1 Linguistics, Phonetics, and Speech-Language Pathology: Clinical Linguistics and Phonetics

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1.1 A Brief Historical Overview of Clinical Linguistics and Phonetics

The speech-language sciences and arts have, of course, informed speech-language pathology for a long time; for example, the knowledge of normal articulation was imported from phonetics, the use of terms for word classes (such as nouns and verbs) from traditional grammar. However, the more recent close interaction between linguistics and communication disorders started only in the 1970s. Kent (2011), in a review of the development of the journal *Clinical Linguistics and Phonetics*, points to Duchan's online survey of the development of speech-language pathology, where she refers to the period from 1965 to 1975 as the "linguistic era" (see Duchan, 2011).

In the 1970s and 1980s David Crystal and his colleagues developed linguistically based profiling techniques for the analysis of normal and disordered syntax and morphology (Crystal, 1979; Crystal, Fletcher, and Garman, 1976), and then phonology, prosody, and semantics (Crystal, 1982). At the same time an interest in the clinical application of modern phonological theory began to emerge, with publications by Grunwell (1982), Ingram (1976, 1981), Edwards and Shriberg (1983), and Elbert and Gierut (1986), among others. Interestingly, however, the appearance of the term "clinical linguistics" dates to the end of this period, with the publication of the book of that title by David Crystal (1981). Crystal defines clinical linguistics as "the application of linguistic science to the study of communication disability, as encountered in clinical situations" (Crystal, 1981: 1). He added to this definition: "clinical linguistics is the application of the theories, methods and findings of linguistics (including phonetics) to the study of those situations where language

handicaps are diagnosed and treated" (Crystal, 1984: 31). Limiting the direction of application from linguistics to language disorder is intentional: "the orientation … should be noted. It may be contrasted with the approach of neurolinguists, for example, who study clinical language data in order to gain insights into linguistic or neurological theory" (Crystal, 1984: 30–31). Nevertheless, despite Crystal's wish for clinical linguistics to be a unidirectional hybrid discipline, many researchers working in the field have adopted a bidirectional approach. For example, Ball and Kent (1987: 2) wrote that they preferred a definition that allows "either applying linguistic/ phonetic analytic techniques to clinical problems, or showing how clinical data contribute to theoretical issues in linguistics/phonetics." The work of Grodzinsky and colleagues (e.g. Grodzinsky, 1986, 1990) illustrates the use of data from language disorder to inform syntactic theory.

Clinical linguistics developed through the publication of a number of important books (some noted above), the drawing up of analysis procedures and the development of instrumental techniques (to which we return below). An important milestone for this new field of study was the launching of a new academic journal, *Clinical Linguistics and Phonetics*. This took place in 1987, with an initial volume of just two issues (soon increased to four). Now in its twenty-fifth year, the journal publishes 12 issues a year, testimony to the increase in interest and work in clinical linguistics.

1.2   The Role of Clinical Linguistics and Phonetics in Speech-Language Pathology

In this section we will look at some of the contributions made from clinical linguistics and phonetics to clinical practice and research in speech-language pathology, starting with the investigation of speech output impairments as informed by clinical phonetics. The description of disordered speech has benefitted in several ways from the input of clinical phonetics, not least in phonetic transcription, which forms the foundation on which much of both clinical decision-making and clinical speech research builds. Phonetic transcription using the IPA (International Phonetic Alphabet) has long been the norm in data analysis in disordered speech. However, it became clear fairly early on that the range of sounds encountered in the clinic appeared to be larger than the range encountered in natural language. At first ad hoc symbolizations were devised by speech-language pathologists (SLPs) to deal with sounds that could not be denoted through the use of IPA symbols or diacritics because they did not occur in natural language (Grunwell, 1982). In 1983 the King's Fund in the UK published a paper describing a proposed range of additional symbols for just these atypical sounds: the Phonetic Representation of Disordered Speech (PRDS; PRDS, 1983). While a step forward, these PRDS symbols had limited currency, being little known, for example, in North America. The 1989 meeting of the International Phonetic Association in Kiel instituted a committee to examine the symbolization of atypical sounds found in disordered speech. It considered the PRDS

symbols and other suggestions and eventually recommended a set of Extensions to the International Phonetic Alphabet (extIPA) for clinical use. This was described in Duckworth *et al.* (1990), and has been updated since (see, e.g. Ball, Müller, and Rutter (2010) for the most recent (2008) revision).

The provision of the extIPA symbols set (and later on the VoQS voice quality symbols; see Ball, Esling, and Dickson, 2000; Ball and Müller, 2005) is a good example of how insights from phonetics have influenced developments in communication disorders. However, it is also arguable that the needs of speech pathology (in this case the description, through transcription, of atypical speech) have informed phonetics. While it is true that Pike (1943) contained descriptions of a wide range of sounds (both linguistic and nonlinguistic), it is only since the development of extIPA that phoneticians seem to have recognized this range of sounds not found in natural language (for example, through the inclusion of the extIPA symbols in publications of the International Phonetic Association).

Another example of a two-way interaction between speech science and speech pathology can be found with instrumental analyses of speech. A wide range of these exist (see, e.g. Awan, 2008; Ball and Code, 1997; Gibbon, 2008; Kent and Kim, 2008; Whitehill and Lee, 2008; and Chapters 4, 12, and 13 in this volume). Some of these techniques examine speech production processes, some the acoustic signal, and others the perception of speech. While these techniques were mainly developed for the investigation of normal speech, some of them were given a special impetus through their use in the speech clinic. We can point to two of these in particular: electropalatography (EPG) and electroglottography (EGG) (also known as electrolaryngography, ELG). The work by Gibbon and colleagues on "covert contrasts" using EPG is a good illustration of this clinic–research interaction. Gibbon investigated articulatory contrasts made by a speaker that are not perceptible by the listener. For example, in Gibbon (1990) the author reports that one of two sisters is transcribed as backing alveolars to velars, but the other is not. EPG patterns recorded for both sisters had tongue contacts at both alveolar and velar positions at the onset of target alveolars, but the EPG tongue–palate contact patterns at the point of release differed. One sister released her velar contacts before her alveolar ones (thereby producing a release burst that was acoustically similar to that of the control subject), whereas the other released her alveolar contacts first and velar ones last, thereby producing a release burst that sounded like that of [g].

As Fourcin (2000) has pointed out, ELG (or EGG) can help establish links between objective measurement using laryngograph-type signals and the use of subjective auditory dimensions of voice quality description. This is because ELG measurement techniques are able to provide a way of escaping from the current clinical bias towards the utilization of data that are convenient for the researchers, because they are easy to measure (sustained vowels for example), but that are rather less relevant to real-life voice use.

Clinical linguistic research has also informed development of the application of phonology to disordered speech. As Bowen (2009) notes, insights from early phonological theory began to be applied clinically in the 1960s. Many researchers working within clinical linguistic tradition helped spread later theoretical developments within phonology to clinical situations. For example, Grunwell used Stampe's framework of natural phonology in clinical assessment (Grunwell, 1987, 1997; Stampe, 1979).

Bernhardt and Stemberger, and Gierut and Dinnsen applied nonlinear models of phonology, and more recently Optimality Theory, to disordered speech data (Bernhardt and Gilbert, 1992; Bernhardt and Stemberger, 2000; Dinnsen, 1997; Dinnsen and Gierut, 2008), and the current authors have used more functional and cognitive models of phonology for the analysis of clinical data (Ball, Rutter, and Code, 2008; Müller, Ball, and Rutter, 2008). Ball, Müller, and Rutter (2010) describe a range of phonological approaches and how these can be used to analyze disordered-speech data and also to help plan intervention.

Concrete outcomes from clinical phonology include a range of assessment instruments based on different models of phonology, or combining several such approaches. Arguably, the two such assessments most within the clinical phonology tradition are the PACS procedure (Grunwell, 1985) and PROPH, a profile developed by David Crystal (Crystal, 1982) (see Ball and Müller, 1997, for a comparison of the two profiles). Both these assessments rely on naturalistic speech data and provide profiles of the speaker's phonological abilities, using a range of phonological analyses, rather than standardized scores derived from a limited set of tokens.

1.3   Research Philosophies, and the Rest of this Book

Clinical linguistics and phonetics is far from a homogenous field in terms of research traditions, philosophies, and methods adopted by its practitioners. In fact one might go so far as to say that the one thing all clinical linguists and phoneticians have in common is an interest in data related to language or speech disorder, which in turn represents a rather wide remit, and not one that is entirely straightforward in definition (for instance, do we describe the communicative sequelae of dementia as primarily *cognitive* or *linguistic*, and indeed, what difference does it make?). Some clinical linguists would describe their work as, essentially, a branch of applied linguistics, where the application is the (eventual) translation of linguistic and phonetic analyses into clinical assessment and intervention, while others take theorizing about the nature of human language, speech, and cognition as their inspiration, and wish to investigate how impairments of speech and language inform such theories.

In all branches of science that ultimately take human conditions as their object of investigation, there is a potential tension between different scientific orientations (and at times, priorities). Thus, confronted with any one person with aphasia, one may ask numerous questions, such as, but not limited to, "what can this person's history of stroke and the effects on her language processing tell me about human language?"; "what characteristics of aphasia do I see in this person?"; "which specific language skills are impaired by a stroke such as the one experienced by this person?"; "how does aphasia affect this person's life?"; "what tools do I need to effectively assess the language skills and deficits in this person?"; "what do I need to know in order to plan effective intervention for this person?"; "what does this person have to tell me about how aphasia affects her life?", and so forth.

The starting point for research in clinical linguistics and phonetics is always going to be a person with impaired language or speech, whether he or she is a participant in a group study, or a single "case." While ethical conduct is of course a prerequisite of all good research, working with vulnerable populations such as children or people with a variety of impairments of communication and cognition imposes particularly stringent requirements. In Chapter 2 of this book, Thomas W. Powell discusses research ethics in the clinical arena, from the planning stage to the eventual dissemination of research results.

In order to situate different approaches to research in clinical linguistics and phonetics, and the role of the individual in them, it is useful to make reference to Luria's distinction between *classical* and *romantic* science (Luria, 1987a, 1987b; see Sabat, 2001, for discussion, with specific reference to dementia research). Classical science is reductionist in philosophy and approach, and aims to find general and generalizable insights. Phenomena are analyzed into component parts which are investigated using standardized procedures. A classical researcher aims at discovering the, ideally, context-free essence of the object investigated, a "truth" or general characteristic that transcends any one individual case. Classical reductionist science is typified by experimental group studies. Thus, research aiming for explanations of "the nature of," for instance, language impairment in aphasia, or Specific Language Impairment, or phonological delay tends towards experimental or quasi-experimental studies. Given the difficulty in finding large groups of people exhibiting sufficiently similar constellations of symptoms of speech or language impairment (in the absence of confounding variables, and well enough matched for the purposes of an experiment), many quasi-experimental studies in this field are case studies intended to contribute, by a process of accumulation, to a generalizable body of knowledge. Such clinical case studies have a long and proud history in medicine, psychology, and indeed the clinical speech and language sciences (see, e.g. Code *et al.*, 1996, 2003).

Chapter 3 in this volume, by Vesna Mildner, is something of a *tour de force* of principles of experimental and quasi-experimental research as relevant to clinical linguistics and phonetics. Mildner discusses steps in experimental research design, the concepts of reliability and validity, the choice of appropriate design variants (including pre- and non-experimental designs), and questions of subject selection, data collection, and interpretation. May Bernhardt and colleagues (Chapter 4) use the International Classification for Function (ICF; WHO, 2007) as a framework for their chapter on experimental and quasi-experimental research on speech production and (re)habilitation. A researcher's beliefs and assumptions are what underlie that researcher's constructs of what constitutes, for example, "disorder," and how it can be investigated. Judith Oxley's chapter on experimental and quasi-experimental research on disordered language (Chapter 5) includes a discussion of nosological constructs, and of theories accounting for language development and change that drive research. At the heart of data analysis and interpretation in experimental and quasi-experimental research is the application of appropriate statistical methods, since statistical significance serves as a determinant of whether the hypothesis investigated is to be accepted or rejected. Statistical methods as applicable to clinical linguistics and phonetics are the topic of Chapter 14, by Eleanora Rossi.

With classical reductionist science, Luria contrasts what he calls *romantic* science, which is holistic in approach and philosophy and attempts to *not* reduce phenomena to abstract component parts and generalizable characteristics, but rather to "preserve the wealth of living reality" (1987b: 6). Clinical linguists and phoneticians oriented towards this goal often tend towards qualitative approaches, which involve a flexible approach to research design and the avoidance of a priori hypothesis formation. Qualitative studies in clinical linguistics are also often based on single cases, and include the layering of multiple types of data in an attempt to capture complexities embedded in, and emergent from, the real-life and individual concerns and priorities of the participant(s) (see Chapter 6, on qualitative research). Chapters 7 and 8 are dedicated to two strands of qualitative research, namely the Ethnography of Communication (by Jacqueline A. Guendouzi), and Conversation Analysis (by Scott Barnes and Alison Ferguson). Clinical sociolinguistics, which in Chapter 9 (by Martin J. Ball and Louise Keegan) is operationalized as the application of sociolinguistic methods (specifically the investigation of sociolinguistic variation) to the clinical context, is another branch of clinical linguistics that aims at capturing the complexity of the living reality of human communicative encounters; in this case, interactions with and between persons with speech and language impairments.

The core of any linguistic or phonetic analysis is a solid body of high-quality data, and many studies involve the processing of audio or video data. Chapter 10, by Benjamin Rutter and Stuart Cunningham, deals with audio and video data, the analytical purposes for which they are useful, and their recording and storage. Data recording is a first step in analysis, since the data recorded will constrain, and thereby help to focus, an analysis. Impressionistic approaches have long been a mainstay in clinical phonetics and linguistics. For such analyses, researchers employ a variety of transcription methods to transform audio or video data into a graphic source for and record of analyses. Such methods, their applicability to different areas of research, and their role in data analysis are the topic of Chapter 11, by Martin J. Ball and colleagues. While transcription-based approaches essentially rely on the transcriber's perceptual and transcription skills to filter the data into usable units, acoustic data processing methods remove this particular filter from the analysis and base interpretation on acoustic measurements. Mark Huckvale (Chapter 12) presents an introduction to acoustic measures of voice pitch, voice quality, segmental characteristics, and prosody relevant for use in clinical phonetics. A further avenue of analysis in clinical phonetics is speech imaging, that is, a variety of techniques that produce visual representations of movements of the vocal tract. Such methods, their applicability in clinical phonetics, and the technical requirements involved are the topic of Chapter 13, by Joan Rahilly. In Chapter 15, Brian MacWhinney and colleagues present a branch of research that is becoming increasingly prominent in linguistics in general, and clinical linguistics in particular, namely corpus-based approaches. Given the rapid advances in storage and processing capacity of mainstream computing in recent years, it is now feasible for researchers to access and investigate large corpora of language data without having to invest in expensive specialist computer hardware (the same is also true of acoustic analysis; see Chapter 12). MacWhinney and colleagues base their chapter on the AphasiaBank project, which to our knowledge is the largest and fastest-growing corpus of language data relating to language impairment in the world.

Doing research in clinical linguistics and phonetics is, in our humble opinion, fun while it lasts. However, it would not warrant the label of "research," nor would it warrant inconveniencing research participants, unless the ultimate goal of the research endeavor is dissemination, that is, the publication of our investigations for scrutiny by the research community, and for the purpose of contributing to the available body of knowledge in our field. Writing and disseminating research can follow many avenues, including theses and dissertations in fulfillment of degree requirements, edited books, journal articles, conference presentations, and more. The writing and dissemination of research is discussed in the final chapter of this book (Chapter 16, by Sharynne McLeod).

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