CHAPTER 42

PROSODY IN CHILDREN WITH ATYPICAL DEVELOPMENT

RHEA PAUL, ELIZABETH SCHOEN SIMMONS, AND JAMES MAHSHIE

42.1 Introduction

Atypicalities of communication development are among the most common developmental disabilities (Prelock et al. 2008). For some children, communication is the primary aspect of development affected (Bishop et al. 2016). For other children with a variety of developmental disorders—including intellectual disabilities, neuromotor disorders, and autism—communication difficulties are one aspect of their symptomatology. In most of the research aimed at understanding the communication disorders demonstrated by affected children (who represent approximately 13% of the population internationally; McLeod and Harrison 2009), the focus has been on the development of their vocabulary, speech sound production, and syntactic, morphological, and pragmatic abilities. However, there is an emerging literature that addresses the prosodic strengths and difficulties seen in children with communication disorders. This chapter reviews four developmental disorders in which prosody has been reported to show atypicalities: autism spectrum disorder (ASD) (§42.2), developmental language disorder (DLD) (§42.3), cerebral palsy (CP) (§42.4), and hearing loss (HL) (§42.5). The focus is placed on these disorders since Lopes and Lima (2014) report that there is very little research on prosody in other disabilities seen in childhood. Brief descriptions of the impact of each of these disorders on prosodic function will be presented.

As chapters 40 and 41 make clear, children are sensitive to prosodic aspects of speech input by 4–6 months of age, but the full acquisition of receptive and expressive prosodic skills at the lexical and utterance levels extends over the course of childhood, with some features not acquired until after 8 years of age. Rates and sequences can vary across languages.

42.2 Autism spectrum disorder

The US National Institute of Mental Health (2018) defines autism spectrum disorder (ASD) as a group of developmental disorders that include a spectrum of symptoms, skills, and levels of disability and that involve problems communicating and interacting with others, repetitive behaviours, and circumscribed interests. ASD is diagnosed when these symptoms impair the individual's ability to function in important areas such as school, work, and community settings. Severity can range from very mild to profound impairment. Overall prevalence is reported by this source at 1.7% in 8-year-old children.

A core feature, and one of the primary diagnostic symptoms, of ASD is a qualitative impairment in social communication (American Psychiatric Association 2013). Although some individuals with ASD have limited spoken language abilities, current estimates (Developmental Disabilities Monitoring Network Surveillance Year 2010 Principal Investigators and Centers for Disease Control and Prevention 2014) suggest that more than 70% of those with ASD, as currently defined, function within or near the normal range in intellectual ability and use spoken language as their primary means of communication. Research on the development of language in speakers with ASD (summarized by Kim et al. 2014) suggests relative strengths in the areas of phonology (Bartolucci and Pierce 1977; Kjelgaard and Tager-Flusberg 2001), morphosyntax (Eigsti et al. 2007; Tager-Flusberg et al. 1990), and vocabulary (Jarrold et al. 1997; Kjelgaard and Tager-Flusberg 2001) when compared to pragmatic abilities, which constitute their primary communication difficulties.

Prosody, however, has also been identified as a significant component of the deficits seen in speakers with ASD. Since Kanner's (1943) original description of the autistic syndrome, prosodic differences in speakers with ASD have been noted (e.g. Pronovost et al. 1966; Ornitz and Ritvo 1976; Fay and Schuler 1980; Baltaxe and Simmons 1985). While not universal in speakers with ASD, when inappropriate prosody is present, it tends to persist over time, even when other aspects of language improve (Rutter and Lockyer 1967; Tager-Flusberg 1981; Shriberg et al. 2001).

42.2.1 Prosody production

Shriberg et al. (2001) were perhaps the first to apply a validated assessment instrument to the study of prosody in ASD. They assessed speech samples from 30 young adult speakers with ASD and reported more utterances coded as inappropriate in the domains of phrasing, stress, and resonance for the ASD group than for typical speakers. Paul et al. (2005b), reporting on the same sample of young adults, showed, as earlier studies had reported (Simmons and Baltaxe 1975), that the prosodic deficits found were not universal in the sample; only 47% of participants demonstrated these impairments, primarily in the areas of phrasing and use of stress. For this portion of the sample, however, stress difficulties were significant predictors of both social and communicative ratings on standardized instruments. Recent work suggests that this perception of prosody impairment in ASD is the result of both extended duration and extreme pitch variation used to produce simpler pitch contours that are used more repetitively (Diehl et al. 2009; Green and Tobin 2009; Nadig and Shaw 2012; Diehl and Paul 2013; Fusaroli et al. 2017). These findings suggest that although not all speakers with ASD show deficits in prosody, when they do, the deficits are associated with perception of poorer social and communicative skills on the part of significant others. DePape et al. (2012), in reviewing studies of prosodic production, concluded that the degree of prosodic impairment in speakers with ASD is related to their general language level, and that these impairments affect not only the acoustic character of the output but also speakers' ability to convey crucial information regarding meaning in utterances. Although most of this research has been carried out on English speakers, Chan and To (2016) report that speakers of tonal languages with ASD show similar atypicalities.

42.2.2 Prosody perception

While there is now a fairly consistent body of evidence of impairment in the expressive prosodic abilities of affected speakers with ASD, a growing literature on the understanding of prosodic information in ASD has yielded some contradictory findings (for reviews see McCann and Peppé 2003; Diehl and Paul 2009). Some studies have reported deficits in the comprehension of prosody used to express emotional states (e.g. Lindner and Rosén 2006; Wang and Tsao 2015; Rosenblau et al. 2017). Others have found that individuals with ASD are just as capable as controls of identifying basic emotional states from prosody (Boucher et al. 1998; Grossman et al. 2010; Brennand et al. 2011; Lyons et al. 2014). Still, it is also the case that several studies have found deficits in the recognition of certain emotions (e.g. happiness: Wang and Tsao 2015; surprise: Martzoukou et al. 2017) and not others, and that emotional prosody recognition is more problematic when prododic cues are discrepant with other information, such as facial expression (Lindström et al. 2016).

Some studies have employed neuroimaging techniques in order to understand emotional prosodic processing in adolescents and adults with ASD. Eigsti et al. (2012) and Gebauer et al. (2014) reported finding broader recruitment of executive and 'mind-reading' brain areas in ASD for a relatively simple emotion-recognition task involving prosody. Eigsti et al. interpreted these findings to suggest that participants had developed less automaticity in processing this information. Rosenblau et al. (2017) reported significant differences between typically developing (TD) individuals and individuals with ASD on both behavioural and neural levels of processing of emotional prosody. These findings, in conjunction with those concerning the inconsistencies noted above, may suggest that processing emotional prosody is effortful and resource intensive for speakers with ASD.

Prosody, however, plays a role not only in the communication of emotional information but also in structural language processes such as lexical segmentation, lexical identification, and syntactic parsing (Cutler et al. 1997; Wagner and Watson 2010). Chapter 40, for example, discusses the role played by 'prosodic bootstrapping' in the acquisition of word order, phrase, and clausal boundaries. Research on these nonpragmatic functions of prosody in ASD is thought to be critical for determining whether prosodic deficits seen in this syndrome are distinct from the general pragmatic deficit noted earlier, or merely collateral to it.

The role of intonational phrasing in syntactic parsing has been explored, with mixed results. Three studies, which respectively included adolescents, young adults, and school-aged children, found no difference between participants with ASD and TD controls (Paul et al. 2005a; Peppé et al. 2007; Chevallier et al. 2009), and one found that persons with ASD performed worse than age- and language-matched controls (Järvinen-Pasley et al. 2008). The participants in the last of these studies were less verbally proficient than those in the other studies, suggesting that methodological and age differences may influence results.

Diehl et al. (2008) compared prosodic comprehension in adolescent speakers with ASD to a control group. Participants were asked to point to the correct picture in syntactically ambiguous sentences. Speakers with ASD were less likely than their TD peers to act in concordance with the prosodic cue in following directions they heard (1).

(1) Put the dog . . . in the box on the star (Put the dog into the box that's on a star).
Put the dog in the box . . . on the star (Put a dog that's in a box onto a star).

Diehl et al. (2015) used both eye-tracking and behavioural responses in an experimental paradigm similar to that used in their 2008 study. They found that speakers with ASD were as likely as TD peers to use prosodic information to resolve syntactic ambiguity, provided that conflicting cues (e.g. lexical bias to interpret the first prepositional phrase heard as a destination, even when a second prepositional phrase requires reanalysis of this interpretation) were absent.

Diehl et al. (2015) interpreted these data to suggest that the deficits observed in the understanding of both emotional and linguistic prosody in this population may not be due to a global deficit in prosodic processing. Rather, they may stem from weaknesses in interpretation of information in the auditory-linguistic signal, as well as in the ability to form and override expectations based on prior knowledge and integration of cues from non-auditory sources (e.g. facial expression, situational context) and with social-cognitive knowledge (e.g. theory of mind). It may be the combination of these pressures to integrate information from a variety of sources when processing natural language that leads to the inconsistent performance seen in speakers with ASD on a variety of prosodic tasks, rather than a weakness specific to prosody per se. This interpretation of the findings in this population may help to explain its members' relative strengths in production.

In sum, prosodic deficits have consistently been reported in about half of the individuals with ASD who speak, and these deficits affect others' perceptions of the affected speakers. Conclusions on the source of differences in receptive prosodic capacity are more mixed, and additional research is clearly needed in this area.

42.3 Developmental language disorder

Developmental language disorder (DLD), sometimes referred to as specific language impairment, is a neurodevelopmental condition that affects approximately 7% of the general population in the UK and the USA, with males more likely to receive a diagnosis of DLD than females (Tomblin et al. 1997). Individuals with DLD are characterized as having impairments in expressive and/or receptive language skills in the absence of obvious sensory deficits, neurological impairment, or other developmental disorders such as ASD. Although there is significant heterogeneity within the disorder, children with DLD frequently present with delayed lexical development, grammatical impairments, and impoverished sentence structure. Subtle pragmatic impairments may also be evident (Schwartz 2009).

As we have seen, prosody plays a critical role in language processing—specifically, in parsing and organizing sentences into comprehensible linguistic units (Frazier et al. 2006), providing word boundary cues (Cutler and Carter 1987), and supporting pragmatic processing (Dahan 2015). It would seem plausible that prosodic impairments would be evident in those with DLD; however, there is mixed evidence in the literature on this point.

42.3.1 Prosody production

There is a dearth of literature evaluating the acoustic properties of prosodic output in children with DLD. However, one study by Snow (1998) used acoustic measures to quantify prosody production in a group of 4-year-olds with and without DLD. This project measured syllable duration and the use of falling pitch contours within utterances collected during spontaneous language sampling. Results reveal that the children with DLD marked syntactic boundaries using prosody production, including final syllable lengthening and falling pitch contours, in the same way as their typical peers. These findings suggest that these speakers provide at least some acoustic features in their prosodic output in a typical manner.

42.3.2 Prosody perception

There is evidence to suggest that basic auditory processing of low-level prosodic information is impaired in children with DLD. Cumming et al. (2015) report that 9-year-olds with DLD demonstrate diminished sensitivity to amplitude rise time in speech. Since the amplitude envelope transmits information about the global prosodic structure of an utterance, poor sensitivity to this structure may explain some of the higher-level language-processing difficulties observed in the disorder. Haake et al. (2013) suggest additional difficulties in children with DLD in impoverished processing of durational information. When participants with DLD were presented with pairs of tones varying in duration and had to choose which tone was longer, a subset of participants demonstrated impaired performance, while the remaining participants demonstrated performance on par with age-matched typical peers. Thus, it should be noted that deficits were not seen across all participants.

In a study of younger children, an unfiltered sentence was presented to preschoolers with DLD. A filtered sentence that either matched the unfiltered sentence or varied on between one and three prosodic parameters was presented after the unfiltered sentence (Fisher et al. 2007). The children with DLD performed more poorly than the TD children in determining whether the sentences matched. The authors argue that diminished performance on this task in the DLD group supports the notion that those with the disorder may not derive the same support for sentence parsing and comprehension from prosodic information as compared to language-typical peers.

In summary, the findings reported here suggest that some sublexical, basic auditory processing impairments may underpin the linguistic prosody deficits observed in a subset of children with DLD. Nonetheless, at least on average, these children display the ability to produce most of the prosodic distinctions tested. It is unclear from the handful of studies presented here whether prosodic functioning is generally impaired in children with DLD, whether only a subset of the DLD population experiences prosodic difficulty, or whether any of the differences reported between DLD and TD groups are clinically meaningful, given the relatively intact production reported. Continued research is needed to evaluate the relationship between basic auditory processing skills and linguistic prosody within the language impairments that characterize the disorder.

42.4 Cerebral palsy

CP is a developmental disorder characterized by movement and postural disturbance that is nonprogressive in nature. It usually has its onset in the pre- or perinatal period, caused by damage to the central nervous system. It is often accompanied by problems with sensation, perception, cognition, communication, and behaviour (Rosenbaum et al. 2007b). Speech and language problems in children with CP arise primarily from deficits in speech motor control, although comorbid problems in cognition, language, and/or sensation and perception can exist (Hustad et al. 2010). Recent data from population-based samples suggest that 60% of children with CP have some type of communication problem (Bax et al. 2006), the most common of which is dysarthria, a motor speech disorder that results from impaired movement of the muscles used for speech production (American Speech-Language Hearing Association 2017). Dysarthria is characterized by speech that is aberrant in rate, pitch, intensity, and rhythm; may show changes in voice quality; and often includes imprecise consonant articulation and vowel distortions that result in reduced speech intelligibility.

42.4.1 Prosody production

Most of the research on prosodic performance in CP has been carried out on adults rather than children. Patel (2002a) showed that adults with CP and severe dysarthria were able to produce vowels with both contrastive pitches and durations. Patel (2002b) was able to show that typical listeners could identify pitch contour cues provided by severely dysarthric speakers with CP in question versus statement contexts, even though the range of frequency control by these speakers was reduced, suggesting that the speakers with dysarthria were able to exert sufficient control to signal the functional question–statement distinction in their speech. Patel (2003) found that the speakers with dysarthria due to CP used pitch, duration, and intensity cues to signal contrast, and compensated for their reduced control of pitch by exploiting control of loudness and duration. Patel (2004) and Patel and Campellone (2009) reported similar findings for the ability of speakers with dysarthria due to CP to produce contrastive stress, again suggesting compensatory strategies. Connaghan and Patel (2017) showed that some speakers with CP benefit from using contrastive stress as a strategy to improve intelligibility.

In one of the few studies conducted on children with CP, Kuschmann et al. (2017) reported on 15 adolescents with moderate dysarthria who were provided with an intervention programme targeting a range of language skills. In monitoring outcomes on intonation, they noted a significant increase in the use of rising intonation patterns after intervention. There were also some indications that the increase in rising intonation was related to gains in speech intelligibility for some of the participants. Pennington et al. (2018) also examined the effect of intervention aimed at respiration, phonation, and speech rate in adolescents with CP and dysarthria. They found that increases in intensity and reductions in pitch were associated with gains in intelligibility.

In sum, the sparse literature on the prosody of the speech of adult speakers with CP focuses only on production and suggests that some elements of prosody can be preserved in this population, despite limitations in articulatory accuracy. Adult speakers with CP appear able to exploit pitch, duration, and loudness changes to convey communicative information, often using these cues in a compensatory fashion. Training appears to increase their ability to do so.

42.5 Hearing loss

Approximately 2 or 3 out of every 1,000 children in the United States are born deaf or hard of hearing (National Institutes of Health 2016), with about half showing severe to profound loss. Ninety per cent of these congenitally deaf children are born to parents with normal hearing. While more than 50% of all incidents of congenital hearing loss in children result from genetic factors, other causes include prenatal infections, illnesses, toxins consumed by the mother during pregnancy, and other conditions occurring at the time of birth or shortly thereafter (American Speech-Language Hearing Association 2018).

Many children with hearing loss have some degree of residual hearing, although any impairment to hearing will impact the development of spoken language. Severity of deficits in reception and production of spoken language depend not only on the type and extent of hearing loss but also on age at identification and intervention, and the type of intervention.

Perhaps the most significant advance in hearing technology since the advent of the hearing aid has been the development and use of cochlear implants with children. Prior to the widespread use of cochlear implants, children with hearing loss relied on hearing aids to access speech. These children were typically characterized as having affected speech, including articulatory errors (Hudgins and Numbers 1942; Smith 1975) and distorted vocal and prosodic characteristics (Hood and Dixon 1969; Monsen 1974; Monsen et al. 1979). But deaf children who have received cochlear implants prior to 3 years of age have generally acquired higher levels of speech and language skills (Flipsen 2008, 2011; Niparko et al. 2010) compared to peers using hearing aids.

42.5.1 Prosody production

Numerous studies indicate that a notable problem among children with cochlear implants (CWCI) is the ability to sustain stable fundamental frequency (f0) and amplitude, which is likely to affect both the prosodic patterns and overall quality of speech (Campisi et al. 2006; Wan et al. 2009; Holler et al. 2010). Studies (e.g. Higgins et al. 2003; Campisi et al. 2006; Gu et al. 2017b) confirm that these differences negatively impact the production of prosody.

A limited number of studies have directly examined the production of prosodic features by CWCI. Snow and Ertmer (2012) reported that CWCI exhibit early changes in intonation during the first six months of auditory experience with their implants, similar to those of hearing children. Additional evidence, however, shows that children with cochlear implants present a range of atypicalities in prosody production.

42.5.1.1 *Prosody production in sentences*

Lenden and Flipsen (2007) reported a number of differences in free speech related to production of stress and speaking rate, but no consistent difficulties with phrasing or pitch. Peng et al. (2008) elicited a series of syntactically matched questions and statements from children and youth with cochlear implants and an age-matched group of children with typical hearing (CWTH). The production scores of CWCI were significantly below those of the CWTH for both sentence types. But Barbu (2016) reported that results from a panel of listeners revealed no significant difference between the CWCI and CWTH groups in the production of rising and falling intonation contrasts to signal a question or a statement, and that the groups were similar in the use of f0 and, to a lesser extent, intensity, to distinguish between statements and questions.

Mahshie et al. (2016) used the focus output subtest of the Profiling Elements of Prosody in Speech-Communication (PEPS-C; Peppé et al. 2007) to elicit utterances with varied stress patterns from early-implanted CWCI. Listener judgements revealed no significant difference between the two groups' ability to accurately produce word stress, but acoustic analysis suggested that the CWCI relied less on altering f0 in achieving focus.

42.5.1.2 *Emotional prosody production*

Research examining the ability to produce speech conveying emotional states is limited in this population. Nakata et al. (2012) compared hearing and implanted children's imitation of a series of utterances that conveyed surprise (rising intonation contour) and disappointment (falling-rising intonation contour). The CWCI had an overall poorer ability to imitate these patterns. While the CWTH showed a steady improvement with age, the scores of the CWCI were not correlated with age and were similar to those of the youngest hearing children. Wang et al. (2013) compared the ability to imitate 'happy' and 'sad' sentences between nine 'highly successful' bilateral implant users and an age-matched group of CWTH. Findings revealed poorer performance for the CWCI.

42.5.2 Prosody perception

42.5.2.1 *Prosody and sentence perception*

Unlike the other disorders discussed here, a good deal of research on children with HL focuses on perception of prosody. Despite significant improvements in speech perception abilities resulting from cochlear implants, the speech information provided by these devices is impoverished when compared to that contained in the intact acoustic signal. Most significant is the absence of f0 information, suggesting that CWCI have limited ability to perceive (and thus to produce) prosodic features (Peng et al. 2008). This is confirmed by studies (e.g. Most and Peled 2007) that have compared the ability of CWCI and children with hearing aids to perceive intonation, syllable stress, word emphasis, and word pattern; these studies report that the children with hearing aids outperformed CWCI in perceiving both intonation and stress.

In addition, a number of studies have compared prosody perception in CWCI and CWTH. Peng et al. (2008) compared the ability of early-implanted CWCI and age-matched hearing individuals to produce and perceive questions and statements. Accuracy scores and appropriateness of pitch contours were significantly lower for both production and perception of these patterns in the CWCI. See et al. (2013) reported similar findings for perception of intonation. Torppa et al. (2014) examined word and sentence stress perception by CWTH and two subgroups of CWCI, one with some degree of musical experience and a second without. The results suggest that music training for CWCI was associated with scores more similar to those of the typically hearing group than the group without music instruction, suggesting that training may improve auditory perception in children with cochlear implants.

Holt et al. (2015) used a reaction time paradigm to examine response to prosodic cues in adolescents with and without cochlear implants. The group with implants showed slower reaction times than did the hearing group, suggesting that 'deficits in the perception of prosodic cues may impact on an individual's language processing speed' (p. 6).

Fortunato (2015) examined the role of prosody in the interpretation of syntactically ambiguous sentences and reported that a group of Portuguese-speaking CWCI differed in their use of prosodic forms to disambiguate sentences when compared to a matched group of CWTH.

42.5.2.2 *Prosody and emotion perception*

Hopyan-Misakyan et al. (2009) used the Diagnostic Analysis of Nonverbal Behavior (DANVA-2; Nowicki and Duke 1994), a research measure of emotion perception, to compare the ability of CWCI and age- and gender-matched CWTH to recognize four affective states: happy, sad, angry, and fearful. The CWCI performed more poorly on all four categories of emotions. However, Chin et al. (2012) examined the ability of CWCI to imitate utterances that conveyed happy and sad emotions and found no significant difference between CWCI and an age-matched group of CWTH. Nakata et al. (2012) likewise compared affective prosody perception by CWCI and CWTH. They reported better performance in the perception of 'happy' and 'sad' in CWCI, though they were not entirely comparable to CWTH, but larger deficits were seen in the perception of 'angry' utterances on the part of CWCI.

In summary, most research examining production of prosody by CWCI suggests deficits in production of stress, question–statement intonation, and mood (Peng et al. 2008; See et al. 2013; Torppa et al. 2014) and the use of compensatory strategies (Patel 2004; Patel and Campellone 2009; Connaghan and Patel 2017). Some studies, however, have found comparable performance among CWCI and CWTH. These differences may be accounted for by differences in the characteristics of the children studied and the methods used to obtain utterances. That is, research suggests that children who receive their implants prior to 3 years of age have better speech and language outcomes than do children who receive their implants at an older age (see Kirk and Hudgins 2016). While studies of early-implanted children tend to report performance close to that of CWTH, studies showing more differences contained significant numbers of children implanted after age 3. Methods that examine imitated utterances or highly structured elicited productions, as opposed to those using spontaneous speech, may also play a role in the discrepant outcomes reported. Research on prosody perception in this population reveals deficits in various aspects of perception. Performance is slower, less consistent, and less efficient than in typical development, rather than unequivocably absent. One study of CWCI and music training suggests positive effects of perception practice.

42.6 Clinical practice in developmental prosody disorders

42.6.1 Assessing prosody deficits

There are few instruments available for assessing prosody. The Prosody-Voice Screening Protocol (PVSP; Shriberg et al. 1992) is a measure that can be used to examine prosodic variables in free speech samples, in terms of stress, rate, phrasing (fluency), loudness, pitch, and voice quality. As a screening measure, the PVSP suggests a cutoff score of 80% for identifying a prosodic deficit. That is, if fewer than 80% of the subject's utterances are rated as appropriate in one of the six areas above, the speech sample is considered to demonstrate prosodic difficulties in that area. The PVSP has undergone extensive psychometric study and demonstrates adequate reliability at the level of summative prosody-voice codes. However, the PVSP is highly labour-intensive, requiring transcription and utterance-by-utterance judgements to be made for each prosody/voice code. It also requires intensive training and practice before adequate skill levels can be obtained by raters.

The aforementioned PEPS-C (Wells et al. 2004; Wells and Stackhouse 2015) samples a range of expressive and receptive prosodic elements in an elicitation format. With normative data reported for children aged 5–13, the measure has been used with typical children and those with a range of disabilities. Like the PVSP, it can identify prosodic deficits, but many children with disorders score within the normal range on this measure and the items are somewhat unlike any natural speech context.

The aforementioned DANVA-2 (Nowicki and Duke 1994), a norm-referenced measure of emotion perception, has been shown to be internally consistent and reliable over time, and its strong psychometric properties render it a useful instrument. The Child Paralanguage subtest consists of recorded repetitions of the same neutral sentence depicting four emotional states (happy, sad, angry, and fearful) with either high or low emotional intensity: 'I'm going out of the room now, but I'll be back later.' The child responds by selecting one of four pictures that represent the four emotions. This measure has been used frequently in studies of perception of emotional prosody.

A variety of notation systems have been developed to allow the annotation of transcribed speech samples to indicate prosodic features. Wells and Stackhouse (2015) supply one example in their Intonation Interaction Profile (IIP). They provide guidance for coding the appropriate use of turn-ending prosody, focus within utterances, and tone used to align with previous utterances within transcriptions. These and other notations allow the clinician to rate turn-taking, focus, and tone-matching in order to identify areas in need of intervention.

Table 42.1 Recording form for judging prosodic production in spontaneous speech

	Clinical judgement		
Prosodic parameter	Appropriate	Inappropriate	No opportunity to observe
Rate			
Stress in words			
Stress in sentences			
Fluency; use of repetition, revision			
Phrasing; use of pauses			
Overall pitch level; relative to age/gender			
Intonation (melody patterns of speech)			
Loudness			

Acoustic analysis, using software such as Praat (Boersma 2001), has also been used to analyse prosodic features, although no standardized methods using this approach have yet been published. Most clinicians assess prosody by relying primarily on subjective rating scales such as the one shown in Table 42.1 (Paul and Fahim 2014) to make judgements about prosodic performance. At this writing, there are no truly standardized measures of prosody production or perception, despite the importance of understanding function in these areas.

42.6.2 Treatment of prosody deficits

Few interventions have been developed to address prosodic deficits, particularly for children with developmental disorders. One problem facing developers of prosody intervention is the lack of normative information on the sequence of acquisition of various aspects of prosody (Diehl and Paul 2009). A few single-subject reports have appeared. Kuschke et al. (2016), for example, report on several cases in which fairly traditional language intervention techniques coupled with focused listening activities aimed at highlighting prosody were employed to some effect (Matsuda and Yamamoto 2013). However, the literature on interventions for prosody primarily focuses on ASD and HL, whereas a literature on prosody intervention is lacking for children with DLD and CP.

Lo et al. (2015) employed melodic contour training with 16 adult cochlear implant users. Therapy involved training using five-note contours forming nine different patterns, such as falling or rising-falling. Following training, the implant users exhibited improved consonant perception along with some benefits for question–statement prosody perception.

Rothstein (2013) published a volume of activities for preschool through school-aged children with HL that uses developmentally appropriate activities (singing, pretending, character voices) to improve receptive and prosody production skills in the areas of loudness, pitch, rhythm, and overall intelligibility. No data have been published on the efficacy of this approach, however.

Dunn and Harris (2016) also provide a volume of activities designed to address prosody, specifically in speakers with ASD. The programme includes a qualitative screening measure, with ratings based on observation of spontaneous speech. The programme itself presents a series of rule-based activities that employ visual cueing and physical activity to teach awareness and use of breath support, airflow, phonation, and motor sequencing in each area of prosody separately (volume, rhythm, pitch, stress, etc.) via exercises that start with sounds and words and move through phrases, sentences, paragraphs, and conversation. The authors report that research has been done on the effects of the intervention, although this research has not been published as of this writing.

Wells and Stackhouse (2015) present an additional intervention manual, with activities developed for a range of developmental levels (prelingusitic through school age) and some targeted for specific aetiologies (autism, learning disabilities, deafness). The system requires a high level of transcription and analytic capability and, while a great deal of developmental information on prosodic acquisition is reviewed in the volume, no empirical data on the efficacy of the programme are provided.

Simmons et al. (2016) reported on the use of a mobile application, SpeechPrompts, designed to treat prosodic disorders in children with ASD and other communication impairments using tablet computer technology. The app allows clinicians to provide sample utterances with pictured pitch and loudness characteristics and rates client productions as matching or diverging from the models. Forty students, 5–19 years old with prosody deficits, received treatment provided by their speech-language pathologists in school settings, using the app on a tablet device for short periods of time (10–20 minutes) one or two times per week for eight weeks. Post-treatment ratings suggest that SpeechPrompts was useful in the treatment of prosodic disorders, but efficacy data are not available.

42.7 Conclusion

This review has identified several emerging trends in this research. In terms of prosodic perception, the data from children with DLD, ASD, and HL converge somewhat on the notion of less rapid, complete, and efficient processing of the auditory signal that carries prosody, resulting in not absent, but inconsistent and inefficient perception of prosodic cues. Although this perception is, on average, lower than that seen in typical populations, it would seem to provide information adequate to learn a good deal about prosody that allows for, again, production of a range of prosodic parameters. This development, however, is somewhat delayed, less accurate, and less efficient than normal, but is not entirely absent. Many in these populations find ways to compensate for both motoric (CP) and perceptual (ASD, DLD, HL) weaknesses to make use of strategies for improving others' perception of their prosody. Both production and perception appear to be amenable to the positive effects of training.

While more research is clearly needed, the current literature suggests that it is possible to obtain at least short-term improvements in prosodic function using a variety of approaches. Better data on the normal development of prosody, improved assessment procedures, and fuller study of the efficacy of a range of treatment approaches will be necessary to advance the current state of clinical practice in this important area of communicative function.