 2016). Streeck (1993) also reported that when a speaker directs their gaze at their own gesture, following the associated key spoken word/s, their gaze will frequently shift to the listener (Streeck,1993). There is evidence of this pattern in the gaze at gesture categories in the current findings.

Overall, the findings presented in this chapter do not provide strong evidence that the listener's HI is associated with an adjustment of gesture production or gesture form. As discussed earlier, the samples used in the analysis were taken from conversational activities with participants sitting face to face in a quiet room designed to simulate everyday communication contexts. The samples of conversations and narratives flowed well and there were few misunderstandings, mis-hearings or requests for clarification on the part of either the CPNH or the CPHI.

Everyday listening situations in home or other environments will frequently include the presence of background noise. In these situations (which may include the babble of several people talking at once) individuals with HI will report that they frequently experience a decrease in speech perception (Picou et al., 2013). This may lead to an increased risk of misunderstandings and breakdowns in communication requiring repair. Hence the second phase of this investigation introduced periods of background noise during the (Cases 2–7) interactions to determine if demanding listening conditions would influence the gesture production and gaze direction of PCPs with their CPHI and/or their CPNH. The results regarding the effect of additional of background noise on gesture production of the PCPs with their CPHI and their CPNH will be presented in the next chapter.

6 THE EFFECT OF NOISE ON GESTURE PRODUCTION

This chapter presents the results regarding the effect of background noise on the production of gestures by PCPs in dyadic conversations in Cases 2–7. These findings follow on from the initial case study presented in Chapter 4 and the results of the case study series presented in Chapter 5. As discussed in Chapter 4, Case Study 1 interactions were conducted in a quiet environment. Results indicated that PCP1 did not alter the frequency of her gesturing nor other characteristics of either imagistic gesture size or gaze direction during gesture production. There were few indications that the CPHI experienced hearing difficulties in the quiet environment. The fact that these difficulties were not observed in this participant suggests that there may have been no perceived need for PCP1 to modify her gestures or use more gestures with the CPHI. Consequently, the method in subsequent interactions was modified to include background noise interspersed with quiet at fixed time intervals during each task. PCPs 2–7 participated in free conversations and narratives using the same method as implemented in Case Study 1 except that intermittent background noise was introduced.

Chapter 5 presented the analysis of gesture occurring during periods of quiet in recorded samples of interaction arising in Cases 2–7. Resulting insights into the effect of HI on gesture behaviours included that some individuals may increase the frequency or size of their gestures when interacting with a CP with HI. However, the results were varied, and they did not support a substantial effect of HI on gesture frequency, gesture type, gesture size or gaze direction across cases.

As discussed in Chapter 2, individuals with HI typically report experiencing greater listening challenges in the presence of background noise even while using hearing devices such as hearing aids or cochlear implants (Picou et al., 2013; Pryce & Gooberman-Hill, 2012). This may lead to a greater reliance on visual information to enhance comprehension of spoken messages (Tye-Murray et al., 2007). Research with normally hearing individuals provides evidence that the inclusion of gesture may increase the ability to comprehend speech in noise. Research efforts focused on changes in experimental task accuracy in challenging listening conditions with and without gesture have shown increased task accuracy with the addition of gesture in normal hearing individuals (Berger & Popelka, 1971; Riseborough, 1981). Rogers (1978) proposed that, as the listening environment becomes more demanding and the auditory signal becomes more difficult to access, visual information including gesture increases in importance.

Recent experimental studies support the notion that gestures enhance speech comprehension particularly in challenging listening conditions (Obermeier, et al., 2012). In addition, there is evidence that listeners obtain greater benefit from iconic gestures combined with visual speech cues than from either visual speech or gesture alone, when presented with degraded speech (Drijvers and Özyürek (2017). Furthermore, Trujillo et al (2021) demonstrated that speakers with normal hearing produced enhanced gestures in the presence of speaker babble while portraying single action verb meanings to a listener.

The current investigation sought to shed light on whether the presence of background noise may lead to changes in gesture production and audience design of gesture by a PCP with a CPHI or with a CPNH during everyday interactions. In the context of Cases 2–7 it was anticipated that the introduction of background noise would increase listening difficulty, particularly for the CPHI, and so increase the potential for misunderstandings and communication breakdowns. Based on the research findings described above and in Chapter 2, the question was posed whether PCPs would modify their gesture frequency and/or characteristics as a marker of audience design in the presence of background noise particularly when interacting with their CPHI.

The results presented in this chapter focus on the independent variable of background noise. More specifically, gesture patterns in the presence of background noise were analysed in terms of: (a) the frequency with which gestures occur, (b) the emic characteristics of gestures' function or meaning, (c) the etic or physical qualities of imagistic gestures' size, and (d) gaze direction during imagistic gesture production. This chapter presents both quantitative results and qualitative commentary with respect to gesture production during periods of background noise for PCPs (Cases 2–7) while conversing and narrating with their CPHI and their CPNH. The comparisons described in each individual case include (a) comparisons between interactions in the presence of noise with the CPHI versus the CPNH and (b) comparisons between interactions in quiet versus noise with the CPHI and with the CPNH.

To address the overarching research question, namely whether patterns of gesture change based on the hearing status of the CP, the specific research questions addressed in this chapter in reference to the gestures produced by PCPs 2–7 in the presence of background noise are:

2.1.(a) How frequently is gesture produced in the presence of background noise?

2.1.(b) Do gesture rates differ between interactions in background noise and in quiet with CPHI and/or with CPNH?

2.1.(c) Do gestures rates differ between interactions with CPHI and interactions with CPNH in the presence of background noise?

2.2.(a) Are some gesture types produced more frequently than others in the presence of background noise?

2.2.(b) Do the proportions of different gesture types differ between interactions with CPHI and interactions with CPNH in the presence of background noise?

2.2.(c) Do the proportions of different gesture types differ between interactions in background noise and quiet with CPHI and/or with CPNH?
2.3.(a) Does the size of imagistic gestures differ between quiet and noise with CPHN and /or with CPHI?
2.3.(b) Does the size of imagistic (iconic and metaphoric) gestures differ between interactions with CPHI and interactions with CPNH in the presence of background noise?
2.4.(a) Where do PCPs as speakers direct gaze during imagistic gesture production in the presence of background noise?
2.4.(b) Do gaze patterns during imagistic gesture production differ between quiet and noise with CPHN and /or with CPHI?
2.4.(c) Do gaze direction patterns during imagistic gesture production differ between interactions with CPHI versus interactions with CPNH in the presence of background noise?

The next section of this chapter provides a summary of the methodology and methods used in Cases 2–7. The results are presented in Section 6.2. The chapter concludes with a general discussion of the findings for the independent variable of background noise.

6.1 Method

6.1.1 Participants

The case study triads (Cases 2–7) comprised the same participants described in Chapter 5 (see Table 3.1, Section 5.2.1, and Appendix I). Each triad comprised a normally hearing participant (PCP2–7) and two familiar CPs, one with a HI (CPHI) and one with normal hearing (CPNH). The triad participants interacted in two dyads The first dyad consisted of the PCP and their CPHI and the second, PCP and their CPNH.

6.1.2 Procedure - Background Noise

The method in this chapter follows that described in Chapter 3 and adapted in Chapter 5. The recording of the conversation consisted of five minutes of quiet followed by five minutes of background noise (60dBA) then a further five minutes of quiet and a final five minutes of noise at a higher intensity (70dBA). Due to the shorter duration of the narrative two minutes of quiet was followed by two minutes of noise (60dBA) and a further two minutes of quiet then a final two minutes of noise at a higher intensity (70dBA). The background noise was an 8-speaker babble recording (see Section 3.4.2.6). For each recording the talk and gesture during the quiet and the loudest available period of noise was transcribed. Narrations were all completed within five minutes (see Appendix R). The relatively short duration meant that the first period with lower (i.e., 60dB) intensity noise was the only noise sample available. Consequently, the sample periods used for the analysis presented in this chapter consisted of (a) the second five-minute periods of quiet and noise during the free conversation task and (b) the first two-minute period of quiet followed by the first two-minute period of noise during the shorter narratives. In the conversation the second, louder period of conversation in noise was analysed. This increased the likelihood that the listening condition would be sufficiently challenging to have an impact on auditory speech comprehension and hence increase the potential need for the listeners to attend to visual cues.

6.1.3 Transcription and Analysis

Transcription and annotation of the noise segments were completed in the same manner as described in Chapter 3 and Chapter 5, following the coding and annotation guidelines (see Section 3.6). The focus of the analysis described in this chapter was the same as the preceding analyses of the characteristics of the PCPs' (2–7) gesture production. The analysis included gesture frequency, type, and imagistic gesture size and associated gaze direction during the portions of interaction occurring in noise and quiet, as summarised in the following sections.

6.1.3.1 Gesture Frequency

The number of gestures produced per 100 spoken words was calculated for the total gestures (excluding beats) and for imagistic (iconic and metaphoric) gestures produced in each sample period of noise for each conversation and narrative. The results are presented in Section 6.2.1.

6.1.3.2 Gesture Type

Apart from measuring overall gesture frequency, the frequency of different types of gesture used was also studied. Gestures were allocated into six categories, as described in the coding guidelines (see Section 3.6.2). Gesture types identified were iconic, metaphoric, deictic (abstract or concrete) (McNeill,1992), interactive (Bavelas, 1992), and emblems (Kendon, 2004). The first level of analysis was the total number of each type of gesture. Due to the considerable variation in total gesture numbers produced by PCPs, gesture type proportions of total gestures were calculated. The results are presented in Section 6.2.2.

The next sections of the chapter present the findings of the analysis of the emic or physical features of gesture size and of the gaze movements associated with the gestures. As discussed in previous chapters, a subset of gestures comprising imagistic gestures was used in the analysis of size and associated gaze direction in the presence of background noise.

6.1.3.3 Gesture Characteristics – Size

As described in previous chapters (see Section 3.5.4.2 & Section 3.6.3) an adapted version of the gesture space diagram (McNeill, 1992) was used to determine gesture size. Operationally, gesture size was identified as the number of gesture space borders crossed during gesture production. Gestures were categorized in two ways: (a) each gesture was assigned to one of three categories; small (i.e., no borders crossed), medium (i.e., one to two borders crossed), and large (i.e., more than three borders crossed) and (b) each gesture was assigned to one of two categories; small (i.e., no borders crossed) and medium-large (i.e., one or more border crossed). The proportion of the total number of imagistic gestures in each subcategory was calculated. The results are presented in Section 6.2.3.

6.1.3.4 Gaze Direction

As described in previous chapters (see Section 3.6.5 & Section 3.6.4), gaze direction of PCPs during imagistic gesture production in the presence of background noise was identified. Each gesture was assigned to one of three categories; gaze at the gesture; gaze at the CP and gaze away from CP (at some other point or object in space). Gaze at gesture included (a) gestures at which gaze was directed during the stroke phase and (b) gestures at which gaze was directed during the preparation phase but that moved to the listener (CPHN or CPHI) during the stroke performance. The proportion of the total number of gestures for each subcategory was calculated. The results are presented in Section 6.2.4.

6.2 Results

The research questions and results in this section refer to the gesture production of PCPs 2–7 when interacting with CPNH and with CPHI in the presence of background noise.

6.2.1 Gesture Frequency

The research questions addressed in this section are:

2.1.(a) How frequently is gesture produced?

2.1.(b) Do gesture rates differ between interactions in background noise and quiet with CPHI and/or with CPNH?

2.1.(c) Do gesture rates differ between interactions with CPHI and interactions with CPNH in the presence of background noise?

Table 6.1 shows the total gesture rates and imagistic gesture rates for PCPs 2–7 in conversation and narrative with the CPHI and the CPNH. The highlighted rows show the gesture rates in noise.

Table 6.1

Total Words, Gesture (G) Numbers and Total and Imagistic (IM) Gesture Rates in Conversation (C) and Narrative (Na) with CPNH (NH) and CPHI (HI) in Quiet (Q) and Noise (N)

Case		2				3				4				5				6				7			
	Task	C		Na		C		Na		C		Na		C		Na		C		Na		C		Na	
		NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI
Total words	Q	421	256	511	328	330	592	278	303	350	538	269	223	449	188	304	299	492	277	248	225	356	461	241	265
	N	344	325	-	-	412	515	277	351	394	377	273	234	379	352	339	277	298	250	263	234	353	466	194	202
Total G	Q	18	18	66	44	15	43	24	23	7	53	23	23	29	9	31	35	42	13	39	36	9	5	9	9
	N	10	34	-	-	12	52	28	27	32	23	32	34	37	26	53	49	31	13	43	38	15	34	11	11
Total G rate	Q	4.28	7.03	12.92	13.41	4.55	7.26	8.63	7.59	2.00	9.85	8.55	10.31	6.46	4.79	10.20	11.71	8.54	4.69	15.73	16.00	2.53	1.08	3.73	3.40
	N	**2.91**	**10.46**	**-**	**-**	**2.91**	**10.10**	**10.11**	**7.69**	**8.12**	**6.10**	**11.72**	**14.53**	**9.76**	**7.39**	**15.63**	**17.69**	**10.40**	**5.20**	**16.35**	**16.24**	**4.25**	**7.30**	**5.67**	**5.45**
Total IM	Q	9	3	41	22	6	20	17	18	3	21	17	10	13	6	26	19	28	9	16	17	2	3	6	7
	N	5	16	-	-	6	22	20	22	11	8	22	16	26	15	30	29	17	4	25	23	8	15	8	7
Total I M Rate	Q	2.14	1.17	8.02	6.71	1.82	3.38	6.12	5.94	0.86	3.90	6.32	4.48	2.90	3.19	8.55	6.35	5.69	3.25	6.45	7.56	0.56	0.65	2.49	2.64
	N	**1.45**	**4.92**	**-**	**-**	**1.46**	**4.27**	**7.22**	**6.27**	**2.79**	**2.12**	**8.06**	**6.84**	**6.86**	**4.26**	**8.85**	**10.47**	**5.70**	**1.60**	**9.51**	**9.83**	**2.27**	**3.22**	**4.12**	**3.47**

Note. Highlighted rows show the results for the noise samples

6.2.1.1 Gesture Rates in Conversation

As seen in Table 6.1, total gesture rates in conversations in noise with the CPNH ranged from 2.91 (Case 2 & 3) to 10.40 gestures per 100 words (Case 6) and with the CPHI from 5.20 (Case 6) to 10.46 gestures (Case 2). Imagistic gestures rates with the CPNH ranged from 1.45 (Case 2) to 6.86 gestures (Case 6) and with the CPHI from 1.60 (Case 6) to 4.92 gestures (Case 4).

6.2.1.2 Gesture Rates in Narrative

As seen in Table 6.1, total gesture rates in the narratives in noise with the CPNH ranged from 5.67 (Case 7) to 16.35 gestures per 100 words (Case 6) and with the CPHI from 5.45 (Case 7) to 17.69 gestures (Case 6). In Case 4, Case 5, and Case 6 total gesture rates were greater than 14.50. Imagistic gesture rates with the CPNH ranged from 4.12 (Case 7) to 9.51 gestures (Case 2) and with the CPHI from 3.47 (Case 7) to 10.47 (Case 5).

6.2.1.3 Gesture Rates in Quiet versus Noise

To investigate the effect of background noise on total and imagistic gesture rates, differences in rates in quiet versus noise were calculated for interactions with the CPHI and independently for interactions with the CPNH. The results are shown in Table 6.2.

Table 6.2

Differences in PCP Gesture Rates in Conversation (C) and Narrative (Na) Between Quiet (Q) and Noise (N) with CPNH and CPHI

Case		*2*		*3*		*4*		*5*		*6*		*7*	
	Task	C	Na	C	Na	C	Na	C	Na	C	Na	C	Na
CPNH Noise - Quiet		-1.37	-	-1.63	1.48	6.12	3.17	3.30	5.44	1.87	0.62	1.72	1.94
CPHI Noise - Quiet		3.43	-	2.83	0.10	-3.75	4.22	2.60	5.98	0.51	0.24	6.21	2.05

Note. Gesture rate differences were calculated by subtracting the rate in quiet from the rate in noise. A positive difference indicates that the gesture rate was higher in noise than in quiet. A negative difference indicates that the gesture rate was higher in quiet than in noise.

In conversation with the CPNH, gesture rates were higher in noise than quiet in Case 4, Case 5, Case 6, and Case 7. Differences between gesture rates in noise and quiet ranged from 1.72 (Case 7) to 6.12 gestures (Case 4). Case 2 and Case 3 showed slightly lower gesture rates in noise than in quiet. In narrative with the CPNH all gesture rates were higher in noise than in quiet. Differences ranged from a minimum of 0.62 (Case 6) (suggesting essentially no difference) to 5.44 gestures (Case 5).

In the conversations with the CPHI gesture rates were higher in noise than in quiet in Case 3, Case 5, Case 6, and Case 7. Differences between gesture rates ranged from a minimum of 0.51 (Case 6) (suggesting essentially no difference) to 6.21 gestures (Case 7). Case 4 showed a lower gesture rate in noise than quiet with a difference of 3.75 gestures. In the narratives with the CPHI gesture rates were higher in noise than quiet. Differences ranged from a minimum of 0.10 (Case 3) and 0.24 (Case 6) (suggesting essentially no difference) to 5.98 (Case 5) gestures.

6.2.1.4 Gesture Rates in Noise with CPHI versus CPNH as Listeners

To investigate the effect of background noise together with HI on the total and imagistic gesture rates, differences between PCP gesture rates with CPNH and CPHI were calculated. The results are shown in Table 6.3.

Table 6.3

Differences in Gesture Rates (G-rate) in Conversation (C) and Narrative (Na) Between CPHI and CPNH in Quiet (Q) and in Noise (N)

Case		2		3		4		5		6		7	
	Task	C	Na	C	Na	C	Na	C	Na	C	Na	C	Na
Total G-rate	**Q**	2.76	0.50	2.72	-1.04	7.85	1.76	-1.67	1.51	-3.84	0.27	-1.45	-0.30
	N	7.55	-	7.18	-2.42	-2.02	2.81	-2.38	2.06	-5.20	-0.11	3.05	-0.22
Imagistic G-rate	**Q**	-0.97	-1.32	1.56	-0.17	3.05	-1.84	0.30	-2.20	-2.44	1.10	0.09	0.15
	N	3.47	-	2.82	-0.95	-0.67	-1.22	-2.60	1.62	-4.10	0.32	0.95	-0.66

Note. Gesture rate differences were calculated by subtracting the CPNH rate from the CPHI rate. A positive difference indicates that the gesture rate was higher when the PCP was in interaction with the CPHI than with CPNH. A negative difference indicates that the gesture rate was higher when the PCP was in interaction with the CPNH than with CPHI. Highlighted rows show the results for the noise samples

Higher total gesture rates were found in conversation with the CPHI than with the CPNH in Case 2, Case 3, and Case 7. The differences in total gesture rates were 7.55 (Case 2) and 7.18 (Case 3). That is, PCP2 produced 7.55 and PCP3 produced 7.18 more gestures per 100 words when conversing with their CPHI than their CPNH in noise. This was followed by a gesture rate difference of 3.05 gestures (Case 7). By contrast, in Cases 4, Case 5, and Case 6 lower rates were found with the CPHI than the CPNH (range 2.02–5.20) The largest difference in rate was 5.20

(Case 6) indicating that PCP6 produced 5.20 more gestures per 100 words when conversing with their CPNH than with their CPHI.

Imagistic gesture rate differences in the conversation task mirrored the earlier results. The largest differences in rates were 3.47 (Case 2) and 2.82 gestures (Case 3). This was followed by a gesture rate difference of 0.95 gestures (Case 7). By contrast, differences for Cases 4, Case 5, and Case 6 were in the opposite direction, showing lower rates with the CPHI than the CPNH (range 0.67–4.10).

In narrative the total gesture rate differences were 0.11 (Case 6) and 0.22 (Case 7) suggesting that PCP6 and PCP7's gesture rates did not differ with their respective CPNH versus CPHI. The largest differences in rates were 2.81 (Case 4) and 2.06 (Case 5). That is PCP4 produced 2.81 and PCP5 2.06 more gestures per 100 words with their respective CPHI than CPNH. By contrast, the difference for Case 3 was in the opposite direction, indicating that PCP3 produced gestures at a higher rate by 2.42 gestures with the CPNH. Imagistic gesture rate differences were less than or close to 1.00 in Case 3, Case 4, Case 6, and Case 7, suggesting minimal or no change in gesture rates in narrative with the CPHI and the CPNH.

As illustrated in Figures 6.1 and 6.2, these results in relation to gesture frequency indicate that noise had an impact on the PCPs' gesture rates in conversation and in narrative with both the CPNH and the CPHI. However, comparison of gesture rates in noise between the CPHI and the CPNH suggested that in the majority of interactions the presence of background noise had little or no differential impact on the gesture production of PCPs in terms of the hearing status of the listener.

6.2.2 Gesture Type Frequency

The research questions addressed in this section are

2.2.(a) Are some gesture types produced more frequently than others in the presence of background noise?

2.2.(b) Do the proportions of different gesture types differ between interactions in background noise and quiet with CPHI and/or with CPNH?

2.2.(c) Do proportions of different gesture types differ between interactions with CPHI and interactions with CPNH in the presence of background noise?

Figure 6.1

Gesture Rates in Conversation in Quiet and Noise with CPNH and CPHI

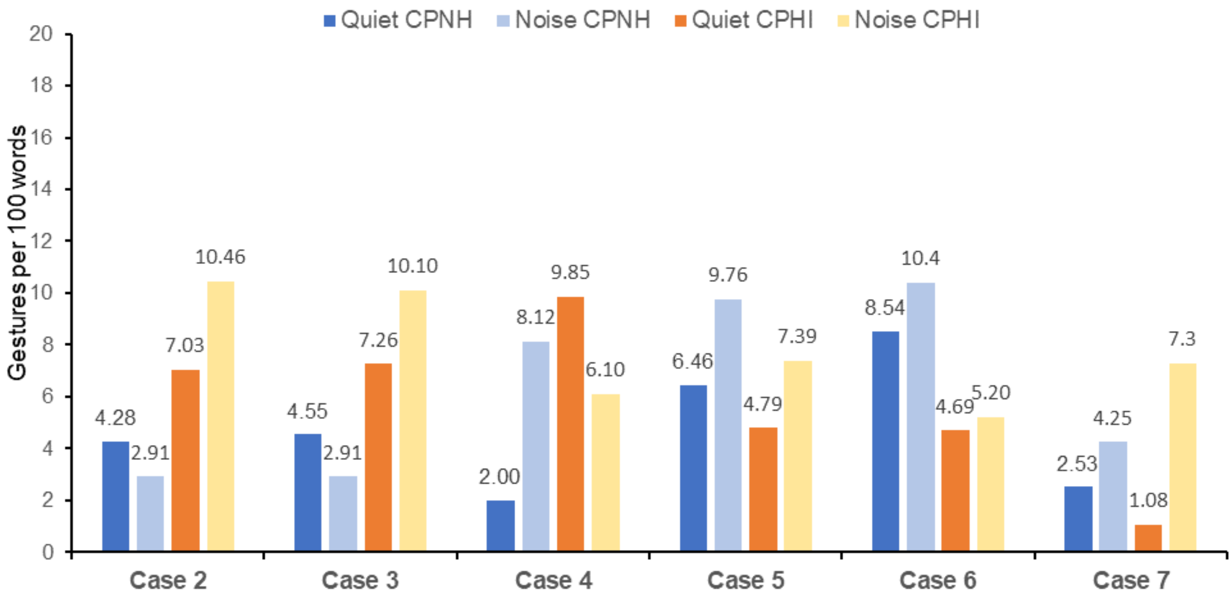
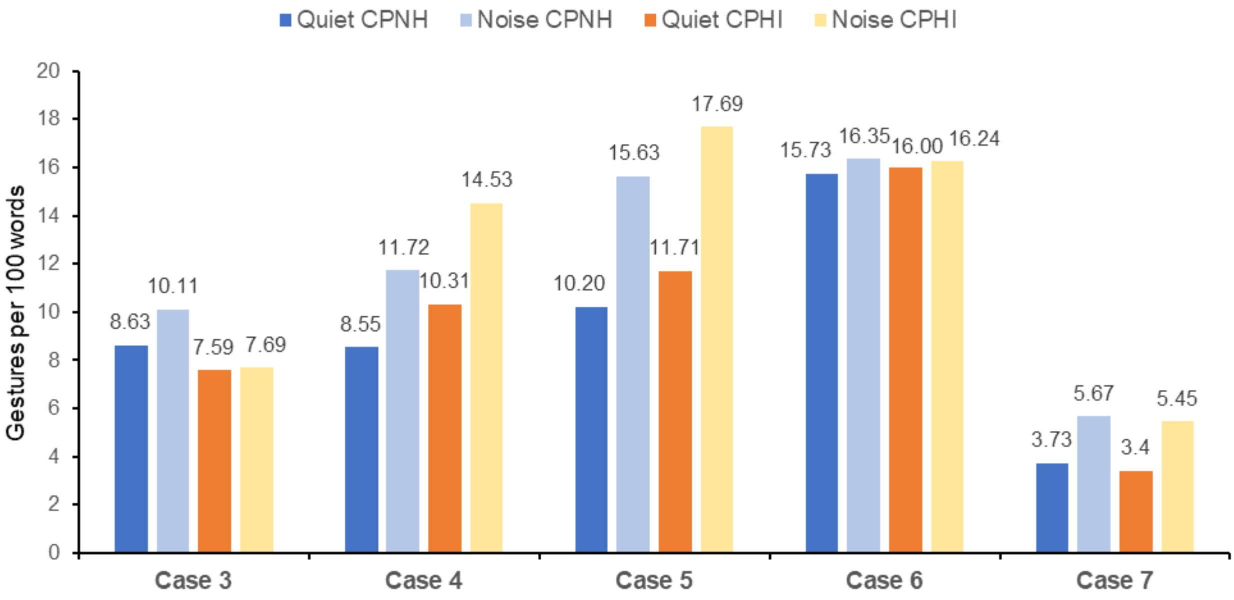


Figure 6.2

Gesture Rates in Narrative in Quiet and Noise With CPNH and CPHI



A gesture type proportion of total gestures (excluding beats) was calculated for each of the six categories (iconic, metaphoric, deictic abstract, deictic concrete, interactive, and emblems) and for imagistic gestures (iconic and metaphoric combined). The results are presented in Table 6.4. The highlighted rows show the proportions by gesture type for PCPs 2–7 in the noise samples to distinguish them from the results obtained during the quiet samples.

The findings are very similar to those comparing frequency of different gesture types in quiet, outlined in Chapter 5. As seen in Table 6.4, all gesture categories including iconic, metaphoric, deictic abstract, deictic concrete, interactive, and emblems were represented. The highest proportion of gestures by type was imagistic gestures followed by interactive gestures in most interactions with both the CPNH and the CPHI. Iconic gestures were again typically the predominant imagistic type produced by PCPs, with relatively low proportions of metaphoric gestures. Proportions of imagistic gestures ranged from 42.31% (Case 3 conversation) to 81.48% (Case 3 narrative) with the CPHI and from 50.00% (Case 2 & Case 3 conversation) to 72.73% (Case 7 narrative) with the CPNH. The Case 4 conversations were an exception with the proportion of interactive gestures with both the CPNH (50.00%) and the CPHI (56.52%) higher than the proportion of imagistic gestures (34.38% & 34.78% respectively). The Case 6 conversation with the CPHI was also an exception given the higher proportion of interactive gestures (53.85%) followed by imagistic gestures (30.77%). However, it should be noted that this conversation involved only 13 gestures overall.

Imagistic gestures and interactive gestures were the predominant gesture types in interactions with both the CPHI and the CPNH. The next stage of the analysis therefore focused on imagistic and interactive gestures.

6.2.2.1 Gesture Type: Quiet versus Noise with CPNH as Listener

Proportions of imagistic gestures produced by PCPs differed in quiet versus noise samples with the CPNH by less than +/-12% in Case 2, Case 3, Case 4, and Case 6 conversations and in Cases 3, Case 4, and Case 7 narratives while proportions of interactive gestures differed by less than +/-10%. In the Case 6 narrative, the Case 5 conversation and narrative, and the Case 7 conversation larger differences in gesture type proportions in quiet versus in noise were found (see Table 6.4).

In Case 6 the proportion of imagistic gestures was higher when PCP6 narrated in noise (58.14%) than in quiet (41.03%), and the proportions of interactive and deictic gestures were lower in noise (32.57% & 9.30%) than in quiet (41.03% & 17.95%).

Table 6.4

Gesture Type Numbers and Proportions in Conversation (C) and Narrative (Na) With CPNH (NH) and CPHI (HI) in Quiet (Q) and in Noise (N)

Case		2				3				4				5				6				7			
Task		C		Na [g]		C		Na		C		Na		C		Na		C		Na		C		Na	
		NH % (*n*)	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI
Iconic	Q	16.67 (3)	11.11 (2)	56.06 (19)	43.18 (37)	20.00 (3)	39.53 (17)	66.67 (16)	73.91 (17)	28.57 (2)	22.64 (12)	73.91 (17)	39.13 (9)	13.79 (4)	44.44 (4)	51.61 (16)	48.57 (17)	59.52 (25)	53.85 (7)	30.77 (12)	41.67 (15)	11.11 (1)	60.00 (3)	66.67 (6)	66.67 (6)
	N	50.00 (5)	47.06 (16)	-	-	25.00 (3)	30.77 (16)	64.29 (18)	70.37 (19)	6.25 (2)	13.04 (3)	56.25(18)	47.06 (16)	56.76 (21)	46.15 (12)	47.17 (25)	51.02 (25)	48.39 (15)	7.69 (1)	41.86 (18)	39.47 (15)	40.00 (6)	41.18 (14)	72.73 (8)	63.64 (7)
Meta [a]	Q	33.33 (6)	5.56 (1)	6.06 (4)	6.82 (3)	20.00 (3)	6.98 (3)	4.17 (1)	4.35 (1)	14.29 (1)	16.98 (9)	0.00	4.35 (1)	31.03 (9)	22.22 (2)	32.26 (10)	5.71 (2)	7.14 (3)	15.38 (2)	10.26 (4)	5.56 (2)	11.11 (1)	0.00	0.00	11.11 (1)
	N	0.00	0.00	-	-	25.00 (3)	11.54 (6)	7.14 (2)	11.11 (3)	28.13 (9)	21.74 (5)	12.50 (4)	0.00	13.51 (5)	11.54 (3)	9.43 (5)	8.16 (4)	6.45 (2)	23.08 (3)	16.28 (7)	21.05 (8)	13.33 (2)	2.94 (1)	0.00	0.00
Total IM [b]	Q	50.00 (9)	16.67 (3)	62.12 (41)	50.00 (22)	40.00 (6)	46.51 (20)	70.83 (17)	78.26 (18)	42.86 (3)	39.62 (21)	73.91 (17)	43.48 (10)	44.83 (13)	66.67 (6)	83.87 (26)	54.29 (19)	66.67 (28)	69.23 (9)	41.03 (16)	47.22 (17)	22.22 (2)	60.00 (3)	66.67 (6)	77.78 (7)
	N	**50.00 (5)**	**47.06 (16)**	**-**	**-**	**50.00 (6)**	**42.31 (22)**	**71.43 (20)**	**81.48 (22)**	**34.38 (11)**	**34.78 (8)**	**68.75 (22)**	**47.06 (16)**	**70.27 (26)**	**57.69 (15)**	**56.60 (30)**	**59.18 (29)**	**54.84 (17)**	**30.77 (4)**	**58.14 (25)**	**60.53 (23)**	**53.33 (8)**	**44.12 (15)**	**72.73 (8)**	**63.64 (7)**
Deictic Ab [c]	Q	0.00	11.11 (2)	7.58 (5)	9.09 (4)	20.00 (3)	13.95 (6)	8.33 (2)	8.70 (2)	0.00	15.09 (8)	13.04 (3)	26.09 (6)	3.45 (1)	11.11 (1)	3.24 (1)	14.29 (5)	9.52 (4)	0.00	17.95 (7)	8.33 (3)	22.22 (2)	20.00 (1)	33.33 (3)	22.22 (2)
	N	0.00	2.94 (1)	-	-	25.00 (3)	15.38 (8)	10.71 (3)	0.00	12.50 (4)	0.00	12.50 (4)	8.82 (3)	8.11 (3)	19.23 (5)	5.66 (3)	2.04 (1)	16.13 (5)	0.00	9.30 (4)	10.53 (4)	13.33 (2)	17.65 (6)	18.18 (2)	9.09 (1)
Deictic C [d]	Q	0.00	11.11 (2)	0.00	0.00	6.67 (1)	2.33 (1)	0.00	0.00	0.00	0.00	0.00	0.00	6.90 (2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N	10.00 (1)	5.88 (2)	-	-	0.00	1.92 (1)	3.57 (1)	3.70 (1)	0.00	4.35 (1)	3.13 (1)	0.00	0.00	0.00	0.00	4.08 (2)	0.00	15.38 (2)	0.00	0.00	0.00	5.88 (2)	0.00	0.00
	Q	44.44 (8)	61.11 (11)	30.30 (20)	40.91 (18)	26.67 (4)	37.21 (16)	20.83 (5)	8.70 (2)	57.14 (4)	43.40 (23)	13.04 (3)	26.09 (6)	41.38 (12)	22.22 (2)	12.90 (4)	28.57 (10)	23.81 (10)	30.77 (4)	41.03 (16)	44.44 (16)	55.56 (5)	20.00 (1)	0.00	0.00

Case		2				3				4				5				6				7			
Task		C		Na [g]		C		Na		C		Na		C		Na		C		Na		C		Na	
		NH % (*n*)	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI
Inter [e]																									
	N	**40.00 (4)**	**41.18 (14)**	**-**	**-**	**25.00 (3)**	**40.38 (21)**	**14.29 (4)**	**14.81 (4)**	**50.00 (16)**	**56.52 (13)**	**15.63 (5)**	**41.18 (14)**	**18.92 (7)**	**23.08 (6)**	**37.74 (20)**	**34.69 (17)**	**29.03 (9)**	**53.85 (7)**	**32.56 (14)**	**26.32 (10)**	**33.33 (5)**	**32.35 (11)**	**9.09 (1)**	**27.27 (3)**
Embl [f]	Q	5.56 (1)	0.00	0.00	0.00	6.67 (1)	0.00	0.00	4.35 (1)	0.00	1.89 (1)	0.00	4.35 (1)	3.45 (1)	0.00	0.00	2.86 (1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N	0..00	2.94 (1)	-	-	0.00	0.00	0.00	0.00	3.13 (1)	4.35 (1)	0.00	2.94 (1)	2.70 (1)	0.00	0.00	0.00	0.00	0.00	0.00	2.63 (1)	0.00	0.00	0.00	0.00

Note. Highlighted rows show the results for the noise samples.

[a] Meta = metaphoric. [b] IM = iconic and metaphoric gestures = imagistic. [c] Deictic Ab= deictic abstract. [d] Deictic C = deictic concrete. [e] Inter = interactive.

[f] Embl=emblem. [g] Case 2 narrative was conducted in quiet only.

In Case 5 the proportion of imagistic gestures was also higher when PCP5 conversed in noise (70.27%) than in quiet (44.83%) while the proportion of interactive gestures was lower in noise (18.92%) than in quiet (41.38%). By contrast, the proportion of imagistic gestures was lower when PCP5 narrated in noise (56.60%) than in quiet (83.87%) while the proportion of interactive gestures was higher in noise (37.74%) than in quiet (12.90%).

In Case 7 the proportion of imagistic gestures was higher when PCP7 conversed in noise than in quiet, however, given the small number of gestures in both quiet and noise (respectively, 9 and 15 gestures) comparisons of proportions have limited meaning. Low numbers of gestures in one or both conditions mean that one gesture already represents a high proportion. Hence these differences may be inflated as they may only comprise a difference of one or two gestures. Overall, these results suggest that (with the above exceptions) in most interactions participants did not substantially alter their patterns of use of gesture types in quiet versus noise with the CPNH.

6.2.2.2 Gesture Type: Quiet versus Noise with CPHI as Listener

Proportions of imagistic gesture type produced by PCPs differed in quiet versus noise samples with the CPHI by less than +/-9% in Case 3, Case 4, and Case 5 in conversation and in narrative. The low numbers of gestures produced by PCPs in the Case 6 conversation and Case 7 conversation and narrative did not allow meaningful comparisons to be made. As seen in Table 6.4, the Case 6 narrative and Case 2 conversation showed greater differences in gesture type proportions in quiet versus noise.

In Case 6 the proportion of imagistic gestures was higher when PCP6 narrated in noise (60.53%) than in quiet (47.22%) while the proportion of interactive gestures was lower in noise (26.32%) than in quiet (44.44%). In conversation PCP6 produced few gestures in quiet and noise (respectively 13 and 13) and thus comparisons of proportions have limited meaning.

In Case 2 the proportion of imagistic gestures was substantially higher when PCP2 was conversing in noise (47.06%) than in quiet (16.67%) while the proportions of interactive and deictic (concrete and abstract) gestures were lower in noise (41.18% & 8.82%) than in quiet (61.11% & 22.22%). By contrast, in Case 7, PCP7 produced few gestures when conversing in quiet (five) and when narrating in quiet and noise (respectively 9 and 11 gestures) so that comparisons have limited meaning.

Overall, these results suggest that in most interactions there is little evidence that participants altered their use of different gesture types in quiet compared to noise with their CPHI. The exceptions were the Case 6 narrative and Case 2 conversation. The increased the use of imagistic gestures suggested that PCP6 and PCP2 may have been relying more on gesture to portray semantic content under more difficult listening conditions.

6.2.2.3 Gesture Type in Noise with CPHI versus CPNH as Listeners

Proportions of imagistic gestures produced by PCPs differed between conversations with the CPHI and CPNH by less than 13% in Case 2, Case 4, Case 5, and Case 7, the proportions being equal or higher with the CPNH. In Case 6 the proportion of imagistic gestures was lower when PCP6 conversed with their CPHI (30.77%) than with their CPNH (54.84%), while the proportion of interactive gestures was higher with their CPHI (53.85%) than their CPNH (29.03%; see Table 6.4).

Proportions of imagistic gestures did not differ substantively between narratives with the CPHI and the CPHN in Case 3, Case 5, Case 6, and Case 7. The differences in proportions ranged from 2.39% to 10.05%. The proportions were marginally higher with the CPHI in Cases 3, Case 5, and Case 6 but lower with the CPHI in Case 7. In Case 4 the proportion of imagistic gestures was lower when PCP4 narrated with their CPHI (47.06%) than with their CPNH (68.75%) while the proportion of interactive gestures was higher with their CPHI (41.18%) than with their CPNH (15.63%; see Table 6.4).

Overall, these results suggest that in most interactions (with the exception of Case 6 conversation and Case 4 narrative) participant PCPs did not substantially alter the balance of gesture types in the presence of background noise with their CPHI compared to their CPNH. The next sections of the chapter present the findings of the analysis of the emic or physical features of gesture size and of the gaze movements associated with iconic and metaphoric gestures.

6.2.3 Gesture Characteristics – Gesture Size

The research questions addressed in this section are:

2.3.(a) Does the size of imagistic gestures differ between quiet and noise with CPHN and /or with CPHI?

2.3.(b) Does the size of imagistic (iconic and metaphoric) gestures differ between interactions with CPHI and interactions with CPNH in the presence of background noise?

As outlined previously (see Section 6.1.3.3), each gesture was categorised according to the number of borders crossed during the performance of the stroke. Gesture size proportions of the total imagistic gestures were calculated for the three size categories, small, medium, and large and for the combined medium-large category (i.e., one or more gesture space borders crossed) and are presented in Table 6.5. Results obtained in the noise samples are highlighted to distinguish them from results obtained during the quiet samples.

Table 6.5

Proportions of Imagistic (IM) Gestures by Size in Conversation (C) and Narrative (Na) Produced With CPNH (NH) and CPHI (HI) in Quiet (Q) and in Noise (N)

Case		2				3				4				5				6				7			
Borders	Task	C		Na		C		Na		C		Na		C		Na		C		Na		C		Na	
		NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI
< 1	Q	44.44 (4)	33.33 (1)	36.59 (15)	18.18 (4)	0	30.00 (6)	47.06 (8)	27.78 (5)	0.00	42.86 (9)	17.65 (3)	40.00 (4)	23.08 (3)	83.33 (5)	30.77 (8)	26.32 (5)	41.38 (12)	44.44 (4)	31.25 (5)	25.00 (4)	50.00 (1)	33.33 (1)	33.33 (2)	28.57 (2)
	N	20.00 (1)	18.75 (3)	-	-	33.33 (2)	31.82 (7)	16.67 (3)	36.36 (8)	27.27 (3)	37.5 (3)	31.82 (7)	31.25 (5)	38.46 (10)	40.00 (6)	26.67 (8)	10.34 (3)	29.41 (5)	100 (4)	37.50 (9)	26.09 (6)	0.00	80.00 (12)	25.00 (2)	33.33 (2)
1-2	Q	33.33 (3)	33.33 (1)	31.71 (13)	45.45 (10)	83.33 (5)	60.00 (12)	35.29 (6)	38.89 (7)	0	33.33 (7)	58.82 (10)	30.00 (3)	53.85 (7)	0.00	46.15 (12)	57.89 (11)	37.93 (11)	44.44 (4)	56.25 (9)	50.00 (8)	50.00 (1)	66.67 (2)	33.33 (2)	57.14 (4)
	N	80.88 (4)	56.25 (9)	-	-	50.00 (3)	59.09 (13)	50.00 (9)	50.00 (11)	36.36 (4)	50.00 (4)	50.00 (11)	43.75 (7)	46.15 (12)	40.00 (6)	40.00 (12)	58.62 (17)	47.06 (8)	0.00	37.50 (9)	43.48 (10)	71.43 (5)	20.00 (3)	75.00 (6)	66.67 (4)
3+	Q	22.22 (2)	33.33 (1)	31.71 (13)	36.36 (8)	16.67 (1)	10.00 (2)	17.65 (3)	33.33 (6)	100 (3)	23.81 (5)	23.53 (4)	30.00 (3)	23.08 (3)	16.67 (1)	23.08 (6)	15.79 (3)	20.69 (6)	11.11 (1)	12.50 (2)	25.00 (4)	0.00	0.00	33.33 (2)	14.29 (1)
	N	0.00	25.00 (4)	-	-	16.67 (1)	9.09 (2)	33.33 (6)	13.64 (3)	36.36 (4)	12.50 (1)	18.18(4)	25.00 (4)	15.38 (4)	20.00 (3)	33.33 (10)	31.03 (9)	23.53 (4)	0.00	25.00 (6)	30.43 (7)	28.57 (2)	0.00	0.00	0.00
1-6+	Q	55.56 (5)	66.67 (2)	63.41 (26)	81.82	100 (6)	70.00 (14)	52.94 (9)	72.22 (13)	100 (3)	57.14 (12)	82.35 (14)	60.00 (6)	76.92 (10)	16.67 (1)	69.23 (18)	73.68 (14)	58.62 (17)	55.56 (5)	68.75 (11)	75.00 (12)	50.00 (1)	66.67 (2)	66.67 (4)	71.43 (5)
	N	80.00 (4)	81.25 (13)	-	-	66.67 (4)	68.18 (15)	83.33 (15)	63.64 (14)	36.36 (8)	62.50 (5)	68.18 (15)	68.75 (11)	61.54 (16)	60.00 (9)	73.33 (22)	89.66 (26)	70.59 (12)	0.00	62.50 (15)	73.91 (17)	100 (7)	20.00 (3)	75.00 (6)	66.67 (4)
Total IM Ge	Q	9	3	41	22	6	20	17	18	3	21	17	10	13	6	26	19	29	9	16	16	2	3	6	7
	N	5	16	-	-	6	22	18	22	11	8	22	16	26	15	30	29	17	4	24	23	7	15	8	6

Note. Highlighted rows show the results for the noise samples.

6.2.3.1 Gesture Size in Quiet versus Noise with CPNH and CPHI as Listeners

Gesture size was analysed by focusing on cases in which the higher numbers (16–30) of imagistic gestures were produced by PCPs 2–7 in both quiet and noise samples with either CPHI and/or CPNH. Thus, Case 3 conversation and Case 3, Case 5, and Case 6 narratives with the CPHI as well as Case 6 conversations and Case 3, Case 4, Case 5, and Case 6 narratives with the CPNH were selected. The remaining interactions are not discussed here due to the low gesture numbers (≤ 13) produced in either quiet or noise, making comparisons less meaningful. The findings are described below and can be seen in Table 6.5.

Case 3 CPHI Conversation: The highest proportion by gesture size produced by PCP3 was the medium gestures in both quiet (60.00%) and in noise (59.09%) conditions followed by small then large. The differences between proportions in quiet and in noise were less than 1.82%. This suggests that there was not a substantial change in the size of gestures produced by PCP3 between conditions.

Case 3 CPHI Narrative: The highest proportion by gesture size produced by PCP3 was the medium gestures in both quiet (38.89%) and in noise (50.00%). In quiet this was followed by large (33.33%) and small (27.78%). In noise the proportion of medium-size gestures was followed by small (36.36%) and then large gestures (13.64%). This shows that PCP3 produced a lower proportion of large gestures and a higher proportion of medium-size and small gestures in noise than in quiet.

Case 5 CPHI Narrative: The highest proportion by gesture size produced by PCP5 was the medium gestures in both quiet (58.62%) and in noise (57.89%). In quiet this was followed by small gestures (26.32%) and large (15.79%), and in noise large (31.03%) was followed by small gestures (10.34%). This shows that PCP5 produced a similar proportion of medium-size gestures in noise and quiet but a lower proportion of small and a higher proportion of large gestures in noise.

Case 6 CPHI Narrative: The highest proportion by gesture size produced by PCP6 was the medium gestures in both quiet (37.50%) and in noise (43.48%). In quiet this was followed by equal proportions of small and large gestures (25.00%), and in noise the proportion of large (30.43%) was followed by small gestures (26.09%). The differences in proportions were less than 6% between quiet and noise conditions. This suggests that there was not a substantial change in the size of gestures produced by PCP6 between conditions.

Case 3 CPHN Narrative: The highest proportion by gesture size produced in quiet was the small gestures (47.06%) followed by medium (35.29%) and then large (17.65%). In noise the highest proportion was medium-size (50.00%) followed by large (33.33%) and then small gestures

(16.67%). This shows that PCP3 produced a higher proportion of medium-size and large gestures and a lower proportion of small gestures in noise than in quiet.

Case 4 CPNH Narrative: The highest proportion of gestures by size produced by PCP4 was the medium gestures in both quiet (58.82%) and in noise (50.00%). This was followed in quiet by large (23.53%) and small gestures (17.65%), and in noise small (31.82%) was followed by large gestures (18.18%). This shows that that PCP4 produced similar proportions of medium-size gestures in quiet and in noise but a higher proportion of small and correspondingly lower proportion of large gestures in noise.

Case 5 CPNH Narrative: The highest proportion of gestures by size produced by PCP5 was the medium gestures in both quiet (46.15%) and in noise (40.00%). This was followed in quiet by small (30.77%) and large gestures (23.08%), and in noise large (33.33%) was followed by small gestures (26.67%). This shows that PCP5 produced a similar proportion of medium and small gestures in quiet and in noise but a higher proportion of large gestures in noise.

Case 6 CPNH Narrative: The highest proportion of gestures by size produced by PCP6 was the medium gestures in quiet (56.25%) followed by small (31.25%) and large gestures (12.50%). In noise equal proportions of medium-size and small gestures (37.50%) were produced followed by large gestures (25.00%). This shows that PCP6 produced a lower proportion of medium-size gestures and correspondingly slightly higher proportions of small and large gestures in noise than in quiet.

Case 6 CPNH Conversation: The highest proportion of gestures by size produced by PCP6 in quiet was the small gestures (41.38%%) followed closely by medium (37.93%) and then large gestures (20.69%). In noise the highest proportion was medium size (47.06%) followed by small (29.41% and large (23.53%). This shows that PCP6 produced a higher proportion of medium-size gestures and a correspondingly lower proportion of small gestures in noise than in quiet. Differences in proportions of large gestures in quiet and noise were not substantial.

In summary, the highest proportion of gestures by size was the medium gesture category in Case 3 conversation and narrative and in Case 5 and Case 6 narratives with CPHI in both quiet and noise. The highest proportion was also the medium-size gestures with CPNH in Case 3 narrative and Case 6 conversation in noise, Case 6 narratives in quiet, Case 4 and Case 5 narrative in both quiet and noise.

Overall, it appears that medium-size gestures often made up the largest proportion and large gestures the lowest proportion across all settings. There is not a consistent pattern of difference with respect to gesture size in interaction with either the CPNH or the CPHI in quiet versus noise.

There were instances of a higher proportion of large gestures (Case 5 CPHI narrative, Case 3, Case 5, and Case 6 CPNH narratives) or medium-size gestures (Case 6 CPNH conversation) in noise than quiet, but the opposite pattern was also seen with a higher proportion of small gestures (Case 3 CPHI narrative, Case 4 CPNH narrative) or no substantial difference at all (Case 3 CPHI conversation).

6.2.3.2 Gesture Size in Noise with CPHI versus CPNH as Listeners

Gesture size was analysed by focusing on cases in which the higher numbers of imagistic gestures were produced by PCPs 2–7 in the noise samples with both CPHI and CPNH (range 18–29). Thus, Cases 3, Case 5 and Case 6 narratives were selected for analysis using the two methods (a) the three category (small, medium-size, and large gestures) and (b) the two category (small and medium-large) method. The findings are described below and can be seen in Table 6.5. The remaining interactions are not discussed here due to the lower gesture numbers produced (≤ 15) with either the CPNH and/or the CPHI, making comparisons less meaningful.

Case 3 Narrative***:*** Eighteen imagistic gestures were produced by PCP3 with their CPNH and 22 with their CPHI. The highest proportion of gestures by size was the medium gestures with both the CPNH and the CPHI (50%). With CPNH this was followed by large (33.33%) and small gestures (16.67%), and with the CPHI small (36.36%) gestures were followed by large (13.64%). This shows that when narrating, PCP3 produced a higher proportion of small gestures and a lower proportion of large gestures with their CPHI than their CPNH. This contrasts with the narrative-in-quiet sample (see Section 5.2.3.1) in which PCP3 produced a lower proportion of small gestures and a higher proportion of large gestures with their CPHI than with their CPNH.

The two-category analysis showed that a higher proportion of small gestures was produced with the CPHI (36.36%) than with the CPNH (16.67%) and a lower proportion of medium-large gestures with the CPHI (63.64%) than with the CPNH (83.33%).

Case 5 Narrative: Thirty Imagistic gestures were produced by PCP5 with their CPNH and 29 with their CPHI. Case 5 results show a similar pattern to the results for the quiet section of the narrative. The highest proportion of gestures by size with both the CPNH and the CPHI was medium-size gestures (58.62% and 40.00%) followed by large (31.03% and 33.33%) and small gestures (26.67% and 10.34%). This shows that PCP5 produced a lower proportion of small gestures and a higher proportion of medium-size gestures with their CPHI than their CPNH.

The two-category analysis showed that the highest proportions were medium-large gestures with both the CPNH and the CPHI. A lower proportion of small gestures was produced with the CPHI (10.36%) than with the CPNH (26.67%) and a higher proportion of medium-large gestures with the CPHI (89.66%) than with the CPNH (73.33%).

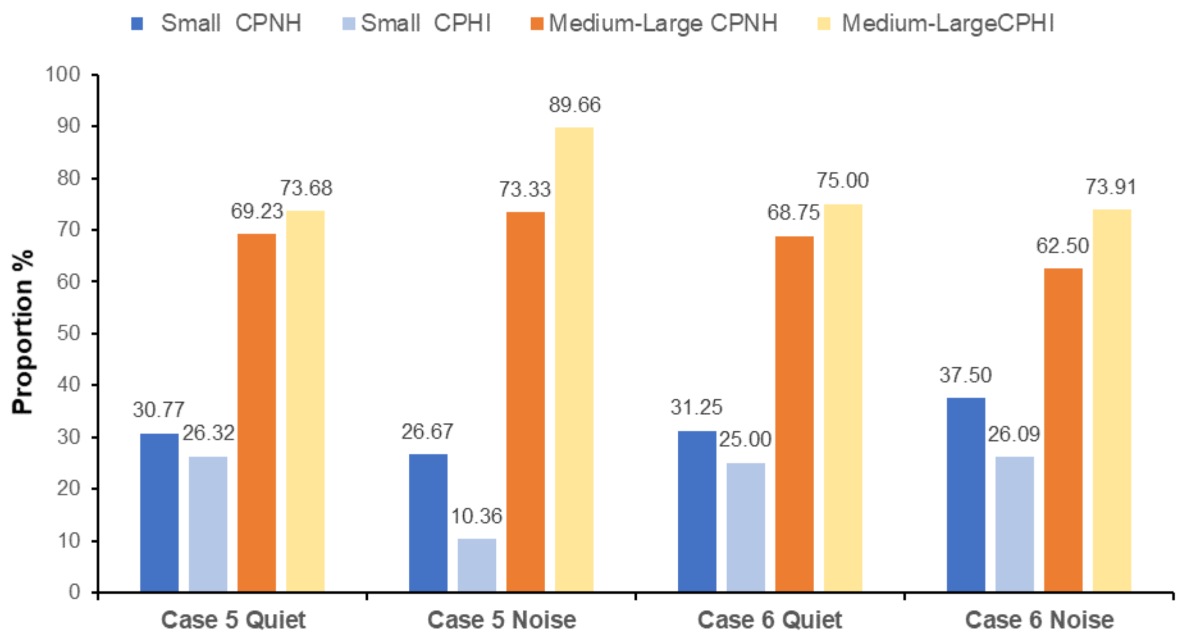
Case 6 Narrative**:** Twenty-four gestures were produced by PCP6 with their CPNH and 23 with their CPHI. The highest proportion by gesture size with the CPHI was the medium gestures (43.48%) followed by large (30.43%) and small gestures (26.09%). With the CPNH the proportions of small and medium-size gestures were equal (37.50%) followed by large gestures (25.00%). This shows that PCP6 produced a lower proportion of small gestures and a slightly higher proportion of medium-size and large gestures with their CPHI than their CPNH.

The two-category analysis showed that the highest proportions were medium-large gestures with both the CPNH and CPHI. A lower proportion of small gestures was produced with the CPHI (26.09%) than with the CPNH (37.50%) and a higher proportion of medium-large gestures with the CPHI (73.91%) than with the CPNH (62.50%).

In Cases 5 and Case 6 but not Case 3 as seen above the PCP produced a lower proportion of small imagistic gestures and a higher proportion of medium-large gestures when speaking with their CPHI than their CPNH. This suggests that some individuals may produce more medium-large gestures rather than (small) gestures produced within one gesture space area with their CPHI compared to their CPNH in the presence of background noise*.* The same pattern was found regarding the quiet sections of the narrative, as illustrated in Figure 6.3 (see also Section 5.2.3.1).

Figure 6.3

Proportions of Imagistic Gestures by Size in Narrative With CPHI and CPNH in Quiet and in Noise



6.2.4 Gaze Direction

The research questions addressed in this section are:

2.4.(a) Where do PCPs as speakers direct gaze during imagistic gesture production in the presence of background noise?

2.4.(b) Do gaze patterns during imagistic gesture production differ between quiet and noise with CPHN and /or with CPHI?

2.4.(c) Do gaze direction patterns during imagistic gesture production differ between interactions with CPHI and interactions with CPNH in the presence of background noise?

As described in Section 3.6.4, each gesture produced by PCPs 2–7 was assigned to one of three categories; gaze at the gesture; gaze at the CP and gaze away from CP (at some other point in the room or space). Gaze at gesture included: (a) gestures at which gaze was directed during the stroke phase and (b) gestures at which gaze was directed during the preparation phase but that moved to the listener (CPHN or CPHI) during the performance of the stroke. Gaze-direction proportions of the total number of imagistic gestures were calculated and are presented in Table 6.6. Results obtained in background noise are highlighted to distinguish them from results obtained during the quiet samples. The results indicate that PCPs' gaze was most frequently directed at the listener with both the CPNH and the CPHI during imagistic gesture production. In conversation with the CPHN the proportion of gestures in the gaze-at-CP category ranged from 70.59% (Case 6) to 100% (Case 4) and in narrative from 62.50% (Case 7) to 87.50% (Case.6). In conversation with the CPHI, the proportion of gaze at CP ranged from 80% (Case 7) to 100% (Case 6) and in narrative from 68.18% (Case 3) to 87.50% (Case.6). The Case 2 conversation with the CPNH was the exception with 40.00% of both gaze-at-gesture and gaze-at-CP gestures. However, there were very few gestures in each category.

6.2.4.1 Speaker Gaze Direction in Noise with CPHI versus CPNH as Listeners

As seen in Table 6.6, in Case 3, Case 4, Case 5 conversation and narrative, Case 7 conversation, and Case 6 narrative the highest proportion by gaze direction was gaze at CP with both CPNH and CPHI. As reported in the analysis gesture by size, there were low numbers of gestures produced by the PCP with either the CPNH and/or the CPHI in many interactions. The cases with the higher numbers (range 18–29) were Case 3, Case 5 and Case 6 narratives. The Case 3, Case 4, and Case 6 conversation; Case 2 and Case 7 conversation and narrative provide less meaningful comparisons due to the low gesture numbers (≤ 15) produced by the PCP with either the CPNH or the CPHI. However, as seen in Table 6.6 the proportion of gestures in the gaze-at-CP category was not substantively different when PCPs interacted with their CPHI and their CPNH.

Table 6.6

Gaze Direction by Proportion (%) of Total Imagistic Gestures in Conversation (C) and Narrative (Na) With CPNH (NH) and CPHI (HI) in Quiet (Q) and in Noise (N)

Case		2				3				4				5				6				7			
Task		C		Na		C		Na		C		Na		C		Na		C		Na		C		Na	
		NH %(n)	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI
Ge on stroke	Q	11.11 (1)	0.00	34.15 (14)	13.64 (3)	0.00	15.00 (3)	23.53 (4)	27.78 (5)	0.00	4.76 (1)	23.53 (4)	10.00 (1)	7.69 (1)	16.67 (1)	23.08 (6)	15.79 (3)	6.90 (2)	11.11 (1)	0.00	25.00 (4)	50.00 (1)	0.00	50.00 (3)	57.14 (4)
	N	40.00 (2)	6.25 (1)	-	-	16.67 (1)	0.00	22.22 (4)	27.27 (6)	0.00	0.00	13.64 (3)	6.25 (1)	3.85 (1)	0.00	16.67 (5)	10.34 (3)	5.88 (1)	0.00	8.33 (2)	4.17 (1)	25.00 (2)	20.00 (3)	37.50 (3)	28.57 (2)
Ge on prep	Q	0.00	0.00	2.44 (1)	9.09 (2)	0.00	5.00 (1)	0.00	11.11 (2)	0.00	4.76 (1)	0.00	10.00 (1)	0.00	0.00	3.85 (1)	0.00	10.34 (3)	11.11 (1)	0.00	0.00	0.00	0.00	0.00	0.00
	N	0.00	0.00	-	-	0.00	9.09 (2)	0.00	0.00	0.00	0.00	0.00	12.50 (2)	0.00	0.00	6.67 (2)	3.45 (1)	23.53 (4)	0.00	4.17 (1)	8.33 (2)	0.00	0.00	0.00	14.29 (1)
At Ge total	Q	11.11 (1)	0.00	36.59 (15)	22.73 (5)	0.00	20.00 (4)	23.53 (4)	38.89 (7)	0.00	9.52 (2)	23.53 (4)	20.00 (2)	7.69 (1)	16.67 (1)	26.92 (7)	15.79 (3)	17.24 (5)	22.22 (2)	0.00	25.00 (4)	50.00 (1)	0.00	50.00 (3)	57.14 (4)
	N	**40.00 (2)**	**6.25 (1)**	**-**	**-**	**16.27 (1)**	**9.09 (2)**	**22.22 (4)**	**27.27 (5)**	**0.00**	**0.00**	**13.64 (3)**	**18.75 (3)**	**3.85 (1)**	**0.00**	**23.33 (7)**	**13.79 (4)**	**29.41 (5)**	**0.00**	**12.50 (3)**	**12.50 (3)**	**25.00 (2)**	**20.00 (3)**	**37.50 (3)**	**42.86 (3)**
Away	Q	22.22 (2)	0.00	24.39 (10)	0.00	33.33 (2)	10.00 (2)	17.65 (3)	0.00	0.00	9.52 (2)	17.65 (3)	30.00 (3)	0.00	0.00	19.23 (5)	0.00	3.45 (1)	0.00	0.00	6.25 (1)	50.00 (1)	0.00	0.00	0.00
	N	**20.00 (1)**	**0.00**	**-**	**-**	**0.00**	**9.09 (2)**	**5.56 (1)**	**4.55 (1)**	**0.00**	**0.00**	**13.64 (3)**	**0.00**	**0.00**	**0.00**	**3.33 (1)**	**13.79 (4)**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**14.29 (1)**
At CP	Q	66.67 (6)	100 (3)	39.02 (16)	77.27 (17)	66.67 (4)	70.00 (14)	58.82 (10)	61.11 (11)	100 (3)	80.95 (17)	58.82 (10)	50.00 (5)	92.31 (12)	83.33 (5)	53.85 (14)	84.21 (16)	79.31 (23)	77.78 (7)	100 (16)	68.75 (11)	0.00	100 (3)	50.00 (3)	42.86 (3)
	N	**40.00 (2)**	**93.75 (15)**	**-**	**-**	**83.33 (5)**	**81.82 (18)**	**72.22 (13)**	**68.18 (15)**	**100 (11)**	**100 (8)**	**72.73 (16)**	**81.25 (13)**	**96.15 (25)**	**100 (15)**	**73.33 (22)**	**72.41 (21)**	**70.59 (12)**	**100 (4)**	**87.50 (21)**	**87.50 (21)**	**75.00 (6)**	**80.00 (12)**	**62.50 (5)**	**42.86 (3)**

Note. Highlighted rows show the results for the noise samples. Ge = gesture; CP = communication partner.

Differences in proportions ranged from 0.00% (Case 4 conversation and Case 6 narrative) to 8.52% (Case 4 narrative) suggesting that PCPs directed their gaze at their CPs (CPHI and CPNH) in the majority of gestures produced in noise independently of hearing status.

6.2.4.2 Speaker Gaze Direction in Quiet versus Noise with CPHI and CPNH as Listeners

As in the analysis of imagistic gesture by size, gaze direction was analysed by focusing on cases in which higher numbers (16–30) of imagistic gestures were produced in both quiet and noise samples with either CPHI and/or CPNH. Thus, the following cases were selected for further analysis: Case 3 conversation with the CPHI; Case 6 conversation with the CPHN; and Case 3, Case 5, and Case 6 narratives with the CPHI and the CPNH, and Case 4 narrative with the CPNH. The remaining interactions are not discussed here due to the low gesture numbers (≤ 13) produced in either quiet and/ or noise, making comparisons less meaningful. (These were: Case 2–5 conversations and Case 7 conversation and narrative with the CPNH; Case 2 and Case 4–7 conversations and Case 4 and Case 7 narratives with the CPHI).

Case 3: In conversation and in narrative with their CPHI, PCP3 produced a higher proportion of gaze-at-CP gestures in noise (81.82% & 68.18%) than in quiet (70.00% & 61.11%) and a lower proportion of gaze at gesture in noise (9.09% & 27.27%) than in quiet (20.00% & 38.89%). In narrative with their CPNH, PCP3 produced a higher proportion of gaze-at-CP gestures in noise (72.22%) than in quiet (58.82%, approximately equal proportions of gaze at gesture (22.22% & 23.53%), and a lower proportion of gaze-away gestures in noise (17.65%) than in quiet (5.56%).

Case 4: In narrative with CPNH, PCP4 produced a higher proportion of gaze-at-CP gestures in noise (72.73%) than in quiet (58.82%) and a lower proportion of gestures in the gaze-at-gesture category in noise (13.64%) than in quiet (23.53%).

Case 5: In narrative with their CPNH, PCP5 produced a higher proportion of gaze-at-CP gestures in noise (73.33%) than in quiet (53.85%) and a correspondingly a lower proportion of gaze-away gestures in noise (3.33%) than in quiet (19.23%). (The proportion in the gaze-at-gesture category was also marginally lower in noise). By contrast, in narrative with their CPHI, PCP5 produced a lower proportion of gaze-at-CP gestures in noise (72.41%) than in quiet (84.21%) and a higher proportion of gaze-away gestures in noise (13.79%) than in quiet (0.00%). (The proportion in the gaze-at-gesture category was also marginally lower in the noise).

Case 6: In narrative with the CPHI, PCP6 produced a higher proportion of gaze at CP gestures in noise (87.50%) than in quiet (68.75%) and a lower proportion of gaze at gesture in noise (12.50%) than in quiet (25.00%). By contrast, in narrative with the CPNH, PCP6 produced a lower proportion of gaze at CP gestures in noise (87.50%) than in quiet (100%) and higher proportion of gaze at gesture in noise (12.50%) than in quiet (0.00%). Similarly, in conversation with their CPNH, PCP6 produced a lower proportion of gaze-at-CP gestures in noise (70.59%) than in quiet (79.31%) and higher proportion in the gaze-at-gesture category in noise (29.41%) than in quiet (17.24%).

Overall, these findings are similar to those found in quiet, showing that PCPs frequently gazed at their CPHI and CPNH during imagistic gestures production rather than directing gaze at their own gestures. In interactions examined above, the most frequently occurring pattern involved PCPs producing a higher proportion of gestures with gaze directed at their CPHI or CPNH as listener in noise than in quiet. Like the results in Section 6.2.4.1, this suggests that the presence of background noise may have had an influence on CP gaze orientation but independently of hearing status.

6.2.5 Qualitative Commentary

The previous sections presented data comparing the patterns of gesture occurring in quiet and in background noise. The current section provides a qualitative commentary regarding the talk and gesture behaviours of the PCPs during the conversation and narrative tasks conducted in the presence of background noise.

6.2.5.1 Participant Comments about Noise and Visual Cues

On the introduction of the background noise, several participants including PCPs, CPHI and CPNH commented on the noise and the difficulties that they experience in similar situations. In the Case 2 conversation, PCP2 comments to their CPHI on the noise saying; “It makes it very hard for you to hear anything I am saying” (no gesture is associated with this, and the investigator’s observation is that he seems to raise his voice). Following this, PCP2 puts a hand up to his mouth and says, “If I do this you are in trouble” the word “this” seemingly referring to the CPHI’s use of visual speech cues to enhance her understanding. The portion of talk also seems to note that removing visual cues will make speech comprehension more difficult. He then refers to his ability to only pick out or lipread occasional words bleeped out on television. The conversation continues about the background noise and when it fades PCP2 says, “It’s a relief isn’t it when it disappears”.

Similarly, in the Case 4 conversation PCP4 refers to the imposition of the background noise, saying; “Oh be quiet” (and the investigator’s subjective observation is that he seems to raise his voice) and “To be honest I think I am having more trouble with this than you are”. In this final utterance, “this” appears to refer to the background noise. His CPHI agrees with him saying, “Yeah, I think you are”. She continues:

> …. because you are facing me which is not something really, we do very often we usually sit next to each other or something I can I’m having a time reading your lips a bit except when you put your hand like this. Which is not very useful (Case 4 conversation CPHI).

As she speaks, she places her hand in front of her mouth. This talk suggests that she is aware that she can improve her speech perception by watching the face and articulator (lipreading) cues and that sitting face to face facilitates this, even though this is not something she and her husband would normally do. PCP4 proceeds to put his hand in front of his mouth and says, “What am I saying now?” and CPHI responds, “Oh no don’t (name), please”. This portion of talk appears to indicate that they are both aware of her reliance of visual cues in the presence of background noise. When the noise finishes PCP4 says, “Phew, thank goodness those people have left” and “They shouldn’t let people into restaurants that make that much noise”. This implies that he dislikes the noise and is relieved that it has stopped.

In the Case 5 interactions, noise is referred to in the conversations both with the CPHI and with the CPNH. When the noise begins PCP5 says to his CPHI, “It’s going to get hard for you to hear now ay” and the CPHI replies, “Yeah, yeah, very. I’ll be relying on lipreading from here on in”. No gestures are used during this exchange. This talk seemingly refers to the impact of the noise on the auditory speech perception of the CPHI and his awareness of the need to use visual speech cues. A short time later PCP5 requests a repeat herself and comments, “That’s even hard for me”. The discussion continues about managing in the noise and PCP5 says, “You seem to be doing alright with it” and the CPHI indicates again, “I am lipreading a lot. That’s where the pro-lipreading comes in as well”.

In Case 5 in conversation with the CPNH, both participants comment on the background noise as it begins and PCP5 says, “Gee that’s really noisy isn’t it” and the CPNH comments, “I can hear you but now I feel like I need to raise my voice”. PCP5 responds, “yep number one and I feel like I need to concentrate more”. The CPNH continues, “So raising my voice makes me feel anxious” and she goes on to say, “When I am feeling that I lose a bit of concentration”. These comments suggest that both participants dislike the noise and notice a negative impact despite having hearing within normal limits.

In Case 6 in conversation PCP6 and the CPHI also have an extended discussion about background noise and other factors that impact speech comprehension. For example, PCP6 says, “See, I don’t know how you cope with this because even I struggle” and “I also go by visual cues as well. I go oh yeah something’s not right there”. Further into the discussion PCP6 says, “and as the doctor said you are starting to sort of read lips. So, you can sort see what I am saying” to which the CPHI agrees and says, “I can tell by your face whether you are happy or sad. “Yeah, and body language” and “Yeah, so I think comprehension-wise they all add up to help the big picture”. These comments suggest that both have an awareness of visual-speech cues and more broadly visual cues, although gestures are not specifically referred to, and few gestures are used during this portion of talk.

Together these excerpts suggest that participants dislike conversing in noise and are conscious of the impact of noise on the ability of their CPHI to understand speech. Participant comments suggest that they are aware of the benefits of lipreading particularly when speech cues are less audible under difficult listening conditions. It is also of interest to note that informal observations by the investigator (KS) suggest that in many of the conversations and narrations PCPs' overall volume of voice increases with the introduction of background noise. In some instances, direct reference is made to the volume of the talk. For example, in Case 5 the CPHN comments on the volume of her talk during the noise segments as mentioned earlier.

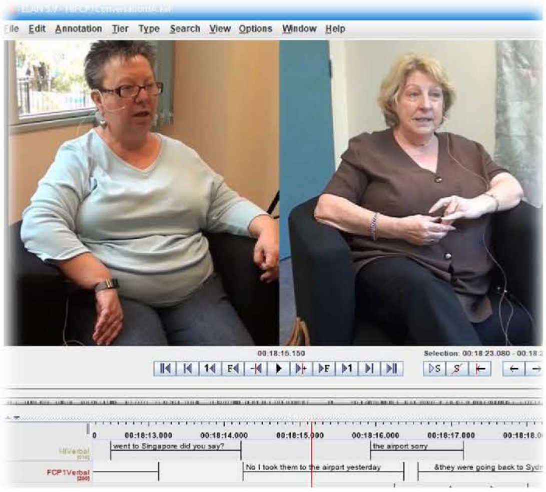
In Case 6 in conversation, PCP6 comments, "When there's loud people, I wonder whether I speak louder or not" to which her CPHI says, "Well you tend to anyway" and PCP6 responds, "That's right. yeah". The interpretation here might be that her CPHI is referring to her tendency to speak louder due to his HI. When PCP6 converses with her CPNH, she also refers to the background noise saying, "Those people next door are very loud aren't they? and her CPNH says "I am wondering if like the study is that we increase the volume of our voices so that you know we can". She doesn't finish her sentence, but it might be inferred that she is suggesting they may need to raise their voices to hear one another over the background noise. Overall, although the difficulty of communicating in noise was acknowledged by participants, there was no local increase in observed patterns of gesture.

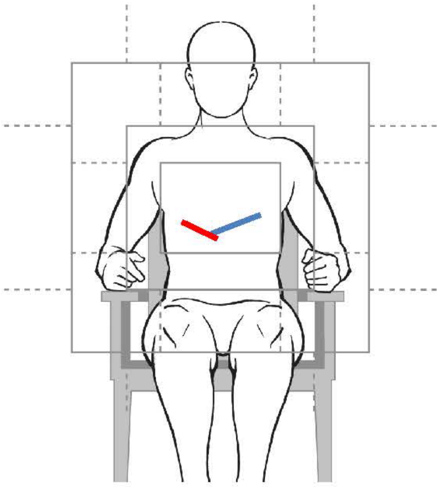
6.2.5.2 Requests for Clarification

In several of the conversations it is evident from the CPHIs' requests for clarification that these participants with HI have greater difficulty following the talk of their PCP. The use of gesture during conversational repair varies. There are instances in which no gesture is produced during the original utterances nor during the repeat. Figure 6.4 shows an example from the Case 3 conversation with the CPHI in which PCP3 has been telling her CPHI about her recent visitors from the USA and their departure the previous day. The CPHI initiates a request for clarification, and PCP3 responds verbally repeating her original talk while her hands remain in a rest position with fingers touching in the centre-centre space.

Figure 6.4

Example of a Request for Clarification and Repair Without Gesture





1 PCP3: so I took them to the airpor:t yes:terday?:

2 CPHI: went to SINGapore did you say¿=

3 PCP3: no I took them to the airport [yesterday]
Ge
Gz ----,,,,,,,,,,,,xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

4 CPHI: oh to the AIR]port so [rry]

5 PCP3: [and the]y were going back to Sydney

6 CPHI: yep ¿=

Similarly in Case 7 in conversation with the CPHI, PCP7 gestures infrequently and tends to speak in short sentences, and she typically provides a verbal repeat without an associated gesture in response to requests for clarification from her CPHI. This is despite her CPHI appearing to experience some difficulty hearing in the background noise. In the example shown in Figure 6.5, the CPHI requests a repeat (line 4), and PCP7 repeats her utterance. The CPHI says, “nuh” with a brief shake of the head, and PCP7 rewords her talk (line 8). During both repeats PCP7’s hands remain in a rest position in the centre-centre/lower centre space.

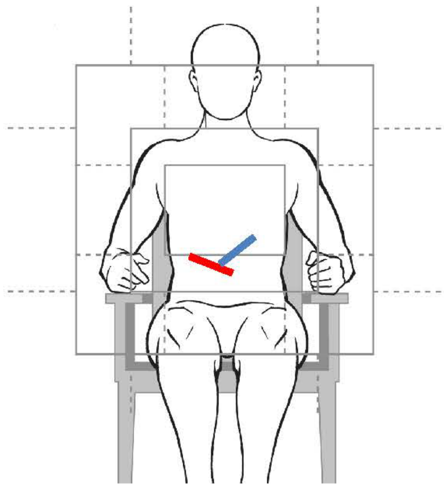
In Case 4 in conversation with the CPHI, there are several instances where PCP4 provides a repeat or clarification. In the example shown in Figure 6.6, the original talk is accompanied by an interactive gesture (which can be paraphrased as “this is my point”) and when a repeat is requested by the CPHI, PCP4 repeats his talk emphasizing a key word “owed” but does not produce a gesture during his talk, his hands and arms remaining in a rest position on the sides of the armchair.

In other instances of gesture and repair, the following two examples illustrate the use of gesture in instances in which a repeat is requested by the CPHI but where the initial verbal repair by the PCP is not successful. This leads to a second request for clarification, then a second repair attempt, and another repetition of the message. Both examples are taken from the Case 4 conversation. In the first example seen in Figure 6.7, the CPHI indicates that she has not heard the original utterance (line 5) and PCP4 repeats his utterance. The CPHI does not respond verbally but appears to be frowning as if she has not understood, and PCP4 rephrases his previous utterance (line 7) while using a gesture (metaphoric) to represent the concept of “getting around” to doing something. The second example is seen in Figure 6.8, when PCP4 refers to calling a friend to congratulate her on her pregnancy. As in the first example, the CPHI requests a repeat and PCP4 repeats his utterance. The CPHI does not give a verbal response but appears to be frowning, and PCP4 rephrases his utterance (line 5) accompanied by a gesture (emblem) resembling the holding of a landline telephone receiver. He holds up his right hand to the side of his head, thumb extended up, the little finger down, and the three remaining fingers curled into the palm.

In the Case 4 and Case 5 narratives with the CPHI, a further pattern is observed. In these examples the trouble source uttered by the PCP is associated with gesture and the repetition is accompanied by a gesture similar in form to the first. In the first example seen in Figure 6.9, PCP4 is retelling the CPHI about the fleece after the father has killed the blind boy’s pet lamb.

Figure 6.5

Example of a Request for Clarification and Repair Without Gesture



1 CPHI: neighbours are back (h) (h) (h)

2 PCP7: yep

3 PCP7: no our neighbours not back til today

4 CPHI: pardon ? (h) (h) (h)

5 PCP7: I said [our neigh]-

6 CPHI: [(h) I c(h)an't-]

7 PCP7: our neighbours not back til today
Ge
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

8 CPHI: nuh *(slight head shake)*

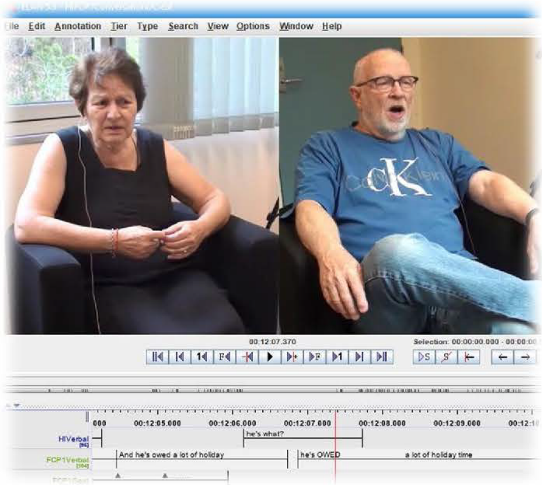
9 PCP7: (name) gets home today
Ge
Gz xxxxxxxxxxxxxxxxxxxxxxxxxx

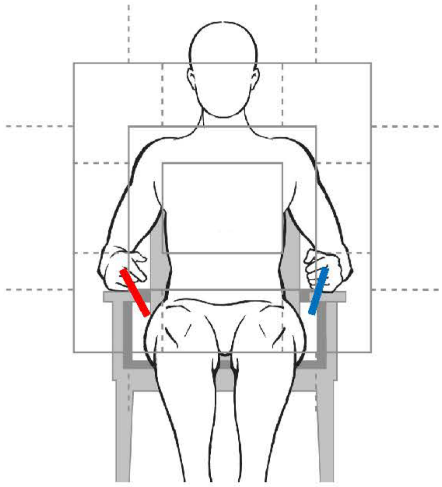
CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

10 CPHI: YES he does

Figure 6.6

Example of a Request for Clarification and Repair Without Gesture - With Verbal Emphasis





1 PCP4: so I said to (name) (0.2) I'm sorry I- have no option here u:m but (name) was fine¿(0.3)

2 PCP4: [but it wou]ld have been nice. he would have got a week's holiday¿

3 CPHI: [yeah]

4 CPHI: yeah: [fair e]nough

5 PCP4: [but] and he's owed a lot of holiday
Ge {▲ ▲.........}
Gz xxxxxxxx,,-------,,,,xxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxx,,-------------------,,,xxxxxxxxxxxxxx
Gz

6 CPHI: he's what?

7 PCP4: he's OW:ED (0.2) a lot of holiday time¿(0.6) (name) is¿=
Ge
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

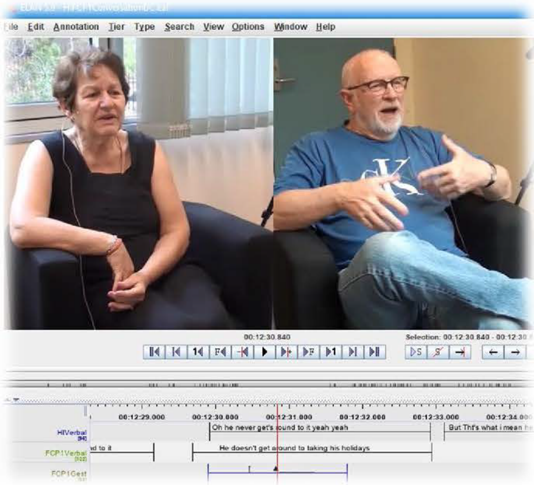
CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

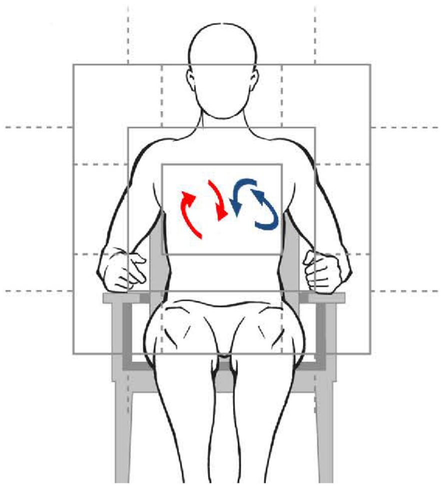
8 CPHI: = oh yeah

9 PCP4 so:: it would have been good for him to (.) use it up

Figure 6.7

Example of Request for Clarification and Repair with Gesture





1 CPHI: he's a bit driven

2 PCP4: (name)?=

3 CPHI: =yeah

4 PCP4: oh he↑ just doesn't get around to it

5 CPHI: mm?

6 PCP4: (.) he doesn't get around to it¿
Ge
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

7 PCP4: (1.2) he doe[sn't get around to taking his holidays¿]
Ge { [▲________ }
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

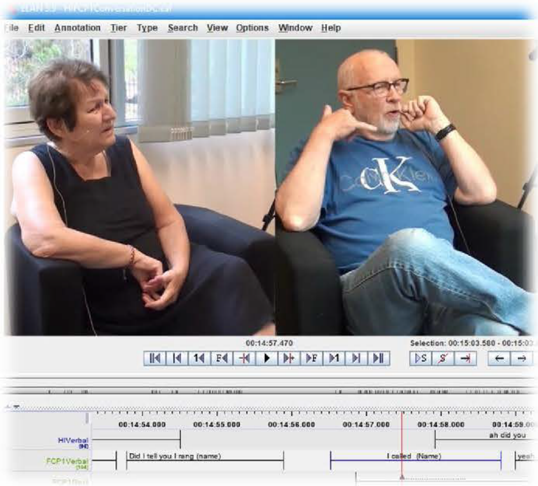
CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

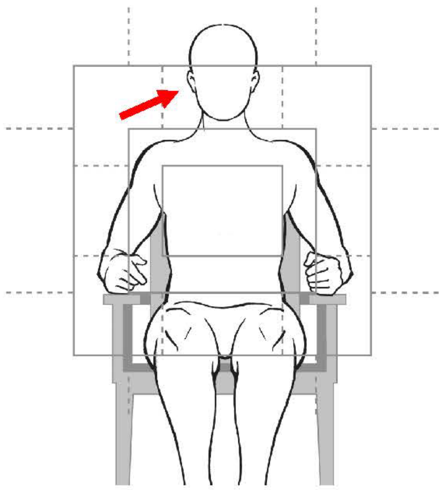
8 CPHI: [oh he never get's round to it yeah y]eah (0.4)

9. CPHI: but that's what I mean he-(.) he-(0.9) yeah

Figure 6.8

Example of Request for Clarification and Repair with Gesture





1 CPHI: now (name) is pregnant I can't be↑lieve it yeah

2 PCP4: mm did I tell you I rang (name)?

3 CPHI: pardon?

4 PCP4: did I tell you I rang (name)? (1.2)
Ge
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

5 PCP4: I called (name)?=
Ge { ▲..................}
Gz xxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxx
Gz

6 CPHI: =ohh did you?

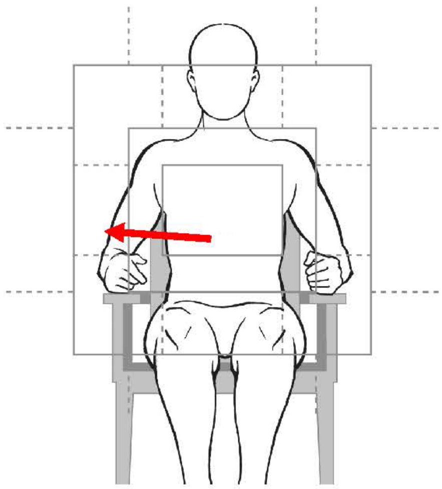
7 PCP4: yeah

8 CPHI: yeah

9.PCP4: and just congratulated her an: called her grannie

Figure 6.9

Example of Request for Clarification and Gesture With Original Talk and on Repair



1 PCP4: and um (0.3) he's just (.) he (.)

2 PCP4: dad's sitting at the table and the p- fleece is there?
Ge ^ { [▲______ }
Gz xxxxxxxxxxxxxxxxxxxxxxx,,**,,,xxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

3 CPHI: he¿ (0.3) [just¿]

4 PCP4: [the fleece?
Ge { [▲ [▲
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

5 CPHI: the FLEECE oh yeah =

6 PCP4: = the dog (1.3) and its he's just sort of thinking

As PCP4 describes the fleece laid out on the table (line 2), he produces a gesture, which evokes an image of the fleece spread out in front of the father. His right hand moves to the centre-centre (preparation) and then (palm facing down) to his right side and outwards to the front periphery before returning to the centre-centre (stroke) and then to a rest position on the armrest. Clarification is sought by the CPHI (line 3) and PCP4 repeats “the fleece” and produces a similar gesture. His right hand moves from the rest position to the centre-centre and then to the right periphery (stroke). It is clear from CPHI’s repetition of the word “fleece” (line 5) that the communication breakdown has been resolved.

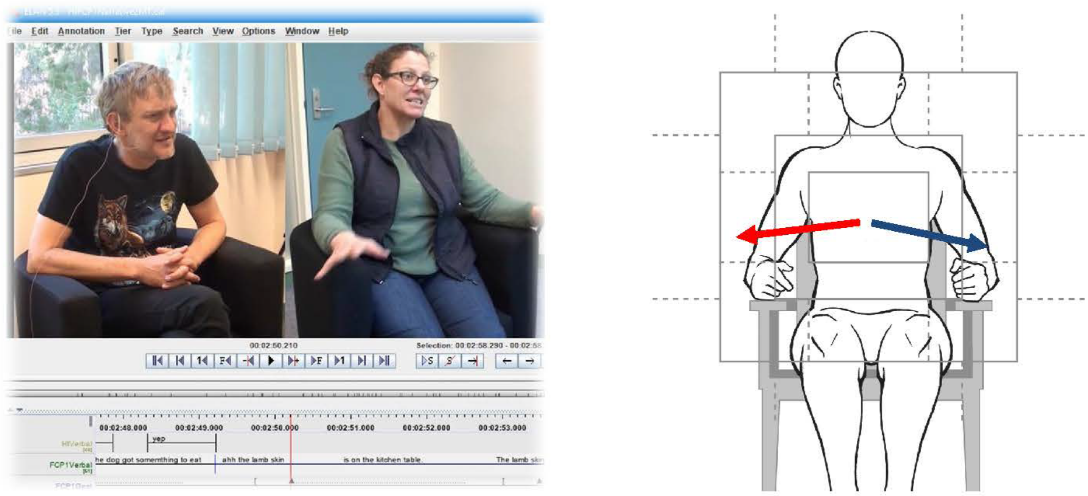
In the second example seen in Figure 6.10, PCP5 has reached the same point in the story. In her talk she refers to the “lamb skin” (line 5) and produces an iconic gesture, which evokes an image of the lambskin spread out on the table. Both hands move from the rest position to the centre-centre (preparation) and (palms facing down) then move outward to either side and remain in a hold position. There is no verbal request for clarification from the CPHI, but he remains silent gazing at PCP5 with what appears to be a frown. This suggests that PCP5 may have perceived her CPHI’s actions to infer that he may not have understood PCP5’s talk. This is followed by PCP5 repeating the key words “the lamb skin” while also repeating the gesture.

In the Case 2 conversation with the CPHI there is evidence of occasional mis-hearing and subsequent PCP2 repairs. In the following example in Figure 6.11, PCP2 is talking about the background noise recording. His talk refers to a loop as he produces a repeated circular motion, which can be interpreted as an iconic gesture representing the repetition of the babble background noise recording. He continues the circling gesture without pausing as his CPHI requests clarification and during his subsequent verbal clarification.

Although there were few instances of mishearing and subsequent repair sequences in the samples, the examples presented in this chapter reveal varying patterns of gesture (or no gesture) following a request for clarification by the CPHI. This suggests that gestures might be implemented by a speaker if there is a perceived need to increase the redundancy of the spoken communication to achieve a successful repair.

Figure 6.10

Example of a Verbal Repeat and a Repeated Iconic Gesture



1 PCP5: then the next sce::ne is you see the father (0.6) give the dog (.) a piece of meat ¿=

2 CPHI: [piece of meat]

3 PCP5: [so the dogs happy¿]

4 CPHI: ye[p]

5 PCP5: the [dog] got something to eat¿

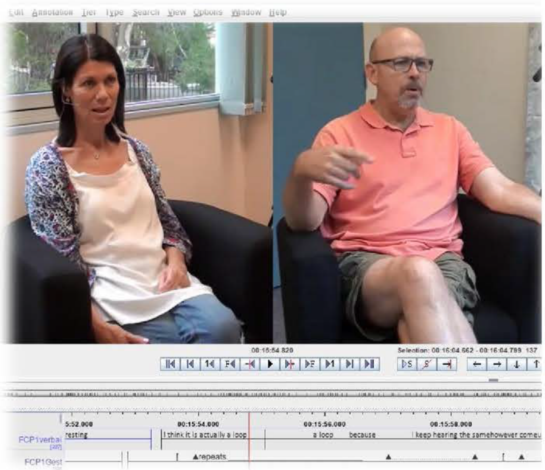
6 CPHI: [yep]

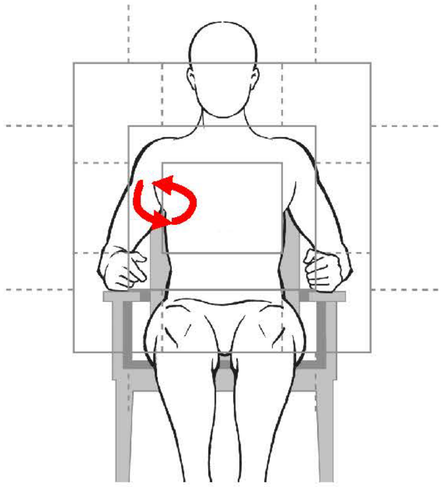
```
7 PCP5: [hhh] uh:: the lamb skin |is on the kitchen table (0.8) the lamb skin? (.)
    Ge    {              [        ▲..............^....^.....^..........     [         ▲............
    Gz    xxxxxxxxxxxxxxxxxxxxxxxx|xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

   CPHI:  xxxxxxxxxxxxxxxxxxxxxxxx|xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
    Gz
```

8 CPHI: (*nods*)

Figure 6.11

Example of Request for Clarification and Repeat Gesture During Repair





1 PCP2: oh well in that case (0.3) I can hear every word they are say[ing¿ and it's really] interesting¿

2 CPHI: ([*laughter*)]

3 PCP2: (0.8) I think it is actually a loop¿
Ge { [▲_______________________________
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

4 CPHI: a group=

5 PCP2: =a loop (.) because (0.6) I keep hearing the same HOWEVER come up in the background¿=
Ge _ ______________[▲.....................................^ [▲ ^ ^ }
Gz xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

CPHI: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Gz

6 CPHI: =however?=

7 PCP2: however yeah

6.3 Discussion

Quantitative data and qualitative commentary on the conversation and narrative samples conducted in background noise compared to those conducted in quiet were presented in this chapter to explore the impact of noise on the patterns of gesture production of the PCPs with their CPHI and their CPNH.

As reported in Chapter 5 on the interactions in quiet, there was considerable variability in the gesture rates between participants in the presence of background noise. Overall PCP speaker gesture rates, and in particular imagistic gesture rates, were higher in narratives than in free conversations. However, no association was apparent between these overall gesture rates and the hearing status of the listener.

A comparison of PCP gesture rates in quiet and in noise with each CPHI and CPNH revealed higher overall gesture rates in the noise samples when compared to the quiet samples in most cases. This finding suggests that noise had an impact on the PCP gesture rates with both CPNH and CPHI. However, comparison of gesture rates in noise between the CPHI and the CPNH in individual cases did not show a consistent pattern. In only two cases did PCPs show a substantially higher total gesture rate with their CPHI in conversation. In the other cases small differences were found in the opposite direction. Imagistic gesture rates showed the same pattern. In narrative PCPs showed essentially no difference or small differences (i.e., of less than three gestures per 100 words) between the two CPs. Imagistic gesture rates in narrative also showed essentially no or minimal differences between the CPHI and the CPNH.

As discussed in Chapter 2, it might be expected that PCPs increase their gesture production under more difficult listening conditions to increase visual information due to the potential reduction in accessible auditory cues for a listener, particularly in the presence of an individual with HI. The current findings indicate that the introduction of background noise did tend to lead to an increase in speakers' gesture rates with both CP types. That is, the noise was perhaps the more critical variable than the listeners' hearing status. When comparing gestures rates two cases demonstrated considerably higher PCP gesture rates with the CPHI than with the CPNH in conversation. However, in most interactions no substantial differences between gesture rates with the CPHI and the CPNH were found. Taken together, these results suggest that speakers may increase their gesture rate in response to adverse listening conditions but that the hearing status of a listener may not necessarily have a differential impact on gesture rate.

Findings for gesture type proportions were the same as those in quiet, namely imagistic and interactive gestures were the predominant gesture types. In most interactions PCPs did not substantially alter the proportions by type in quiet compared to noise with their CPHI or their

CPNH. Furthermore, proportions of imagistic gestures produced by PCPs in noise did not show substantial differences with their CPHI compared to their CPNH in conversation or in narrative.

As reported in Chapter 5, there are few investigations which have reported proportions of gesture by type. Studies that introduce background noise have been experimental in nature, focus on a specific gesture type (frequently iconic gestures) and on gesture perception rather than production (e.g., Drijvers et al., 2017; Drijvers et al., 2018a; Holle et al., 2010; Rogers, 1978).

The present study is distinctive in terms of the categorization and analysis of gesture type proportions in both free conversations and in narratives. The quantitative analysis presented here suggests that PCPs do not alter the proportion of gesture types produced in the presence of background noise but continue to produce predominantly imagistic and interactive gestures in similar proportions in quiet and noise. Moreover, the hearing status of their CP did not appear to alter this pattern.

Comparisons of gesture size between PCPs' gestures in quiet and in noise did not reveal a consistent pattern of difference when interacting with either their CPNH or their CPHI. There were interactions during which a higher proportion of large gestures were produced by PCPs in noise than in quiet. However, the opposite was also found in other interactions with a higher proportion of small gestures produced in noise than in quiet. There were also interactions where or no substantial difference in size proportions was found.

Comparisons of gesture size between interactions with either the CPHI or the CPNH as listeners showed a higher proportion of larger size gestures produced with the CPHI than with the CPNH in two narratives. This suggests that some individuals may produce larger gestures with their CPHI compared to their CPNH in the presence of background noise. It should be noted that a similar pattern was seen in the same two PCP participants in quiet (see Section 5.2.3.1). This suggests that some individuals may produce larger gestures with their CPHI than with their CPNH independent of presence of background noise. There are few existing research findings to compare the current findings with as it is only recently that the impact of noise on gesture size been explored (see Chapter 8 for further details).

The findings of the current study (although limited) may suggest that the presence of a HI may have a more pronounced impact on gesture size than the presence of noise. However, the comparisons described were for the narrative only. When considering analysis of conversations, it is important to consider the influence of factors, such as the nature of the content portrayed by a speaker, shared knowledge, or motivation of the interlocuters.

The analysis of gaze in the presence of noise revealed that the predominant gaze direction during PCP imagistic gesture production was toward the CPHI and the CPNH in all interactions. This was also the case in the quiet condition. Comparisons between the CPHI and CPNH as listeners in the noise samples did not show substantial differences in gaze direction proportions, and gaze at CP remained the highest proportion with both CPs. In the within CP comparisons between quiet and noise conditions, a frequently occurring pattern was PCPs producing a higher proportion of gestures with gaze directed at the listener (CPHI or CPNH) in noise than in quiet. This suggests that the presence of noise had an impact on gaze orientation of PCPs as speaker during gesture production.

Overall, these findings show that in the presence of noise, speakers continued with a high frequency of gaze directed at their CP during gesture production independent of hearing status of the CP as listener. The findings also suggest that speakers may demonstrate a higher proportion of gaze-at-CP gestures when background noise is present than in quiet conditions (and a corresponding decrease in the gaze at gesture). Thus, the hearing status of the CP (CPNH or CPHI) did not appear to have a differential impact on the PCP gesture associated gaze behaviour in the presence of background noise.

Although prior research has explored gaze as a communication and social behaviour (Bavelas et al., 2002; Goodwin, 1980), the impact of noise on gaze orientation has not been previously investigated. Nevertheless, Skelt's (2006, 2010) conversation analytic study of the impact of HI on dyadic conversations including gaze orientation provides some insights relevant to the current study (see Chapter 8).

The qualitative observations reported earlier in this chapter indicate that CPs, regardless of hearing status, typically found the background noise unpleasant and reported that it had a negative impact on their ease of interaction. Comments by PCPs and CPHIs during the free conversations highlighted an awareness not only of hearing difficulties imposed by the presence of background noise but the benefits of visual speech cues, referred to as lipreading.

Communication during the interaction samples appeared to flow without frequent breakdowns in communication. However, during repair of misunderstandings some patterns began to emerge. For example, when a CPHI requested a clarification, a repetition of the talk was a frequent response. When the principal talk was not accompanied by gesture the repeat which followed did not typically include a gesture. There are a couple of examples when a verbal repetition was unsuccessful in communicating the intended message, and a gesture was produced during a second repair attempt. These observations raise the questions about how and which gestural or verbal strategies PCPs implement in interactions in the presence of background noise and are discussed in Chapter 8.

Together the qualitative and quantitative results in this chapter and the preceding chapter provide some insights into the impact of HI and noise on gesture production of participants with both their CPHI and their CPNH. The fourth and final independent variable explored in the current study is the type of conversational activity.

As mentioned in the preceding chapters, gesture production rates were found to be higher in narrative than in conversation. Narratives have been used frequently in the study of gesture as have experimental designs using referential communication tasks. However, except for the considerable and ground-breaking work of Kendon (1972; 1980; 2004) and McNeill (1992), natural unconstrained conversations have received less attention. The use of a narrative task and the ecologically valid free conversation in the current study provides an opportunity to investigate how gesture behaviours might differ between these interaction types. Thus, the results examining the impact of free conversation versus narrative on gesture production of the normally hearing PCPs with their CPHI and their CPNH in both quiet and noise are presented in the next chapter.

7 THE EFFECT OF TASK TYPE ON GESTURE: NARRATIVE AND CONVERSATION

This chapter presents the results about the impact of interaction type on speaker PCPs' gesture production. Conversational activities may be considered to belong to different types or categories (e.g., phatic [social], planning or monologue (Malinowski, 1923) or on a continuum from small talk to formal (institutional) interviewing (Hakulinen, 1999). Clark (1996) described conversations as demonstrating three main characteristics: (a) the presence of active interlocuters who carry out (b) a collaborative activity (c) with a shared goal or purpose. Interlocuters work together to define the beginning and end and the timing of their actions during their spontaneous interaction (Clark 1996).

Gesture frequency has been found to differ between narrative task types. For example, Feyereisen and Havard (1999) found that descriptions of a physical activity or *procedural narrative* (e.g., wrapping a gift) were associated with a higher frequency of representational (primarily iconic gestures) than the description of a visual scene. Cocks, et al. (2007) compared tasks including comic strip narrations, *talking about personal information personal narrative* description of personal information and events associated with positive or negative emotions in addition to procedural narratives. Findings showed higher rates of representational gestures (iconic and pantomime) in procedural narratives than other narrative types in non-brain damaged/ control participants.

Two tasks were used in the current investigation in which participants were seated and interacted face-to-face. The first was free conversation during which participants were asked to converse as they would in their everyday environment about any topics that might spontaneously arise. Although the task maintains a high level of ecological validity, each conversation evolved differently and varied considerably in content. The second task used in this investigation was a story-narrative task with the goal that the PCP would spontaneously narrate in detail a story presented to them in a short film viewed immediately prior. There were no other constraints placed on either speaker or listener, hence fulfilling Clark's criteria as a conversation activity. The investigator is aware of only one published case study in which free conversation versus narrative is used to compare gesture behaviours across task types, involving the same interlocuters. Stam (2016) used a cartoon film narrative and an oral proficiency task, approximating a natural/free conversation involving an advanced English learner and experienced interviewer. Findings showed that the English learner produced more gestures per spoken clause and a higher proportion of iconic gestures in the narrative than in the conversation task (Stam, 2016).

The results presented in this chapter focus on the independent variable of conversation type. Gesture patterns in conversation and in narrative in quiet and in background noise were analysed in terms of (a) the frequency with which gestures occur, (b) the emic characteristics of gestures' function or meaning, (c) the etic or physical qualities of imagistic gestures' size, and d) gaze direction during imagistic gesture production.

The specific research questions addressed in this chapter in reference to the gestures produced by PCPs 2-7 in free conversations versus narrative with CPNH and CPHI are:

3.1.(a) Do gesture rates differ between conversations and narratives in quiet?

3.1.(b) Do gesture rates differ between conversations and narratives in the presence of background noise?

3.2.(a) Do the proportions of different gesture types differ between conversations and narratives in quiet?

3.2.(b) Do proportions of different gesture types differ between conversations and narratives in the presence of background noise?

3.3.(a) Does the size of imagistic (iconic and metaphoric) gestures differ between conversations and narratives in quiet?

3.3 (b) Does the size of imagistic (iconic and metaphoric) gestures differ between conversations and narratives in the presence of background noise?

3.4.(a) Do gaze direction patterns during imagistic gesture production differ between conversations and narratives in quiet?

3.4.(b) Do gaze direction patterns during imagistic gesture production differ between conversations and narratives in the presence of background noise?

7.1 Method

7.1.1 Participants

The case study triads (Cases 2–7) comprised the same participants described in earlier chapters (see Table 3.1, Section 5.2.1, and Appendix X). Each triad comprised a normally hearing participant (PCP2–7) and two familiar CPs, one with HI (CPHI) and one with normal hearing (CPNH). Within each triad there were two dyads. The first dyad consisted of the PCP and their CPHI and the second, PCP and their CPNH.

7.1.2 Procedure

The method in this chapter follows that described in Chapters 3 and 5. Each dyad participated in two interactional tasks in the same order. The first task was free conversation and the second was a narrative. During both interactional tasks, periods of quiet were interspersed with periods of background multi-speaker noise. As outlined previously, the loudest available noise period in each interaction was selected for analysis. As a result, the background noise in the conversation samples was louder (70dBA) than in the narrative samples (60dBA) due to the shorter duration of the narratives. (see Section 3.4.2.6 and Section 6.1.2).

7.1.3 Transcription and Analysis

As before, the analysis included comparisons of gesture frequency, type, imagistic gesture size and associated gaze direction during the free conversation and the narrative each occurring in quiet and noise.

7.2 Results

7.2.1 Gesture Frequency

The research questions addressed in this section are:

3.1.(a) Do gesture rates differ between conversations and narratives in quiet?

3.1.(b) Do gesture rates differ between conversations and narratives in the presence of background noise?

As before, the number of gestures produced per 100 spoken words was calculated for each CP (PCPs 2–7) for total gestures (excluding beats) and for imagistic gestures in conversation and narratives with CPNH and CPHI (see Table 7.1). The highlighted columns show the gesture rates in free conversation and narratives.

7.2.1.1 Gesture Rates in Conversation versus Narrative in Quiet

As seen in Table 7.1, total gesture rates in the conversations ranged from 1.08 (Case 7 CPHI) to 9.85 gestures per 100 words (Case 4 CPHI). Imagistic rates ranged from 0.56 (Case 7 CPNH) to 5.69 (Case 6 CPNH). Total gesture rates in the narrative ranged from 3.40 (Case 7 CPHI) to 16.00 gestures per 100 words (Case 6 CPHI). Imagistic rates ranged from 2.49 (Case 7 CPNH) to 8.02 (Case 2 CPNH).

To investigate the effect of task type on total and imagistic gesture rates, differences between rates in conversation and narratives in quiet were calculated (see Table 7.2). Total gesture and imagistic gesture rates were higher in the narrative than during conversation in all cases. Total gesture rate differences ranged from 0.33 (Case 3) to 11.61 (Case 6) with CPHI and from 1.21 (Case 7) to 8.64 (Case 2) with CPNH. The largest difference in total gesture rates was 11.31 (Case 6 CPHI). That is, PCP6 produced 11.31 gestures per 100 words more in the narrative than in conversation. Small differences of 0.33 (Case 3) and 0.46 (Case 4) were found with CPHI indicating a negligible difference in total gesture rates between respective narrative and conversations.

The imagistic gesture rate differences ranged from 0.58 (Case 4) to 5.54 (Case 2) with CPHI and 0.76 (Case 6) to 5.89 (Case 2) with CPNH. The largest differences in imagistic gesture rates were 5.54 (Case 2 CPHI) and 5.89 (Case 2 CPNH). That is, PCP2 produced 5.54 and 5.89 more gestures per 100 words when narrating with CPHI and CPNH respectively than when in conversation (see Table 7.2 & Figure 7.1).

Table 7.1

Total Words, Gesture (G) Numbers and Total and Imagistic (IM) Gesture Rates in Conversations (C) and Narrative (Na) With CPNH (NH) and CPHI (HI) in Quiet (Q) and Noise (N)

Case		2				3				4				5				6				7			
	Task	C		Na		C		Na		C		Na		C		Na		C		Na		C		Na	
		NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI
Total words	Q	421	256	511	328	330	592	278	303	350	538	269	223	449	188	304	299	492	277	248	225	356	461	241	265
	N	344	325	-	-	412	515	277	351	394	377	273	234	379	352	339	277	298	250	263	234	353	466	194	202
Total G	Q	18	18	66	44	15	43	24	23	7	53	23	23	29	9	31	35	42	13	39	36	9	5	9	9
	N	10	34	-		12	52	28	27	32	23	32	34	37	26	53	49	31	13	43	38	15	34	11	11
Total G rate	**Q**	**4.28**	**7.03**	**12.92**	**13.41**	**4.55**	**7.26**	**8.63**	**7.59**	**2.00**	**9.85**	**8.55**	**10.31**	**6.46**	**4.79**	**10.20**	**11.71**	**8.54**	**4.69**	**15.73**	**16.00**	**2.53**	**1.08**	**3.73**	**3.40**
	N	**2.91**	**10.46**	**-**	**-**	**2.91**	**10.10**	**10.11**	**7.69**	**8.12**	**6.10**	**11.72**	**14.53**	**9.76**	**7.39**	**15.63**	**17.69**	**10.40**	**5.20**	**16.35**	**16.24**	**4.25**	**7.30**	**5.67**	**5.45**
Total IM	Q	9	3	41	22	6	20	17	18	3	21	17	10	13	6	26	19	28	9	16	17	2	3	6	7
	N	5	16	-	-	6	22	20	22	11	8	22	16	26	15	30	29	17	4	25	23	8	15	8	7
Total IM Rate	**Q**	**2.14**	**1.17**	**8.02**	**6.71**	**1.82**	**3.38**	**6.12**	**5.94**	**0.86**	**3.90**	**6.32**	**4.48**	**2.90**	**3.19**	**8.55**	**6.35**	**5.69**	**3.25**	**6.45**	**7.56**	**0.56**	**0.65**	**2.49**	**2.64**
	N	**1.45**	**4.92**	**-**	**-**	**1.46**	**4.27**	**7.22**	**6.27**	**2.79**	**2.12**	**8.06**	**6.84**	**6.86**	**4.26**	**8.85**	**10.47**	**5.70**	**1.60**	**9.51**	**9.83**	**2.27**	**3.22**	**4.12**	**3.47**

Note. Light highlighted columns show results for CPNH (C & Na) and dark highlighted columns show results for CPHI (C & Na).

Table 7.2

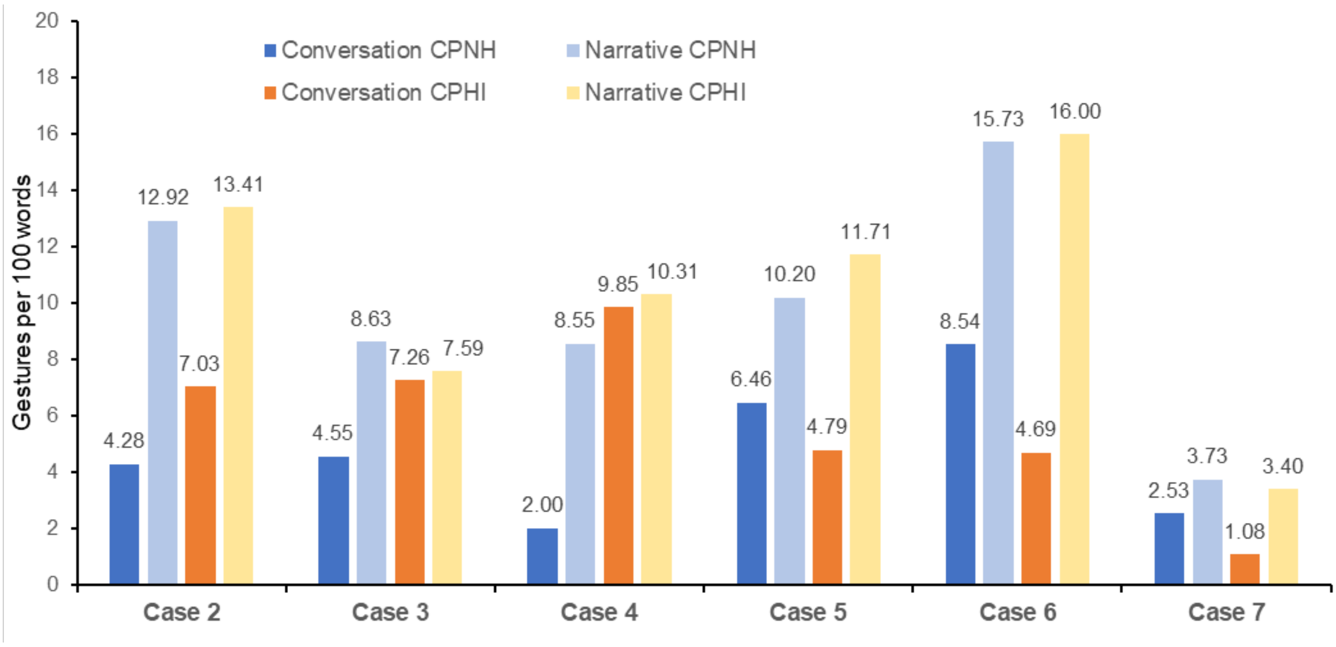
Differences in PCP Gesture Rates between Conversation (C) and Narrative in Quiet (Q) and in Noise (N) with CPHI and CPNH

Case		2	3	4	5	6	7
Total G-rate							
CPHI	**Q**	6.38	0.33	0.46	6.92	11.31	2..31
	N	-	-2.40	8.43	10.30	11.04	-1.85
CPNH	**Q**	8.64	4.09	6.55	3.74	7.19	1.21
	N	-	7.20	3.60	5.87	5.95	1.42
Imagistic G-rate							
CPHI	Q	5.54	2.56	0.58	3.16	4.31	1.99
	N	-	2.00	4.72	6.21	8.23	0.25
CPNH	Q	5.89	4.30	5.46	5.66	0.76	1.93
	N	-	5.76	5.27	1.99	3.80	1.86

Note. Gesture rate differences were calculated by subtracting the rate in the conversation from the rate in the narrative. A positive difference indicates that the gesture rate was higher in the narrative. A negative difference indicates that the gesture rate was higher in the conversation.

Figure 7.1

Gesture Rates in Conversation and Narrative in Quiet With CPNH and CPHI



Small differences of 0.58 (Case 4 CPHI) and 0.76 (Case 6 CPNH) indicate negligible differences in gesture rates between the narrative and conversation. In summary as illustrated in Figure 7.1, the results show that total and imagistic gesture rates in the narratives were higher than in conversation in quiet in all cases. In some cases, these differences were, however, very small (less than one gesture per 100 words).

7.2.1.2 Gesture Rates in Conversation versus Narrative in Noise

As seen in Table 7.1, total gestures rates in the conversation ranged from 2.91 (Case 2 & 3 CPNH) to 10.46 gestures per 100 words (Case 2 CPHI). Imagistic gesture rates ranged from 1.45 (Case 2 CPNH) to 6.86 (Case 5 CPNH). Total gesture rates in the narrative ranged from 5.45 (Case 7 CPHI) to 17.69 gestures per 100 words (Case 5 CPHI). Imagistic gesture rates ranged from 3.47 (Case 7 CPHI) to 10.47 (Case 5 CPHI).

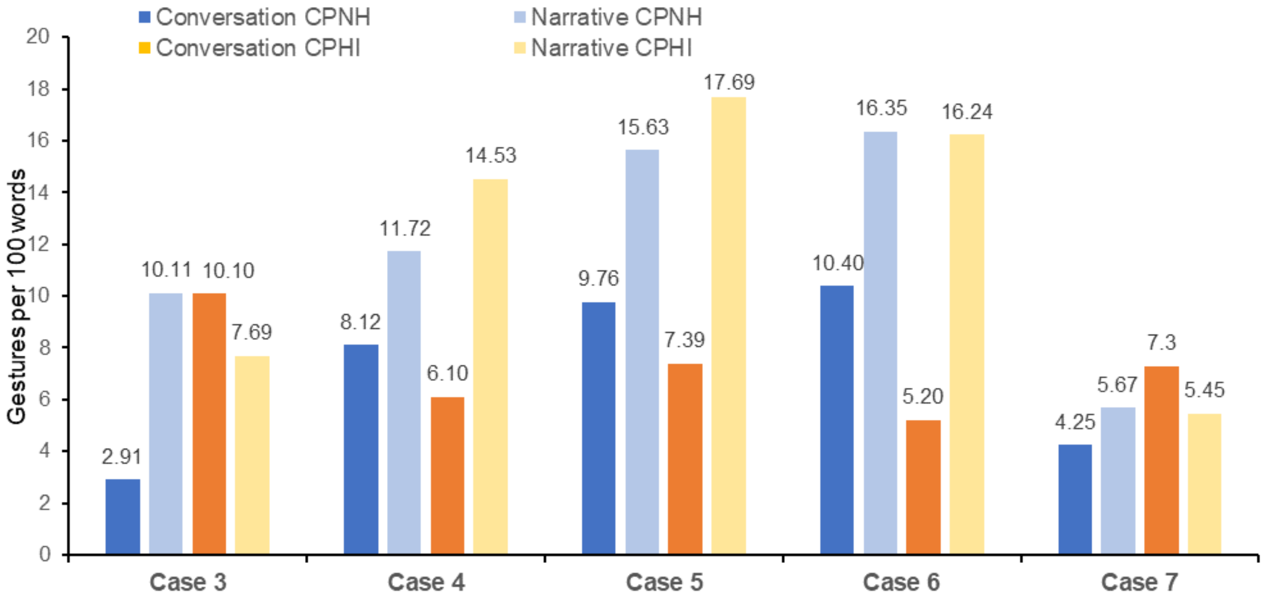
To investigate the effect of conversational task type on total and imagistic gesture rates in noise, differences between rates in conversation and narratives were calculated (see Table 7.2). Total gesture rates were higher in narrative than in conversation for Cases 3–7 with the CPNH and Cases 4, Case 5, and Case 6 with the CPHI. The total gesture rate differences in these cases ranged from 8.43 (Case 4) to 11.04 (Case 6) with CPHI and from 1.42 (Case 7) to 7.20 (Case 3) with CPNH. The largest difference in total gesture rates was 11.04 (Case 6 CPHI). That is, PCP6 produced 11.04 more gestures per 100 words in narrative than in conversation. The exceptions to this pattern were Case 3 and Case 7 where the total gesture rates with CPHI were 2.4 gestures and 1.85 gestures higher in conversation than narrative. By contrast, in quiet, the difference between PCP3 gesture rates in conversation and narrative was negligible whereas PCP7's total gesture rate with their CPHI was 2.31 gestures higher in narrative than in conversation (see Section 7.2.1.1).

Imagistic gesture rates were higher in narrative than in conversation in all interactions with both the CPHI and CPNH. The imagistic gesture rate differences ranged from 0.25 (Case 7) to 8.23 (Case 6) with CPHI and 1.86 (Case 7) to 5.76 (Case 3) with CPNH. The largest difference in imagistic gesture rates was 8.23 (Case 6 CPHI). That is, PCP6 produced 8.23 more gestures per 100 words with CPHI in narrative than in conversation. The smallest and only difference under one gesture was 0.25 (Case 7 CPHI), indicating a negligible difference in gesture rates between narrative and conversation in noise.

Overall, as illustrated in Figure 7.2, the results show that in all cases in quiet and most cases in noise, the total and imagistic gesture rates in the narratives were higher than in the conversations. In some cases, these differences were, however, very small (less than one gesture per 100 words). There were two instances in noise (Case 3 and Case 7 with CPHI) where the gesture rate was lower in the narrative than the conversation.

Figure 7.2

Gesture Rates in Conversation and Narrative in Noise With CPNH and CPHI



7.2.2 Gesture Type Frequency

The research questions addressed in this section are:

3.2.(a) Do gesture type proportions differ between conversations and narratives in quiet?

3.2.(b) Do proportions of different gesture types differ between conversations and narratives in the presence of background noise?

As in previous results chapters, proportions of gesture by type (excluding beats) were calculated for each of the six categories (iconic, metaphoric, deictic abstract, deictic concrete, interactive, and emblems) and for imagistic (iconic and metaphoric gestures combined). The results are presented in Table 7.3. Imagistic gestures and interactive gestures were the predominant gesture types in interactions with both CPHI and CPNH. The next stage of the analysis therefore focused on imagistic and interactive gestures.

7.2.2.1 Gesture Type: Narrative versus Conversation in Quiet

As reported in Chapter 5 and seen in Table 7.3, in the conversation task, the highest proportions of gestures by type were imagistic and interactive gestures produced during the quiet samples. In Cases 3–6 with the CPHI and CPNH, Case 2 with the CPNH, and Case 7 with the CPHI, the highest proportion by gesture type was imagistic gestures ranging from 39.62% (Case 4 CPHI) to 69.23% (Case 6 CPHI).

Table 7.3

Gesture (Ge) Type Numbers and Proportions in Conversation (C) and Narrative (Na) With CPNH (NH) and CPHI (HI) in Quiet (Q) and in Noise (N)

Case		2				3				4				5				6				7			
		C		Na[g]		C		Na		C		Na		C		Na		C		Na		C		Na	
		NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH %(n)	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI
Total Ge	Q	18	18	66	44	15	43	24	34	7	53	23	23	29	9	31	35	42	13	39	36	9	5	9	9
	N	10	34	-	-	12	52	28	27	32	23	32	34	37	26	53	49	31	13	43	38	15	34	11	11
Iconic	Q	%(n) 16.67 (3)	11.11 (2)	56.06 (19)	43.18 (37)	%(n) 20.00 (3)	39.53 (17)	66.67 (16)	73.91 (17)	%(n) 28.57 (2)	22.64 (12)	73.91 (17)	39.13 (9)	%(n) 13.79 (4)	44.44 (4)	51.61 (16)	48.57 (17)	%(n) 59.52 (25)	53.85 (7)	30.77 (12)	41.67 (15)	%(n) 11.11 (1)	60.00 (3)	66.67 (6)	66.67 (6)
	N	50.00 (5)	47.06 (16)	-	-	25.00 (3)	30.77 (16)	64.29 (18)	70.37 (19)	6.25 (2)	13.04 (3)	56.25 (18)	47.06 (16)	56.76 (21)	46.15 (12)	47.17 (25)	51.02 (25)	48.39 (15)	7.69 (1)	41.86 (18)	39.47 (15)	40.00 (6)	41.18 (14)	72.73 (8)	63.64 (7)
Meta[a]	Q	33.33 (6)	5.56 (1)	6.06 (4)	6.82 (3)	20.00 (3)	6.98 (3)	4.17 (1)	4.35 (1)	14.29 (1)	16.98 (9)	0.00	4.35 (1)	31.03 (9)	22.22 (2)	32.26 (10)	5.71 (2)	7.14 (3)	15.38 (2)	10.26 (4)	5.56 (2)	11.11 (1)	0.00	0.00	11.11 (1)
	N	0.00	0.00	-	-	25.00 (3)	11.54 (6)	7.14 (2)	11.11 (3)	28.13 (9)	21.74 (5)	12.50 (4)	0.00	13.51 (5)	11.54 (3)	9.43 (5)	8.16 (4)	6.45 (2)	23.08 (3)	16.28 (7)	21.05 (8)	13.33 (2)	2.94 (1)	0.00	0.00
Total IM[b]	Q	**50.00 (9)**	**16.67 (3)**	**62.12 (41)**	**50.00 (22)**	**40.00 (6)**	**46.51 (20)**	**70.83 (17)**	**78.26 (18)**	**42.86 (3)**	**39.62 (21)**	**73.91 (17)**	**43.48 (10)**	**44.83 (13)**	**66.67 (6)**	**83.87 (26)**	**54.29 (19)**	**66.67 (28)**	**69.23 (9)**	**41.03 (16)**	**47.22 (17)**	**22.22 (2)**	**60.00 (3)**	**66.67 (6)**	**77.78 (7)**
	N	**50.00 (5)**	**47.06 (16)**	**-**	**-**	**50.00 (96)**	**42.31 (22)**	**71.43 (20)**	**81.48 (22)**	**34.38 (11)**	**34.78 (8)**	**68.75 (22)**	**47.06 (16)**	**70.27 (26)**	**57.69 (15)**	**56.60 (30)**	**59.18 (29)**	**54.84 (17)**	**30.77 (4)**	**58.14 (25)**	**60.53 (23)**	**53.33 (8)**	**44.12 (15)**	**72.73 (8)**	**63.64 (7)**
Deictic Ab[c]	Q	0.00	11.11 (2)	7.58 (5)	9.09 (4)	20.00 (3)	13.95 (6)	8.33 (2)	8.70 (2)	0.00	15.09 (8)	13.04 (3)	26.09 (6)	3.45 (1)	11.11 (1)	3.24 (1)	14.29 (5)	9.52 (4)	0.00	17.95 (7)	8.33 (3)	22.22 (2)	20.00 (1)	33.33 (3)	22.22 (2)
	N	0.00	2.94 (1)	-	-	25.00 (3)	15.38 (8)	10.71 (3)	0.00	12.50 (4)	0.00	12.50 (4)	8.82 (3)	8.11 (3)	19.23 (5)	5.66 (3)	2.04 (1)	16.13 (5)	0.00	9.30 (4)	10.53 (4)	13.33 (2)	17.65 (6)	18.18 (2)	9.09 (1)
Deictic C[d]	Q	0.00	11.11 (2)	0.00	0.00	6.67 (1)	2.33 (1)	0.00	0.00	0.00	0.00	0.00	0.00	6.90 (2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N	10.00 (1)	5.88 (2)	-	-	0.00	1.92 (1)	3.57 (1)	3.70 (1)	0.00	4.35 (1)	3.13 (1)	0.00	0.00	0.00	0.00	4.08 (2)	0.00	15.38 (2)	0.00	0.00	0.00	5.88 (2)	0.00	0.0

Case		2				3				4				5				6				7			
		C		Na [g]		C		Na		C		Na		C		Na		C		Na		C		Na	
		NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH %(n)	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI
Inter [e]	Q	**44.44 (8)**	**61.11 (11)**	**30.30 (20)**	**40.91 (18)**	**26.67 (4)**	**37.21 (16)**	**20.83 (5)**	**8.70 (2)**	**57.14 (4)**	**43.40 (23)**	**13.04 (3)**	**26.09 (6)**	**41.38 (12)**	**22.22 (2)**	**12.90 (4)**	**28.57 (10)**	**23.81 (10)**	**30.77 (4)**	**41.03 (16)**	**44.44 (16)**	**55.56 (5)**	**20.00 (1)**	**0.00**	**0.00**
	N	**40.00 (4)**	**41.18 (14)**	**-**	**-**	**25.00 (3)**	**40.38 (21)**	**14.29 (4)**	**14.81 (4)**	**50.00 (16)**	**56.52 (13)**	**15.63 (5)**	**41.18 (14)**	**18.92 (7)**	**23.08 (6)**	**37.74 (20)**	**34.69 (17)**	**29.03 (9)**	**53.85 (7)**	**32.56 (14)**	**26.32 (10)**	**33.33 (5)**	**32.35 (11)**	**9.09 (1)**	**27.27 (3)**
Embl [f]	Q	5.56 (1)	0.00	0.00	0.00	6.67 (1)	0.00	0.00	4.35 (1)	0.00	1.89 (1)	0.00	4.35 (1)	3.45 (1)	0.00	0.00	2.86 (1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	N	0..00	2.94 (1)	-	-	0.00	0.00	0.00	0.00	3.13 (1)	4.35 (1)	0.00	2.94 (1)	2.70 (1)	0.00	0.00	0.00	0.00	0.00	0.00	2.63 (1)	0.00	0.00	0.00	0.00

Note. Light highlighted columns show results for CPNH (C & Na) and dark highlighted columns show results for CPHI (C & Na).

[a] Meta = metaphoric. [b] IM = iconic and metaphoric gestures = imagistic. [c] Deictic Ab= deictic abstract. [d] Deictic C = deictic concrete. [e] Inter = interactive.

[f] Embl=emblem. [g] Case 2 narrative was conducted in quiet only.

In Case 2 with the CPHI and Case 7 with the CPNH the highest proportions were interactive gestures at 61.11% and 55.56% followed by imagistic at 16.67% and 22.22% respectively. Imagistic gestures were the highest proportion in all interactions in the narrative and ranged from 41.03% (Case 6) to 83.87% (Case 5) with the CPNH and from 43.48% (Case 4) to 78.26% (Case 3) with the CPHI.

The proportion of imagistic gestures was higher in narrative than in conversation in Case 2, Case 3, Case 4, and Case 7 with both the CPHI and CPNH; and in Case 5 with the CPNH. The differences ranged from 12.12% (Case 2 CPHI) to 44.44% (Case 7 CPNH) higher in the narrative. The proportion of interactive gestures was higher in conversation than in narrative in Cases 2, Case 3, Case 4, and Case 7 with both CPHI and CPNH); and in Case 5 with the CPNH. The differences ranged from 14.14% (Case 2 CPHI) to 55.56% (Case 7 CPNH). By contrast, in Case 5 and Case 6 with the CPHI and Case 6 with the CPNH the proportion of imagistic gestures was higher in conversation than narrative with the differences being 12.38%, 22.0%, and 25.64% respectively, and the proportion of interactive gestures was higher in narrative with the differences being 6.35%, 13.68%, and 17.22% respectively.

As discussed in Chapter 5, the CPHI in Case 5 produced long periods of talk while PCP5 made only an occasional comment and produced few (*n*=9) gestures in conversation relative to the number made in the narrative task (*n*=35). Similarly, PCP6 produced a total of 13 gestures in conversation in contrast to 36 gestures in narrative with their CPHI in quiet. The small numbers inflate the proportional value of each gesture and consequently inflate differences in relation to the narratives with larger numbers. This is a possible explanation for the differences in proportions of imagistic gestures produced by PCP5 and PCP6 found in conversation compared to narrative.

7.2.2.2 Gesture Type: Narrative versus Conversation in Noise

As reported in Chapter 6 (see Section 6.2.2) and seen in Table 7.3, the highest proportions of gestures by type were imagistic and interactive gestures in conversation in noise. In Case 2, Case 3, Case 5, and Case 7 with the CPHI and CPNH and Case 6 with the CPNH, the highest proportion was imagistic gestures ranging from 42.31% (Case 3 CPHI) to 70.27 % (Case 5 CPNH). The highest proportion was interactive gestures followed by imagistic in Case 4 (CPHI 56.52 % & 34.78% and CPNH 50% & 34.38%) and Case 6 (CPHI 53.85% & 30.77%). Imagistic gestures were the highest proportion for all interactions in the narrative and ranged from 47.06% (Case 4 CPHI) to 81.48% (Case 3 CPHI).

The proportion of imagistic gestures was higher in narrative than conversation in Cases 3, Case 4, Case 6, and Case 7 with CPHI and CPNH and in Case 5 with CPHI. The differences ranged from 1.49 % (Case 5 CPHI) to 39.17 % (Case 3 CPHI) higher in narrative. In parallel the proportion of interactive gestures was higher in conversation than in narrative in Case 3, Case 4, Case 6, and

Case 7 with the CPHI and in Case 3, Case 4, and Case 7 with the CPNH. The differences ranged from 5.08 % (Case 7 CPHI) to 34.38% (Case 4 CPNH).

By contrast, in Case 5 with the CPHI the proportion of interactive gestures was (11.62%) higher in narrative (34.69%) than in conversation (23.08%). The proportion of imagistic gestures produced by PCP5 with the CPNH was (13.67%) higher in conversation than narrative (70.27% & 56.60%) and the proportion of interactive gestures (18.82%) lower in conversation than narrative (18.92% & 37.74%). In Case 6 the proportion of imagistic and interactive gestures produced by PCP6 with the CPNH was marginally higher in narrative (by 3.30% & 3.53%) than conversation.

Overall, these results show that, in most cases, the proportion of imagistic gestures was higher in narrative than in conversation while the proportion of interactive gestures was higher in conversation than narrative in both quiet and noise (see Figures 7.3 and 7.4).

Figure 7.3

Proportions of Imagistic Gestures in Conversation and Narrative in Quiet With CPNH and CPHI

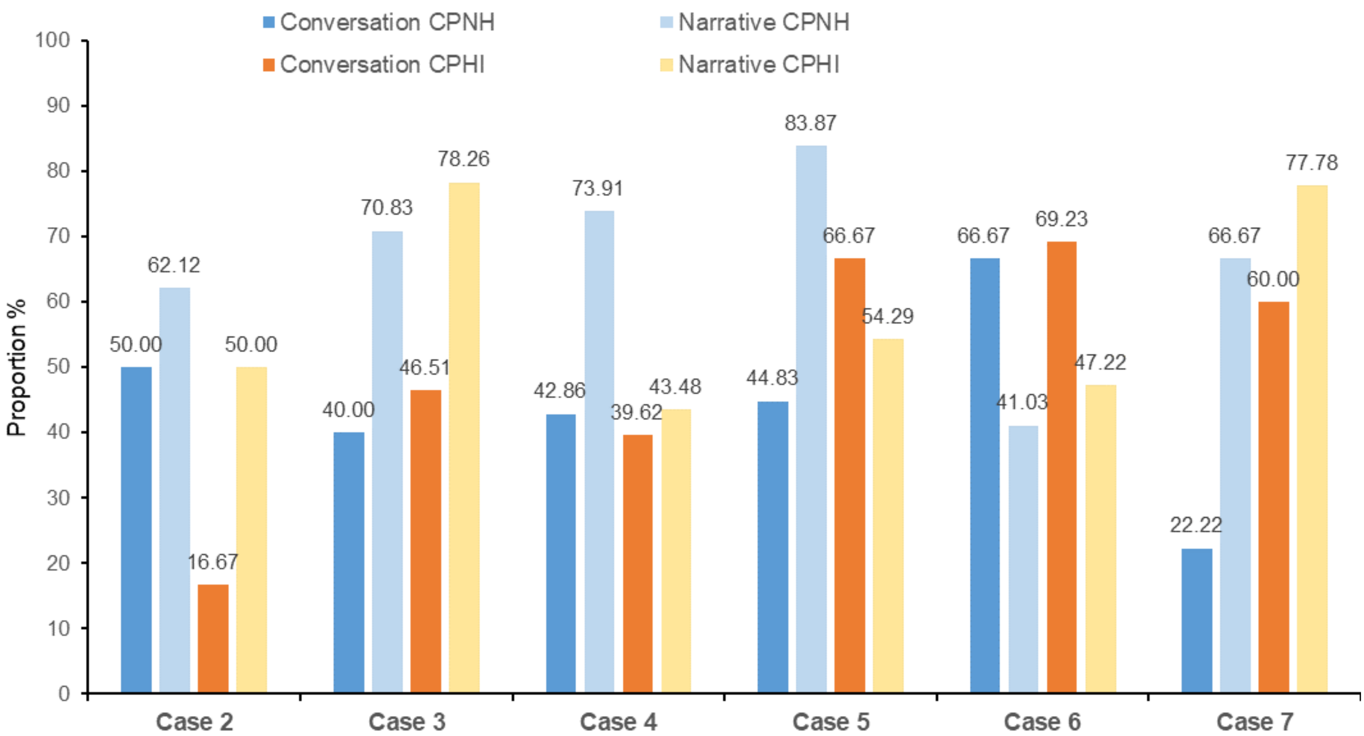
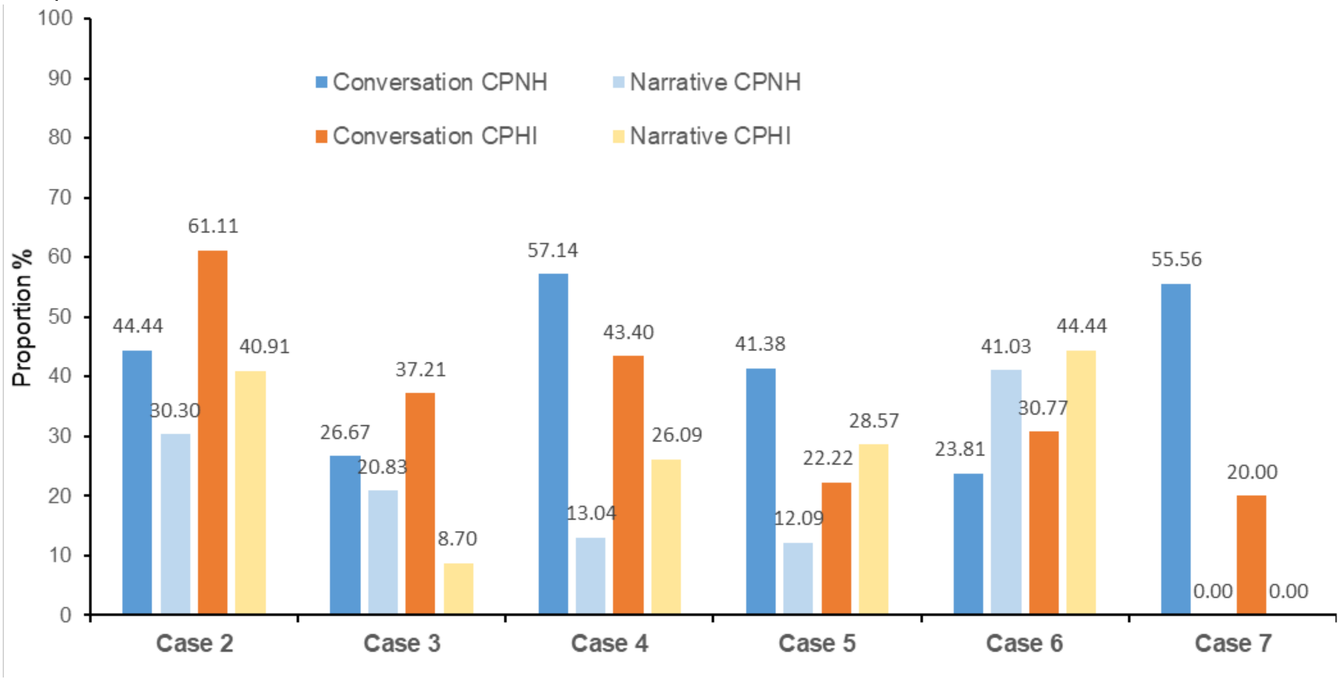


Figure 7.4

Proportions of Interactive Gestures in Conversation and Narrative in Quiet With CPNH and CPHI



This suggests that as anticipated when narrating, speakers produced a high proportion of imagistic gestures, particularly iconics, portraying the semantic content and action of the story. The results also suggest that the distribution of gesture types was not influenced by the setting (quiet versus noise) or the hearing status of the CP.

7.2.3 Gesture Characteristics – Gesture Size

The research questions addressed in this section are:

3.3.(a) Does the size of imagistic (iconic and metaphoric) gestures differ between conversations and narratives in quiet?

3.3.(b) Does the size of imagistic (iconic and metaphoric) gestures differ between conversations and narratives in the presence of background noise?

As described in Section 3.6, each gesture was categorised according to the number of borders crossed during the performance of the stroke. Gesture size proportions of the total imagistic gestures were calculated for the three size categories, small, medium, and large and for the combined medium-large category (i.e., one or more gesture space borders crossed) and are presented in Table 7.4. Columns are highlighted to distinguish results in conversation and narrative. To investigate the impact of interactional task type on gesture size, proportions of gesture by size in conversations and narratives were analysed in selected cases presented in the next sections.

Table 7.4

Proportions (%) of Imagistic Gestures by Size in Conversation (C) and Narrative (Na) with CPNH (NH) and CPHI (HI) in Quiet (Q) and in Noise (N)

Case		*2*				*3*				*4*				*5*				*6*				*7*			
Borders	Task	C		Na		C		Na		C		Na		C		Na		C		Na		C		Na	
		NH %(n)	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI	NH	HI
< 1	Q	44.44 (4)	33.33 (1)	36.59 (15)	18.18 (4)	0	30.00 (6)	47.06 (8)	27.78 (5)	0.00	42.86 (9)	17.65 (3)	40.00 (4)	23.08 (3)	83.33 (5)	30.77 (8)	26.32 (5)	41.38 (12)	44.44 (4)	31.25 (5)	25.00 (4)	50.00 (1)	33.33 (1)	33.33 (2)	28.57 (2)
	N	20.00 (1)	18.75 (3)	-	-	33.33 (2)	31.82 (7)	16.67 (3)	36.36 (8)	27.27 (3)	37.5 (3)	31.82 (7)	31.25 (5)	38.46 (10)	40.00 (6)	26.67 (8)	10.34 (3)	29.41 (5)	100 (4)	37.50 (9)	26.09 (6)	0.00	80.00 (12)	25.00 (2)	33.33 (2)
1-2	Q	33.33 (3)	33.33 (1)	31.71 (13)	45.45 (10)	83.33 (5)	60.00 (12)	35.29 (6)	38.89 (7)	0.00	33.33 (7)	58.82 (10)	30.00 (3)	53.85 (7)	0.00 (0)	46.15 (12)	57.89 (11)	37.93 (11)	44.44 (4)	56.25 (9)	50.00 (8)	50.00 (1)	66.67 (2)	33.33 (2)	57.14 (4)
	N	80.88 (4)	56.25 (9)	-	-	50.00 (3)	59.09 (13)	50.00 (9)	50.00 (11)	36.36 (4)	50.00 (4)	50.00 (11)	43.75 (7)	46.15 (12)	40.00 (6)	40.00 (12)	58.62 (17)	47.06 (8)	0.00 (0)	37.50 (9)	43.48 (10)	71.43 (5)	20.00 (3)	75.00 (6)	66.67 (4)
3+	Q	22.22 (2)	33.33 (1)	31.71 (13)	36.36 (8)	16.67 (1)	10.00 (2)	17.65 (3)	33.33 (6)	100 (3)	23.81 (5)	23.53 (4)	30.00 (3)	23.08 (3)	16.67 (1)	23.08 (6)	15.79 (3)	20.69 (6)	11.11 (1)	12.50 (2)	25.00 (4)	0.00	0.00 (0)	33.33 (2)	14.29 (1)
	N	0.00	25.00 (4)	-	-	16.67 (1)	9.09 (2)	33.33 (6)	13.64 (3)	36.36 (4)	12.50 (1)	18.18 (4)	25.00 (4)	15.38 (4)	20.00 (3)	33.33 (10)	31.03 (9)	23.53 (4)	0.00	25.00 (6)	30.43 (7)	28.57 (2)	0.00	0.00	0.00
1-6+	Q	55.56 (5)	66.67 (2)	63.41 (26)	81.82	100 (6)	70.00 (14)	52.94 (9)	72.22 (13)	100 (3)	57.14 (12)	82.35 (14)	60.00 (6)	76.92 (10)	16.67 (1)	69.23 (18)	73.68 (14)	58.62 (17)	55.56 (5)	68.75 (11)	75.00 (12)	50.00 (1)	66.67 (2)	66.67 (4)	71.43 (5)
	N	80.00 (4)	81.25 (13)	-	-	66.67 (4)	68.18 (15)	83.33 (15)	63.64 (14)	36.36 (8)	62.50 (5)	68.18 (15)	68.75 (11)	61.54 (16)	60.00 (9)	73.33 (22)	89.66 (26)	70.59 (12)	0.00	62.50 (15)	73.91 (17)	100 (7)	20.00 (3)	75.00 (6)	66.67 (4)
Total Ge	Q	9	3	41	22	6	20	17	18	3	21	17	10	13	6	26	19	29	9	16	16	2	3	6	7
	N	5	16	-	-	6	22	18	22	11	8	22	16	26	15	30	29	17	4	24	23	7	15	8	6

Note. Light highlighted columns show results for CPNH (C & Na) and dark highlighted columns show results for CPHI (C & N).

7.2.3.1 Gesture Size: Conversation versus Narrative in Quiet

Gesture size was analysed by focusing on cases in which the higher numbers (10–26) of imagistic gestures were produced by PCPs in both narrative and conversation. In Case 3 and Case 4 (CPNH), Case 5 and Case 6 (CPHI), and Case 2 and Case 7 (CPNH & CPHI) the number of imagistic gestures produced in either one or both interactions was low (< 10) and hence comparisons between proportions were considered to be of limited meaning and are not reported here. Thus, Case 3 and Case 4 (CPHI) and Case 5 and Case 6 (CPNH) were selected for further analysis.

Case 3 CPHI: Twenty imagistic gestures were produced by PCP3 in conversation and 18 in narrative. The proportion of medium-size gestures was higher in conversation (60%) than narrative (38.89%), and the proportion of large gestures was lower in conversation (10%) than narrative (33.33%). The differences in proportions by gesture size between conversation and narrative were minimal in small gestures (2.22% higher in conversation) and in medium-large gestures (2.22% higher in narrative). This shows that PCP3 produced a higher proportion of medium-size gestures corresponding with a lower proportion of large gestures with the CPHI in conversation than narrative.

Case 4 CPHI: Twenty-one imagistic gestures were produced by PCP4 in conversation and 10 in narrative. The differences in proportions by size between conversation and narrative were small, ranging from 2.86% to 6.19%, showing a higher proportion of small and medium gestures and a lower proportion of large gestures in conversation than narrative.

Case 5 CPNH: Thirteen imagistic gestures were produced by PCP5 in conversation and 26 in narrative. The differences in proportions by size between conversation and narrative were small ranging from 0% to 7.69% showing a higher proportion of medium and medium-large gestures and a lower proportion of small gestures in conversation than narrative.

Case 6 CPNH: Twenty-one imagistic gestures were produced by PCP6 in conversation and 16 in narrative. The proportion of medium-size gestures was lower in conversation (37.93%) than narrative (56.25%). The proportion of medium-large gestures was also lower in conversation (58.62%) than narrative (68.75%). By contrast, the proportions of small and large gestures were higher in conversation (41.38% & 31.25%) than narrative (20.69% & 12.50%). This shows that PCP6 produced a higher proportion of medium-size gestures and medium-large in narrative than conversation.

In summary, PCP3 produced a higher proportion of large imagistic gestures with their CPHI and PCP6 a higher proportion of medium gestures (and medium-large) with their CPNH in narrative than conversation. The remaining comparisons, PCP4 with their CPHI and PCP5 with their CPNH showed small differences and differing patterns in proportions by gesture size between conversation and narrative.

7.2.3.2 Gesture Size: Conversation versus Narrative in Noise

Gesture size was analysed by focusing on cases in which the higher numbers (11–30) of imagistic gestures were produced by PCPs in both narrative and conversation. In Case 3 (CPNH), Cases 4 and Case 6 (CPHI), and Case 7 (CPNH & CPHI) the number of imagistic gestures produced in either one or both interactions was low (<10). In Case 2 the narrative was conducted in quiet only, so an analysis was not possible (see Section 3.4.2.6). Thus, Case 3 and Case 5 (CPHI) and Case 4, Case 5 and Case 6 (CPNH) were selected for further analysis.

Case 3 CPHI: Twenty-two imagistic gestures were produced by PCP3 in conversation and 22 in narrative. The proportion of medium-size gestures was higher in conversation (59.09%) than narrative (50%) The differences in proportions by gesture size between conversation and narrative were minimal in small and large gestures (4.55% higher in narrative) and for medium-large gestures (4.55% higher in conversation). This shows that PCP3 produced a somewhat higher proportion of medium size gestures in the conversation than narrative with their CPHI.

Case 4 CPNH: Eleven imagistic gestures were produced by PCP4 in conversation and 22 in narrative. The proportion of medium-large gestures was higher in narrative (68.18%) than conversation (36.36%). The proportion of medium-size gestures was also higher in narrative (50%) than conversation (36.36%) and the proportion of large gestures was lower in narrative (18.18%) than conversation (36.36%). The difference in proportions by size in small gestures between conversation (27.27%) and narrative (31.82%) was minimal (4.55% higher in narrative). This means that PCP4 produced a higher proportion of medium and medium-large gestures but a lower proportion of large gestures in narrative than conversation with their CPNH.

Case 5 CPNH: Twenty-six imagistic gestures were produced by PCP5 in conversation and 30 in narrative. The proportion of large gestures was higher in narrative (33.33%) than conversation (15.38%). The proportion of medium-large gestures was also higher in narrative (73.33%) than conversation (61.54%), and the proportion of small gestures was higher in the conversation (38.48%) than in narrative (26.67%). The difference in proportions by medium size between conversation (46.15%) and narratives (40%) was minimal (6.15%). This shows that PCP5 produced a lower proportion of large gestures and medium-large gestures and a higher proportion of small gestures with their CPNH in conversation than in narrative with their CPNH.

Case 5 CPHI: Fifteen imagistic gestures were produced by PCP5 in conversation and 29 in narrative. The proportion of small gestures was higher in conversation (40.00%) than in narrative

(10.34%). By contrast, the proportions of medium-size gestures, medium-large and large gestures were lower in conversation (40.00%, 20.00% ,60.00% respectively) than in narrative (58.62%, 31.03%, 89.68% respectively). This shows that PCP5 produced a lower proportion of medium and large gestures and a higher proportion of small gestures in conversation than narrative with their CPHI.

Case 6 CPNH: Seventeen imagistic gestures were produced by PCP6 in conversation and 24 in narrative. The proportions of medium size and medium-large gestures were higher in conversation (47.08%, 70.59%) than narrative (37.50%, 62.50%), and the proportion of small gestures was lower in conversation (29.41%) than narrative (37.50%). The difference in proportions by size between the conversation (23.53%) and narrative (25%) was negligible for large gestures (1.47% higher in narrative). This shows that PCP6 produced a higher proportion of medium and medium-large gestures and a lower proportion of small gestures in conversation than narrative with their CPNH.

In summary, PCP3 and PCP5 with their respective CPHI and PCP4 and PCP5 with their respective CPNH produced a higher proportion of medium and /or large gestures in narrative than in conversation. A higher proportion of small gestures were produced by PCP5 with their CPNH and CPHI in conversation than narrative. By contrast, PCP6 produced a lower proportion of medium and medium-large gestures and a higher proportion of small gestures in narrative than conversation. Together, these cases showed a trend towards a higher proportion of medium to large gestures to be produced by PCPs in noise in narrative than in conversation. A similar trend was not seen in the quiet samples.

7.2.4 Gaze Direction

The research questions addressed in this section are:

3.4.(a) Do gaze direction patterns during imagistic gesture production differ between conversations and narratives in quiet?

3.4.(b) Do gaze direction patterns during imagistic gesture production differ between conversations and narratives in the presence of background noise?

As described in Section 3.6.4, each gesture produced by PCPs 2–7 was assigned to one of three primary categories: gaze at the gesture, gaze at the CP, and gaze away from CP (at some other point in the room or space). Gaze-direction proportions of the total number of imagistic gestures are presented in Table 7.5. Columns are highlighted to distinguish results in conversation and narrative. As mentioned in previous chapters the results indicate that PCPs' gaze was most frequently directed at the listener with both the CPNH and the CPHI during imagistic gesture. To investigate the impact of interactional task type on gaze direction during imagistic gesture, proportions of gesture by gaze direction in conversations and narratives were analysed in selected cases.

7.2.4.1 Speaker Gaze Direction in Conversation versus Narrative in Quiet

Gaze direction was analysed by focusing on cases in which the higher numbers (10–26) of imagistic gestures produced by PCPs in both conversation and narrative with the CPHI and/or CPNH. In Case 3 (CPNH), Case 5, and Case 6 (CPHI) and Case 2 and Case 7 (CPNH and CPHI) the number of imagistic gestures produced in either one or both interactions was low (<10), hence making comparisons between proportions of limited meaning. Thus, Case 3 and Case 4 (CPHI) and Case 5 and Case 6 (CPNH) were selected for analysis.

Case 3 CPHI: Twenty imagistic gestures were produced by PCP3 in conversation and 18 in narrative. The proportion of gaze at gesture was higher in the narrative (38.89%) than in conversation (20%). The proportions of gaze-at-CP and gaze-away gestures were higher (by 8.89% and 10.00% respectively) in conversation (70.00% & 10.00%) than narrative (61.11% & 0.00%). This shows that PCP3 directed gaze at their CP in a higher proportion and at their own gesture in a lower proportion of gestures in conversation than narrative while interacting with their CPHI.

Case 4 CPHI: Twenty-one imagistic gestures were produced by PCP4 in conversation and 10 in narrative. The proportion of gaze-at-CP gestures was higher in conversation (80.95%) than in narrative (50.00%). The proportion of gaze-away gestures was also higher in narrative (30.00%) than conversation (9.52%) while the proportion of gaze at gesture was lower in conversation (20.00%) than in narrative (20.00%). This shows that PCP4 directed gaze toward their CPHI in a higher proportion and at their own gesture in a lower proportion of gestures in conversation than narrative.

Case 5 CPNH: Thirteen imagistic gestures were produced by PCP5 in conversation and 26 in narrative. The proportion of gaze-at-CP gestures was higher in conversation (92.31%) than in narrative (53.85%). The proportions of gaze-at-gesture and of gaze-away gestures were lower in conversation (7.69% & 0.00%) than narrative (26.92% & 19.23%). This shows that PCP5 directed gaze at their CPNH in a higher proportion of gestures in conversation than narrative. These results also show that PCP5 directed gaze at their own gesture and away (from gestures and their CPNH) in a higher proportion of gestures in narrative than conversation.

Table 7.5

Gaze Direction by Proportion (%) of Total Imagistic Gestures in Conversation (C) and Narrative (Na) With CPNH (NH) and CPHI (HI) in Quiet (Q) and in Noise (N)

Case		*2*				*3*				*4*				*5*				*6*				*7*			
Task		C		Na		C		Na		C		Na		C		Na		C		Na		C		Na	
		NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI	NH %(n)	HI
Ge on stroke	Q	11.11 (1)	0.00	34.15 (14)	13.64 (3)	0.00	15.00 (3)	23.53 (4)	27.78 (5)	0.00	4.76 (1)	23.53 (4)	10.00 (1)	7.69 (1)	16.67 (1)	23.08 (6)	15.79 (3)	6.90 (2)	11.11 (1)	0.00	25.00 (4)	50.00 (1)	0.00	50.00 (3)	57.14 (4)
	N	40.00 (2)	6.25 (1)	-	-	16.67 (1)	0.00	22.22 (4)	27.27 (6)	0.00	0.00	13.64 (3)	6.25 (1)	3.85 (1)	0.00	16.67 (5)	10.34 (3)	5.88 (1)	0.00	8.33 (2)	4.17 (1)	25.00 (2)	20.00 (3)	37.50 (3)	28.57 (2)
Ge on prep	Q	0.00	0.00	2.44 (1)	9.09 (2)	0.00	5.00 (1)	0.00	11.11 (2)	0.00	4.76 (1)	0.00	10.00 (1)	0.00	0.00	3.85 (1)	0.00	10.34 (3)	11.11 (1)	0.00	0.00	0.00	0.00	0.00	0.00
	N	0.00	0.00	-	-	0.00	9.09 (2)	0.00	0.00	0.00	0.00	0.00	12.50 (2)	0.00	0.00	6.67 (2)	3.45 (1)	23.53 (4)	0.00	4.17 (1)	8.33 (2)	0.00	0.00	0.00	14.29 (1)
At Ge total	Q	11.11 (1)	0.00	36.59 (15)	22.73 (5)	0.00	20.00 (4)	23.53 (4)	38.89 (7)	0.00	9.52 (2)	23.53 (4)	20.00 (2)	7.69 (1)	16.67 (1)	26.92 (7)	15.79 (3)	17.24 (5)	22.22 (2)	0.00	25.00 (4)	50.00 (1)	0.00	50.00 (3)	57.14 (4)
	N	40.00 (2)	6.25 (1)	-	-	16.27 (1)	9.09 (2)	22.22 (4)	27.27 (5)	0.00	0.00	13.64 (3)	18.75 (3)	3.85 (1)	0.00	23.33 (7)	13.79 (4)	29.41 (5)	0.00	12.50 (3)	12.50 (3)	25.00 (2)	20.00	37.50 (3)	42.86 (3)
Away	Q	22.22 (2)	0.00	24.39 (10)	0.00	33.33 (2)	10.00 (2)	17.65 (3)	0.00	0.00	9.52 (2)	17.65 (3)	30.00 (3)	0.00	0.00	19.23 (5)	0.00	3.45 (1)	0.00	0.00	6.25 (1)	50.0 (1)	0.00	0.00	0.00
	N	20.00 (1)	0.00	-	-	0.00	9.09 (2)	5.56 (1)	4.55 (1)	0.00	0.00	13.64 (3)	0.00	0.00	0.00	3.33 (1)	13.79 (4)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.29 (1)
At CP	Q	66.67 (6)	100 (3)	39.02 (16)	77.27 (17)	66.67 (4)	70.00 (14)	58.82 (10)	61.11 (11)	100 (3)	80.95 (17)	58.82 (10)	50.00 (5)	92.31 (12)	83.33 (5)	53.85 (14)	84.21 (16)	79.31 (23)	77.78 (7)	100 (16)	68.75 (11)	0.00	100 (3)	50.00 (3)	42.86 (3)
	N	40.00 (2)	93.75 (15)	-	-	83.33 (5)	81.82 (18)	72.22 (13)	68.18 (15)	100 (11)	100 (8)	72.73 (16)	81.25 (13)	96.15 (25)	100 (15)	73.33 (22)	72.41 (21)	70.59 (12)	100 (4)	87.50 (21)	87.50 (21)	75.00 (6)	80.00 (12)	62.50 (5)	42.86 (3)

Note. Light highlighted columns show results for CPNH (C & Na) and dark highlighted columns show results for CPHI (C & Na)

Case 6 CPNH: Twenty-one imagistic gestures were produced by PCP6 in conversation and 16 in narrative. The proportion of gaze-at-CP gestures was higher in narrative (100%) than conversation (79.31%), and the proportion of gaze-at-CP gestures was lower in narrative (0.00%) than conversation (17.24%). The proportions of gaze-away gestures were negligible in conversation (3.45%/ one gesture) and there were none in narrative. This shows that PCP6 directed gaze at their CPNH in a higher and at their own gesture in a lower proportion of gestures in narrative than conversation.

In summary, Case 3, Case 4, and Case 5 show that PCPs directed their gaze toward their CPNH or CPHI in a higher proportion of gestures in conversation than narrative while producing a lower proportion of gestures with gaze directed at their own gesture. In Case 6, however, the opposite pattern was found and PCP6 directed gaze at their CPNH in a lower and at their own gesture in a higher proportion of gestures in conversation than narrative.

7.2.4.2 Speaker Gaze Direction in Conversation versus Narrative in Noise

Gaze direction was analysed by focusing on the cases in which the higher numbers (11–30) of imagistic gestures were produced by PCPs in both narrative and conversation. In Case 3 (CPNH), Cases 4, Case 6 (CPHI), and Case 7 (CPNH & CPHI) the number of imagistic gestures produced in either one or both interactions was low (<10), hence comparisons between proportions were of limited meaning and are not reported here. In Case 2 the narrative was conducted in quiet only so comparisons could not be made. Thus, Case 3 and Case 5 (CPHI) and Case 4, Case 5, and Case 6 (CPNH) were selected.

Case 3 CPHI: Twenty-two imagistic gestures were produced by PCP3 in conversation and 22 in narrative. The proportion of gaze at gesture was higher in narrative (27.27%) than in conversation (9.09%). The proportions of gaze-at-CP and gaze-away gestures were higher in the conversation (81.82% & 9.09%) than narrative (68.18% & 4.55%). This shows that PCP3 directed their gaze at their CPHI in a higher proportion and at their own gesture in a lower proportion of gestures in conversation than narrative.

Case 4 CPNH: Eleven imagistic gestures were produced by PCP4 in conversation and 22 in narrative. The proportion of gaze-at-CP gestures was higher in conversation (100%) than narrative (72.73%). The proportion of gaze-at-gesture and gaze-away gestures was lower in conversation (0.00% & 0.00%) than narrative (13.64% & 13.64%). The proportion of gaze-away gestures was higher in narrative (13.64 %) than conversation (0.00%). This shows that PCP4 directed their gaze at their CPNH in a higher proportion and at their own gesture and away in another direction in a lower proportion of gestures in conversation than narrative.

Case 5 CPNH: Twenty-six imagistic gestures were produced by PCP5 in conversation and 30 in narrative. The proportion of gaze-at-CP gestures was higher in conversation (96.15%) than narrative (73.33%) and the proportion of gaze at gesture was higher in narrative (23.33%) than conversation (3.85%). The proportion of gaze-away gestures was negligible in conversation (0.00%) and narrative (3.33%). This shows that PCP5 directed their gaze at their CPNH in a higher proportion and at their own gesture in a lower proportion of gestures in conversation than narrative.

Case 5 CPHI: Fifteen imagistic gestures were produced by PCP5 in conversation and 29 in narrative. The proportion of gaze at CP gestures was higher in the conversation (100%) than narrative (72.41%%) while the proportion of gaze at gesture was higher in narrative (13.79%) than in conversation (0%). The proportion of gaze away gestures was higher in narrative (13.79%) than conversation (0%). This shows that PCP5 directed their gaze at their CPHI in a higher proportion and at their own gesture in a lower proportion of gestures in conversation than narrative.

Case 6 CPNH: Seventeen imagistic gestures were produced by PCP6 in conversation and 24 in narrative. The proportion of gaze-at-CP gestures was higher in narrative (87.50%) than conversation (70.59%). The proportion of gaze at gesture was higher in conversation (29.41%) than narrative (12.50%). There were no gaze-away gestures produced by PCP6. This shows that PCP6 directed their gaze at their CPNH in a lower proportion and at their own gesture in a higher proportion of gestures in conversation than narrative.

In summary, in Case 3 and Case 5 with the CPHI and Case 4 and Case 5 with the CPNH, PCPs directed their gaze at their CPNH or CPHI in a higher proportion of gestures while producing a lower proportion of gestures with gaze directed at their own gesture in conversation than narrative. In Case 6, however, the opposite was found and PCP6 directed gaze at their CPNH in a lower and at their own gesture in a higher proportion of gestures in conversation than narrative. Across cases the numbers and therefore proportions of gaze-away gestures were small and differences between tasks were negligible or higher in narrative than conversation.

7.3 Discussion

Quantitative data regarding the impact of interactional task type on imagistic gesture production of PCPs 2–7 both in quiet and in noise were presented in this chapter. The results with respect to gesture rates show that total and imagistic gesture rates were higher in most cases (yet very small differences in some cases) in the story narrative than in conversation both in quiet and in noise. This finding is consistent with previous reports that speakers will typically produce imagistic, particularly iconic, gestures while retelling a story, portraying action with limited dialogue, such as the cartoons used by McNeill (1992). This is also in line with Stam’s (2016) case study findings which showed a higher frequency of gestures in narrative that during discourse (proficiency conversation/task).

However, there were two exceptions to these results (Case 7 and Case 3 in interaction with their respective CPHI) in the noise samples, namely that the total gestures rates were higher in conversation than narrative. By contrast, with CPHI in quiet PCP7's total gesture rate was higher (by 2.31 gestures) in narrative than in conversation and the differences in PCP3 gesture rates between conversation and narrative were negligible. As discussed earlier (see Section 3.4.2.6 and Section 6.1.2), the level of background noise during the conversation sample was approximately 10dB louder than during the narrative noise sample. The contrasting results in quiet and noise for these cases might be explained by the level of the noise during the conversation (but not the narrative) being sufficiently high to impact on the gesture production of PCP3 and PCP7 with the CPHI and thus leading to an increase in the total gesture rate.

The highest proportions of gestures by type were imagistic and interactive gestures in conversations whereas imagistic gestures were the largest proportion in all narratives. In most cases the proportion of imagistic gestures was higher in narrative than in conversation in both quiet and noise, while the proportion of interactive gestures was higher in conversation than in the narrative. To the best of the investigator's knowledge (except for Stam, 2016) , these direct comparisons have not been made in previous research in terms of relative frequency of gesture types by interaction type (i.e., story narratives and free conversation). In agreement with the current findings, Stam's (2016) case study participant produced a greater proportion of iconic gestures in narrative than in conversation. The current results also appear consistent with McNeill's (1992) findings that speakers will use larger numbers of particularly iconic gestures during narrative clauses compared to other gesture types (McNeill, 1992). However, there were examples (Case 5 and Case 6), in which the proportion of imagistic gestures was higher and the proportion of interactive gestures lower in conversation than narrative. This suggests that the PCPs may have placed greater reliance on interactive gestures when narrating than when conversing. A possible reason might be that due to the unfamiliar content (reduced common ground), the PCPs used interactive gestures more frequently to seek acknowledgement of understanding from their CP.

No obvious trend was found with respect to gesture size in the quiet samples. There were, however, several interactions during noise (PCP3 and PCP5 with their respective CPHI and PCP5 and PCP4 with their respective CPNH) in which PCPs produced a higher proportion of medium and /or large gestures in narrative than conversation. These results suggest a possible trend for PCPs to produce a higher proportion of medium to large gestures in narratives than in conversations in the presence of background noise.

The trend toward the higher proportion of medium to large gestures in narrative than in conversation may reflect the nature of the semantic content portrayed in the film and thus subsequent narrative. The film features a pet lamb tethered on a rope some distance from the hut where a blind boy lives with his father. The young blind boy is pictured feeling his way along the rope to cuddle the lamb. It was clear in many interactions that the PCPs arms were frequently extended to either side or in front to portray the spatial dimensions of the scene and the action of the blind boy feeling his way along the rope to his pet lamb. It may be inferred that the resulting gestures were therefore frequently categorised to be medium to large.

As discussed with respect to size, only a small number of cases were reviewed in the analysis of gaze, because PCPs produced larger numbers of imagistic gestures in both narrative and conversation in these cases, such that valid comparisons could be made. The largest proportion by gaze direction was the gaze at CP in all interactions. Both in quiet and noise most of the cases reviewed (Cases 3, Case 4, & Case 5) show that PCPs directed their gaze at their (CPNH or CPHI) for a higher proportion of gestures in conversation than narrative. While producing a lower proportion of gestures with gaze directed at their own gesture. An exception was seen in Case 6 in which PCP6 directed gaze at their CPNH for a lower and at their own gesture for a higher proportion of gestures in conversation than narrative in both quiet and noise samples.

It has been suggested that speakers will direct their gaze towards their own gesture to draw attention to them reflecting their significance to the listener. However, this may also be a means of gauging the accuracy of gesture portrayal and hence demonstrate a speaker-focused function of gaze (Streeck, 2009). During the narrative, participants may have tended to more often direct gaze at their gesture to monitor the accuracy of their description and draw attention to the information portrayed in the gesture.

The results presented in this chapter have compared gesture production in narrative and free conversations from emic and etic perspectives. Overall, the main finding is that total and imagistic gesture rates in narrative were higher than in conversation in both quiet and noise regardless of the hearing status of the listener This finding has relevance in relation to future methodological approaches to the conduct and analysis of natural face-to-face conversations, which will be discussed in the following chapter.

The final chapter of this thesis presents a summary and further discussion of the findings described in Chapters 4–7 in light of previous research and theoretical concepts. The clinical and rehabilitative implications of the findings are explored and finally, reflections on the method and methodology will guide a discussion of future research directions.

8 DISCUSSION

In this final chapter, the findings of the data set are summarised, and the implications discussed in the context of existing research and in terms of potential future research and clinical directions. The impetus for this study lies in a desire to expand the practice in hearing rehabilitation and research, which has focused almost entirely on the benefits of using auditory-only and/or audio-visual/lipreading cues. By contrast, extra-verbal visual communication cues including hand and arm gestures, facial expression, gaze, and body posture have received little research attention within the context of conversations involving individuals with HI. The role gesture plays during everyday interactions involving an individual with HI, and how gestures produced by a CP might assist in reducing or resolving communication difficulties have been largely unexplored. Hence, the aim of the current research was to explore the characteristics of a PCP's gesture production when interacting with a familiar CPHI versus when interacting with a frequent CPNH to determine whether PCPs tailor their gesture production to the hearing status and listening needs of their CPHI.

Seven normally hearing adults (PCPs 1–7) participated in dyadic everyday-style interactions with two of their CPs, one with HI and one with normal hearing in a parallel case study design. In each case, one dyad consisted of the PCP and their CPHI and the second dyad of PCP and CPNH. Each dyad participated in two interactional tasks, a free conversation and a narrative. The focus of the analysis was on the characteristics of the PCPs' (PCP1–7) gesture production and the impact of HI (HI or NH), background noise (noise or quiet) and task type (free conversation or narrative) on the dependent variables analysing various aspects of gesture. The dependent variables examined were gesture frequency, the emic characteristic of gesture type (or function) in addition to the etic features of imagistic gestures including size and gaze direction during imagistic gesture production.

8.1 Summary of the Findings

The initial case study (see Chapter 4) demonstrated that everyday interactional tasks, namely free conversation and narrative, could be used successfully in eliciting a range of gesture types. However, the overall findings show considerable variability across the participants (PCPs 2–7) and thus provide limited support for a substantial impact of HI on the gesture frequency or the characteristics of PCPs' gestures in quiet or in the presence of background noise. The findings are summarised below with respect to the independent variables: HI, background noise, and the interactional task type.

Gestures were produced more frequently by PCPs in conversation with the CPHI than with the CPNH in quiet in several cases. Total gesture rates in narrative were similar for PCPs 2–7 in the CPHI and the CPNH conditions across all cases and amongst these, imagistic gesture rates were similar for most cases. Finally, gestures were produced more frequently by PCPs in the presence of background noise than in quiet with both the CPHI and with the CPNH. The predominant types of gestures produced were imagistic and interactive gestures in both quiet and noise conditions. There were not substantial differences in many of the interactions in terms of the proportions by gesture type produced by PCPs: (a) in quiet versus noise when interacting with the CPHI or with the CPNH and (b) with the CPHI versus the CPNH when interacting in quiet and when interacting in noise.

The findings regarding gesture size suggest a trend across PCPs when talking in quiet to produce a lower proportion of small gestures with the CPHI than gestures of medium to large size. A higher proportion of larger gestures was seen in two cases when PCPs interacted with their CPHI than with their CPNH in both quiet and in noise. There was, however, no consistent pattern of difference between gesture by size proportions in the quiet versus the noise samples with the CPHI or CPNH.

The predominant gaze direction was toward the CPHI and the CPNH during CP imagistic gesture production across all interactions. When talking in quiet PCPs directed gaze toward the listener for a higher proportion, and at their own gestures or away (at another object or point in space) for a lower proportion, of their imagistic gestures with their CPHI than their CPNH. When talking in noise PCPs did not show substantial differences in gaze direction proportions between interactions with their CPHI and their CPNH. However, PCPs tended to produce a higher proportion of gestures with gaze directed at their CP in noise than in quiet regardless of the hearing status of the CP (CPHI or CPNH).

The results with respect to the independent variable of conversation type showed that total gesture rates and imagistic gesture rates were higher in most cases in narrative than in conversation, albeit that these differences were only minimal in some cases. This was the case in both the quiet and the noise samples. Furthermore, in most cases the proportion of imagistic gestures was higher in narrative than in conversation (in quiet and in noise) while the proportion of interactive gestures was higher in conversation than in narrative.

The findings regarding gesture size suggest a trend among PCPs when narrating in noise to produce a higher proportion of medium to large gestures than in conversation. No clear trend was found with respect to gesture size in the quiet samples.

The highest proportion by gaze direction was gaze at CP in all interactions. Both in quiet and noise most of the cases reviewed show that PCPs directed their gaze at the listener (CPNH or CPHI) in a higher proportion of gestures in conversation than in narrative while producing a lower proportion of gestures with gaze directed at their own gesture.

Despite the substantial variation across the cases and limited evidence of PCPs' audience design as implied by their gesture patterns, some trends in the quantitative data were noted. In addition, qualitative observations revealed some distinct patterns of gesture use arising during instances of communication breakdown and repair. The findings regarding gesture frequency, gesture form, imagistic gesture size, and gaze direction during gesture production and their relation to hearing impairment and background noise are discussed in the following sections.

8.2 Hearing Impairment, Noise and Gesture

8.2.1 Gesture Frequency

The current findings show considerable variation in gesture rates across cases. While all PCPs did use gesture, some PCPs produced gesture at low rates across their different CPs and interactive tasks. It is difficult to make comparisons between gesture rates in the present study and rates reported in previous research because most authors do not report means and/or ranges in individual gesture rates. Furthermore, tasks and/or content of dialogues or narratives vary across studies. However, individual variability has been widely recognised in previous gesture studies and several factors affecting the frequency of gesture production have been explored previously (Chu et al., 2014).

Age is one factor which have been identified in prior research to influence gesture rate, as discussed in Chapter 2. For example, overall gesture rates were similar, but younger adults produced more representational gestures (portraying semantic meaning) than older adults during object descriptions (Cohen & Borsoi, 1996), during different types of narrative (Feyereisen & Havard, 1999) or during a spatial description task (Arslan & Göksun, 2021). Furthermore, Schubotz et al. (2019) found that younger but not older adults decreased their gesture frequency when narrating shared semantic content.

Other individual characteristics also seem to affect gesture frequency. For instance, women have been found to produce more gestures than men in cartoon narrations (Hostetter & Hopkins, 2002). In addition, a higher frequency of gestures portraying semantic meaning has been linked to (a) more frequent expression of negative affect (Wiens et al., 1980), (b) a higher level of extraversion and neuroticism (Hostetter & Potthoff, 2012), and (c) to greater abstract reasoning ability in geometric problem solving (Sassenberg et al., 2011). Other researchers have found associations between gesture rates and cognitive functions, particularly spatial and conceptualisation skills (Arslan & Göksun 2021; Chu et al., 2014; Hostetter & Alibali, 2007).

In the present investigation, an upper age limit of 70 years was set to minimise the influence of age-related cognitive changes on gesture production. However, as PCP ages ranged from 45 to 69 years, several of the participants would be considered *older* adults. and possible effects of age on gesture cannot be ruled out. Therefore, age as well as other individual factors may have influenced the gestures rates and contributed to the variability across participants seen in the current findings.

Gesture frequency may also be influenced by characteristics specific to the context, the activity, or the CPHI or CPNH as a marker of a speaker's audience design, as discussed in earlier chapters (e.g., Alibali et al., 2001; Bavelas et al., 2002; Campisi & Özyürek, 2013; Jacobs & Garnham, 2007; Kelly et al., 2011; Mol et al., 2009, 2011). Instances of a potential effect of the hearing status, as a CP characteristic, on the rate of gesture production were found in the current study. For example, the total rate of gesture production by PCPs was higher with the CPHI than the CPNH in some cases (Case 2–4) in conversations conducted in quiet. In two cases (Cases 2 and Case 3) there were higher imagistic gesture rates with the CPHI than the CPNH in conversation conducted in quiet. Higher total gesture rates were also found with the CPHI than with the CPNH in narrative in two cases (Case 4 and Case 5). These results are in line with previous findings showing increases in speaker gesture rate with a change in the characteristics of a CP, including adults versus children (Campisi & Özyürek, 2013) and attentive versus inattentive listeners (Jacobs & Garnham, 2007). The implication is that while some PCPs increased the frequency of their gesture in response to the hearing status of their listeners others showed little change. By contrast, the frequencies of both total gestures and imagistic gestures were higher in noise than in quiet in most cases regardless of the hearing status of the CP. However, no substantial differences were found when comparing gestures rates in the quiet and noise conditions when PCPs were interacting with their CPHI and their CPNH.

As discussed in Chapter 2, a small number of studies have demonstrated the benefit of gesture alone in enhancing the comprehension of a spoken message presented in noise to listeners with HI or to normal hearers (Drijvers & Özyürek, 2017; Drijvers et al., 2018a, 2018b; Obermeier et al., 2012; Rogers, 1978). While Drijvers and Özyürek (2017) found evidence for an additional benefit when combining visual speech perception with gesture. The impact of background noise or HI on gesture production rate, however, has to-date not been studied.

The current results suggest that background noise had a greater effect on gesture rates than hearing status in some dyads and suggests the inference that some speakers increase the frequency of gesture in response to adverse listening conditions but not necessarily in response to the hearing status of their CPs. The implication is that the influence of the noise on the speaker (and thus the potential impact on their own speech perception) might have been a more critical factor than the listeners' hearing status in terms of gesture frequency.

The analysis of gesture type is discussed in the next section with reference to the impact of hearing status and background noise on the distribution of the gesture types used by participants.

8.2.2 Gesture Type

The interactions analysed in this study provided instances of the full range of the gesture types selected for analysis, namely, iconic, metaphoric, deictic abstract, and deictic concrete, and emblems. The predominant gesture types in quiet and noise conditions as a proportion of the total gestures were iconic gestures and the combined category of iconic and metaphoric gestures (imagistic gestures) followed by interactive gestures. This pattern was found in most conversations and all narratives in quiet and noise with both the CPNH and the CPHI.

The expectation was that higher proportions of imagistic gestures, those which provide semantic information, would be produced by PCPs with their CPHI to compliment the information provided in the talk and increase the redundancy of their message. However, in most cases proportions of imagistic gestures produced by PCPs did not show substantial differences between interactions with the CPHI and the CPNH in quiet or in noise. There were some instances in quiet in which PCPs produced a greater proportion of interactive gestures than imagistic gestures with the CPHI than with the CPNH. This suggests that, in some interactions, the balance of gesture types may change toward a higher proportion of interactive gestures and a correspondingly lower proportion of imagistic gestures when PCPs are aware of their recipient's hearing impairment.

Overall, the findings suggest that the presence of the CP's HI did not have a measurable effect on the gesture types produced by the PCPs. Furthermore, in most interactions no substantial differences were found by the gesture type in quiet conditions compared to noise. Thus, it appears that neither the presence of background noise, nor HI status either alone or together had a substantial effect on the distribution of gesture types used by PCPs.

Since the early work of Kendon (1981, 2004) and McNeill (1992) there have been few studies in which either the range of gesture types or their distribution within everyday interactions were reported, as was the case in the present study. McNeill (1992) identified that iconic, metaphoric, beat, and deictic gestures were used during cartoon narrations, and that beats and iconic gestures were produced in equal numbers. However, the balance between narrative phrases (i.e., those relating to the content of the story) and extra-narrative phrases (i.e., those that summarised or set the scene) was found to differ. The iconic gestures occurred predominantly in narrative phrases while beats appeared in similar numbers in narrative and extra-narrative phrases. Iconic gestures made up 43.5% and iconic and metaphoric combined (i.e., imagistic) 50.6% of total gestures (including beats) with small numbers of metaphoric (7.1%), deictic (4.67%; McNeill, 1992).

It may be inferred from McNeill's results that when there is a story component embedded in a conversation a greater number of narrative phrases involving iconic gestures are used. As described in Chapter 5, there were segments in conversations with CPNH (Case 5 and Case 6) in which PCPs spent time retelling a story of an incident. This might explain why a higher proportion of imagistic gestures were found in the interactions with the CPNH than with the CPHI. The suggestion is that the specific content of a spontaneous conversation will likely have some impact on the frequency and proportions of gesture type. Thus, differences between two conversations in terms of gesture type might be expected even when one or both interlocuters are the same.

De Marchena (2018) reported gesture rates per minute (rather than proportions of total gestures, as reported here) finding that *representational gestures* (imagistic gestures in the present investigation) were produced at significantly higher rates than other gesture types (including interactive, deictic, beats, and numerical gestures[8]) by participants with autism and controls in a collaborative referential communication task. This was followed by beats (not included in the primary analysis of the current study) and interactive gestures. The present results are consistent with these findings, namely that imagistic gestures were the primary gesture type produced during the interactions.

Stam (2016) found that the full range of gesture types were produced by an advanced adult English learner. in both narrative and proficiency interview/conversation tasks. In line with the current results, iconic gestures were the predominant type in the narrative task. However, unlike the findings of the present study, metaphoric and not iconic gestures made up the highest proportion in the interview/conversation task (Stam, 2016). This suggests that the topics and content of the conversation may have been primarily abstract in nature.

As discussed in Chapter 2, interactive gestures are used to guide an interaction rather than to contribute to content (Bavelas et al., 1995; Bavelas et al., 1992). As Bavelas (1992; 1995) demonstrated, the context of an interaction (monologue versus face-to-face dialogue) may influence patterns of interactive gesture production. Other researchers have revealed individual factors that may also affect interactive gesture production. For example, adults who have autism produced a higher rate of interactive gestures (and undefinable gestures) than did a control group (de Marchena et al., 2018). Chu et al. (2014) found a positive association between empathy scores and rates of interactive gestures. That is, individuals with greater awareness of their CP's perspectives and feelings produced more interactive gestures. The implication arising from these

[8] Numerical gestures involved holding up fingers to indicate a quantity

studies is that the occurrence of interactive gestures may be influenced by the context of an interaction or the characteristics of an individual.

As mentioned earlier, there were interactions in which the distribution of gesture types shifted toward a higher proportion of interactive gestures than imagistic gestures. A consistent pattern, however, was not seen in individual PCPs across interaction type or the hearing status of their CPs. Thus, the difference in the balance of gesture types in these individuals cannot be attributed to individual speaker characteristics, but rather, may be the result of a perception that the pragmatic aspects of a particular interaction benefitted from greater use of appropriate guiding or facilitative gestures. The distribution and frequency of gesture types is further discussed in relation to interaction type in Section 8.3.

In summary, this section has identified some of the key findings of the patterns of gestures identified in this study. Most importantly, it outlines the greater frequency of imagistic gestures across quiet and noise conditions and regardless of the hearing status of the listener. Few additional trends were noted in the emic characteristics of the data. In the next section the discussion moves to the etic characteristic of gesture size.

8.2.3 Gesture Size

As discussed in Chapter 2, gesture size has been noted to be a marker of audience design (Beattie & Shovelton, 2005; Campisi & Özyürek, 2013; Holler & Wilkin, 2011; Hostetter et al., 2011; Mol et al., 2011; Tellier et al., 2021). This led to the expectation that gesture production response to HI may include an increase in size to enhance the gesture and thereby potentially an understanding of the associated talk. In the present study, the analysis of gesture size in the quiet condition suggested the following trends:

- PCPs produced a lower proportion of small gestures compared to gestures of medium or large size when narrating with their CPHI than their CPNH
- PCPs produced a higher proportion of gestures that cross one or more borders than gestures produced within in one gesture space division (medium-large category) with their CPHI than with their CPNH

These trends accord with previous experimental work (Beattie & Shovelton, 2005; Campisi & Özyürek, 2013; Holler & Wilkin, 2011; Hostetter et al., 2011; Mol et al., 2011; Tellier et al., 2021) demonstrating the modification of gesture size in response to the characteristics of a situation or of a CP and lend support to the idea that individuals may increase the size of their imagistic gestures as part of their audience design in response to the hearing status of a CP.

Results from the present study showed an inconsistent pattern of difference with respect to the size of gestures between the quiet and noise samples in the presence of either the CPNH or the CPHI. There were instances in which there was a higher proportion of large than of small gestures in the presence of background noise, but the opposite effect was also seen, and in some cases, there was no substantial difference. The findings suggest that the effect of background noise on the size of PCPs 'gestures was variable.

Comparisons in the presence of background noise between CPs revealed two cases (Case 5 and 6) in which a higher proportion of larger size gestures were produced by PCPs with their CPHI than with their CPNH during the narrative task. On first inspection this suggests that some individuals may produce larger gestures with their CPHI than their CPNH in the presence of background noise, but the same pattern was seen for the same two PCP participants when interacting in quiet (see Section 5.2.3.1 and 6.2.3.2.). In turn, this suggests that some individuals may produce larger gestures with their CPHI than their CPNH, independent of the presence of background noise. However, analysis of this effect was only possible in three cases and as such, this finding may not be generalized across all dyads. Overall, the results do not provide substantial evidence for the impact of background noise on gesture size but raise the possibility that some individuals may modify gesture size when interacting with a CP with HI independent of the presence of background noise.

There is little existing research to compare with the current findings. Researchers have identified gesture size as a marker of message tailoring which may increase for children (Campisi & Özyürek, 2013), when the listener is visible to the speaker (Mol et al., 2011) or when high motivation exists to communicate accurate information (Hostetter et al., 2011). However, the impact of noise on patterns of gesture including gesture size has remained largely unexplored. In one of the few investigations into the impact of noise, Trujillo et al. (2021) examined gesture production during an action-verb communication task when multi-speaker babble was presented via headphones to the speaker and the recipient. Gesture size was determined by using motion capture technology measuring the maximum distance away from the body of the primary gesturing hand. The addition of noise produced a (marginally) statistically significant increase in gesture size and a significant increase in the number of movements within a single gesture (termed *submovements*). The submovements included repeated strokes portraying the same content or a series of separate movements or strokes (Trujillo et al., 2021). From these findings one might infer those measures of gesture size (or configuration in terms of submovements) may have been more sensitive to differences than the measurements used in the present study and thus explain the lack of substantial evidence of an increase in gesture size in background noise. Another explanation for the current results could be that the background noise was not sufficient to lead to the perception by the speaker that a modification of gesture size was necessary. Participant comments provided further insights into the impact of background noise on CPs and are discussed in the next section.

A further possible influence on gesture size may have been the motivation of PCPs. Experimental evidence has shown that motivation to communicate accurate information may influence gesture size. Hostetter et al. (2011) found that speakers will produce larger gestures when the consequences of the listener receiving and comprehending the speaker's message is of high significance for the speaker. In line with these findings, motivation may have played a role in the present investigation (see Section 8.2.5 for further discussion).

8.2.4 Reactions to Background Noise

This study did not include a formal evaluation of participants' perceptions of the effect of background noise levels on their ability to communicate. However, some participants commented spontaneously about these conditions during the recordings. As discussed in Chapter 6, several participants with and without HI referred to a general dislike of background noise and expressed relief when the noise faded away. Furthermore, PCPs' comments demonstrated awareness of the likely impact of background noise on the speech comprehension of their CPHI. These comments are consistent with well accepted clinical reports of the challenges presented by background noise as well as research showing reduced speech perception scores in the presence of noise in individuals with HI (Picou et al., 2013; Pryce & Gooberman-Hill, 2012).

One way to gauge the success of a conversation is the interactive flow and how many sequences of turns are required to repair mishearings or misunderstandings (Lind et al., 2006; Lind et al., 2009). In the current conversations participants continued to converse with relative ease with few obvious difficulties or misunderstandings that required a repair sequence, even in the background noise condition. Participants often referred to their own need or the need of their CPHI to observe visual speech cues, typically referred to by participants as "lipreading", in the presence of background noise. For instance, one participant with HI commented that they use facial expressions and body language to gauge how their CP is feeling. However, no mention was made of gesture in any of these remarks. Communication partners were sitting face to face throughout the interaction, so that facial and articulator cues were available and the CPHI may well have been successfully accessing visual-speech cues consistent with their own comments. Hence, PCPs may not have perceived a need to modify their gesture production. It is possible that this influenced the speaker's motivation for clarifying their talk by using gesture.

8.2.5 Motivation

Motivation may also have influenced communication behaviours including gesture in the current study. Participants engaged in everyday conversation with no externally imposed requirement to convey specific information towards a particular goal. In the narrative task PCPs were instructed to retell the film story in as much detail as possible so that their CPHI or CPNH would be able to retell the story accurately. There were no obvious external adverse consequences from unsuccessful communication or an inaccurate narration. As a result, PCPs may not have perceived a sufficient need to or have felt sufficient motivation to substantially modify their gestures. In accordance with this explanation a previous study demonstrated an influence on gesture size (but not on gesture rate) when high importance was attached to the communication of accurate information between participants when collaborating compared to working alone during a game task. Thus, when the motivation to communicate was higher, speakers modified their gestures (Hostetter et al., 2011).

It is possible that other sources of motivation may also have impacted gesture production. For example, participant PCP7 openly expressed a strong dislike of the film used in the narration task to both the CPHI and CPNH, and as the first details of the story unfolded the CPNH also indicated that they did not like the story content and preferred to change the topic. Thus, it is possible that the motivation to communicate further detail was reduced. There was a lower gesture rate between these dyads by comparison with other dyads' narrative task recording which may have been influenced by the participants' dislike of the story and reduced motivation.

The results of the fourth dependent variable, gaze direction during imagistic gesture production, are discussed in the next section.

8.2.6 Gaze Direction

The analysis showed that the predominant gaze direction during imagistic gesture production by PCPs was toward the CPHI or the CPNH in all interactions in both quiet and noise. The analysis also revealed that PCPs directed their gaze to the listener for a higher proportion of gestures with the CPHI than the CPNH when narrating in quiet. In addition, PCPs directed gaze at their own gestures or away at another point in space for a lower proportion of imagistic gestures with CPHI than CPNH, suggesting that the presence of a CP with HI had some impact on gaze direction in the quiet condition. By contrast, PCPs tended to produce a higher proportion of gestures with gaze at the CP when background noise was present with both their CPHI and their CPNH. Thus, the predominant gaze direction by PCPs as speakers during gesture production remained gaze at CP regardless of hearing status of the recipient or the presence of noise. This is not surprising considering Kendon's (1967) "normative" findings showing considerable rates of interlocuter gaze toward a CP while speaking as well as listening. The hearing status of a CP, however, did appear to have some effect on the PCPs gesture associated gaze behaviour in quiet while background noise showed an effect independent of hearing status.

There were few instances of gaze directed by speakers at their own gesture observed the current data. Previous investigations suggested that speakers will frequently direct gaze toward their own gestures to highlight the importance of the information provided by the gesture. For instance, Streeck (1993) observed that the gestures falling under the speaker's own gaze tend to provide semantic detail which contributes to the content of the talk rather than having an interactive or pragmatic function. However, measures of frequency were not reported making quantitative comparisons with the current results impossible. The limited examples of gaze at gesture found in current interactions suggests that monitoring the attention and feedback of the listener (Argyle & Dean, 1965; Kendon, 1967) and managing turn-taking (Bavelas, Coates, et al., 2002; Ford et al., 1996; Goodwin, 1980; Ho et al., 2015) were the primary functions of gesture.

It has been speculated that using gaze to highlight gestural content might increase in the presence of a CPHI to highlight important semantic information and enhance comprehension as a marker of audience design tailored to the CPHI's reduced access to the spoken signal. In the present study, there was, however, evidence of a decrease in this category of speaker gaze orientation in the presence of a CPHI. Rather, the predominant gaze orientation was toward the listener. These findings are more aligned with previous research which indicates that CPs of HI listeners will consistently monitor their CPHI directing gaze toward them while conversing (Skelt, 2006, 2010). As discussed earlier, Skelt (2006) found CPs of adults with HI had much higher rates of gaze towards their CPHI, both in listener and speaker roles than found by Kendon (1967). A possible explanation for the current finding, therefore, is that CPs frequently prioritise observation of their CPHI to check signs of mishearing or difficulty hearing even while producing gesture. This may be a strategy employed by the CP to avoid misunderstandings and maintain conversational fluency as suggested by Skelt (2006, 2010).

The impact of noise on speaker gaze orientation in interaction has not been previously reported. The findings reported in Chapter 6 showed that PCPs directed gaze at their CPHI and CPNH in a higher proportion of gestures in noise than quiet. This corresponded with a decrease in the proportion of gestures involving gaze at their own gesture. This was the typical pattern observed in conversation and narrative with the CPHI and in narrative with the CPNH. It suggests that gaze orientation was influenced by the presence of background noise regardless of the hearing status of the CP. Listening in the presence of background noise will frequently result in auditory challenges for adults with HI and normally hearing individuals alike (Picou et al., 2013). The current results suggest that the need for the PCPs to monitor their CP's understanding independent of hearing status may have led to fewer gesture fixations by PCPs under more challenging listening conditions. These findings may reflect the potential influence of background noise in increasing a speaker's visual monitoring of a CP rather than directing attention to their own gestures (or away from their CP).

The discussion in the preceding sections has shown some limited evidence of the influence of HI on the dependent variables. In summary, when PCPs interacted with their CPHI there was:

- an increase in gesture rate in some interactions but in others no change
- no change in gesture type distribution
- a trend for fewer small gestures compared to medium/large to be produced in quiet and larger gestures produced in quiet *and* noise in two cases
- no difference in the predominant gaze at CP during gesture and a trend for a higher proportion of gaze at CP in quiet

These findings suggest that there was not a substantial and consistent impact of HI on the audience design of the selected etic and emic characteristics of gestures across participants. Findings suggested some influence of background noise specifically on gesture rate of PCPs independent of their CP's hearing status. When PCPs interacted in the presence of background noise there was:

- an increase in gesture rates in most cases
- no change in gesture type distribution
- no consistent pattern in gesture size
- no difference in the predominant gaze at CP during gesture and a trend for a higher
- proportion of gaze at CP

8.3 Narrative versus Conversation

The results with respect to task type across most cases were:

- total gesture rates and imagistic rates were higher in narrative than conversation
- the proportion of imagistic gestures was higher in narrative than conversation
- the proportion of interactive gestures was higher in conversation than narrative

These findings appeared to be independent of hearing status or the interaction in quiet versus background noise.

The early work of McNeill (1992) has shown that speakers typically produce substantial numbers of imagistic, particularly iconic, gestures while narrating a cartoon story (McNeill, 1992). This is broadly consistent with the current results. As seen in Chapter 7, even PCP7, who produced a low gesture rate in both conversation and narrative, showed higher total and imagistic gesture rates in narrative. The cartoon stories such as those used by McNeill (1992) portray characters in action with limited dialogue. Similarly, the short film *Lamb* revolves around the actions of a blind boy and his father with only occasional brief dialogue. Thus, narratives will contain semantic content portraying the physical actions, spatial relations and objects of a story and hence, typically lead to substantial use of iconic gestures.

Prior work has not reported comparisons between narrative and dialogue in the same way as was investigated in the present study, except for Stam (2016). The film used in the current investigation contained highly visual content in a similar manner to the cartoon in Stam's study. Consistent with the current findings, Stam's (2016) participant produced a greater proportion of iconic gestures in narrative than in conversation. The high proportion of iconic gestures in narrative may reflect greater difficulty in verbal compared with gestural expression of visual, spatial and motion events (Alibali, et al., 1999; Feyereisen & Harvard, 1999, Riseborogh,1982). On the other hand, the narrative task may have been more challenging than the free conversation given the requirement to not only recall but also relate a film story in clear detail to the listener. (Stam, 2016). Thus, the large amount of visual processing needed may be reflected in the high iconic gesture frequency. In line with the view that gesture is closely connected to thought and language, gestures may mirror a speaker's thought processes and thus internal visualisation of a scene and/or action sequence (Hostetter & Alibali, 2008; Hostetter & Alibali, 2019). Hence, the role of gesture may be not only to communicate information to the listener but may lessen the cognitive load to facilitate the recall and expression of the content (Stam, 2013).

Previous research has shown that when interlocuters do not share information or knowledge (common ground) they increase the frequency (Jacobs & Garnham, 2007) or the semantic detail in their gestures (Galati & Brennan, 2014; Holler & Stevens, 2007; Holler & Wilkin, 2009). Hence, an alternative reason for the present findings might be that the PCPs included more semantic detail in gesture during the narration as their CP had no information about the film. By contrast, during the free conversation frequent CPs would be expected to have significant shared knowledge when discussing topics of their own choice. This is consistent with McNeill's (1992, 2005) notion that gestures are typically produced when discourse includes components high in *communicative dynamism*, such as information that is new, focused or contrasting.

There was a higher proportion of interactive gestures found in conversation than in narrative. A possible explanation for this might be that free conversation will involve greater turn-taking activity than a narrative and result in a higher proportion of interactive gestures. However, a narrative task is still interactional. Any face-to-face dyadic communication will characteristically involve contributions and active participation by both interlocuters in a range of verbal and nonverbal behaviours, often referred to as *back-channelling* via the use of *continuers, s*uch as "yes" "uh-huh" or giving a nod (Levelt, 1993; Yngve, 1970). Interactive gestures, as described by Bavelas et al. (1995), have different functions (see also Table.3.7). The primary interactive gestures produced by the speaker during a narrative may be *seeking* gestures designed to elicit acknowledgement from the listener that they are following the content and *general delivery* gestures*,* which might be paraphrased as *"This is the information I am giving you*."

There were also cases (Case 5 & Case 6), in which the proportion of interactive gestures was higher in narrative than in conversation with both CPNH and CPHI. This may reflect a more prominent role of interactive gestures in these PCPs in monitoring and checking the listener's understanding of the unfamiliar narrative content. However, there are, no clear findings in the literature to support these explanations and this may be an area that warrants further investigation.

A small number of cases showed a trend towards a higher proportion of medium and/or large gestures made by PCPs in narrative than conversation, particularly in the presence of background noise. The characteristics of some gestures suggest this trend might be due to the use of the film to generate the narrative task. For instance, the PCPs' arms were often extended across gesture space boundaries and into the periphery or extreme periphery to portray the tethering rope to which the pet lamb was attached and the actions of the blind boy finding his way along the rope. As a result, the gesture strokes frequently crossed multiple gesture space boundaries and were therefore categorised as medium size or larger gestures. Yet a firm conclusion about the impact of the hearing status of the listener cannot be made as the selected cases included only two interactions with CPHI and three with CPNH.

As reported previously, the largest proportion of gestures by gaze direction was the gaze-at-CP category across all interactions. Most PCPs directed their gaze at their CPHI or CPNH in a higher proportion of gestures in conversation than in narrative, while a lower proportion of gestures were produced with the PCP's gaze directed at the gesture. This was found in quiet and in noise and was independent of hearing status. This may reflect the increased turn-taking activity found in free conversation and increased need for PCPs to monitor one another to coordinate and maintain the flow of the interaction.

It has been suggested that speakers will gaze toward their own gesture to draw the listener's attention to them (Streeck, 1994). However, this may also be a means of judging/monitoring and adjusting the accuracy of the gesture portrayal and hence demonstrate a speaker-focused function of gaze (Streeck, 2009). Participants were instructed to retell the film story as accurately and in as much details as possible. Therefore, to describe the action and spatial relations of the story correctly, participants may have tended to more often direct their gaze at the gesture to both monitor the accuracy of their description as well as to draw attention to the information portrayed in the gesture.

The limited evidence of a substantial modification of gesture characteristics as markers of audience design in the present study leads to the question under what circumstances PCPs might modify their communication behaviours in response to the presence of a CPHI. Possible interpretations of these results might be found when considering the meaning and purpose of conversation together with CAT and audience design which are explored in the next section.

8.4 Conversation, CAT, and Audience Design

Communication Accommodation Theory proposes that intergroup accommodations/adjustments to speech are frequently based on stereotypical images of communication needs (Giles, 1991). For instance, this is seen in the way mothers use “babytalk” or *motherese* (Saint-Georges et al., 2013), carers speak to the elderly known as *elderspeak* (Shaw et al., 2022) or native speakers address non-native speakers (*foreigner talk*; Ferguson, 1975; Tellier et al., 2021). Only limited research, however, has examined gesture within the frame of CAT. Tellier et al. (2021) reported evidence of adjustments to both speech and gesture when native speaker trainee teachers addressed a non-native CP. The trainee teachers produced overall more gestures when explaining words to non-native than native speakers. They used more iconic and deictic gestures and their gestures were significantly larger in interaction with the non-native participants.

The cases in this investigation did not show a consistent pattern of gesture modifications by PCPs when interacting with their CPHIs and therefore do not provide strong evidence that gesture accommodations were made based on a stereotypical or general representation of individuals with HI. Participants within each triad were familiar with one another, communicated frequently, and had a shared history and social context. Thus, from a CAT perspective they were members of the same” group” and their shared characteristics may have been stronger determiners of the style of gesture behaviour than the presence of absence of a HI.

The CAT concept of convergence also presents a possible explanation for the current results. Simmons-Mackie (2018) suggested that convergence might account for the reluctance of individuals with aphasia to implement alternative communication strategies in everyday interactions. If CPs without aphasia do not use alternative strategies, individuals with aphasia may seek to converge their communication rather than adopt a different communication style (Simmons-Mackie, 2018). Similarly, in the present study, adaptation of communication behaviour, such as an increase in gesture rate or size, to be noticeably different to their CP with HI may have conflicted with the tendency to communicate in a familiar manner. Thus, PCPs may be more likely to maintain a gesture production style that is like their CP regardless of hearing status.

Communication Accommodation Theory can also account for individual differences and variability, such as seen in the current study. As discussed in Chapter 2, the CAT term *interpretability strategy* refers to modifications made in direct response to the perceived needs of a CP (Gallois & Giles, 2015). Thus, it might be inferred that communication adjustments may be based on moment-by-moment evaluation and appreciation of an interlocuter ‘s specific needs as they arise rather than more general perceptions of the communication needs of individuals with HI.

Conversation is typically an orderly, collaborative process by which interlocuters work together to build a common understanding (Clark, 1996). According to Clark's principle of *least joint effort* (Clark, 1996; Clark & Brennan, 1991; Clark & Schaefer, 1989; Clark & Wilkes-Gibbs, 1986), interlocuters react in the moment to select the best available strategies likely to require the least time, effort, and resources to achieve efficient communication. Strategies may be a combination of both verbal and nonverbal behaviours (Clark & Krych, 2004).

The findings of the current study might be explained in terms of the *least joint effort* principle (Clark, 1996). Remarks made by the PCPs during the recordings in this investigation suggested that they were aware that their CPHI might experience difficulty perceiving speech, particularly in the presence of background noise. However, the PCPs do not appear to have made global adjustments to their gesture production (or their talk). Rather, they may have implemented specific modifications when there was an indication from their CP as the listener that a message had not been received. That is, when additional effort was perceived to be warranted to maintain conversational flow. This is consistent with the notion of audience design proposed by Newman-Norlund et al. (2009) who suggested that interlocuters base their communication behaviours on existing knowledge and their understanding of a CP and/or context as it unfolds during the interaction. Thus, speakers will implement moment-by-moment, dynamic modifications of their communication behaviours as perceived necessary to facilitate an effective interaction.

These modifications may be dependent on the individual's repertoire of communication behaviours. Although formal measurements of vocal intensity were not undertaken, subjective observations by the investigator suggested that an increase in PCPs' speech volume follows the onset of the background noise. There were spontaneous comments from two participants about the possibility that they may either speak more loudly in noise or for the benefit of their CPHI. These observations are in line with previous research showing that individuals increase their vocal effort in the presence of background noise, resulting in an increase in speech intensity, known as the *Lombard effect* (Fitzpatrick et al., 2015; Trujillo et al., 2021). Such adaptations are considered an indication of a speaker's intention to maintain message intelligibility, and hence, contribute to audience design of the talk (Summers et al., 1988; Trujillo et al., 2021). The findings of Trujillo et al. (2021) corroborated previous evidence of the Lombard effect showing an increase in speech intensity in noise, and showed that when a speaker increased speech volume, gestures were not produced. However, when gestures were used speakers made modifications to gesture regardless of the presence of speech (Trujillo et al., 2021).

The use of single words as stimuli in the action verb communication task in the study by Trujillo et al. (2021) necessarily limits its generalisability to more natural interactions used in the current study. However, the findings together with the subjective observations from the current study raise the possibility that an increase in vocal volume may be the strategy favoured by individuals in the presence of background noise to overcome potential listening difficulties. Other strategies such as gestures might be introduced subsequently if, despite increased voice level, problems arise or threaten to arise. As suggested by Skelt (2010), close visual monitoring by CPs of a CPHI may occur in anticipation of problem sources/mishearings. However, speakers may not implement other communication behaviours unless the listener signals continuing or extended difficulty or there is an overt misunderstanding or breakdown in communication.

The strategies used to address breakdowns or potential breakdowns may be contingent upon a hierarchy of individual strategies which may vary dependent upon the context or circumstances and with respect to the modality or combination of modalities that are implemented. Qualitative findings related to request for clarification and conversational repair provided in Chapter 6 lend some support to this notion.

8.5 Gesture and Repair Sequences

As noted earlier, there were few instances of communication breakdown, requests for clarification and subsequent repair sequences. Those that occurred did so primarily when PCPs interacted with their CPHI in the presence of background noise. During these exchanges, the PCP's turn at talk is followed by a visual or verbal signal that their CPHI has not understood (a request for clarification) and in response the PCP repeats or provides clarification.

Four patterns of gesture use during repair emerged from examination of these sequences. The first pattern was the *no gesture-no gesture* sequence when the PCP's original utterance was not accompanied by gesture nor was a gesture produced during the repetition. The second was the *gesture-no-gesture* pattern in which the original utterance was associated with a gesture, but the repetition was not, when the PCP used verbal emphasis of a key word in the verbal repetition instead. The third pattern was a *no gesture-no-gesture-gesture* sequence involving two requests for clarification. Following a request for clarification from CPHI, PCP provided a repeat without gesture. This was unsuccessful in that CPHI indicated the need for further clarification and the PCP responded by rephrasing the verbal utterance this time accompanied by a gesture. The final pattern was the *gesture-gesture* sequence in which the PCP's original utterance and verbal repetition of the key words are both accompanied by gestures. A repetition of talk is associated with a repetition of the gesture.

The first three patterns suggest that the initial strategy selected in response to a request for clarification may be verbal, and that gesture may be employed as an addition to the talk when the first repair attempt is unsuccessful. The gesture-speech balance and relative contributions of strategies might be interpreted using Grice's Maxims. Grice (1975) suggested that a *cooperative* *principle* operates during effective communication. He described a series of guidelines or maxims which determine how talkers behave during a conversation. These maxims were developed with reference to spoken communication but may be extrapolated to gesture/nonverbal communication. Two of these maxims seem particularly pertinent to the role of gesture. The maxim of *quantity* indicates that any contribution to a conversation should be informative but only as informative as is necessary. This maxim might be violated if, for example, talk is accompanied by too many nonverbal signals or gestures which may result in higher processing demands and potentially prove confusing to the listener and consequently reduce the flow of a conversation. The maxim of *manner* refers to how the talk is conveyed as it should not be obscure or ambiguous but brief and orderly (Grice, 1975). Gestures which are ill-defined or incongruent to the accompanying talk or produced with inappropriate timing in relation the talk may also violate these maxims. To adhere to these maxims a cooperative CP would implement unambiguous gesture in a methodical manner which balances the speech and gesture content to suit the context and the CP.

It is presumed that prior to the onset of hearing loss, adults with acquired HI and their CPs will have developed typical conversational behaviours, including the use of co-speech gesture and other nonverbal behaviours as part of their communicative repertoire. With the acquisition of HI and the reduced ability to perceive speech accurately, communication difficulties amongst CPs are likely to arise. Some CPs may not be aware of the negative impact of specific communication behaviours on the speech perception of the CPHI, such as speaking quickly, eliding words, or not facing the speaker. Others, however, may have developed an awareness of strategies which address the needs of the person with HI (Erber, 1996) as implied by participant comments about the value of visual-speech cues/lipreading in this investigation.

Following Grice's maxims of quantity and manner, CPs may engage in considerable pre-emptive efforts to maintain a fluent conversation with their CP with HI (Pajo & Klippi, 2013; Skelt, 2006). Skelt (2006) noted that this was the case with experienced clinical audiologists, but also in one example of an untrained but experienced non-audiologist partner. This raises the possibility that pre-emptive strategies might be developed by frequent CPs with appropriate training (Ekberg et al., 2016; Skelt, 2006). The idea that aural rehabilitation as an intervention may require increased focus on the CP rather than on the individual with HI has received some research attention in the domain of speech production (Caissie et al., 2005; Picheny et al., 1985, 1986, 1989). The speech characteristics which may enhance the understanding of listeners with HI and how these might be taught to CPs have been explored. This research has relevance when considering gesture as a potential component of intervention and CP training.

8.6 Communication Partner Training

Early research efforts in speech perception identified several characteristics that differentiated clear and conversational speech, including increased duration, more frequent pauses, and longer duration of speech sounds (Picheny et al., 1985, 1986, 1989). Enhanced speech perception scores in participants with HI independent of hearing loss configuration have been associated with the use of clear speech by their CPs (Picheny et al., 1985; Uchanski et al., 1996).

More recently, instruction in speech production has been found to lead to improvements in clear speech skill in some speakers, which improved speech comprehension in individuals with HI (Caissie et al., 2005; Caissie & Tranquilla, 2010; Gagné et al., 1995). Minimal instruction, that is asking a speaker to "speak clearly" as if speaking with an individual with HI, resulted in enhanced clear speech and increases in speech perception scores for listeners (Payton et al., 1994; Schum, 1996). Gagné et al. (1995) reported, however, that minimal instruction did not lead to improvements in all speakers. More detailed instructions have been found to lead to greater talker change (Helfer, 1997) but less improvement than an intervention program including instruction, guided learning and practice during everyday interactions with CP with HI (Caissie et al., 2005). Changes for the speaker who received a 45-minute intervention were more substantial than for the speaker without specific instruction but with minimal instruction to speak clearly. The clear speech skills were maintained in the trained talker at the one-month session (Caissie et al., 2005).

If it is possible for a speaker to change their speaking technique and should there be evidence for the need to change patterns of gesture when communicating with an adult who has HI, it may be possible for the familiar CPs of individuals with HI to learn more effective use of co-speech gesture with appropriate intervention and practice. From a rehabilitation perspective, the question arises whether it may be possible to teach individuals to increase or enhance their use of gesture.

8.6.1 Gesture Intervention

Regarding individuals with HI, Erber (1996) highlighted the importance of the role of the CP in maintaining conversational fluency and observed that some CPs find it difficult to modify or maintain changes to speech patterns following a communication breakdown. The key to improving conversational flow may be raising awareness of communication behaviours and how they might be used most effectively when required in sustaining conversational fluency. This is described as *metalinguistic awareness;* a conscious understanding of what happens in communication and communication breakdown (Erber & Lind, 1994).

Some experimental designs include overt instructions to participants to use gesture and have shown increases in gesture rate as a result (e.g., Chu & Kita, 2011). Others have failed to replicate this finding. Parill et al. (2016) suggested that, because gestures are typically produced subconsciously, individuals directed to gesture during a task may find it difficult to do so particularly if it is something that they do infrequently. There have been few reported attempts to teach the use of gesture. One study found that giving teachers brief instruction about the value of linking ideas with gesture led to an increase in gesture production during a math's lesson (Hostetter et al., 2006). Participants also decreased gesture production when instructed to do so, demonstrating the ability to control their gesture production and thus, it appeared that raising awareness of gesture and how it can be used in a particular context enabled its effective use and control.

Participants in the present study made no overt mention of gesture. However, participant comments highlighted (see also Section 6.2.5.1) an awareness amongst individuals with HI and their CPs that they could benefit from attention to visual-speech cues, particularly in the presence of background noise. This may reflect the attention in aural rehabilitation settings paid to visual-speech/lipreading cues as a means of ameliorating the impact of acquired HI on conversational fluency. Rehabilitation audiologists typically refer to the importance of observing visual-speech cues to enhance understanding as part of informational counselling. Yet, the use of gesture tends to receive less emphasis as part of aural rehabilitation.

As discussed in Chapter 2, the emphasis given to visual-speech cues in clinical settings is supported by research evidence that visible-speech cues will supplement auditory-only speech information and improve speech comprehension in normally hearing individuals and those with HI (Sommers & Phelps, 2016; Sommers et al., 2005; Stevenson et al., 2015; Tye-Murray et al., 2010; Tye-Murray et al., 2016). However, speech perception may be negatively impacted by either high noise levels such that insufficient auditory information may be available to support visual speech cues (Drijvers & Özyürek, 2017; Ross et al., 2007; Stevenson et al., 2015) and/or by babble noise created by multiple speakers compared to speech weighted noise (Myerson et al., 2016). The implication is that there will be circumstances in which listeners cannot rely on visual-speech cues and thereby the importance of other sources of visual information to support speech comprehension will be increased.

Other factors, for instance, age-related decline in working memory may also influence an individual's ability to process and integrate multimodal sources of information (Cocks et al., 2011; Schubotz et al., 2021). Individuals can benefit from a combination of speech cues, and non-speech cues such as gesture but the benefit to the listener may be dependent upon the availability of these cues and the individual's ability to perceive, process, and integrate information from different sources (Schubotz et al., 2021). In the context of the current investigation, this underscores the key role of the CPs of adults with HI in making a range of multimodal cues available to facilitate speech comprehension of their CPHI.

Intervention designed to increase the metalinguistic awareness of gesture production and perception may enable CPs to expand their communicative repertoire and implement gesture effectively when appropriate to do so. In the development of functional intervention programs, audiologists might look to combine the traditional emphasis on use of audio-visual speech perception with nonverbal cues including gesture in conversation.

The way in which these multimodal cues combine and integrate has become an area of increasing research interest. As summarised in Chapter 2, research interest has expanded to explore the neural processing which has begun to elucidate the processes involved in the perception and integration speech, gesture, and other nonverbal behaviours. The most recent literature provides not only evidence of speech-gesture integration but interactions between the processing of multimodal cues. The effect of one cue measured in the neural processing will alter depending on the potential information provided by other cues. For example, the effect of visual speech cues increased in the presence of informative “meaningful” gestures as well as beats (Zhang et al., 2021).

The work in this area not only demonstrates speech and gesture processing are integrated but also illuminates the dynamic and composite nature of multimodal language processing. In efforts to address the complexities of multimodal language comprehension and production cognitive science researchers are advocating for a psycholinguistic model and propose cognitive mechanisms involved in semantic, pragmatic, and perceptual language processing. They highlight the importance of accounting for complex interactions of a plethora of multimodal cues including speech, verbal signals, visual speech cues, gesture, gaze, and other nonverbal behaviours (Holler & Levinson, 2019).

As discussed in Chapter 2, there are several theories and models concerning the function and conduct of co-speech gestures. Some of these existing theoretical models have been tested for compatibility with the experimental data on gesture and speech behaviour of individuals with aphasia (de Beer et al., 2020; de Ruiter & de Beer, 2013). De Ruiter and de Beer (2013) concluded that together the listener-focused GP (McNeill & Duncan, 2000), Sketch (de Ruiter, 2000), and Interface Models (Kita & Özyürek, 2003) could account for findings in speakers with aphasia. De Beer et al. (2020) collected data from both participants with aphasia and without speech impairment to assess against the Sketch and the AR Sketch Models. Findings suggested that the original Sketch Model but not the new model was able to account for the gesture production patterns in individuals with aphasia. The impact of HI as a receptive communication disorder suggests also that listener-focused rather than speaker-focused models of gesture production may apply.

The present investigation explores the possible listener-focused functions of gesture. However, it is not possible to test the current data with any certainty against the existing models of gesture production, due to the small data set and the absence of consistent patterns of results across participants in support of a listener-focused function of gesture. Yet, the variability in the findings might be interpreted using two of the models that incorporate the notion of audience design, namely the GSA (Hostetter & Alibali, 2019) and the Sketch Model (de Ruiter, 2000).

8.7 Theoretical Models Revisited

The GSA is not a computational model but provides a framework for relating gesture to thought processes (Hostetter & Alibali, 2008; 2019). The model proposes that a gesture will be produced if the cognitive activation of the visual thought simulations is strong enough to reach the *gesture threshold* and result in production of a gesture (Hostetter & Alibali, 2008; 2019). This concept of a threshold may account for Individual variability in overall gesture frequency. The implication is that some may tend to encode information, particularly spatial information in a linguistic form rather than in visual/motor imagery. These individuals may have a higher gesture threshold and therefore be less likely to produce a gesture.

The GSA also proposes that a gesture threshold may be influenced by individual factors including the context or characteristics of a specific situation (although the terms *audience design* or *recipient design* are not used). Evidence that teachers can vary their gesture frequency when asked to do so supports the notion that individuals might choose to alter their gesture thresholds dependent on the perceived benefit of gesture and perceived needs of the listeners (Hostetter et al., 2006). As proposed by Hostetter and Alibali (2008), “Speakers may lower their threshold if they believe that their listener’s may have difficulty understanding what is being said” (p. 505). This may be a temporary lowering of the threshold when a need for gesture is perceived. This might explain the results of the current study showing an increase in PCP gesture rates in the presence of background noise.

Considering the variable influence of HI on gesture rates seen in the current results (in the quiet condition), the perceived need to lower the gesture threshold may also have varied, resulting in an overall increase in gesture rate in some PCPs but not others. The model’s authors also suggest that there may be momentary changes in the threshold away from an interlocutor’s more stable threshold. This implies a process of dynamic change (Hostetter & Alibali, 2019). For instance, a gesture threshold might be temporarily lowered when a communication breakdown or mishearing occurs and result in the production of gesture/s during the subsequent repair sequence. Thus, the gesture threshold can be used to explain differences in gesture rates. The mechanisms by which the form of a gesture is determined is less clear. Hostetter and Alibali (2019) suggest that some characteristics may be determined by the cognitive simulations which precede the gesture execution and others as the gesture is performed. The final adjustments and fine tuning will be based on the communicative context, cultural and environmental factors (Hostetter & Alibali, 2019).

The Sketch Model (de Ruiter, 2007) refers to recipient design as an "intriguing computational problem" (p.31). The model proposes that a sketch containing imagistic information is sent to the gesture planner. Once a gesture plan is prepared a message is sent back to the conceptualiser to signal that the motor plan is ready and that the spoken utterance can proceed in synchrony with the gesture (de Ruiter, 2000). Recipient design of a gesture is considered to take place in the gesture planner. De Ruiter (2000, 2007) refers to characteristics of the physical environment influencing the form and execution of a gesture, such as the location of a listener, the visibility of the speaker to the listener or features of the physical environment (e.g., so as not to hit a listener or an object in the environment; de Ruiter, 2000). No reference is made to the characteristics of the listener. It might be inferred, however, that feedback from a listener indicating speech perception difficulties, such as facial expression or requests for repeats, would also lead to modifications.

The (original) Sketch Model might also be used to explain changes or variability in gesture frequency. Factors adversely influencing the transmission of the verbal message, such as the presence of background noise or difficulties expressing oneself in a foreign language, are identified in the conceptualiser via internal and external feedback mechanisms (de Ruiter, 2000). This in turn may lead to more information being encoded as sketches rather than preverbal messages to compensate for the verbal/speech challenges and therefore result in increased gesture frequency. Thus, the model may account for the higher PCP gesture rates observed in some cases with CPHI compared to CPNH and the increase in PCP gesture rates in the presence of background noise.

Compatibility testing of the current findings against the models of gesture production was limited by the variability across the seven cases. Additional work revealing patterns of results in support of a listener-focused function of gesture may enable fresh application and even adaptation of the theoretical models to interactions involving individuals with HI. Important directions for future research to further explore the influence of HI on the characteristics of gesture in interaction are discussed in the next section.

8.8 Reflections on Method: Limitations and Future Directions

This study has been able to report on patterns of gesture behaviours associated with two tasks approximating natural conversational events to investigate the impact of HI and background noise on PCP gesture in a series of case studies. A case study approach meant that comparisons within each case dyad (PCP & CPHI and PCP & CPNH) were relatively controlled. There were, however, potential variables not explored or controlled that may have impacted the gesture of participants and led to differences between cases or interactions, e.g., the individual tendency to gesture or not, the relationship between CPs, in other words, how familiar they are with one another, their prior knowledge and experience communicating, and age or generational differences (considering the majority of the CPNH were adult children of PCPs and younger than their PCP and CPHI). These variables potentially had a significant effect on the behaviours observed in the current study.

In the free conversation task, the content was spontaneous, as no constraints were placed on the topics of conversation. The strength of this approach is that it allows for the study of (reasonably) natural interaction and the attendant patterns of behaviour. In the present study some behaviour patterns emerged which warrant further investigation in future research, particularly across a larger participant sample. Quantitative findings highlight individual variability across a range of measures while qualitative analysis revealed some specific patterns of communication behaviour, during communication breakdown and repair and in the presence of background noise, which suggest pathways for further investigation. While free conversation has benefits in terms of ecological validity, the impact of the lack of control of content needs to be recognised (Schegloff & Sacks, 1977). The addition of the narrative task provided a contrast as the content was pre-determined and limited by the story being told or retold. Despite being dominated by monologue-type turns and involving relatively little turn-taking behaviour, the narrative task permitted more controlled comparisons between dyads.

The present study is the first investigation (to the author's knowledge) of the influence of HI on gesture in everyday interaction. In view of the exploratory aim and the intensive and time-consuming nature of the multilayered/multivariable transcription and analysis, case numbers were limited to seven. This meant that quantitative analysis using inferential statistics and generalisation to the wider population of CPs of adults with HI would not be meaningful. However, the value of even a small number of cases should not be underestimated. As Eysenck (1976) wrote "sometimes we simply have to keep our eyes open and look carefully at individual cases not in the hope of proving anything, but rather in the hope of learning something" (p.9).

The strength of the current study lies in new insights it provides into the previously unexplored domain of HI and gesture production in conversation. The existing seven case study recordings will be a valuable basis for the creation of a larger data corpus. A larger collection of cases would allow both quantitative analysis as well as further qualitative identification of individual and cross-case patterns of gesture behaviour.

The small number of gestures produced during many of the interactions was also a limiting factor, which reduced the power of the quantitative analysis to identify trends and reduced the number of valid comparisons possible. During the narrative task, gesture rates were higher than in the free conversation. However, participants were able to narrate the film story in less than five minutes. This limited the sample periods to two minutes in quiet and two minutes in noise. The short film

Lamb was seven minutes in duration. The selection of a longer film may increase the time required to narrate the story and result in a longer sample and a larger number of gestures. To obtain a greater number of gestures, future investigations might increase the length of the conversational samples in both quiet and noise, for example from five to 10 minutes, or have participants conduct to separate conversations of 10–20 minutes duration in both quiet and noise.

As reported, all the interactions analysed flowed with few requests for clarification or repeats by either CPNH or CPHI. To learn more about the use of gesture under challenging listening conditions, future studies may target participants with greater degrees of hearing loss and/or reports of substantial difficulty communication with familiar CPs. Higher levels of background noise might be used to some effect, although caution should be exercised should noise levels become so loud as to prevent any conversation. As one participant with HI noted in conversation, in everyday situations he and his partner would likely not continue a conversation in noise for an extended period and would be more likely to move away to a quieter location.

The use of recordings taken from real-life situations and more typical listening environments may make interaction more realistic and further increase ecological validity of future investigations. Beechey et al. (2018, 2019, 2020) for example, employed recordings of real-life sound scapes, such as a café, a shopping mall food court, an open plan office, and a social gathering in studies of speech acoustics of talkers with normal hearing and talkers with HI. They stress the importance of assessing communication ability of adults with HI as accurately as possible to determine real-world the impact of HI on everyday communication. They see that the challenge is to develop realistic everyday communication tasks and find a balance between ecological validity and control of variables. Beechey et al. (2019) have developed a referential communication task and propose it as an alternative or addition to more traditional clinical speech perception measures to assess communication ability.

The current study revealed few instances of gesture modification which might be attributed to the hearing status of the CP. Thus, identifying individuals and potential participants who may be more likely to modify their gesture as part of their communication repertoire will be an important factor in advancing research in this area. Exploring other methods to evaluate functional communication ability might sharpen the focus on the characteristics of the CPs who do modify gesture and the characteristics of CPHI for whom they alter their gesture. For example, the lipreading ability of CPHI might be assessed to determine if this influences the gesture production of their PCP (Tye-Murray, 2021).

The PCPs in the current study knew of the existence of their CP's HI. It remains unknown how aware the PCPs were of their CPHI's true ability to manage their communication. As discussed earlier, some individuals will have a greater consciousness or metalinguistic awareness of the specific challenges that they face in communication affected by HI and the management strategies that they each employ. Speech and language researchers have developed tools to assess the functional communication in stroke survivors (Doyle et al., 2003) and in adults with aphasia (Kagan et al., 2004). In a similar manner some form of assessment such as a questionnaire might be developed to evaluate individuals' awareness of the consequence of the HL and take this into sharper account than done in the present study.

8.8.1 Analysis of Conversations

The current study was focused on the gesture production of the CP with normal hearing as speaker in interaction with CPs with and without HI. This investigation has provided some insights into the gesture production of normally hearing CPs and the influence of HI and the presence of background noise. However, considering the dynamic nature of conversation, it will be key to investigate the role of nonverbal behaviours in the future, including gesture in the coordination between CPs and the impact of a CP with HI on that process. Past studies have explored conversational sequences involving adults with acquired HI and the influence of HI on primarily the patterns on verbal behaviours (Lind et al., 2006; Pajo, 2012, 2013; Skelt, 2007). Of these studies, only Skelt's work incorporated gaze orientation (Skelt, 2010). Future work is needed to gain further insight into the ways in which interlocuters may adapt and adjust to one another during an interaction and the ways in which nonverbal behaviours including gesture and gaze are implemented and coordinated to promote conversational fluency and repair communication breakdowns.

In light of the considerable variability in gesture behaviours amongst participants in the present study, the case study approach will be a suitable method for future research. Analysis of multiple case studies allows researchers to explore individual behaviours in depth in addition to patterns of behaviour across cases, with an appropriate balance of quantitative and/or qualitative measures (Nelson & Gilbert, 2020). Future studies might employ conversation analysis techniques as a method to investigate the impact of gesture on the sequentiality and reciprocity of turns in talk. For example, this might build on past research exploring the occurrence and functions of mimicked gestures in face-to-face interaction (Holler & Wilkin, 2011).

The current corpus contains a body of data which is worthy of further investigation, and which may point to other gesture characteristics as targets for analysis. Examples of characteristics for further study of the effect of HI may include the frequency and length of pre- or post-gesture holds (Trujillo et al., 2021), the location in the gesture space in which gestures occur, and/or the viewpoint from which a gesture is produced.

McNeill (1992) identified iconic gestures as either *character-viewpoint* gestures (produced from the perspective of the character referred to by the speaker C-VPT) or *observer-viewpoint* gestures (produced from the perspective of someone observing the situation O-VPT). For example, a speaker may represent the action of running by holding index and middle finger back and forth representing moving legs (O-VPT) or the speaker may move their arms forward and back as if they were themselves running (C-VPT). Beattie, Webster & Ross (2010) found that participants more often paid overt attention to small C-VPT (termed *low span*) gestures than large C-VPT (termed *high span*) or O-VPT gestures and that these gestures were the most communicative (average accuracy score 83.3%). Future studies might look also at the effect of HI on the frequency and size of these C-VPT and O-VPT gestures.

Galati and Brennan (2014) addressed another aspect in the *precision* or informativeness of gesture. In this study it was found that participants produced more precise gestures during the first narration of a cartoon story compared to retelling the same story to the same listener. Each narration was rated for gesture precision on a scale of 1–7 for similarity to the original cartoon by two independent judges (Galati & Brennan, 2014). Future research might explore other methods of defining or evaluating the precision of gesture.

Another important avenue for further investigation will be a closer analysis of the relationship between gesture and speech, including the timing and positioning of a gesture within a spoken utterance (*gesture – speech synchrony*; McNeill, 2016) and evaluation of the semantic content or meaning of a gesture as redundant or complimentary to associated speech (Cocks, et al., 2009; Kita & Özyürek, 2003).

Considering the dynamic and complex nature of natural conversation, it will be important explore gesture produced by both normally hearing CPs as well as their CPHI in future studies. Research addressing the effect of HI on a range of gesture characteristics, such as those mentioned above, would add to the findings of the present study. The resulting body of data would in turn provide a framework for the development of appropriate interventions.

8.8.2 Intervention Research

An important question in the context of adult acquired HI and aural rehabilitation intervention is whether it is beneficial to provide training to adults with HI and their CPs to increase or enhance their use of gesture to facilitate conversational fluency. The possibility of intervention to increase or enhance CPs' use of gesture was raised earlier in this discussion. Future studies might mirror clear speech intervention studies (Caissie et al., 2005) and include a *no training* condition and/or a minimal instruction condition and a targeted structured training program. Pre- and post-evaluations might include analysis of conversational interactions such as those used in the current study to determine if changes occur and if so whether they are maintained in the longer term. Spontaneous change in CP gesture frequency and characteristics might also be explored following technical/amplification intervention for example, pre and post cochlear implantation or hearing aid fitting. A critical aspect of intervention research will also be the identification of individuals who will benefit from and thus be potential candidates for gesture training.

8.9 Conclusion

The aim of this thesis was to examine influence of the presence of a CP with HI on the co-speech gestures produced by a familiar CP during everyday conversation. The combined qualitative and quantitative analyses revealed trends and case examples of the effect of the presence of a HI on the occurrences of gesture produced by PCPs. However, the substantial variation in the quantity and characteristics of gestures across cases raises further questions for future exploration. Additional work remains to identify individuals who may be more likely to adapt their gestures to account for the HI of a CP and the emic and etic features of gesture which may be influenced by HI.

Future research using a case study methodology and a conversation analytic approach would allow further qualitative analysis of sequential patterns and individual variations in gesture use to be explored in greater depth. Thus, further work may aim to develop an evidence base of gesture and other nonverbal behaviours as they arise in conversations involving individuals with HI.

The ongoing study of gesture has revealed much about the conduct and characteristics and influences on gesture across many disciplines. The work presented in this thesis begins to bridge the gap between gesture studies and the analysis of patterns of gesture during conversation in which HI is a factor. Furthermore, it is the first piece of work to research communication and acquired HI in the context of natural patterns of talk adding gesture to the analysis of conversation.

The impetus for future research lies in the desire to inform and enhance rehabilitative practices with the aim to assist individuals with HI and their CPs in the face of communication challenges imposed by HI. The method and findings of this thesis present a springboard of opportunity for into a new line of inquiry to achieve this objective.

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APPENDIX A-PARTICIPANT INFORMATION & CONSENT

Flinders UNIVERSITY

Dept. of Speech Pathology and Audiology

Flinders University, Adelaide
GPO Box 2100
Adelaide SA 5001

Tel: 08 7221 8833
Fax: 08 8204 5935
http://www.flinders.edu.au//sohs/sites/audiology

PARTICIPANT INFORMATION SHEET

Name of Organisation: Flinders University

Participant Information Sheet: Hearing Impaired Adult

Title of the project:
Patterns of communication involving adults with acquired hearing impairment and their familiar communication partners.

Researchers

Ms Karen Sparrow: PhD candidate/Lecturer in Audiology: Speech Pathology & Audiology

Supervisors: Dr Willem Van Steenbrugge Senior Lecturer: Speech Pathology & Audiology

Dr Christopher Lind Senior Lecturer: Speech Pathology & Audiology

Invitation to participate

You are invited to participate in this research project but you do not have to be involved, whether you wish to or not is entirely up to you. Whether you take part or not, your medical care and the services which you receive from Flinders Medical Centre or Flinders University will not be affected in any way.

Selection

You are invited to participate in this project because you are on the SACIC/FMC/CanDo: Hearing waiting/review list to receive a cochlear implant or you have received a cochlear implant and are a client of SACIC/FMC/CanDo: Hearing.

Audiology staff from SACIC/FMC/CanDo: Hearing have agreed to write to/contact you to ask if you would like to take part in this study.

Aims of the project

The main aim of the project is

To investigate patterns of communication behaviour during conversations involving adults with a hearing impairment and their familiar communication partners.

Summary of procedures

As a participant, you will be asked to take part in a:

1. Short clinical interview to confirm your eligibility to participate.
2. Audiological assessment

a) a standard hearing assessment under headphones (if a test result done within 6 months is not available).

b) a speech perception in quiet and in noise test while you are wearing your hearing aids/cochlear implant/s. (if test results done within 6 months are not available).

3. Other Assessments:

a) a standard vision test (while wearing any prescribed glasses/lenses)

b) an assessment of problem solving ability.

c) You will also be asked to imitate a number of physical movements to assess your physical mobility.

4. Filming Session (maybe on the same day in the one session if you prefer)

You will be filmed talking with a familiar communication partner (e.g. your wife or husband or friend) in a comfortable room within the Speech Pathology department at Flinders Medical Centre. You will be asked to undertake one or more of the following tasks during filming:

a) Talking for approximately 20 minutes about any one topic or a range of topics.

b) You will be asked to listen to your communication partner telling you about a short film they have been shown.

c) You and your partner will be asked to have a planning discussion (approximately 20 minutes) about a topic agreed upon together in consultation with the chief investigator.

Background speaker babble noise may be introduced during any of these tasks to simulate a more realistic everyday listening environment, namely conversing in a noise environment.

Commitments

You will be asked to request the participation of one /two people with whom you interact with regularly (e.g. your spouse or partner, a family member or friend).

You will be asked to attend the Flinders University Audiology Clinic on one or two occasions together with one or two family members or friends. Each session will take approximately two to three hours.

Benefits

This study will help us to understand more about the way people communicate in different situations when one of them has a hearing loss. It may lead to improvements in the way clinicians carry out communication training with hearing impaired adults and their families to help them learn strategies to make conversation easier.

Risks and adverse effects

The procedures used are non-invasive clinical assessments and are unlikely to cause any discomfort or anxiety, including the filming of the session. However, if at any time you feel you are adversely affected by your participation in this study arrangements can be made for you to receive appropriate advice or counselling from a health care professional entirely independent of Flinders University.

Compensation

Participants in this study are insured under the Flinders University Insurance scheme. You may feel some distress from participation in this study. If this occurs you may withdraw from this study if you wish and your care will not be affected in any way. By participating in this study you do not give up any of your legal rights.

Confidentiality

All records containing personal information will remain confidential and no information which could lead to your identification will be released, except as required by law.

You will not be indentified by your name in any data spread sheets or in the film transcripts.

Under Australian privacy law all information collected about you must be kept confidential, unless you agree to it being released. If the results of this study are published, for example in scientific journals, you will not be identified by name.

All results and film data will be held securely at Flinders University, within the Speech Pathology & Audiology department and retained for at least 5 years after publication of the results of the project, as required by standard research practices.

With your consent SACIC staff will provide access to recent audiological test data. With your consent, film data from your participation in this study may be used in the future for teaching purposes or research presentations. You will be given a separate consent form for this.

Publication

The overall results of this study may be published in conference papers, journals or other places as appropriate. always in a manner in which you cannot be identified.

Withdrawal

Your participation in this study is entirely voluntary and you have the right to withdraw from the study at any time without giving a reason. If you decide not to participate in this study, or if you withdraw from the study, you may do so freely, without affecting the standard care or treatment you will receive.

Outcomes

The final results of the study will be made available to you in summary form, but only on request.

Expenses and payments

You will receive a shopping voucher for participation in this study and compensation for reasonable travel costs for visits made during the study.

Contact

If you have any concerns or questions, or would like further details about the project, then you may contact Karen Sparrow. If you have any issues that are of concern and you do not wish to share them with the research team, then you are encouraged to contact independent organisations such as Life Line (telephone 13 11 14)

Name: Karen Sparrow

Qualifications: BA, MSc, MAudSA (CCP)

Department/Address: Department of Speech Pathology & Audiology

Contact telephone number :(08) 8204 8986

Email address:karen.sparrow@flinders.edu.au

Complaints

This study has been reviewed by the Southern Adelaide Clinical Human Research Ethics Committee. If you wish to discuss the study with someone not directly involved, in particular in relation to policies, your rights as a participant, or should you wish to make a confidential complaint, you may contact the Executive Officer on 8204 6453 or email research.ethics@health.sa.gov.au

Flinders
UNIVERSITY

Dept. of Speech Pathology and Audiology

Flinders University, Adelaide
GPO Box 2100
Adelaide SA 5001

Tel: 08 7221 8833
Fax: 08 8204 5935
http://www.flinders.edu.au//sohs/sites/audiology

CRICOS Provider No. 00114A

Consent to participation in research

I, ...

....

(first or given names) (last name)

give consent to my involvement in the research project (short title):

Patterns of communication during conversations involving adults with acquired hearing impairment and their frequent communication partners ....

....

I acknowledge the nature, purpose and contemplated effects of the research project, especially as far as they affect me, have been fully explained to my satisfaction by

Karen Sparrow ....

....

and my consent is given voluntarily.

I acknowledge that the detail(s) of the following has/have been explained to me, including indications of risks; any discomfort involved; anticipation of length of time; and the frequency with which they will be performed:

1. Standard non-invasive assessments of hearing, speech discrimination, vision, problem solving and physical mobility will not involve any risks or discomfort ....

2. I will be asked to conduct conversations with a communication partner familiar to me and these conversations will be filmed for later analysis ....

3. I will ask one or two of my frequent communication partners (e.g. wife, husband, son, daughter, friend) with normal hearing/mild hearing loss and no significant reported communication difficulties to participate as part of this study ....

4. My participation will involve two sessions of approximately 2- 3 hours duration. ....

5. Under Australian privacy law all information collected about me must be kept confidential, unless I agree to it being released. Any publications or presentations will not identify me by name.

I have understood and am satisfied with the explanations that I have been given.

I have been provided with a written information sheet.

I understand that my involvement in this research project may not be of any direct benefit to me and that I may withdraw my consent at any stage without affecting my rights or the responsibilities of the researchers in any respect.

I declare that I am over the age of 18 years.

I acknowledge that I have been informed that should I receive an injury as a result of taking part in this study, I may need to start legal action to determine whether I should be paid.

Signature of Research Participant: ....

Date: ....

I, ... have described to ....

the research project and nature and effects of procedure(s) involved. In my opinion he/she understands the explanation and has freely given his/her consent.

Signature: ....

Date: ....

Status in Project: ....

I (Name) ____am interested in participating in the study described above.

The following person/people with whom I interact regularly is/are willing to participate as communication partner/s in the study.

Name:

Name:

I/we would be happy to be contacted.

Phone……………………………………. Or email………………………………….

Alternatively, you and your nominated communication partner/s may contact Karen Sparrow at Flinders University directly by Phone 82048986, by Fax 82045935 or by email karen.sparrow@flinders.edu.au to indicate your willingness to participate in this study.

APPENDIX B-PARTICIPANT INFORMATION & CONSENT (PCP/CPNH)

Flinders UNIVERSITY

Dept. of Speech Pathology and Audiology
Flinders University, Adelaide
GPO Box 2100
Adelaide SA 5001
Tel: 08 7221 8833
Fax: 08 8204 5935
http://www.flinders.edu.au/sohs/sites/audiology

PARTICIPANT INFORMATION SHEET

Name of Organisation: Flinders University

Participant Information Sheet: Frequent Communication Partner

Title of the project:
Patterns of communication involving adults with acquired hearing impairment and their familiar communication partners.

Researchers

Ms Karen Sparrow: PhD candidate/Lecturer in Audiology: Speech Pathology & Audiology

Supervisors: Dr Willem Van Steenbrugge Senior Lecturer: Speech Pathology & Audiology

Dr Christopher Lind Senior Lecturer: Speech Pathology & Audiology

Invitation to participate

You are invited to participate in this research project but you do not have to be involved, whether you wish to or not is entirely up to you. Whether you take part or not, your medical care and the services which you receive from Flinders Medical Centre or Flinders University will not be affected in any way. Whether you take part or not, the medical care and the services which your hearing impaired communication partner receives from Flinders Medical Centre or Flinders University will not be affected in any way.

Selection

You are invited to participate in this project because a) you are a familiar communication partner of a person who is on the FMC/SACIC waiting list to receive a cochlear implant/ has received a cochlear implant/ is a client of Flinders University Hearing Services/CanDo: Hearing/ who has agreed to participate, b) your hearing impaired family member or friend has requested your participation and c) you do not have any significant hearing difficulties.

Aims of the project

The main aim of the project is to investigate patterns of communication behaviour during conversations involving adults with a hearing impairment and their familiar communication partners.

Summary of procedures

As a participant, you will be asked to take part in:

1. Short clinical interview to confirm your eligibility to participate.
2. Audiological assessment
    a) a standard hearing assessment under headphones.

inspiring achievement

ABN 65 524 596 200 CRICOS Provider No. 00114A

Participants in this study are insured under the Flinders University Insurance scheme. You may feel some distress from participation in this study. If this occurs you may withdraw from this study if you wish and your care will not be affected in any way. By participating in this study you do not give up any of your legal rights.

Confidentiality

All records containing personal information will remain confidential and no information which could lead to your identification will be released, except as required by law.

You will not be identified by your name in the result/data spread sheets or in the film transcripts.

Under Australian privacy law all information collected about you must be kept confidential, unless you agree to it being released. If the results of this study are published, for example in scientific journals, you will not be identified by name.

All results and film data will be held securely at Flinders University, within the Speech Pathology & Audiology department and retained for at least 5 years after publication of the results of the project, according to standard research practices..

With your consent, film data from your participation in this study may be used in the future for teaching purposes or research presentations.

Publication

The overall results of this study may be published in conference papers, journals or other places as appropriate and always in a manner in which you cannot be identified.

Withdrawal

Your participation in this study is entirely voluntary and you have the right to withdraw from the study at any time without giving a reason. If you decide not to participate in this study, or if you withdraw from the study, you may do so freely, without affecting the standard care or treatment you will receive.

Outcomes

The final results of the study will be made available to you in summary form if requested.

Expenses and payments

You will receive a shopping voucher for participation in this study and compensation for reasonable travel costs for visits made during the study.

Contact

If you have any concerns or questions, or would like further details about the project, then you may contact Karen Sparrow or Dr Willem Van Steenbrugge

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Flinders University, Adelaide
GPO Box 2100
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Fax: 08 8204 5935
http://www.flinders.edu.au//sohs/sites/audiology
CRICOS Provider No. 00114A

Consent to participation in research

I, ...

....

(first or given names) (last name)

give consent to my involvement in the research project (short title):

Patterns of communication during conversations involving adults with acquired hearing impairment and their frequent communication partners ....

....

I acknowledge the nature, purpose and contemplated effects of the research project, especially as far as they affect me, have been fully explained to my satisfaction by

Karen Sparrow ....

....

and my consent is given voluntarily.

I acknowledge that the detail(s) of the following has/have been explained to me, including indications of risks; any discomfort involved; anticipation of length of time; and the frequency with which they will be performed:

1. Standard non-invasive assessments of hearing, speech discrimination in noise, vision, problem solving and physical mobility will not involve any risks or discomfort. ....

2. A (hearing impaired person) with whom I communicate frequently has requested my participation in this study.

3. I will be asked to conduct conversations with my hearing impaired familiar communication and or /another familiar communication partner and these conversations will be filmed for later analysis.

4. My participation will involve two sessions of approximately 2-3 hours duration. ....

5. Under Australian privacy law all information collected about me must be kept confidential, unless I agree to it being released. Any publications or presentations will not identify me by name.

I have understood and am satisfied with the explanations that I have been given.

I have been provided with a written information sheet.

I understand that my involvement in this research project may not be of any direct benefit to me and that I may withdraw my consent at any stage without affecting my rights or the responsibilities of the researchers in any respect.

I declare that I am over the age of 18 years.

I acknowledge that I have been informed that should I receive an injury as a result of taking part in this study, I may need to start legal action to determine whether I should be paid.

Signature of Research Participant: ....

Date: ....

I, ... have described to ....

the research project and nature and effects of procedure(s) involved. In my opinion he/she understands the explanation and has freely given his/her consent.

Signature: ....

Date: ....

Status in Project: ....

APPENDIX C-PARTICIPANT CONSENT FILM DATA

Dept. of Speech Pathology and Audiology
Flinders University, Adelaide
GPO Box 2100
Adelaide SA 5001
Tel: 08 7221 8833
Fax: 08 8204 5935
http://www.flinders.edu.au//sohs/sites/audiology

I,…………………………………………………………………………………………(FCP/HI)

give consent to the use of film segments in which I appear as part of the research study:

Patterns of Communication during conversations involving adults with acquired hearing impairment and their frequent communication partners.

I understand that:

- With my consent, film data from my participation in this study may be used in the future for teaching purposes or research presentations.
- This will be in the form of short film segments or written transcription examples for the purpose of illustrating about the research results and/or for teaching purposes.
- I will at no time be identified by my real name.
- All information will be held securely at Flinders University, within the Speech Pathology & Audiology department and not copied or supplied to individuals outside the research team
- I may withdraw my consent at anytime.

Signature of research participant……………………………………………………………..

Date……………………….

Signature of Chief Investigator……………………………………………………………

Date……………………….

APPENDIX D-ETHICS APPLICATION APPROVAL

Southern Adelaide Clinical Human Research Ethics Committee

Government of South Australia
Southern Adelaide Health Service

Ethics application approval

You are reminded that this letter constitutes ethical approval only. You must not commence this research project at a SA Health site until separate authorisation from the Chief Executive or delegate of that site has been obtained.

03 June 2013

Dear Ms Sparrow

This is a formal correspondence from the Southern Adelaide Clinical Human Research Ethics Committee (SAC HREC EC00188). This committee operates in accordance with the "National Statement on Ethical Conduct in Human Research (2007)." No hard copy correspondence will be issued.

Application Number: 173.13

Title: Patterns of communication during different conversational tasks, in quiet and in noise, involving adults with acquired hearing impairment and familiar communication partners.

Chief investigator: Ms Karen Sparrow

SA health site/s approved: Flinders Medical Centre

The Issue: The Southern Adelaide Clinical Human Research Ethics Committee (SAC HREC) have reviewed and approved the above application. The approval extends to the following documents/changes:

- Cover letter.
- SA Health Indemnity provided by John Markic, Manager, Insurance Services dated 26 March 2013.
- Letter of support from Associate Professor Paul McCormack, Head of Department in Speech and Audiology.
- Letter of endorsement form Nina Swiderski, Clinical manager Senior Audiologist.
- Letter of endorsement form Kathleen Holland, Senior Audiologist at Flinders Medical Centre.
- Letter of endorsement form Karen Sparrow, Senior Audiologist at Flinders University.
- FRCPM score sheet.
- Hand & Arm Mobility Functional Assessment.
- Clinical data sheet Audiogram.
- Clinical Data: Hearing Impaired Participant.
- Clinical Data – Frequent Communication Partner.
-

Your response to committee concerns received via email on 07 May 2013 containing the following:

- Minuting addressing specific committee concerns.
- General research application dated 18 May 2013.
- Annotative practice
- Client letter dated 18 May 2013.
- McNeill 1992 Transcription.
- Transcription glossary.
- Patient information sheet and consent form dated 18 May 2013 (clean and tracked).

Flinders Medical Centre

The Flats G5 – Rooms 3 and 4

Flinders Drive, Bedford Park SA 5042

T: 08 8204 6453

F: 08 8204 4586

E:Research.ethics @health.sa.gov.au

Approval Period: 03 June 2013 to 02 June 2016

Please retain a copy of this approval for your records.

TERMS AND CONDITIONS OF ETHICAL APPROVAL
Final ethical approval is granted subject to the researcher agreeing to meet the following terms and conditions.

As part of the Institution's responsibilities in monitoring research and complying with audit requirements, it is essential that researchers adhere to the conditions below.

Researchers have a significant responsibility to comply with the *National Statement 5.5.* in providing the SAC HREC with the required information and reporting as detailed below:

1. **The approval only covers the science and ethics component of the application**. A SSA will need to be submitted and authorised before this research project can commence at any of the SA Health sites identified in the application.
2. **Compliance** with the *National Statement on Ethical Conduct in Human Research* (2007) & the *Australian Code for the Responsible Conduct of Research* (2007).
3. To **immediately report to SAC HREC** anything that may change the ethical or scientific integrity of the project.
4. **Report Significant Adverse events (SAE's)** as per SAE requirements available at our website.
5. **Submit an annual report on each anniversary of the date of final approval** and in the correct template from the SAC HREC website.
6. **Confidentiality** of research participants MUST be maintained at all times.
7. A copy of the **signed consent form** must be given to the participant unless the project is an audit.
8. Any **reports or publications derived from the research** should be submitted to the Committee at the completion of the project.
9. All requests for **access to medical records** at any SAHS site must be accompanied by this approval email.
10. To **regularly review the SAC HREC website** and comply with all submission requirements, as they change from time to time.
11. The researchers agree to use **electronic format** for all correspondence with this department.

Kind Regards

Rhiannon Kitik
Administration Officer
SAC HREC

FLINDERS MEDICAL CENTRE

Government of South Australia
Southern Adelaide Health Service

01 July 2013

Dr Karen Sparrow
Speech Pathology and Audiology
Flinders University
GPO Box 2100
ADELAIDE SA 5001

Dear Dr Sparrow

HREC reference number: 173.13
SSA reference number: SSA/12/SAC/94
Project title Patterns of communication during different conversational tasks, in quiet and in noise, involving adults with acquired hearing impairment and their familiar communication partners.
Ethics approval: 03 June 2013 - 02 June 2016

RE: Site Specific Assessment Review

Thank you for submitting an application for authorisation of this project. I am pleased to inform you that authorisation has been granted for this study to commence at the following site: Flinders Medical Centre.

- Site specific assessment form dated02 April 2013
- CV for Dr Karen Sparrow
- SA Health Indemnity provided by John Markic, Manager, Insurance Services dated 26 March 2013
- Flinders University indemnity approval from Steve Semmler, Insurance Officer dated 25 March 2013
- Patient information sheet and consent form dated 18 May 2013 (clean and tracked).
- Client letter dated 18 May 2013.

Should you have any queries about the consideration of your Site Specific Assessment form, please contact Bev Stewart Campbell on 08 8204 4507.

The SSA reference number should be quoted in any correspondence about this matter.

Yours sincerely

Bev Stewart Campbell
Research Governance Officer
Southern Adelaide Clinical Human Research Ethics Committee

Flinders Medical Centre

The Flats G5 – Rooms 3 and 4

Flinders Drive, Bedford Park SA 5042

T: 08 8204 6453

F: 08 8204 4586

E:Research.ethics @health.sa.gov.au

APPENDIX E-ETHICS EXTENSION APPROVAL

Office for Research
Flinders Medical Centre / The Flats F6/F8
Flinders Drive, Bedford Park SA 5042
Tel: (08) 8204 6453
E: Health.SALHNOfficeforResearch@sa.gov.au

Government of South Australia
SA Health
Southern Adelaide Local Health Network

Extension request to ethics approval approved

02 June 2016

Dear Ms Sparrow

The Southern Adelaide Clinical Human Research Ethics Committee (SAC HREC EC00188) have reviewed and provided ethical approval for this extension which appears to meet the requirements of the *National Statement on Ethical Conduct in Human Research*

Application number: OFR # 173.13

Study title: Patterns of communication during different conversational tasks, in quiet and in noise, involving adults with acquired hearing impairment and familiar communication partners.

Chief Investigator: Karen Sparrow

Approval Date: 02 June 2016

Ethics approval period: 02 June 2016 to 02 June 2017

Public health sites approved under this application: Flinders Medical Centre

The below document/s have been reviewed and approved:

- SAC HREC Extension Request and Annual Review form dated 16 May 2016

TERMS AND CONDITIONS OF ETHICAL APPROVAL
As part of the Institution's responsibilities in monitoring research and complying with audit requirements, it is essential that researchers adhere to the conditions below and with the *National Statement chapter 5.5.*

Final ethical approval is granted subject to the researcher agreeing to meet the following terms and conditions:

1. If University personnel are involved in this project, the Principal Investigator should notify the University before commencing their research to ensure compliance with University requirements including any insurance and indemnification requirements.
2. Compliance with the *National Statement on Ethical Conduct in Human Research* (2007) & the *Australian Code for the Responsible Conduct of Research* (2007).
3. To immediately report to SAC HREC anything that may change the ethical or scientific integrity of the project.
4. Report Significant Adverse events (SAE's) as per SAE requirements available at our website.
5. Submit an annual report on each anniversary of the date of final approval and in the correct template from the SAC HREC website.
6. Confidentiality of research participants MUST be maintained at all times.
7. A copy of the signed consent form must be given to the participant unless the project is an audit.
8. Any reports or publications derived from the research should be submitted to the Committee at the completion of the project.
9. All requests for access to medical records at any SALHN site must be accompanied by this approval email.
10. To regularly review the SAC HREC website and comply with all submission requirements, as they change from time to time.
11. Once your research project has concluded, any new product/procedure/intervention cannot be conducted in the SALHN as standard practice without the approval of the SALHN New Medical Products and Standardisation Committee or the SALHN New Health Technology and Clinical Practice Innovation Committee (as applicable) Please refer to the relevant committee link on the SALHN intranet for further information.

Dani Eley
Administration Officer, Office for Research

On behalf of

Petrina Kasperski
Ethics Officer (QA), Office for Research

APPENDIX F-ETHICS EXTENSION APPROVAL 2

Office for Research

Flinders Medical Centre
Ward 6C, Room 6A219
Flinders Drive, Bedford Park SA 5042
Tel: (08) 8204 6453
E: Health.SALHNOfficeforResearch@sa.gov.au

Government of South Australia
SA Health
Southern Adelaide Local Health Network

Extension Request to Ethics Approval: Approved

15 April 2019

Ms Karen Sparrow
Speech Pathology & Audiology
Flinders University

Dear Ms Sparrow

OFR Number: 173.13
HREC reference number: HREC/13/SAC/93
Project title: Patterns of communication during different conversational tasks, in quiet and in noise, involving adults with acquired hearing impairment and familiar communication partners.
Chief Investigator: Ms Karen Sparrow

Ethics Approval Period: 03 June 2019 – 03 June 2021

The Southern Adelaide Clinical Human Research Ethics Committee (SAC HREC EC00188) have reviewed and provided ethics approval for this extension which appears to meet the requirements of the *National Statement on Ethical Conduct in Human Research (2007, updated 2018).*

Public health sites approved under this application:

- Flinders Medical Centre

The below documents have been reviewed and approved:

Document	Version	Date
Annual review and extension request form	1	04.04.2019

Terms and Conditions of Ethics Approval

SALHN has recently introduced site monitoring of authorised studies. This approval/authorisation is subject to participation in this monitoring process. You will be notified in advance if your site has been selected for an inspection

It is essential that researchers adhere to the conditions below and with the *National Statement chapter 5.5.*

Final ethics approval is granted subject to the researcher agreeing to meet the following terms and conditions:

1. For all studies approved before the introduction of governance review, the extension request approval is conditional on the SSA or Access Request Form being submitted and authorised. The SSA or Access Request form is required within 60 days from receipt of this letter. Failure to submit the SSA or Access Request Form could result in ethics approval extension to lapse.
2. If University personnel are involved in this project, the Principal Investigator should notify the University before commencing their research to ensure compliance with University requirements including any insurance and indemnification requirements.
3. Compliance with the *National Statement on Ethical Conduct in Human Research* (2007, updated 2015) & the *Australian Code for the Responsible Conduct of Research* (2018).
4. To immediately report to SAC HREC anything that may change the ethics or scientific integrity of the project.
5. Report Significant Adverse events (SAE's) as per SAE requirements available at our website.
6. Submit an annual report on each anniversary of the date of final approval and in the correct template from the SAC HREC website.
7. Confidentiality of research participants MUST be maintained at all times.
8. A copy of the signed consent form must be given to the participant unless the project is an audit.
9. Any reports or publications derived from the research should be submitted to the Committee at the completion of the project.
10. All requests for access to medical records at any SALHN site must be accompanied by this approval email.
11. To regularly review the SAC HREC website and comply with all submission requirements, as they change from time to time.
12. Once your research project has concluded, any new product/procedure/intervention cannot be conducted in the SALHN as standard practice without the approval of the SALHN New Medical Products and Standardisation Committee or the SALHN New Health Technology and Clinical Practice Innovation Committee (as applicable) Please refer to the relevant committee link on the SALHN intranet for further information.

For any queries about this matter, please contact The Office for Research on (08) 8204 6453 or via email to Health.SALHNOfficeforResearch@sa.gov.au

Yours sincerely,

Professor Bill Heddle
Chair
Southern Adelaide Clinical Human Research Ethics Committee

APPENDIX G-CLINICAL DATA SHEET CPHI

Clinical Data: Participant with Hearing Impairment

Participant Code: M/F

Clinic:

DOB:

First Language:
Other Languages spoken:

Frequent Communication Partner 1 Code:
Relationship to Participant:
Language spoken with participant:

Frequent Communication Partner 2 Code:
Relationship to Participant:
Language spoken with participant:

Do you use sign language/have you ever learnt sign language?

Have you ever attended aural rehabilitation classes?

Are you aware of any neurological deficits? e.g. Have you been diagnosed acquired speech and language problem such as aphasia or /as a result of a stroke?

Absence of or immobility of a hand or arm.? (observation):

Left or right- handed?

<u>Clinical Assessments:</u>

Otoscopy:

Current audiogram/speech results: obtained: date

QuickSIN:

Aided vision assessment: vision while using corrective lenses of better than 6/12 or 20/40: YES/NO

The Raven's Coloured Progressive Matrices (RCPM) test : within normal range: YES/NO

Functional assessment of hand and arm mobility:

APPENDIX H-CLINICAL DATA SHEET PCP/CPNH

Clinical Data – Communication Partner

Participant Code: M/F

DOB:

First Language:
Other Languages spoken:

Relationship to HI participant:
Language spoken with HI participant:

Are you aware of any hearing/communication difficulties or hearing loss?

Do you use hearing aids?

Do you use sign language/have you ever learnt sign language?

Have you ever attended aural rehabilitation classes with a partner or friend?

Are you aware of any neurological deficits? e.g. Have you been diagnosed acquired speech and language problem such as aphasia or /as a result of a stroke?

Absence of or immobility of a hand or arm? (observation)

Left or right-handed?

<u>Clinical Assessments:</u>

Otoscopy:

Audiogram:

QuickSIN:

Aided vision assessment: vision while using corrective lenses of better than 6/12 or 20/40 YES/NO

The Raven's Coloured Progressive Matrices (RCPM) test: within normal range: YES/NO

Functional assessment of hand and arm mobility:

APPENDIX I-CLINICAL ASSESSMENT RESULTS

Case	Participant	Hearing PTA [a] Right/Left dB	Speech Discrimination in quiet % [c]	QuickSiN SNR Loss (dB)	Vision 6/ [e]	Raven CPM /37 [f]	Percentile [g]	Hand/Arm Function /10
1	PCP	5/5		3.5	6	30	50	10
	CPHI	[b]/CI	96 CUNY	5.5	4.8 (-1)	29	40-50	10
	CPNH	0/0		0.0	6 (-1)	35	>50nn	10
2	PCP	7/5		-1.5	6 (-1)	36	>95	10
	CPHI	70/CI	98 CUNY	17.5	6	26	25 [h]	10
	CPNH	3/0		2.0	4.8 (-1)	35	nn	10
3	PCP	8/8		0.5	6	34	90	10
	CPHI	62/83	90	9.0	9.5 (-1)	32	50-75	10
	CPNH	3/5		0.0	6 (-2)	35	95	10
4	PCP	23/15		1.0	4.8	36	>95	10
	CPHI	68/72	83	18.5	6	32	75-90	10
	CPNH	2/2		1	4.8	34	nn	10

Case	Participant	Hearing PTA [a] Right/Left dB	Speech Discrimination in quiet % [c]	QuickSiN SNR Loss (dB)	Vision 6/ [e]	Raven CPM /37 [f]	Percentile [g]	Hand/Arm Function /10
5	PCP	5/7		1	4.8 (-2)	36	>50	10
	CPHI	57/78	73	19	3.8 (-1)	34	>50	10
	CPNH	0/-5		1	4.8 (-1)	34	>50	10
6	PCP	12/7		0	4.8 (-2)	34	90	10
	CPHI	70/67	80	8.5	7.5	35	95	10
	CPNH	15/12		1	4.8	35	>50	10
7	PCP	5/2		1	9.5 (+2)	34	90	10
	CPHI	>100/CI	66 CNC	9	4.8 (-2)	33	75	10
	CPNH	0/2		0.0	3.8 (-1)	37	nn	10

Note. PCP = principal communication partner; CPHI = communication partner with hearing impairment; CPNH = communication partner with normal hearing.

[a] PTA = pure tone average is an average of the hearing thresholds measured at 500Hz, 1kHz and 2kHz. A PTA < 20dB indicates hearing within normal limits. CI indicates that the CPHI uses a cochlear implant in that ear. [b] This participant had a mild to profound hearing loss in the right ear and was scheduled for a second CI; a PTA was not available. [c] The AB word test was presented in free field. The score indicates the percentage of phonemes correctly identified by participants at a comfortable listening level using CI and/or hearing aids. Alternative speech test results are indicated. CUNY = CUNY sentences; CNC = CNC word test.

[d] SNR loss = the increase in signal-to-noise ratio required for a participant to understand speech in noise when compared to normative values for normally hearing

adults. [e] Snellen visual acuity scores measured at a three-metre distance. [f] Raven CPM = Raven's Coloured Progressive Matrices absolute scores for Sets A, Ab and B. [g] Raven's CPM percentile scores based on normative data from Raven & Court (1998, Table CPM25). Because small changes in raw scores resulted in large changes in percentiles where necessary the range is reported when the raw score was not attributed its own percentile. [h] This participant met the RCPM inclusion criteria at the lower cut off, a score at or above 25th percentile. In light of this, the relevant recordings were reviewed to check for evidence of the participant experiencing difficulties understanding the requirements of the tasks. None were observed.

APPENDIX J-AUDIOGRAM RECORD SHEET

Removed due to copyright restriction

APPENDIX K-AB WORDS SCORE SHEET

Removed due to copyright restriction

APPENDIX L-QUICKSIN SCORE SHEET

Removed due to copyright restriction

APPENDIX M-SNELLEN VISION ASSESSMENT CHART

Removed due to copyright restriction

APPENDIX N-RCPM SCORE SHEET

Removed due to copyright restriction

APPENDIX O-HAND-ARM FUNCTIONAL ASSESSMENT

Hand & Arm Mobility Functional Assessment

Participant Code:
The examiner is to instruct the participant to imitate each physical movement made.
The participant should let the examiner know if any of the movements are uncomfortable or cause discomfort.

Movement	Left	Right	Comments (if difficulty or discomfort)
Place Hand on Opposite Shoulder			
Put back of hand on the forehead			
Put hand over ear			
Place fist on chest			
Make a circle in the air			
Put the palm of hand on the head			
Put thumb and each finger together			
Make a ball shape with both hands			
Put both arms out straight & move out & up			
Shrug both shoulders			

(adapted from Poeck, 1986)

APPENDIX P-PARTICIPANT INSTRUCTIONS

Free Conversation Instructions:

I would like you to talk about anything you like (just as you would at home) for 10-20 minutes.

There will be some periods of background babble noise coming from the speakers but just continue your conversation.

Narrative Instructions:

I am going to show you (CP) a short film (approx10 minutes) and then ask you to explain the story of the film to CPHI/CPNH as accurately as possible so that they can tell the story to someone else.

After watching the film, the CPs was reinstructed as above before the filming commenced and reminded that there would once again be periods of background babble noise.

APPENDIX Q-FILM TRANSCRIPT: *LAMB*

Removed due to copyright restriction

Lamb by Emma Freeman (2002) Available from YouTube:
https://www.youtube.com/watch?v=WCFh14goWVM

APPENDIX R-NARRATION TIMES

Case	CPNH (min)	CPHI (min)
1	4.58	4.20
2	3.21	2.25
3	5.08	5.12
4	4.44	3.58
5	4.05	4.01
6	4.00	4.02
7	3.36	4.00

APPENDIX S-CA NOTATION

	Definition	Notation
Overlapping Talk	Commencement of overlapping talk	[
	Completion of overlapping talk	]
	No gap and no overlap between speaking turns	=
Pausing	Pauses of less than 0.2 seconds	(.)
	Pauses within a turn in tenths of a second	(0.x)
Pitch	Strongly rising pitch	?
	A marked change in pitch up or down	↑ ↓
	Less strongly rising pitch	¿
Duration	Lengthening of a sound. More colons mean a longer sound	:
	An abrupt stopping of talk	-
	Words that are stressed and/or louder	UPPER CASE
Laughter	Within talk	(h) (h) (h)
	Outside talk	(laughter)

Note. Adapted from Gardner (2001).