

University of Dundee

DOCTOR OF PHILOSOPHY

17 ways to say yes, exploring tone of voice in augmentative communication and designing new interactions with speech synthesis

Pullin, Graham

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Graham Pullin

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NAVIGATIONAL NOTES

ON

17 ways to say yes

BY GRAHAM PULLIN

TO ACCOMPANY
THESIS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
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ABOUT THE NAVIGATIONAL NOTES

I have eventually chosen to structure this thesis as a main volume, accompanied by a second book of 'navigational notes'. The story of how this structure came about is told in the last of the navigational notes.

Each volume, the main thesis and these navigational notes, is intended to play a complementary role: the main thesis adopts a fairly traditional structure, progressing from research context through to research questions, research methods and so on. Whilst this may at times over-simplify the research process, it is useful in providing a relatively straightforward and linear narrative thread—which is valuable in such interdisciplinary research, the telling of which is inherently complex and might otherwise prove too complicated.

Throughout the navigational notes, any marginal notes in Gill Sans relate back to the main thesis.

So, having established a strong thread with the main chapters, the corresponding (and if read in this way, interwoven) navigational notes provide a means to capture important complexities that might have been lost. My supervisor Seaton Baxter preferred to read the navigational notes together, after the main thesis—in this way they provided what he called a second, 'shadow' narrative.

Free to act as reflections on the main text, the navigational notes are an opportunity to be more transparent—and more honest—about what happened and when. To reflect this, they are written in a more informal style (including referring to people I know by their first names).

In particular, I have tried to capture instances when the research moved from one place, position or perspective to another, unforeseen. These events feel fundamental to my growth as a researcher because they have changed the way that I think about research through the act of having done research, myself. Hence, each note is of the form 'A to B'—or I should probably say 'A to P' to reflect the often unexpected outcome as the journey evolved.

INTRODUCTION TO EACH NAVIGATIONAL NOTE

There follows a sentence to introduce the journey described by each note.

Marginal notes indicate the relative section of the main thesis.

1.1 introduction to interdisciplinary context—a lack of tone of voice in communication aids	DISCIPLINES TO INDIVIDUALS How authoritative individuals became my means of navigating a vast interdisciplinary landscape.
1.2 a designer's role in augmentative communication	SKILLS TO SENSIBILITIES How a missing role for design in studying speech transcends the design of user interfaces.
1.4 the structure of this thesis	SUBVERSION TO CONVENTION How the structure of the thesis evolved from more radical ideas to something appropriately more conventional.
2.1.1 methodological perspectives—design exploration	PRACTICE TO RESEARCH How my current research practice builds on my experience at IDEO.
2.1.2 critical design	POINTED TO OPEN-ENDED How I have become increasingly uncomfortable with the (increasingly) critical tone of critical design.
2.1.3 methodological bricolage	HCI TO INTERACTION DESIGN How my transferring wholly to art college from computing prompted a reframing of this research.
2.2.1 methods—interdisciplinary literature review	PHONETICS TO PYGMALION How creative practice in the theatre influenced my deeper academic knowledge of phonetics.
2.2.3 design collections	CONCEPTS TO COLLECTIONS How I learnt from misinterpretations of <i>The Speaking Mobile</i> and the success of <i>Social Mobiles</i> .
2.2.2 embodiment	PROTOTYPING TO ILLUSTRATING How the interactivity of the <i>Six Speaking Chairs</i> became less important as the research evolved.

2.2.5 experience prototyping	EXPERIENCING TO IMAGINING How <i>Speech Hedge</i> was conceived as a thought exercise, more than as a prototype.
2.2.6 descriptive research	AAC TO DESIGN RESEARCH How the research paradigm became design research rather than interdisciplinary AAC.
2.2.8 data visualisation	CALCULATING TO VISUALISING How the techniques of visualisation, rather than statistical analysis, were applied to response data.
2.2.4 reflective practice	EXPLORING TO SPECULATING How the distinction between design exploration and design practice became increasingly blurred.
2.2.7 distilling principles	APPLYING TO DISTILLING How abstract principles were extracted from design responses.
3.1.1 curating the <i>Six Speaking Chairs</i> —alternative models of tone of voice	CREATING TO CURATING How the first project became more about found objects than new models.
3.1.2 <i>Six Speaking Chairs</i>	DEPLOYING TO EMBODYING How our own experience of the chairs became as influential as their exposure to others.
3.1.3 on 'real-time' and 'pre-packaged'	PULLIN & COOK TO PULLIN How the road divided for Pullin and Cook.
3.1.4 17 ways to say yes	VALIDATION TO INSPIRATION How a short exercise in audience participation became more influential than expected.
3.2.1 257 ways to say yes	ORDER TO OPENNESS How the challenge became not so much to select a model but to abandon any model altogether.

- 3.2.2 *Speech Hedge* GATHERING TO GROWING
How a mechanism of discovering through experimenting replaced one of discovering through exploring.
- 3.2.3 *a million ways to say yes* INTUITION TO APPROPRIATION
How differences in perspective became more inspiring than shared understanding.
- 3.2.4 *on performance and preparation* USERS TO COMMUNITIES
How a scale of multiple users inspired speculation beyond the perspective of individuals.
- 3.2.5 *design principles* GUIDELINES TO PRINCIPLES
How AAC principles emerged from design guidelines.
- 4.1 *review of process and outcomes* DESIGNER TO RESEARCHER
How doing this research, myself, has been an education.
- 4.1.5 *original contributions to knowledge* IMPLEMENTATION TO INFLUENCE
How my views about my future role in AAC have evolved during the course of this research.
- 4.2.3 *interesting future expeditions* CONCEPT CARS TO CULTURAL PROBES
How design might contribute to user research in AAC, that could better inspire design.
- 4.2.2 *complementary research projects* EXPLORING TO TRADING
How one metaphor for interdisciplinary research became superseded by another.
- 4.2.1 *planned outputs* LAND TO SEA
How attempting to draw a map of the process gave further insights.
- 4.3 *concluding remarks* MAPS TO NOTES
How these notes arose from seeking maps of expeditions.

DISCIPLINES TO INDIVIDUALS

1.1 introduction to
interdisciplinary context
—a lack of tone of voice
in communication aids

Originally, I conceived of the literature search as an exercise in laying out a complicated interdisciplinary landscape of the fields of speech, disability and technology, along with any existing relationships with the field of design. Of particular interest were the overlaps between fields: AAC (augmentative and alternative communication) involves an overlap of disability and speech; AT (assistive technology) involves an overlap between disability and technology; TTS (Text-To-Speech) involves an overlap between speech and technology. And each of these overlaps is interdisciplinary: AAC involves collaboration between speech and language therapists, communication experts, speech technologists and others, including people without speech of course; assistive technology, collaboration between engineers, clinicians, occupational therapists and disabled people themselves; TTS, collaboration between speech technologists, linguists and software engineers. Voice output communication aids or speech generating devices are then a combination of all three of these already overlapping fields: AAC, AT and TTS!

Beyond these overlaps I have also ventured into broader areas of speech, disability and technology—beyond AAC into less applied speech studies and also into speech-related creative practice; beyond assistive technology into a broader meeting of design and disability; beyond TTS into early mechanical speaking machines, musical instruments and interaction design—with the result that a succinct background to the research questions was beyond me. I initially attempted to weave a narrative thread through these myriad disciplines, but failed: early drafts were too divergent and frustrated my patient readers. More importantly though, this is too much breadth to be able to attest to a depth of knowledge and the soundness of my foundational understanding.

So the background, both in the telling and also in my own reflection, has ended up increasingly focussed not on the disciplines directly, but on the perspectives of authoritative individuals. Three key individuals are Alan Newell, Jeff Higginbotham and Colin Portnuff.

Professor Alan Newell of the School of Computing at the University of Dundee, has been an inspirational role model. I first met Alan at a conference about mobile technology and the excluded user, called 'Can You Hear Us?' in Saltaire in 2000, visited him in Dundee in 2004 and we met again at the inclusive design conference *Include* at the Royal College of Art in 2005, all whilst I was still at IDEO. This ultimately led to my move to Dundee. Although he retired soon after the start of this research, he has had a profound influence, encouraging me to bring my sensibilities to AAC. Over 30 years, he managed

to have a radical, even iconoclastic voice within AAC, yet one that was respected and influential.

Jeff Higginbotham is an opinion former who has also spent 30 years in the field of AAC and is still very much at the forefront of it. I met him first at an ISAAC research symposium in Montréal in August 2008, spent time with him at ISAAC 2010 in Barcelona and visited the University at Buffalo's Signature Center for Excellence in Augmented Communication that he directs in June 2012. His wisdom has been invaluable in trying to sufficiently understand such a complex field in order to make a meaningful contribution to it—given that part of the contribution that I could make comes from having a fresh perspective; at times even a certain naïvety. Open-minded experts are part of my means of making unexpected but relevant contributions to the field.

I never met Colin Portnuff, but was introduced to him through Higginbotham's writings. Eventually Portnuff more than anyone became my route into the heart of this interdisciplinary space, given his eloquence and his authority as a person without speech himself. This is one small way in which I can respect the principle of disability rights "Nothing about us without us" (Charlton 1998) even though Portnuff is no longer alive to involve directly.

These authoritative perspectives are all the more valuable given that there is not a deep tradition of AAC research concerning tone of voice. Portnuff and Higginbotham's discussions of tone of voice both reassured me as to its potential importance but also confirmed that these discussions are still at a very early stage. As such, there might yet be a contribution that an interaction designer could make.

SKILLS TO SENSIBILITIES

I.2 a designer's role in augmentative communication

See reprint of 'expression meets information'.

Design—let alone design research—is conspicuous by its absence in AAC. The only instance of interaction designers being involved that I know of is when Richard Ellenson of Blink Twice engaged Smart Design in New York to design the *Tango!* communication device for children. Ellenson was a New York advertising executive whose son Thomas has cerebral palsy. Not satisfied with any of the communication devices available to Thomas, he set up a company to develop his own. Uncharacteristically in the area of assistive technology, this was not a garden shed operation: Ellenson approached the project as he would an important advertising account, hiring the best talent he could find for each and every role. So he engaged not only the respected speech and language professionals Pati King-DeBaun, Patrick Brune and Beth Dinnean but also companies with no prior involvement in AAC: the kids' television network

Nickelodeon to develop cartoon characters for the user interface, electronics manufacturer Flextronics to bring consumer-market technology and build quality, and design consultants Frog Design and Smart Design. Smart Design's team included interaction designers as well as industrial designers.

But if interaction designers were to be involved again, their expected role in AAC would probably be to create better AAC apps on mobile platforms (there are many already, none I have seen bear the evidence of interaction design).

This is to miss a more fundamental role in which design researchers contribute not their directly relevant skills but their sensibilities in opening up new ways to think about an issue in the first place. This is a theme of *Design meets disability* (Pullin 2009) a book about the relationship between disability-related design and design in general. This book was written in parallel to this research, from 2004 until 2008 and so overlapping for two years, but is not itself part of this submission.

See Appendix B for overview of *Design meets disability*.

There has been an unexpected shift in the relationship between the book and this research. I had anticipated that this research might constitute a broad application of the principles in the book to a particular area of assistive technology. Indeed the book was structured to anticipate this: the final main chapter has a focus on AAC. This chapter concludes by advocating a role for interaction designers, graphic designers and industrial designers in AAC:

See reprint of 'expression meets information'.

"In AAC, aesthetics is not limited to the visual and tactile but encompasses the audible and other time-based qualities too. It includes the resistance and yielding of a button, the responsiveness of an auditory control, and the choreography of an animation. The consideration of aesthetics should extend from the physical design to the interaction design. Or rather, it should expand from the heart of the product outward—from the expressiveness afforded by the interaction to the voice quality and the industrial design, the physical manifestations of these inner qualities. Each sends out its own messages.

"Interaction designers and industrial designers, graphic designers and sound designers, even fashion designers and furniture designers, could contribute so much to AAC and design for disability in general. There is a place here for many of the values of art school design: exploring and feeling, simplicity and provocation, identity and expression." (Pullin 2009a, 179)

Throughout the book I also advocate that designers' contributions start before the design brief is even written. As this research project unfolded, it became apparent that there was an even more upstream role for design within it, because exploring tone of voice in augmentative communication involves exploring issues that are so intangible that no-one was quite sure what 'exploring' them might entail, even in an abstract sense—and at the same time making this exploration visible too.

In this sense, this PhD thesis extends the thesis of *Design meets disability* upstream into an even earlier (and therefore potentially more influential) role for design practice within this interdisciplinary research.

A further barrier to speech-related design research is that design, traditionally considered a visual discipline, does not have an established role in the auditory fields of speech technology and spoken communication. Even exploring new interactions with speech technology, it seems that expertise in speech technology itself is considered more relevant than ability in interaction design. The following is taken from a correspondence requesting that such a research proposal might be reviewed by leading interaction designers:

"The full proposal certainly has a feeling of one which would justify review from a speech perception and synthesis background. This area has a natural appreciation of the user interface and human language." (Andrew Rose, EPSRC, personal correspondence, 27 January 2012) In other words: no. Interaction design is not considered to be a relevant expertise.

Where a more radical and creative approach to speech technology is sought, multidisciplinary research has combined artists and scientists. The Creative Speech Technology Network (CreST) funded by the EPSRC was defined in its Case for Support as:

"The first objective of the network would be to help the artistic members to investigate and articulate what are the most significant properties of speech over which they would like control. Then the technologists can see what control they can provide and design the necessary control facilities making use of interfaces that are appropriately designed." (Edwards and Newell 2010, 2)

There is no mention of design, except as a verb, to be done by artists and scientists. I am the only designer in the network.

The emerging discipline of interaction design has the potential to contribute to the exploration and creation of new interactions with speech technology. (Moggridge 2006, Troika 2008) Daniel Fallman acknowledges that "While there is no commonly agreed definition of interaction design, its core can be found in an orientation towards shaping digital artifacts—products, services, and spaces—with particular attention paid to the qualities of the user experience." (Fallman 2008) Gillian Crampton Smith, the founder of the pioneering Computer Related Design course at the Royal College of Art, London rounds this out:

"Interaction design is the design of the interaction between people and devices, systems or services. This interaction usually involves the 'new technologies' of computing and communications. But interaction design remains a creative activity – like architectural, graphic or product design. And it

concerns the social value and cultural meaning of what is designed, as well as its functional efficiency and aesthetic appeal." (Crampton Smith 2007)

Two complementary roles for interaction design are enacted in this research. The first, most obvious role is to directly explore radical new interactions with speech technology. The second is to use interaction design more indirectly, in order to help us to think and talk about tone of voice in the first place.

And part of the indirect use of interaction design involves applying its sensibilities rather than necessarily its skills. If I review some early written outputs, it surprises me how quickly the research questions and initial methods were decided upon—given that much of the interdisciplinary research was itself still underway at this point, how intuitively. This too is part of a designer's sensibilities.

SUBVERSION TO CONVENTION

1.4 the structure of this thesis

The fairly conventional structure of the main thesis evolved from more radical ideas. Early on, when the research was conceived as a blend of AAC and interaction design (and as such more in an HCI tradition than wholly within design research as it became), the idea was to have one External Examiner from AAC and one from interaction design. Their reading experiences would have been very different, given their different backgrounds, prior knowledge and preoccupations: could the same narrative be written for two different readerships? This led to ideas in which each page was split into two, with the texts proceeding alongside each other. Or even a thesis that was started at one end or the other, but met in an interdisciplinary middle section somehow.

2.1.3 methodological bricolage

Inspired by the concept of methodological bricolage, another idea was to assemble the thesis from different sections, printed on different paper stock—making its assembly visible, even before reading the text. Each would be given a different but appropriate graphic treatment: in the more traditionally academic HCI sections more weight would be given to the text itself, whilst the design research would be far richer in imagery. This was for two reasons: to acknowledge the different cultures and values that lie behind each mode of enquiry, so that each would be engaged with in a different and appropriate manner, and also to present the design exploration of the *Six Speaking Chairs* as a substantive research output in its own right, not just the intermediate step of preparing stimulus material that it might have been within a more traditionally scientific study. Because the chairs themselves are one of the outputs of this research.

There are parallels with Ramia Mazé's PhD, *Occupying time: design, technology, and the form of interaction*. (Mazé 2007) Her methodology is described—by Yee, who verifies this mapping with Mazé herself—as a 3 x 3 matrix of three practice-based projects, each explored from historical, practical and critical viewpoints. Moreover, the format of her thesis involved "presenting the projects as portfolio-formatted inserts that breaks the flow of the theoretical and reflective text (Ramia Mazé, personal communication, August 10, 2010)." (Yee 2010) Mazé's thesis is structured according to three design projects, IT+Textiles, Public Play Spaces, and Static!, each with a rhythm of three different viewpoints, reflected in a different, appropriate presentation of each. (Yee 2010, 12) My thesis might correspondingly have been described in terms of a 2 x 3 matrix: the 2 projects are *Six Speaking Chairs* and *Speech Hedge*. These are not independent, as were Mazé's but represent a progression, almost an iteration; the 3 modes of enquiry are academic research, designerly practice-based research and descriptive research. It feels as though this research shares something with Mazé's, whilst also exhibiting an appropriate uniqueness typically identified by Yee.

1.3 aims and objectives

The common problem in many of these ideas—and there were several others—was that each seemed to introduce complexity. My supervisor, whilst intrigued by these approaches, was nonetheless understandably frustrated by the more convoluted narrative in early drafts: "When are we going to get to the research aims?"

PRACTICE TO RESEARCH

2.1.1 design exploration

My journey at the start of this research has been one from industry to academia. In industry I worked for 17 years (as a studio head, project manager and interaction designer at IDEO; previously as a product designer at Isis and Jones Garrard; as a design engineer at Bath Institute of Medical Engineering; as a project engineer at Mecerlec Developments Ltd.) This PhD is part of that transition, recognising that actually completing a PhD myself will afford me more detailed insights into design research.

At IDEO, our work typically involved 'research for design': human factors research into the people we were designing for—into their existing behaviours, unsolved problems and future aspirations—was nearly always a part of the design process. Very often project-specific research into technologies and manufacturing was also involved. IDEO, and Moggridge Associates before it, had evolved a design process of Understand, Observe,

Visualise, Evaluate (and Refine) and Implement: the understanding and observing fit the category of 'research for design'.

During my time at IDEO, 1997–2005, the nature of the relationship with clients itself evolved. More often we undertook projects that were 'before the brief'. We called these 'Phase 0', to make a distinction with a traditional engineering design process that would start with a 'Phase 1' once the brief was defined. On these projects our work would be directed to helping the client to define a more traditional design brief—which would sometimes be taken in-house or even placed with a different consultancy: then, defining the brief was our role, not just the first part of our role. So 'research for design' would still be involved but often also 'research through design' in which the act of design was used to visualise alternatives, not in the conventional sense of competing design concepts but as conversation pieces to help advance understanding and clarity of the issues concerned.

The third activity I became increasingly involved in was conceiving internal design projects, which these days I would describe as design research projects. *Social Mobiles* was one (of which more later) and *Table Talk* for the RNID and *Blueprint* magazine's exhibition *HearWear* at the V&A Museum was another.

This background is relevant to PhD research. It also is part of the reason that I have gravitated towards a model of design research, that reconciles these different research activities into a more complex practice of research.

POINTED TO OPEN-ENDED

2.1.2 critical design Tony Dunne and Fiona Raby described the objects in their *Placebo* project as "purposely diagrammatic and vaguely familiar... open-ended enough to prompt stories but not so open as to bewilder". (Dunne and Raby 2000, 75) *Placebo* was an inspiration in this research, especially as its objects gave visible presence to invisible radiation, as the chairs make tangible the esoteric qualities of tone of voice. But this sentence in particular was an aspiration that we (Cook and I) adopted on *Six Speaking Chairs*. 'Open-ended' feels appropriate.

My thoughts of whether or not to describe this research as 'critical design' have evolved though. Writing in 2006, within months of the start of this research, I entitled a paper 'Social Mobiles and Speaking Chairs: applying critical design to disruption, discourse and disability' for the European Academy of Design 2007 conference (the theme of which was framed as 'Dancing with Disorder: Design, Discourse, Disaster', hence the 'discourse' and other 'dis-' words in my own title). By using 'critical design' in my own title, I was I think seeking to lend my research credibility by attaching it to a respected

design research movement. And yet, even within this paper, I am more self-critical about this categorisation:

"On reflection, the role of critical design is different in these two projects. [Social Mobiles at IDEO and Six Speaking Chairs at Dundee] Where they differ is that the *Social Mobiles*, perhaps with the exception of the *Knocking Mobile*, were not intended as even embryonic solutions to the problem of anti-social phone use. Whereas the *Speaking Chairs* are being more open-mindedly conceived in the hope one or more of the chairs may form the basis for a usable and effective interface for people with speech and language impairment.

"Perhaps then the term 'critical design' is inappropriate to the *Speaking Chairs*? They are somewhat more optimistic. Yet returning to terms such as 'conceptual design' or 'experimental design' does not express the illustrative role of the chairs, in making visible and tangible and interactive, mental models of expressive speech. Conversely, the adjective 'illustrative' or 'diagrammatic' does not convey the exploratory intent, implying a representation of something existing. Tony and Fiona, in introducing critical design, mention the related terms 'haute couture', 'concept cars', 'design propaganda' or 'visions of the future'. None of these seem any closer...

2.2.3 design collections

"... Perhaps a term is needed that combines the exploration of a landscape of different approaches, along with the visual representation of landmarks in this landscape." (Pullin 2007)

At the same conference, I met Simon Bowen who was proposing embedding critical design into user-centred design in a paper 'Crazy ideas or creative probes?: presenting critical artefacts to stakeholders to develop innovative product ideas'. (Bowen 2007) Simon calls this 'critical artefact methodology'. This is probably how I first conceived of the *Six Speaking Chairs* within this research: an early divergent stage of a subsequently more traditional design project. To a certain extent this is still true, but the chairs became less critical—more open-mindedly illustrative—and the work that followed was also in its own way divergent.

Writing later, roughly half way through this PhD research, for a Statement of Practice 'Curating and creating design collections, from *Social Mobiles* to the Museum of Lost Interactions and *Six Speaking Chairs*' in the journal *Design and Culture*, I am even more equivocal:

"But I am never sure whether to use the term critical design to define my own work these days. The term is so associated with the *Design Interactions* course at the Royal College of Art and its subversive, often dystopian visions of technological futures." (Pullin 2010b, 324)

During the course of this research Tony became Head of Programme of Design Interactions at the RCA, renaming Interaction Design and breaking its

direct lineage from Gillian Crampton Smith's Computer Related Design (CRD). This programme's postgraduates have collectively amassed a body of work through annual degree shows, the tone of which I perceive as being more pointed, less open-ended. Somehow the tone of voice of *Placebo* has been swamped by more strident works. My thoughts turn to another influential design researcher—a past collaborator with Dunne at the RCA—Bill Gaver:

"I see as many parallels with the work of Bill Gaver's Interaction Research Studio at Goldsmiths—another group whose work is sometimes associated with critical design by observers, but not thought of as such by its practitioners. We haven't managed to come up with as compelling an alternative definition yet though." (Pullin 2010b, 324)

I feel a connection with a more recent project, the *Prayer Companion*. This was developed as a resource for the spiritual activity of a group of cloistered nuns, a device that displays a stream of information sourced from RSS news feeds and social networking sites to suggest possible topics for prayers.

"... we balanced specificity in the design with a degree of openness for interpretation to create a resource that the nuns could both understand and appropriate,..." (Gaver et al 2010)

This has a lot in common with Tony and Fiona's original description of *Placebo*. It is less playful than Bill's previous definition of *ludic design*. Bill himself no longer uses the term when describing his studio's work.

Certainly the qualities of being accessible to understanding whilst inviting appropriation are at the heart of *Six Speaking Chairs* and *Speech Hedge*. I can think of nothing more important to their role and so, if a definition were created based on these qualities, I would be tempted to adopt it. It may be that Tony and Fiona more recent thinking, under the title *Speculative everything*, expands the vocabulary.

HCI TO INTERACTION DESIGN

2.1.3 methodological bricolage

There is a strong tradition of AAC research in the School of Computing at the University of Dundee. It is recognised as one of the leading international centres over recent decades, perhaps even the leading group in the UK and it was this that attracted me to Dundee in the first place, through contact with Alan Newell who was a leading researcher in design and disability in general, and AAC in particular, for 30 years. It is Alan, together with Norman Alm and other colleagues, many of whom are now retired, who established Dundee's reputation for radical yet credible AAC research. That reputation today is in the hands of Professor Annalu Waller, Chair of Human Communication

Technologies and her AAC research group in the School of Computing. Annalu defines their mission in terms of combining "computational linguistics and HCI." (Waller 2013) Since Alan's retirement was imminent, my First Supervisor was Norman Alm, succeeded by Peter Gregor, Dean of the School of Computing, when Norman retired in turn in 2009.

My initial teaching/research contract was as a Lecturer on Interactive Media Design, a course jointly managed by School of Computing and DJCAD (Duncan of Jordanstone College of Art and Design, at the University of Dundee) and led by Catriona Macaulay. The course was defined in terms of this duality and, given my background as a designer, I always foresaw a strong element of design research. My contract was 50% with the School of Computing, 50% with DJCAD. Having an AAC-focussed First Supervisor in Computing was therefore complemented by having Professor Mike Press who was Head of Design in DJCAD as my Second Supervisor.

In 2011, whilst I was Course Director of Digital Interaction Design (or DIXD, as I had re-named and focussed Interactive Media Design), it was decided to move DIXD wholly within DJCAD to ease administrative overheads and to allow the creation of a shared programme with Product Design (which had been a joint Engineering and DJCAD course). Since September 2011, my contract has been 100% DJCAD and as part of this transfer the schools wished my First Supervisor to be within DJCAD as well. Seaton Baxter kindly agreed to become my third and last First Supervisor.

I think that it is only since I have repositioned this research wholly within design research that I have more fully understood the distinction between design and the traditional HCI model used by the School of Computing. This distinction can be confusing, since HCI has recently taken to appropriating the name 'interaction design', just as this fully emerges as a discipline in its own right. As an example of this, the title of the textbook 'Voice interaction design: crafting the new conversational interfaces' by Randy Harris suggests that it is about applying interaction design to speech technology. But its very first line illustrates the absence of a recognisable design culture: "We need to be able to work at a level of abstraction concrete enough to provide leverage within the task-artifact cycle, yet abstract enough to cumulate and develop as a theory base." (Harris 2005, xv) The book's description seeks to reassure that it is "Soundly anchored in HCI, cognitive psychology, linguistics, and social psychology." No mention of a corresponding grounding in interaction design itself, the implication being that it is Human Computer Interaction experts who do interaction design, and HCI research that informs it. Daniel Fallman, whose *Interaction Design Research Triangle* has already been introduced, makes repeated mention of the importance of understanding the nature of interaction design

research "because of its sometimes close resemblance to other, *seemingly similar* [my italics] areas of research, such as HCI." (Fallman 2008, 17)

The *Six Speaking Chairs* were originally conceived as a stimulus, albeit a radical stimulus, within an HCI tradition. Informed by discussions with Norman (Alm), Andrew Cook and I had plans for deploying the chairs in carefully controlled conversational contexts, including recording the triadic perspectives, actions and impressions of people using the chairs to speak, their conversational partners and non-participating observers. The formal technique of conversation analysis would then be brought to bear on the subsequent conversations. Not that this might not have been—might not still be—a valuable exercise, but for different reasons (that will be discussed later) Andrew and I came to see this as not being fundamental to our own research. (Cook 2013)

If I attempt to describe a fundamental difference between HCI and design research, I would say that whilst HCI seems to be increasingly open to new design-led techniques in the early stages of research, it still insists on establishing 'validity' in a narrower, more scientific sense. This is represented in the response to an early paper, written in September 2006 (so at the very beginning of this PhD research) 'Beyond Text-To-Speech: playing with expressive speech synthesis', submitted for CHI (Computer Human Interaction—the leading HCI conference) 2007 but not accepted. Even when Cook and I acknowledged the early stages of our exploration "Each of six approaches is to be embodied in a 'Speaking Chair', an early interactive prototype. These chairs will allow early testing with users, building on the pilot study already described", this was the reaction: the meta-review recommended that we "involve more participants to give a stronger validity to the results or expand the range of words that can be spoken expressively to see how the system scales up." The criticism is well-intentioned and constructive, and could have been adopted. But we felt that this would have dictated the subsequent focus of the research: scaling the system up would change the nature of the project. Perhaps it is unreasonable to insist that research that deliberately applies a new perspective, also demonstrate rigour within a traditional research paradigm.

Whilst I was still attempting to straddle these two research cultures, reconciling the introduction of interaction design approaches into an HCI tradition, I thought of this in terms of 'assemblage'. Yet coming wholly into a design research culture, Yee's concept of *bricolage* feels more sophisticated and coherent.

In embracing the idea of this as a design research PhD, albeit applied to a field, AAC, that traditionally has a different research culture. See AAC TO

rigour is discussed in
2.1.3 methodological
bricolage and
4.1.4 on rigour in design
research

INTERACTION DESIGN for a discussion about the specific relationship with AAC culture

PHONETICIAN TO PYGMALION

2.2.1 methods— interdisciplinary literature review

Robin Darwin, Principal/Rector of the Royal College of Art from 1948 to 1971 thought that "students come to the College because they are truly besotted in their work... this is actually a universal ideal—so in a way they are both being selfish in pursuing their dreams and they are doing something that is truly beyond them and contributing to society and the world." (Robin Darwin quoted by Sarah Teasley, Programme Tutor, History of Design, RCA, in conversation with Christopher Frayling, Ron Arad, Antony Gormley and Andrew Marr, marking the 175th anniversary of the Royal College, on *Start the Week*, BBC Radio 4, Monday, November 19, 2012)

So it feels appropriate to declare the influence of my own besottedness on this research—in all seriousness, since if it lies at the heart of design, then it must also play a role in design research. I have been besotted with phonetics ever since I came across David Crystal's *Encyclopaedia of the English language* in 1999. I was drawn to one particular diagram, a two-dimensional chart of vowels, mapped in terms of 'front' to 'back' and 'open' to 'close'. (Crystal 1995, 238) At the time I was working at IDEO on the interaction design of a remote-controlled submarine, *Spyfish*, that involved controlling a video camera through underwater space. The idea that there was such a thing as vowel-space and that diphthongs such as /ei/ could be thought of as paths through, rather than points in this space, fascinated me. I became intrigued by the role that interaction designers might play in conceiving and creating new interactions with speech technology.

See 'a short history of speech technology' and 'the magic of speech technology' in 1.1 a lack of tone of voice in communication aids.

A second interest, in the history of technology, and perhaps also my background in engineering, drew me towards early speaking machines, as discussed in the opening chapters of the main thesis, and in particular the work of Wolfgang Von Kempelen. Kempelen drew on his experimental understanding of the human voice and so also contributed to the future field of phonetics. My visit to his original *Speaking Machine* in the Deutsche Museum in 2003, and the workshop in Budapest to commemorate the 200th anniversary of his death in 2004, both felt like pilgrimages.

In 2002 I enrolled on two degree modules at the University of Westminster, evening classes with Patricia Ashby. This involved classes, homework and exams at a time that I was extremely busy running a studio and client projects at IDEO. But somehow the monastic ritual of preparing phonemic

transcriptions and the enchanting esotericism of the upside down 'e' representing the neutral vowel (also known as 'schwa') were rewarding. I even spent a day's holiday at UCL, to take the day-long examination for the Certificate of Proficiency in the Phonetics of English.

So it was natural that the literature study started with phonetics, including attendance of the British Association of Academic Phoneticians conference in Edinburgh in April 2006 at which I presented a poster '17 different ways to say "yes"'. (Pullin 2006)

What I had no idea of, was that a romantic view of phonetics would lead indirectly to the theatre, and that this would be as influential on the direction of this research than the field of phonetics itself. I started by naively asking playwrights and theatre directors how they describe the way in which they wish an actor to speak a line, and soon learnt that it was taboo to be prescriptive, that the delivery of a line was fundamentally co-created between actor and director. I wondered whether this had always been the case and turned to George Bernard Shaw's *Pygmalion* for no better reason than that the lead male character, Henry Higgins, is a professor of phonetics. Shaw based Higgins loosely on the phonetician Henry Sweet. Beverley Collins and Inger Mees assert that 'The real Professor Higgins' was Daniel Jones (Collins and Mees 1998), but this is hardly defensible given Shaw's own reference to Sweet in the Preface to *Pygmalion*. (Shaw 1941, 6) Perhaps this is a circular relationship, since I have suspected that the film *My Fair Lady*, in which Rex Harrison plays Henry Higgins, opposite Audrey Hepburn and Wilfrid Hyde-White, was formative in my interest in phonetics in the first place.

See 'Pygmalion' and
'with the roar of a
wounded lion' in
3.1.1 finding alternative
models of tone of voice.

But what a lucky thought that was, since Shaw's directions, whilst deeply unfashionable, are so rich, evocative and thought-provoking. Annotations such as [with professional exquisiteness of modulation], ["most musical, most melancholy"] and [with the roar of a wounded lion] (Shaw 1941, 41;56;66) have inspired this project in ways that O'Connor and Arnold's phonetic nuclear tones (O'Connor and Arnold 1973) never could.

CONCEPTS TO COLLECTIONS

2.2.3 design collections

A concept called the *Speaking Mobile* is part of the background to my research. I created it in 2002 at IDEO, as part of a project called *Social Mobiles*. The success of *Social Mobiles*, yet the failure of the *Speaking Mobile* was also significant in defining my approach of 'design collections'.

Inspired by Kempelen's *Speaking Machine*, *The Speaking Mobile* afforded manual manipulation of synthesised speech. There were two keys on the underside of

the *Speaking Mobile*: pressing one allows the user to say “Yes” (actually “Yeah”); the other “No”. The other main control was a thumb joystick on the top surface, that allowed someone to manipulate the intonation of the chosen word in any way they wished, controlling the pitch profile by moving the joystick up and down and the timing, from the start to the end of the word, by moving the joystick from the left to the right. In this way the player could say those two words, or partial versions of them, in any way they wanted to. This could be said to be the antithesis of Text-To-Speech, in which any word can be said, but in only two or three ways.

The interaction involved hand-ear coordination: there was no significant visual element to the interface, just tactile and auditory feedback. Despite involving small hand movements, the interaction could be thought of as being 'gestural'. The movements were often quick and fluid, so novice players found themselves improvising and then learning the 'shapes' of joystick paths for the sounds that they liked.

I hoped that this sketch might be interesting to researchers in phonetics, speech technology and AAC. Still at IDEO, I visited Mark Huckvale, who has research interests in prosody and speech synthesis at the Department of Phonetics and Linguistics (the corresponding part of which has since become the Department of Speech, Hearing and Phonetic Sciences) at University College London (UCL). I also visited David Colven, an expert in AAC at the ACE Centre, Headington, Oxford (for whom I had prototyped a single-switch keyboard for disabled kids for my degree project in Engineering Science at Oxford in 1986). In each case, despite my efforts to the contrary, scrutiny focussed on the way in which I had prototyped the speech synthesis—which I knew was outdated, manipulating primitive formant filters whereas current synthesis involves concatenating diphones and other samples—rather than the interactions with the speech.

Thinking that this might just have been my choice of audience, I tried again to re-use the *Speaking Mobile* when I first came up to Dundee. Just before the research in this thesis began, my first foray into the field of augmentative and alternative communication, presented at ISAAC 2006 in Düsseldorf, was entitled 'The Speaking Mobile Phone: provoking new approaches to AAC design'. (Pullin and Alm 2006) It anticipated the catalytic role that the *Speaking Mobile* might have in the field of AAC: "'The Speaking Mobile' can be thought of as a ridiculous product, but it is thought-provoking in the context of AAC:... The whole point... is to provoke a reaction. ISAAC 2006 is an unrivalled opportunity to share this early work with AAC users, professionals and researchers: to expose fundamental misconceptions and attract complementary

insights, but just as importantly to provoke valuable discussion, debate and even argument." (Pullin and Alm 2006)

But again it was taken too literally and provoked too narrow a discussion. Interest was certainly generated at ISAAC, which I think helped attract engagement with the *Six Speaking Chairs* in 2008, but these first discussions were too often centred on the physical object itself: its accessibility, practicality, connectivity... and its technology again (whereas it was conceived as an experience prototype—the actual technology involved was meant to be irrelevant).

See reprint of 'Curating and creating design collections...' from *Design and culture*.

The context in which the *Speaking Mobile* was created was the *Social Mobiles* project, a collaboration between IDEO and Crispin Jones, which Jones and I led. The longer story can be found in 'Curating and creating design collections', but suffice it to say that it ended up being about a growing issue of "the anger and frustration caused by other people's mobile phones." (IDEO 2002) Our team designed a series of radical concept mobile phones which in different ways encouraged or coerced people to use their mobile phones more considerably in public spaces. Although apparently a response to the growing social issue, it was really a mechanism to illuminate the issue in the first place.

So within this, the *Speaking Mobile* offered a different solution to the problem of antisocial behaviour, whilst also being a vehicle for pursuing new interactions with speech (which I have already confessed to having become fascinated by). Rather than deterring people from making or accepting calls, this phone enabled someone to converse silently on a voice call, generating speech with their hands, rather than with their mouth. They had to wear earphones so that they could hear themselves and the caller, whilst no sound was created in the environment around them. In this way a person receiving a call in a quiet space could respond without disturbing anyone else. The role of intonation was explored, and the ability to steer a conversation through intonation alone:

Crispin: Anton? Sorry, I can't make it tonight

Anton: yeeaaahhhh? [intonation: sarcastic]

Crispin: We could meet up after ten...

Anton: oooooohhhhhh... [intonation: hesitant]

Crispin: How about tomorrow instead?

Anton: yeeeahh! [intonation: enthusiastic]

We reflected on the way in which the *Speaking Mobile* created a medium that is the antithesis of text messaging in the context of mobile telephony, which is so devoid of emotional cues that people often resort to emoticons in order to try and avoid misunderstandings because tone of voice is absent. The *Speaking Mobile* in contrast is almost purely tone of voice.

The *Speaking Mobile* was just one of five radical concepts, each of which changed people's behaviour to make it less socially disruptive. Some were more extreme still—involving electric shocks. The project was a surprising success. It was exhibited internationally: in Tokyo where it won a prestigious CG Arts Award, at Ars Electronica in Linz and at the Victoria and Albert Museum in London and at MoMA, New York as part of 'Design and the elastic mind' curated by Paula Antonelli. It has featured in *Wired*, in numerous newspapers and magazines worldwide, as well as on radio and television including a full-page article in *The Economist*, 'Think before you talk' written by Tom Standage (Standage 2003)—who has also written about Kempelen, *The Mechanical Turk* (Standage 2002) and a cultural and critical history of the telegraph, *The Victorian Internet* (Standage 1998). "... behind these silly-sounding phones is a serious point. Much is made of "user-centric" design, says Mr Pullin, but in the case of mobile phones, the people surrounding the user need to be considered too." (Standage 2003)

At the start of this research I reflected on the success of *Social Mobiles* and the corresponding failure of the *Speaking Mobile*. Fundamental to their success and failure was the issue of how literally each were taken in their respective contexts. It was important that they were not. That the concepts were clear but also that we were not proposing this exactly.

We worked hard at IDEO on the design language of the mobiles: the oversized phones, the ambiguous materials, holly and undyed thermoplastic (ABS, acrylonitrile butadiene styrene), the anachronistic design details—all were meant to convey that this was not a project about the *form* of the phones, rather their *interactions*. And the same has been true of the *Six Speaking Chairs* in this research. This cannot have been the differentiation between the success of *Social Mobiles* and the failure of the *Speaking Mobile*, as the aesthetic was the same (albeit that out of context, the *Speaking Mobile* is less obviously an oversized phone).

I am convinced that the contrast between a whole collection and a single concept that was most influential in the success of *Social Mobiles* in supporting an expansive discussion and the failure of the *Speaking Mobile* to do the same. Therefore the project that was to follow was conceived, by the start of this PhD, as another design collection. That is, a series of contrasting but not competitive concepts, carefully curated as a whole to between them lay out a landscape of possibilities.

PROTOTYPING TO ILLUSTRATING

2.2.5 experience
prototyping

The *Six Speaking Chairs* were originally conceived as interactive prototypes. Tony Dunne makes a distinction between 'the design object as prototype', 'as installation', 'as model', and 'as prop'. A summary of my understanding of his much deeper description is that a 'prototype' is a working device, looking towards manufacture or at least implying this progression; an 'installation' involves a more explicit relationship to a gallery and a design conceived specifically for this context; a 'prop' refers an object seeded into a film or other medium and experienced primarily through this medium; a 'model', here implying a non-working model, may not be so directly representative of a fully-developed design, more illustrative of the essence of a design idea—the word 'genotype' is also used as an equivalent.

Early on in the project, my view was that "In this classification, the *Speaking Chairs* might be considered 'working models', or even 'working genotypes'. They definitely seek to illustrate and represent the essence of an idea for an interface, rather than anything even approaching its final format, its principles rather than its execution. But at the same time these chairs are interactive and can be experienced not just contemplated. The author welcomes hearing about other classifications and precedents in this area that might help determine whether this approach is after all part of an established tradition, or whether another new expression or hybrid might even be appropriate." (Pullin 2007b)

Andrew and I intended that interactions with them, and perceptions of and reflections on these, would be part of the process. Andrew went as far as to prepare beautiful screen-printed sheets for participants, more in the manner of engaging cultural probes (Gaver, Dunne, and Pacenti 1999) than questionnaires, in order to elicit and record their experiences. For a number of reasons, this never happened. These reasons admittedly include slower progress than was planned, but also positive reasons involving the divergent directions of Andrew's and my subsequent individual research. There is further discussion of this in the navigational note PULLIN & COOK TO PULLIN.

The result was that the interactivity of the *Six Speaking Chairs* became far less fundamental to this research than I had anticipated. One might go so far as to describe them more as illustrations than prototypes—were it not for the fact that this too is still part of experience prototyping. The inert pebbles and static skateboards that the IDEO team held and sat on as part of the *Spyfish* project described in 'Experience Prototyping' were nonetheless a way of thinking through making. (Buchenau and Fulton Suri 2000, 428)

EXPERIENCING TO IMAGINING

2.2.5 experience
prototyping

Speech Hedge (on the other hand) was never conceived as an experience prototype. Within the time constraints of engaging Ryan McLeod as a Research Assistant as part of one of his modules on the Master of Design, this would have been unrealistic. Ryan created an interactive but constrained, 'linear' demo—a click through with a bit of added drag-and-drop-ping—but this neither really tested the intuitiveness of the details of the interface, nor allowed appropriately open-ended exploration of the underlying principle.

As a result the exercise that we asked audiences to undertake related to *Speech Hedge* involved them using their imaginations, rather than being a test with a prototype, even an experience prototype. The role of the user interface itself was to provide a context to engage people with the mental model of tonal elements, individual tones of voice and palettes of tones of voice. It was never about leaves, plants and hedges.

AAC TO DESIGN RESEARCH

2.2.6 descriptive
research

The interdisciplinary nature of this research—and not least its ambition to influence fields other than design research itself—of course require it to also be contextualised within other research traditions. As an academic, I am required to have two external examiners and my initial thought was to choose one examiner from interaction design research and one from AAC research. The very attempt to contextualise this research within an AAC tradition was illuminating and influenced its eventual positioning.

At IDEO I would have referred to the 17 ways exercise as 'qualitative research' in order to make it clear that the number of respondents was not sufficient to lend statistical significance to the results (nor, perhaps, were the conditions rigorous or controlled enough to support this). Rather that it was individually as much as collectively that the responses might provide insights.

However, I have found that within AAC research, a distinction is made not just between 'quantitative' and 'qualitative' research methods, but between 'qualitative' and 'descriptive' research. And this distinction is held to be very important. So important that one leading AAC researcher went as far as to say that they would fail any PhD that defined what I was doing as qualitative research rather than as descriptive research. Although understood by many AAC researchers, this distinction is not well known in design research however. For example, in Brenda Laurel's *Design research: methods and perspectives* (Laurel 2003), 'descriptive research' is not even mentioned as an approach—and none of the colleagues I have asked at DJCAD were any the wiser. So whilst I have reflected

this distinction in the main thesis, this episode served as an illustration—and a warning—of how ignorant I was of deep traditions of research in AAC, many of which come not (even) from HCI but from speech and language pathology. If I could be so wrong about descriptive research, then there would undoubtedly be other blindspots. It is almost certain that I have transgressed several other deeply-held traditions of what constitutes valid research in disciplines other than my own, and how to describe these.

So I have instead situated this thesis within design research and chosen to be examined on this basis. Nonetheless I hope that this thesis manages to walk a fine line between expressing honestly the design thinking at the heart of this research, whilst still being accessible to, of interest to, and in some ways credible to researchers in the other fields that it touches upon, and in doing so perhaps even influential.

CALCULATING TO VISUALISING

2.2.8 data visualisation

My first attempts to make sense of the *Speech Hedge* responses involved transcribing them into a spreadsheet in Microsoft Excel and attempting to analyse them numerically. Even though I assumed that the sample size, at a mere 39, was insufficient for statistical significance, I hoped that strong enough trends would be illuminated that tentative conclusions might be drawn. These could be proposed as hypotheses for future experimental research, because I realise that in any case it is poor statistical research practice even to attempt to prove an unanticipated effect from any data: any such experiment would need to be carefully conceived, conducted and controlled in the light of a particular hypothesis.

Even allowing for these provisos, the first results of this activity were disappointing: observations such as that "two-thirds of chosen leaves came from five of sixteen possible choices" seemed vague and ambiguous. As many as five common choices felt like quite a large number, especially given that in each case many of the leaves would be clearly inappropriate (it was unlikely that anyone would reach for 'brusquely' in attempting to synthesise 'coaxing' for example). Was this even clearly not a random effect? The statistics alone would be insufficient within this small sample.

It felt helpful to return to the culture of the project as a whole: the point of *Speech Hedge* and the *Six Speaking Chairs* before it is that tone of voice is very difficult to define, in words (or numbers)—and that visualisation might help illuminate it and make its discussion more accessible. Applying this spirit to the analysis of the results as well, I turned instead to graphical approaches to

envisioning information such as found in the writings of Edward Tufte (Tufte 1990), looking for patterns.

EXPLORING TO SPECULATING

2.2.4 reflective practice Originally it felt as though there would be a distinction between design exploration and design practice in the two projects: that *Six Speaking Chairs* represented open-ended design exploration and *Speech Hedge* more propositional design practice, both within design research. One of the consequences of my own reflective practice has been to challenge and reconsider such a neat distinction.

One irony is that within the exploratory *Six Speaking Chairs*, Chair No. 6, albeit abstractly, is very close to the final proposition of *Speech Hedge* (whereas) *Speech Hedge* itself, although conceived as a proposition, actually ends up exploring some huge issues related to community peer support and open source speech technology (issues not actually explored even by the *Six Speaking Chairs*). So on reflection, both projects feel exploratory.

2.1.2 critical design Fallman himself defines 'design exploration' as "what if?" But this might still encompass propositions and speculations, from concepts optimistically proposed, as well as those more neutral, abstract or ambiguous (in which I would include *Placebo*) to even clearly dystopian critical design. It does feel as though a more nuanced shared vocabulary could be useful—although this is outside the scope and aspirations of this research—as discussed in the navigational note `POINTED TO OPEN-ENDED`.

APPLYING TO DISTILLING

2.2.7 distilling principles If the distinction between *Six Speaking Chairs* to *Speech Hedge* has been less straightforward than expected, then so has the transition between them. Originally the research questions were drafted in the following order:

Q2. How could these alternative perspectives form the basis of future user interfaces?

Q2a. What mental models or design principles might underpin a more complex perspective on controlling tone of voice in AAC?

Q2b. How might these principles be applied to a coherent, intuitive yet expressive user interface for future AAC devices?

Q2c. Could (yes or no?) people engage with such a user interface?

The listing above follows one expectation for academic process: that hypotheses precede experiments and that principles precede examples. So,

because it is just one illustration of more general principles and guidelines which could be applied to all kinds of other interfaces, *Speech Hedge* would be preceded by the principles. Certainly at IDEO we would distil frameworks from insights from observations, from which to derive design principles, from which concepts could be generated.

3.2.2 *Speech Hedge*

This would not be a transparent account of the order in which things happened however. *Speech Hedge* actually came first. I have sketches of it in a pocket notebook that preceded any written articulation of the design principles. *Speech Hedge* arose from playing with the idea that a complex, 'heterogeneous' (this will be explained in the navigational note ORDER TO OPENESS) interface could nonetheless be represented by a simple unified model. As an experienced practitioner I had internally set myself some constraints, such as to be inspired by iTunes and iPod and to divide the user interface into two parts, on two platforms. These underpinned *Speech Hedge* but without having yet been abstracted as transferrable principles. Still, to make it clear that *Speech Hedge* is only an illustration of what might be, principles were distilled from it.

3.2.5 design principles

This then is the order in which they are written up in the thesis: *Speech Hedge* first and the principles in a later chapter.

2.1.1 design exploration

On further reflection, the two activities are of course interwoven and either sequence is an over-simplification of their relationship. It is another of those loops on Fallman's Interaction Design Research Triangle, between design practice/exploration and design studies. In this way, *Speech Hedge* is presented as being more exploratory, more design exploration than design practice—and this feels entirely appropriate, since it is through this work that higher-level issues are being worked out.

3.1.2 *Six Speaking Chairs*

The other reason for ordering the thesis this way was is that it is the principles that the reader is left with and from a research point of view, these feel more valuable for future research than the particular instance of *Speech Hedge* (notwithstanding the value of *Six Speaking Chairs* as a research outcome in itself). It could be an interesting exercise to subsequently see how diverse a range of user interfaces could be created from the principles: to actually encourage and in some way assess diversity. This could be a good test of the principles' usefulness, especially given the rapid change of digital technology in general and in the field of AAC in particular—even though this is outside the scope of this project.

CREATING TO CURATING

3.1.1 curating the *Six Speaking Chairs*—finding alternative models of tone of voice

I have already discussed the role of a design collection in transcending individual concepts. The notion of a fashion collection in haute couture is a reference point here. Later in the paper 'Curating and creating design collections', the connection to another type of collection, museum collections, is made:

2.2.3 design collections

"The editing down of the *Social Mobiles* collection was unplanned, representing a separate stage that followed the creation of the original concepts and which drew out a new perspective. On reflection, this alludes strongly to another type of collection: museum collections, assembled from existing but related artifacts brought together rather than created as a whole.

"The notion of a collection as something more thoughtful than the result of acquisitive collecting goes back at least as far as the sixteenth century. As the museum studies academic Susan Pearce notes, "the crucial idea is that of selection." (Pearce 1992, 5) It is this act of selection that turns an object, which could be any object, into a museum piece. A curator's selection is more interesting if not made strictly on the basis of quality, but as an act of critical editing, in order to illuminate a fresh perspective.

"Curatorship also encompasses how artifacts are exhibited, and in what order or arrangement. Schulz describes systematically arranging collected objects with a larger "aim of transmitting information." (Schulz 1994, 175) In the *Social Mobiles* project, considerable thought went into the order and presentation of the designs. In numbering the collection and when exhibiting it within IDEO or at MoMA or the V&A, we started with the attention-grabbing *Electric Shock Mobile* and subtly moved to subsequent members of the collection that were less satirical and more ambiguous and thought-provoking." (Pullin 2010b)

See reprint of 'Curating and creating design collections'.

During the evolution of the *Six Speaking Chairs*, they became increasingly an exercise in curation rather than creation. I had originally anticipated developing some innovative user interfaces inspired by mental models. Once these models were uncovered however it felt more important to represent them in a way closer to their original form. In other words the chairs became more diagrammatic or illustrative. This even extended to models that we had reservations about, such as the emotional model: we made no attempt to 'improve' this, just to illustrate it to the best of our abilities, since the purpose was to discuss it rather than to refine it at this stage.

DEPLOYING TO EMBODYING

3.1.2 *Six Speaking Chairs*

The roles of the *Six Speaking Chairs* did not end up quite as we originally planned, becoming both lesser and greater in different ways. We originally conceived the chairs as a set of stimuli to elicit responses that we might analyse. Our plan was to deploy them as working, speaking, interactive prototypes in controlled and constrained but nonetheless live conversations and to learn more about their comparative expressiveness and limitations.

This we never did, for a number of reasons. In the early years of the project, Andrew's impressive work in combining hitherto disparate prototyping techniques—granular synthesis and fast Fourier transform (FFT) resynthesis, on both recorded and synthesised samples—took longer than we had hoped with the result that two years into the project, soon after ISAAC 2008, not all the chairs were finished. Of those that were, some, such as Chair No.4 with its infinite freedom, were fully functioning, whereas others, such as Chair No.3 with its 64 combinations of switch positions, were only partially working. The project undoubtedly lost momentum around this point, also because our individual ideas of where the research was going next were changing—discussed in the navigational note PULLIN & COOK TO PULLIN.

What has exceeded our expectations is the influence that building the chairs has had on us, as researchers. The engagement with the ideas behind them involved in detailing and building them amounted to thinking through making. Once they existed, the ideas embodied in them were no longer arbitrary and in flux but fixed, provoking a deeper reflection on each. Our growing relationship with the chairs might be compared to the difference between the way one perceives the qualities of a new acquaintance as opposed to those of an old friend: familiarity breeds a different perspective altogether.

So in contrast to the notion of the chairs as a means to an end, an apparatus with which to carry out testing to establish 'validity' in a scientific sense, we have come to see the chairs as a significant research output in themselves. Certainly this has been borne out by the reaction to this work to AAC audiences: they have acquired something of an iconic status in a field not accustomed to icons. I am asked to simply present the chairs rather than necessarily to justify their creation in terms of hard knowledge that has resulted. We know of researchers, such as Shannon Hennig, using the chairs to frame their own engagement with experts and end users, which suggests that they are being appropriated by others. This feels like the sincerest endorsement of their value.

PULLIN & COOK TO PULLIN

3.1.3 on 'real-time' and
'pre-packaged'

The act of conceiving and building the chairs changed everything: where the project went next and how the road divided for Pullin and Cook. A parting of the ways was always expected because, as a PhD student rather than a Research Assistant, Andrew was expected to develop his own agendas beyond our co-creation of the chairs and to set the direction of his own research. We were already looking ahead to related but distinct individual projects beyond the chairs. Nonetheless the directions we each took were unexpected.

As Pullin & Cook, we shared all six chairs, Andrew being responsible for prototyping the interactive speech whilst I took a lead on the physical design, albeit that we detailed and built this together. For example Chair No.4 (the Rising/Falling Chair, based on phoneticians intonation diagrams) was a re-interpretation of my own *Speaking Mobile*, but realised in a more sophisticated way by Andrew. Nonetheless, there were particular chairs that we each felt a more personal ownership of.

Initially Chair No.5 (the Reassuring/Undermining Chair, with the drumsticks of different materials) felt closest to Andrew's pre-existing interests as a computer musician, under the name Samoyed. We first met when he was a final year student on Interactive Media Design (now Digital Interaction Design). My first teaching role was as module leader for his graduating class. I had presented my developing plans for research to the class in January 2006, and Andrew approached me after this talk and said he'd be interested in any opportunities to be involved—leading to his EPSRC-funded PhD scholarship through the School of Computing. Music and interaction design came together in his degree project, *Tactophonics*, that allows musicians to physically manipulate computer-generated sounds. *Tactophonics* is in the form of a beautifully designed toolkit that lets the performer choose an object that enriches their onstage act. The kit allowed a performer to play pretty much any object they wish by attaching contact microphones which respond to its physical manipulation—not producing sound directly, but generating parameters by which synthesized sounds were shaped. Andrew says he was surprised by just how imaginative people's choices were: musicians chose the branch of a tree, a baseball bat, and a full set of crockery. Andrew was fascinated by gestural interactions and the power of materials to suggest affordances. We were both expecting his own research to follow an arc from computer music into AAC (with me) and back again. This is reflected by Andrew presenting *Tactophonics* as 'Your favourite thing wants to sing' (Cook and Pullin 2007) at *New Instruments for Musical Expression* in New York in 2007.

Meanwhile, Chair No.3 (the Offering/Seeking Chair, based on Nick Campbell's work of parameters of 'Self', 'Other' and 'Event') was the chair that embodied the direction that I believed my own work on the project would take. I was attracted to the idea of a complex parametric model of tone of voice, one that took a broader perspective than the emotional mappings represented by Chair No.2 to include conversational intent and social context and relationships. I was looking forward to designing an approachable user interface based on these principles and the challenge of creating something complex whilst not too complicated.

So we expected my own work to follow a sociolinguistic perspective of speech, epitomised by Chair No.3 and that Andrew's would follow a direction of musical expression explored in Chair No.5. But neither prediction proved to be accurate. Different chairs were to prove more influential after all.

At its time of conception, Chair No.6 (the Terse/Roaring Chair based on George Bernard Shaw's stage directions) had something of the role of an 'overflow'. At a detailed level, at the level of the individual tones of voice chalked onto Chair No. 6, there was an opportunity to include perspectives on tone of voice that had not been represented on the other chairs, if only to give them a presence in the project. 'Roaring' for example, is a description of the sound quality—albeit somewhat indirectly, with an allusion to lions or other animals. It is the actor, reader or listener who must surmise the emotion or conversational intent behind this sound. Whereas each of the previous five chairs were based around coherent models mainly taken from academic research (phonetic, linguistic, emotional...) and so their simplicity is no coincidence: in each case academics were attempting to describe and encompass emotion, prosody or tone of voice according to as simple a model as they could, because it was this model that was their goal. Chair No.6 in contrast takes the work of a playwright as its starting point and so the descriptions of tone of voice are more heterogeneous. They do not sit into or spring from a simple model. At the time of conceiving Chair No.6 then, part of its role was to acknowledge that things might not end up as simple as any traditional academic model.

Despite being conceived last, Chair No.6 with its 17 doorbells and handwritten descriptions of tones of voice, became the icon of the project. Whenever we wished to communicate the project visually, for example on the fliers that we took to ISAAC 2008 in order to advertise our talks and to recruit attendees amidst ten parallel sessions, it served our purposes very well in that it explicitly, and in a single image, illustrated the diversity of approaches to tone of voice that we were taking. Andrew's endearingly untidy handwriting tacitly

conveyed the informality and impermanence, but also the art school spirit of the project, as did terms like 'coily', 'sweetly' and 'whimpering'.

Having the chair in my office for the next year (it's still here), the subtlety, nuance, individuality—even idiosyncrasy: 'brusquely'; 'tickled!—of these descriptions seemed increasingly appropriate. I became more and more convinced that description, rather than synthesis from parameters, was the way to engage with tone of voice after all. Of course this raises as many new challenges: how on earth could current or near-future speech synthesis possibly offer so many detailed tones of voice when speech technologists had yet to perfect so-called basic emotions such as happiness, sadness and anger? But the chair that had started its life almost as an afterthought, increasingly became my focus. And with its control via selection rather than manipulation, after all.

Over the same period, Andrew's priorities had changed not because of his reflections on speech but on interaction design in general. He had come to see his future in interaction design—the physical interaction design epitomised by Naoto Fukasawa—rather than in computer music, and so his focus changed too. Chair No.2 with its dial appropriated from an old Bush radio Andrew felt offered as rich affordances as the more innovative Chair No.5 with its drumsticks of different materials, conceived to explore the theme of materiality. His research became more reflective, and developing a philosophy of interaction design based on the chairs took priority over the chairs themselves or what might follow them.

When *Design meets disability* (Pullin 2009a) was first published, Hugh Herr, who heads the Biomechatronics research group at the MIT Media Lab, reviewed the manuscript for The MIT Press and contributed a blurb for the back cover, describing the book in terms of "design through the lens of disability". At the time I wondered if this was how I saw it myself—was I looking at design through the lens of disability or disability through the lens of design? Tom Shakespeare's book *Disability rights and wrongs* (Shakespeare 2006) has a chapter called 'The role of non-disabled people in the world of disability'. So given the sensitivity of non-disabled people's very involvement in disability studies, which do I have the right to proffer?

Anyway, such thoughts prompted a similar reflection on the relationship between Andrew's and my discipline of interaction design and the subject matter we were applying this to. This actually feels a lot clearer: that for Andrew, the deepest subject matter in his research is interaction design itself. This project, with its focus on speech and tone of voice, is providing a window onto insights into interaction design which transcend this particular application: which could apply equally to projects which didn't involve speech at all. Andrew concurs that he ended up looking at interaction design through

the lens of speech technology. His thesis was correspondingly entitled 'Studying interaction design by designing interactions with tone of voice'. (Cook 2013) Whereas I am—increasingly—looking at speech through the lens of design, hence an earlier and wordier title for this thesis '17 ways to say yes: using interaction design to explore more expressive augmentative communication'. Albeit that I hope to learn something about the act of looking, at anything, through the lens of design at the same time.

VALIDATION TO INSPIRATION

3.1.4 17 ways to say yes

There were several good reasons for conceiving the 17 ways to say yes exercise (in which respondents were asked to list their choice of 17 tones of voice, were they to be restricted to this for the rest of their lives) for our audience at ISAAC 2008, but none of these anticipated the influence it was to have. ISAAC is wonderfully diverse with a mix of people without speech, carers, therapists, researchers and manufacturers. We succeeded in attracting an audience of around forty (no mean feat, given the ten parallel sessions—our fliers helped), a welcome mix of therapists, people without speech and researchers and manufacturers. We wanted to make the most of any audience and as much as anything, the 17 ways exercise was a means of engaging them. Presentations are rarely participatory and conference fatigue can set in. No natural daylight in the rooms didn't help either. Having participants hand in sheets of paper also provided a means of inviting people to leave their contact details with permission to contact them again later.

Our original hope was probably to lend weight to our challenge of a purely emotional model of tone of voice. If people's chosen tones of voice came back and were not after all predominantly emotional, then this would give some justification to our somewhat audacious rejection of the prevalent model of emotional speech in speech technology research.

Beyond this, the corpus of tones might provide a valuable resource against which to gauge the expressiveness of any future concept for a working user interface: could it support anything like the breadth of tones of voice that came back from the 17 ways exercise?

The real influence of the exercise was far more inspirational however, in the richness of the responses and the way that personality was represented not just in 17 ways collectively, but in the individual descriptions. This reinforced my reflections on Chair No.6 and my conviction—that I would not have predicted—that subjective descriptions of tone of voice might be the most interesting basis of all for new interactions with speech technology.

ORDER TO OPENNESS

3.2.1 257 ways to say yes

I think that I expected the transition between the two projects to be as follows: that, from the *Six Speaking Chairs*, one mental model would have emerged as having the most potential to underpin a rich and flexible user interface—perhaps Nick Campbell's three-dimensional model of Self, Other and Event represented in Chair No.3, the Offering/Seeking Chair. Then, informed by the responses to the 17 ways exercise, this model could be refined—perhaps even augmented—so that it might be sufficiently expressive, supporting the breadth that people aspired to. In other words, the challenge at this stage would have been to have made sure that a simple model, with an underlying order, was not just too simple and incapable of affording a sufficient range of expression that people might expect. The next task might then have been to see what might be supported, and what might have to be lost, of the range of tones of voice described by the respondents, were a user interface to be based on this model. And this indeed is the challenge facing several emotion research groups, making a relatively simple two- or three-dimensional model cover the widest range of possible emotions.

'emotional mapping' in
2.1.1 finding alternative
models of tone of voice

Instead, the findings of just how rich, yet how heterogeneous descriptive labels of tones of voice are, made it more interesting to try and support any description whatsoever. And more valid, in terms of the authority and authenticity in people's—laypeople's; AAC users and potential AAC users—own descriptions of tones of voice. The price to pay for this was to eschew a simple model of tone of voice at all, at least in terms of a theoretical framework for defining what a tone of voice is.

This reinforces that Chair No.6, the Terse/Roaring Chair inspired by George Bernard Shaw's stage directions has become so much more than an 'overflow' of ideas that existing models don't quite support, or just a stimulus to elicit responses to the 17 ways exercise. It could actually be the model—or 'non-model'—to aspire to in itself.

In the end, the challenge has ended up being not one of making sure an ordered system was sufficiently complex. Rather to give some semblance of order—so as to make it approachable and understandable to laypeople—to a system that is inherently and appropriately open-ended.

GATHERING TO GROWING

3.2.2 *Speech Hedge*

In *Speech Hedge*, the model of representing tones of voice as plants, composed of individual leaves representing elemental tones, occurred to me quite early on—before Ryan McLeod started working on the project. This was not just a

symptom of the intuitive nature of much design practice, but a practical issue: as an MDes student, our collaboration needed to fit within a single module in a semester, so it needed to be focussed if we were to have time to get into the detailed visual design that would support both my own need to visualise the concept and Ryan's wish to have a strong portfolio piece to support his own career aspirations (in this he was successful, securing a post as designer with Equator in Glasgow).

How this was to scale up to the entire interface took a little longer though, and much discussion with Ryan. We knew that there might be hundreds, if not thousands of possible plants, that people could collect and organise into constrained palettes, to be employed in live conversation later. The question we asked ourselves was how they would navigate all this choice.

We had two alternative metaphors: the first was a forest, in which all possible plants already existed. Different areas of the forest would have a particular 'mood', with related plants found in proximity to each other—which could be beautiful given our plan to use different coloured leaves. The colours and colour palette would change as one walked through the forest which could lend a sense of location but also be a visually stimulating experience, as well as audibly, as you heard the plants in passing. You might then 'harvest' a particular plant for your own use.

We found this a compelling concept, but problematic because of the challenge of mapping the plants—that could vary in so many ways, according to so many criteria—into a two-dimensional space. This is exactly what is done in emotional mapping (Schlosberg 1941) and is part of its weakness: it demands an inherently two-dimensional model, at the expense of accommodating the complexity that we now wished to embrace.

So this navigational model was relinquished in favour of one based around cultivation; the metaphor of a forest was abandoned in favour of somewhere where plants could be grown—a potting shed? Both would have involved discovering new tones for oneself, the latter placing more emphasis on creation than navigation. Although I notice now that it re-emerged in the social network, albeit that the subset of the forest (the wood?) is reframed, dynamically, according to the current choice of leaves.

INTUITION TO APPROPRIATION

3.2.3 a million ways to say yes

Again, the contribution made by the exercise in response to *Speech Hedge*—in which respondents were asked to synthesise different tones of voice from simpler elements—was not as expected. It was conceived as a test of how

See Appendix C for raw data.

engaging and intuitive a user interface might prove. As such I suppose that I was hoping for a large degree of commonality between the respondents attempting to synthesise the same tone of voice. The first pilot study, at ACE North, seemed to confirm this but, with just ten respondents (O 1 to O 10) was far too small to come to any conclusions. The second, larger study at Communication Matters, whilst still not statistically significant with 39 respondents (L 1 to L 39), might have nonetheless added some weight to this. So I confess to being initially disappointed when the responses came back more diverse than I had hoped.

When I followed up with a few of the respondents who had invited me to do so, I found in their reflections a deeper issue. Obviously the key thing missing from the exercise in imagination was to actually hear the tone of voice synthesised and to modify it based on what you heard. But in the few discussions it seemed as though not only were respondents thinking about tones of voice in different ways (some the sounds, some the conversational intents) but that they may also be 'hearing' the tones differently. This involves some conjecture on my part, but it is absolutely fundamental to the promise of such an open-ended interface (and one not relying on machine judgement): that your 'sarcastic' might sound different to mine.

In this way, an exercise that started as an assessment of shared understanding, ended celebrating subjectivity and divergence in understanding. In doing so might be said to support the proposition in an unexpected way, but no less strongly.

USERS TO COMMUNITIES

3.2.4 on performance and preparation

The whole point of seeding a community is that its behaviour and growth would be emergent and not necessarily that predicted by the designer. This in itself is part of a group *appropriating* an assistive technology or designed intervention. Appropriation is a profound aspect of social innovation, itself a recent focus of conferences such as Include at the Royal College of Art. (Myerson 2011) Appropriation is part of what makes a design appropriate. Whilst chairing Include 2011, I became fascinated by the relationship between the adjective 'appropriate' and the verb.

GUIDELINES TO PRINCIPLES

3.2.5 design principles

What became design principles were initially conceived as design guidelines: more tactical ways in which good practice across other markets and industries

might be applied in the design of user interfaces for people without speech. This seemed a valid and useful contribution for an experienced interaction designer to make to a field that has little design practice. As they developed though, they became higher level—more connected to AAC knowledge—and less prescriptive at a detailed level: more principles than guidelines.

What has surprised me is how, in taking a perspective of a community (itself based on the observable precedent of Adobe Kuler), not just the individual user, principles have emerged that transcend design practice and start to suggest new AAC practice. The validity and contribution of these broader AAC principles is obviously very different to that of the interaction design principles—I lack anything like the same authority—so they are offered in a completely different spirit.

DESIGNER TO RESEARCHER

4.1 review of process and outcomes

The individual journeys contained in these navigational notes are significant in a bigger expedition, from research-within-practice at IDEO to practice-within-research within a university, from MDesRCA to PhD. As with any PhD, this train of research could continue. The task is to draw a line under a meaningful body of work within the period of registration, and to write this up so as to reflect on it and to anticipate meaningful future research.

This is of course part of what makes a PhD so daunting, uncovering through the act of writing up, how much more could have been done or how different one's approach could have been. Which is one of the reasons for including these notes from the journey, because the journey, and the knowledge in hindsight, is so much part of the education I have wanted to experience, first hand.

So, with difficulty because there is so much more that could be done both with the *Six Speaking Chairs* and with *Speech Hedge* and so many third projects that could them, a line must be drawn. If it can be said to be anywhere, this coincides with my keynote at Communication Matters in Leicester, 25 September 2011, because this is where I gathered my last empirical data, audience responses to *Speech Hedge*. This was 5 years from the beginning of this research in September 2006. Since then new conversations have begun—most notably during my visit to the United States in June 2012 for the AAC-RERC 'State of the Science' Conference in Baltimore—that I hope will seed future projects and collaborations, but cannot have been said to have influenced the original research within this thesis.

IMPLEMENTATION TO INFLUENCE

4.1.5 original
contributions to
knowledge

There has been a trajectory through this research: *Six Speaking Chairs* was definitely design exploration, taking a high-level view of tone of voice. The notion of a communication aid was abstracted and the chairs deliberately had something of the quality of critical design or even art pieces, rather than being traditional prototypes. This was followed by *Speech Hedge* which, whilst still exploratory, was nonetheless closer to a design response to the issues in AAC. It was a visualisation rather than a working prototype, but far more familiar in the context of a design project.

So one obvious plan would be to continue this trajectory: to anticipate a further step into development and implementation as a next step. Experience prototyping (Buchenau and Fulton Suri 2000) could be invaluable, complemented by building technical prototypes to explore and demonstrate the feasibility of generating complex tones of voice by combining simple elements. Taking such a radical new approach to AAC into substantive development would require strategic planning: who are the necessary partners? Is the best approach to work with AAC partner to influence the speech technology developers, or to interest speech developers in a showcase project? Or are others better placed to take the next step, in terms of resources and abilities—and even motivation?

Nothing could be more compelling than actually managing to put this expressiveness into the hands of people without speech, in some way. And yet, in terms of my own research career, is this the best thing for me to prioritise next? Certainly, whilst I am still Course Director of Digital Interaction Design with extensive teaching commitments, prioritisation is important—much as it would be wonderful to devote more time to research.

My invitation to speak at the AAC–RERC 'State of the Science' conference did seem to be a response to the ideas I am exploring, more than because *Speech Hedge* was perceived to be, itself, the point of interest. So alternatively, if *Six Speaking Chairs* is the level of 'abstraction' at which I am having the most impact within AAC, then perhaps other projects, looking at other aspects within AAC—other under-discussed issues—might make the greatest contribution to the field? It is not clear to me either way and is something that I intend to pursue with the respected leaders of AAC research that I am now in conversation with.

I had thought to use the AAC–RERC audience to get some idea of which aspects of my research are considered most interesting, radical and promising by people who have been involved in AAC research so much longer—and so much more deeply—than I have. One idea was to explicitly read out potential contributions or directions and ask delegates to map them on axes of radical vs.

commonplace (things that are already well-known in AAC after all) and promising vs. questionable. Or perhaps to ask them to do this verbally, directly through tone of voice:

yes [appreciatively] = radical and promising

yes [sceptically] = radical but questionable

yes [dryly] = commonplace and valuable (valuable but commonplace)

yes [wearily] = commonplace and questionable

with two further, more extreme categories:

yes [sarcastically] = just plain wrong! and

yes [enthusiastically] = we should talk further about this...

But I didn't after all do this at the conference—70 attendees in a long and narrow room was not the right situation for this level of interaction. Instead I followed up with just a few by email and some of their responses are referred to in the discussion of contributions to knowledge.

CONCEPT CARS TO CULTURAL PROBES

4.2.3 interesting future expeditions

As AAC applications proliferate on consumer mobile platforms, the case for the involvement of interaction designers seems ever more compelling. But design research might make a valuable but less obvious contribution at the very beginning of the design process, in connection to user research.

The importance of individual voices is itself a current issue in AAC. On 26 June 2012 I visited Jeff Higginbotham and the University at Buffalo's Signature Center for Excellence in Augmented Communication that he directs. Jeff's group are developing a series of personas for AAC users, acknowledging the role of the individual and personal. This is a radical—even controversial amongst some AAC experts—approach in a field that is still dominated by a medical model of clinical descriptions and common symptoms, more than a social model of personal preferences, idiosyncrasies and subjectivity. Design ethnography and design ethnographers could play a valuable role here too.

Beyond personas, a design-led technique such as cultural probes (Gaver, Dunne, and Pacenti 1999) might also play a profound role in creatively engaging people without speech in imagining their future aspirations and inspiring new exploration. A student of mine, Calum Pringle, employed probe-like cards during co-creation workshops with people with dysarthric speech. He went on to create *Subtle Subtitles*, a working prototype using Dragon Dictate speech recognition software, but with the richness and sensitivity that came from designing for his mother who had dysarthric speech herself. That this

project is an exemplar in the field is credit to Pringle, but at the same time an indication of how much more a contribution design could make.

According to Daniel Fallman and Erik Stolterman, design exploration should challenge "mainstream assumptions in design, such as the consumer perspective, technology as tools and usability." (Fallman and Stolterman 2010, 270–271) It is thought-provoking that even the 'consumer perspective' is challenged, and this chimes with Colin Portnuff saying "The most important advice I can give you is to listen to the voice of the customer in every form you can find it. But don't be content with short term success from just giving customers what they ask for." (Portnuff 2006, 6) In a recent experience with the CreST network, we attempted to engage with AAC users to inspire radical new approaches to artificial voices in speech generating devices. A typical response to the invitation to imagine your dream communication aid was "IT WOULD F>>>ING WORK!!!!!!" (Alan Martin, reporting his own conversations with other AAC users, in personal correspondence, 16 February 2012) This is a heartfelt comment on the technical unreliability of many current devices, and the devastating effect this can have on the lives of their users. Not that this participation shouldn't be fundamental to any disability-related design, under the ethics of "Nothing about us without us" (Charlton 1998), but this is to highlight how difficult this is to harness, and also—with Portnuff's moral support—that it is not the only approach.

EXPLORING TO TRADING

4.2.2 complementary research projects

A metaphor for this research was suggested by Daniel Fallman's notion of 'design exploration'. Exploration is a compelling metaphor for research: the academic as a latter-day Livingstone or Shackleton. Of course explorers (perhaps Shackleton and other Antarctic explorers aside) rarely 'discover' a place, more often they are just the first from their culture to see it. Which resonates with this research, venturing into the territory of other disciplines, academic and non-academic, seen for the first time through a designer's eyes. Marco Polo might then be a better precedent. And therefore, acknowledging the presence of other people, travel or trade might be more appropriate metaphors than exploration.

In terms of the participation of disabled people themselves in this research, in line with "nothing about us without us" (Charlton 1998), I think the notion of trade does help us to consider what, whenever their knowledge and experience are passed on, is exchanged in return. The project is exploratory and speculative, and I am always at pains to point this out at any presentation, lest it

set up unrealistic expectations that communication aids with nuanced tone of voice will be available within the year, and with this disappointment when they are not. Exploratory, speculative or critical design projects could nonetheless be of value to disabled people—an issue that I discuss at length in the chapter of *Design meets disability* entitled 'provocative meets sensitive':

"Critical design need not be exploitative if applied to the issues around disability. Instead, disability groups could exploit critical design as a tool to provoke discussion about issues that may otherwise go undiscussed—in particular, the often unspoken assumptions inherent in current development and design for disability. Should hearing aids be invisible? Should prostheses mimic human flesh? Should it matter what equipment for visually impaired people looks like? Should the goal of assistive technology always be independence rather than interdependence?" (Pullin 2009a, 132–133)

LAND TO SEA

4.2.1 planned outputs

The initial metaphor of exploration did however inspire the idea that a map might be drawn of the course of this research. Recalling the expeditions of Shackleton, Scott and Amundsen, a map on which the joint path of Pullin & Cook from September 2006 to September 2008, and our subsequent journeys alone, but in communication, could be plotted.

Rather than to draft a map from scratch, I was keen to return to Daniel Fallman's *Interaction Design Research Triangle* because of its adoption by others and also its reconciliation of exploration, practice and more traditional academic studies. Because of the interdisciplinary nature of the research, with so much drawing on the 'other disciplines', 'society at large' and 'industry' which Fallman labels beyond the triangle, I found my drafts increasingly emphasising not the movement within the triangle, but the exchanges of knowledge and experience involved in paths around it. So I sent Daniel Fallman a first draft to ask whether he thinks that this development adds anything to his model, or perhaps misses the point of the original in some way. I found his response supportive, constructively critical and encouraging:

"... I'm very happy to see that you are using it more or less *exactly* as I had hoped people would use it, as a kind of simple background structure for thinking about design research :) The illustrations [on page 9 and 10 of a draft paper] for instance are spot on what I had hoped for!

"Your idea of "looping" outside of the model is a valid contribution and one which happens a lot in all kinds of design research. This should obviously have been part of the original model, but as I think you mention (?) the purpose of

the original model was maybe more to stake the case of design research and simplify the triangle rather than make the model more complicated" (Daniel Fallman, personal correspondence, 7 August 2012)

Nevertheless this inverts (perhaps subverts) the map to no longer be about the territory of design, but design as the negative space between other activities. Despite the original triangle showing academia, the public and industry beyond the triangle, all mappings I have seen have been within the triangle; bounded by the triangle. (Fallman 2008, Yee 2010) Somehow the triangle started to read less as a land-mass in my map, more as an inland sea. Less the Antarctic; more the Mediterranean.

Then the 'coastal' trade around the triangle put me in mind of ancient Phoenicia. My understanding of the Phoenicians is of a trading nation, whose influence was less a result of the territory that they occupied or the peoples they had conquered, but of the maritime trade they dominated in the ancient Mediterranean. I think of them in terms of a ring of trading settlements around the Mediterranean, flanked by more conventionally territorial empires such as Egypt, Greece and Persia. The historian Fernand Braudel wrote "... we could say of ancient Phoenicia that it was an early version of a world-economy, surrounded by great empires." (Fernand Braudel, *The Perspective of the World*, vol. 3 of *Civilization and Capitalism, 15th–18th Century*, translated by Siân Reynolds, Collins 1984 edition: 25) Perhaps this could serve as a metaphor for the role of design research in this interdisciplinary research.

Fallman thought that "The Phoenician trade route track feels a bit half baked possibly :) but I like the idea of balance that's implied: maybe that's something the triangle strives for as well, balance between the three areas?"

"Are you planning on publishing this at some point? I think it could be edited for instance make a nice contribution to Design Issues. If you want me on board or give more feedback later on I'd be happy to.

—Daniel" (Fallman 2012)

I agree that the reference to Phoenicians is a little flimsy and so I would make this deeper were I to redraft the paper, in order to better make my point about "positioning design in the middle of other disciplines, without laying claim to their territories, at the same time advocat[ing] a unique role for design research."

MAPS TO NOTES

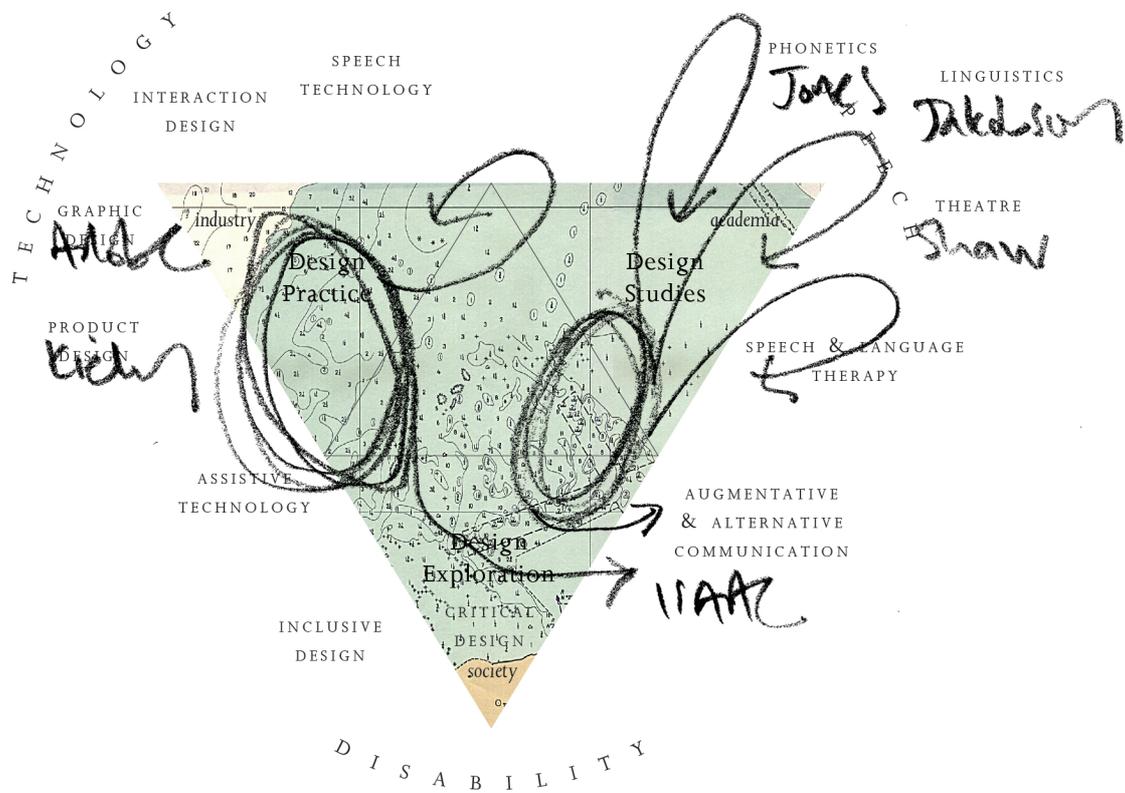
4.3 concluding remarks

In conceiving a map of the research, I thought that the way that expeditions themselves were mapped might provide some useful and appropriate

conventions that I could follow. I imagined various coloured or dotted/solid lines, with a suitable key and occasional dated milestones with dates, as is the convention for maps of expeditions. I searched for such maps in the university library, in case there were additional subtleties that could capture the complexities of my own research narrative.

This detail was not forthcoming, but a kind librarian, Mairi Robb, dug out for me three beautiful boxed sets of maps from a survey of Labrador and Greenland for the American Geographical Society in 1938 that were not on the library shelves. As well as the folded maps, one of the boxes also contained a booklet of 'Navigational Notes' (Forbes 1938), written from direct observation to complement the maps. With titles such as 'Mugford Tickle to Ekortarsuk Fiord', 'Cape White Handkerchief to Aulatsivik Island' these are the inspiration for these more subjective chapters in this thesis.

See overleaf for a sketched
map of this research.



A sketched map of this research, in which interdisciplinary territories are shown mapped around Daniel Fallman's Interaction Design Research Triangle. The right-hand loop represents Six Speaking Chairs, the left-hand loop Speech Hedge.

