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Assessing intonation and prosody in children with atypical language development: the PEPS-C test and the revised version

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Abstract

A procedure for assessing prosody and intonation in children (PEPS-C: Profiling Elements of Prosodic Systems—Children), suitable for use by clinicians with both children and adults, is described. The procedure includes testing of four communication areas in which intonation/prosody has a crucial role: interaction, affect, boundary (chunking) and focus. Each area has parallel tasks for assessing understanding and expression of the functions and ability to discriminate and articulate the prosodic forms involved. The original and revised forms of the test are compared, with some discussion of procedural considerations. Past and present uses of the test and future applications are considered.

Keywords: Prosody, intonation, assessment, interaction, affect, boundary, focus.

Assessment procedures to date

The procedure PEPS-C (Profiling Elements of Prosodic Systems—Child version) was devised in response to a need for a comprehensive procedure to assess prosody and intonation skills. A review of the few existing tests, such as the Prosody Voice Screening Profile (Shriberg, Kwiatkowski and Rasmussen, 1990) and PROP (Crystal, 1982) can be found in Hargrove and McGarr (1994). None of the tests in the review has normative data. None assesses input skills, thus not screening for the possibility that poor ability in this mode may have a detrimental effect on prosodic output and on understanding of language and social skills in general. The

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assessments reviewed tend to examine the forms of prosody without discovering whether the testee would use those forms in a situation where prosodic variation would distinguish between one meaning and another.

PEPS-C, originally designed for use with children, derives from PEPS (Profiling Elements in Prosodic Systems, Peppé, 1998), a test for adults normed in 1994 on 90 southern British English (SBE) people aged 18–52; it has also been used with adults with aphasia (Peppé, 1998). PEPS-C was devised and normed on 120 SBE children (aged 5–14) in 1995–7 (Wells, Peppé and Goulandris, submitted), and in 1998–9 was used with 18 children with the following disorders: autism, speech impairment, pragmatic language impairment, SLI, hearing impairment (aided) and stammering. Results from this study (reported in Wells and Peppé, 2003) suggested that prosodic skills were relatively independent of skills in other language parameters, and that when these were impaired prosodic skills were sometimes good. Prosody may thus form an island of strength that clinicians could build on. PEPS-C has also been used in the USA, with American stimuli (Velleman, 2002).

A four-pronged approach: the aims of PEPS-C and its psycholinguistic framework

PEPS-C is designed to assess the ability of people to understand and to express prosody (i.e., input as well as output mode), both in terms of the auditory discrimination and voice skills required ('form'-level processing) and in terms of how communication is affected by prosody in speech ('function'-level processing). This approach results in four task-types: input form, output form, input function and output function. For diagnostic purposes, this has the advantage of indicating where a problem involving prosody may be situated, in a psycholinguistic framework. For instance, if a person's speech shows atypical prosody, the test will suggest whether this affects the person's ability to use prosody meaningfully for some standard communication purposes (output function) or whether s/he realizes prosody for these functions in an unusual way (output form) that may nevertheless intelligibly convey meaning-differences; and also whether the atypical prosody could result from an input deficit, such as inability to hear the difference between various prosodic forms (input form) or inability to find such variation meaningful (input function). The lexical content of items is matched (or very similar) in all tasks within a communication area, so that ability in one task-type is as comparable as possible with ability in another. With clinical use in mind, testers are required to judge the prosody of responses by choosing one of the two meanings to be conveyed: understanding of how prosodic forms map on to prosodic function is not necessary. The test has so far been used mainly with children, but was revised with adult and child use in mind and pilot studies have shown it to be suitable for use with both.

Common functions of prosody in speech: communication areas

Four of these have been identified, sampling pragmatic, emotional and linguistic domains. In the general description of these areas, we include examples of the specific function used for testing in PEPS-C. We also give an indication of what relative strengths and weaknesses in each area might suggest for a person's communication skills.

Interaction

Different intonations for boundary at conversational turn-ends suggest the kind of response required (pragmatic skills). A sharp rise indicates request for repetition, while a low fall indicates understanding of what the speaker has said. In the original version of PEPS-C, a single word said by one party was repeated by the other in these ways to determine whether the speaker should repeat the word or go on to the next. The output function task differed in that testees heard words and non-words: if understood, they repeated the word with intonation showing affirmation; if not, repetition of what they heard was to be questioned. These tasks have been revised (see below, Task structure: Interaction tasks).

Input strength. Ability to understand what kind of answer is required without clues from syntax and/or vocabulary.

Input weakness. Little understanding that different intonation elicits different types of response.

Output strength. Ability to use intonation in a consistent/predictable way for differentiating between the types of response s/he requires.

Output weakness. One intonational form might be used for all types of turn-ending, or a variety of forms may be used with no consistency of use.

Affect

Affect covers the conveying of mood, emotion or attitude by intonation: given that it is possible to express mood using intonation and a minimum of expressive language, this is an important function of intonation, especially in the speech-impaired population. The instance of attitude-indication used in PEPS-C is to express liking or reservation for a kind of food or drink as shown by different intonation on a single word or syllable.

Input strength. Ability to understand that feelings can be expressed by intonation and knowing what feelings are being expressed.

Input weakness. Person cannot interpret feelings from intonation alone.

Output strength. Ability to use intonation in a consistent/predictable way for making his/her own feelings known.

Output weakness. Little can be assumed about her/his feelings from tone of voice alone.

Chunking

Chunking is a term for boundary or delimitation, i.e., the prosodic grouping of words to delimit speech into 'chunks', often reflecting linguistic (syntactic) divisions. In ToBI (the Tone-Break Index system, Pierrehumbert, 1980) these are denoted by

boundary tones; in the 'nuclear tone' school (Cruttenden, 1997), 'chunks' are tone-groups, information units, or tone-units; for Halliday (1967), chunking would be 'tonality'. The example used in the test to demonstrate chunking is the distinction between simple and compound nouns in a list (in the phrase 'cream buns and jam', 'cream' and 'buns' can be two simple nouns or one compound noun, depending on whether or not there is a prosodic boundary after 'cream').

Input strength. Ability to know when someone has finished speaking, and to understand syntactic groupings in speech (where distinguished by prosody).

Input weakness. Person may interrupt speakers, or not answer when expected; and may get confused in processing long utterances.

Output strength. Ability to indicate when s/he has finished speaking and to group units of information intelligibly.

Output weakness. Speech may have no 'breaks' or seem dysfluent.

Focus

Focus concerns the well-established notion that focal information in an utterance is indicated prosodically: focus is what is conveyed by the pitch accent in ToBI, by the nuclear tone in the nuclear tone school, and by 'tonicity' for Halliday. It is also known as sentence-accent, sentence-stress and main stress. All utterances have accent/stress even if the focus is the entire import of the utterance ('broad focus'), in which case accent occurs on the accent-bearing syllable of the last lexical item. Focus may also be 'narrow' ('contrastive stress'): in this case, accent/stress shifts to the accent-bearing syllable of the most important word, or the contrasted syllable (e.g., 'not ACcess but EXcess'). PEPS-C covers understanding and expression of variation in accent-placement.

Input strength. Ability to know what item is being emphasized in what is said to her/him.

Input weakness. Person may miss the importance of the main point of what is said to her/him.

Output strength. Ability to indicate deliberately importance of a particular word.

Output weakness. Wrong item sounds emphasized; no one word sounds more salient than another; or speech sounds overly emphatic, as though every word is stressed.

Procedural considerations

Conversation sample or elicitation?

In a conversation sample the chances are remote that there will be even one occurrence of prosody being the sole disambiguator of an utterance. Unless it is, there is little possibility of being able to quantify reliably how far the good use of

prosody is responsible for determining the correct interpretation of an utterance and thus important to communication. The artificiality of elicited prosody can be reduced to a minimum (as it is in PEPS-C) by ensuring that in the testee's use of prosody s/he is given the chance (in output tasks) to convey meaning that is not already known to the tester, and (in input tasks) to identify meaning that is not conveyed by lexis and syntax. The revised PEPS-C also includes a semi-structured conversation sample that may provide examples of naturally-occurring conversational prosodic function for comparison with elicited examples.

Eliciting meaning-options

As a way of making the meaning/intention unknown to the tester, the testee was encouraged in the original version to choose a meaning-option to convey, in three out of four output function tasks. This led to unbalanced numbers of meaning-options: for instance, if a person likes all the foods presented in the Affect task, there is no way of knowing how s/he would express reservation. Another way of hiding intention from the tester is by randomization of the stimuli (as in the Chunking tasks, when people are presented with randomly-ordered picture-strips), and this method has been adopted in the revised version; only the Affect output function task allows the testee to choose an option (and extra items are available to help redress imbalance in this task if necessary).

Attention span

The original PEPS-C test took approximately 60 minutes to administer: the revised test takes 45 minutes. Input form tasks were particularly taxing, requiring close attention by the testee: the length of these has now been halved by combining one- and two-syllable items (Affect and Interaction) as an 'Intonation input form task', and one involving multi-syllable items (Chunking and Focus) as a 'Prosody input form task'. Each revised task contains 16 items: eight of each of the original tasks. The two revised output form tasks similarly comprise 16 items: eight of each of the original tasks.

Assessment of atypical but not misleading prosody

Although prosody may not be badly misleading, it can sound atypical, and this quality is hard to quantify. Output form tasks in the PEPS-C assess the ability to imitate prosody. As well as task scores, general impressions from conversation-samples as to the normality of a person's prosody are valid. The tasks offer scope for:

- discovering whether prosodic forms are in a person's 'repertoire' when they are not generally used by her/him;
- comparing performance in an imitation task with performance using similar lexis in an output function task;
- providing data comparable between individuals for specialist analysis.

Task structure

All input tasks contain 16 items. Each is binary-choice, favoured over multiple (three- or four-way) choice to facilitate the memory load of alternative

interpretations to be applied to one stimulus. As many as 16 items are necessary to ensure an acceptable number of scores (11, i.e., 0–5 and 12–16) not obtainable by chance. Level of difficulty in all items of a task is as similar as possible for the same reason. Items with varied numbers of syllables are included to assess skills when prosody is distributed over more than one syllable. In input form (same-different) tasks, stimuli are laryngograph recordings, i.e., a recording of the laryngeal signal of the stimuli for input function tasks: prosody only, with no segmental information, like hearing a person talking in an adjoining room. 'Same' and 'different' responses were preferred over other formats to ensure clarity of stimuli in the auditory memory. All output tasks contain 16 items (12 in the original version) for ease of comparison with input tasks, although fewer items would be sufficient because the possibility of variation in answers is much greater in output than in input. The tester receives independent non-prosodic verification of the testee's intended meaning. Table 1 gives examples of all tasks and shows the changes between old and new versions.

Interaction tasks (Turn-end Type tasks, revised version)

Children sometimes had difficulty in understanding both of the original function tasks. When the input task was well understood, results appeared to give an accurate reflection of a person's pragmatic conversational abilities for distinguishing types of turn-ending, and can be used with the revised version as an optional task. In the output function task, the use of non-words in the task was problematic on two counts: children with communication impairment tended to be disconcerted by them, and the tester's judgement was biased towards expecting non-word stimuli to elicit an intonational request for repetition and real-word stimuli to elicit intonational affirmation of understanding.

For the revised version the distinction between offering and naming food (using food-items familiar from the Chunking and Affect tasks and the preliminary vocabulary check) is used. The pictured options are of a person looking at the testee with eyebrows raised and holding out the food on a tray (offering), and of the same person looking down at a book with the food depicted in a speech bubble. In this way the task is easier to understand; the use of non-words is avoided; the output task mirrors the input task more than in the original version; no new vocabulary is required; and since output function items are randomized the tester cannot predict whether the person is offering or naming other than by intonation.

Affect tasks

The task is to express and convey opinions about foods and drinks. The original task used the vocalization 'mm' to indicate preferences; in the revised version the name of the food is used. This makes the task more comparable with tasks in other communication areas. The original task is optionally available for children with limited expressive language.

Chunking tasks

The original function tasks used names of food items and the distinction between simple and compound nouns. Food items that can be simply and unambiguously

Table 1. *PEPS-C: a summary of tasks and materials used; old and new versions compared*

Task	Abbreviated instructions and examples
Legend: LH = rise, HL = fall, LHL = rise-fall, HLH = fall-rise. Bold & underline = accented.	
Checks	Vocabulary, same-different distinction
Old Interaction Input Function	Go on to the next item or repeat the last one? Testee names pictures (cup, key, etc) which tester repeats either HL or LH with low onset (affirming, i.e., 'go on') or LH with high onset (questioning, i.e. 'repeat')
New Turn-end Type Input Function	Is he offering it to you or saying what he sees in the book? Testee hears e.g., 1. LH apples? (offering) 2. HL tea. (naming)
Old Turn-end Type Output Function	Is this a word you recognize or not? Testee repeats recorded words (e.g., 'lemon') and non-words (e.g., 'lunny') sounding affirming or questioning
New Interaction Output Function	If the picture shows someone offering food, say the food as though you were offering it to me; if it shows somebody looking at a book, just tell me what the food is.
Old Affect Input Function	Does she like it or is she not too keen on it? Testee names food-items and hears recorded stimuli, e.g., 'mm' (LHL or HLH)
New Affect Input Function	Does she like it or is she not too keen on it? Testee hears e.g., 1. LHL apples (likes it) 2. HLH tea (not keen).
Old Affect Output Function	Think of the food-item mentioned by tester (e.g., bananas) and say 'mm' meaning either you like it or are not too keen on it
New Affect Output Function	Say the food sounding as though you like it if you do, and as though you're not too keen if you aren't. Then give me a smiley face if you like it and a no-smile face if you're not keen on the food
Old Interaction Input Form	Same or different? e.g., 1. HL'cup' - HL'cup'; 2. LH'key'-HL'key', etc.
Old Affect Input Form	Same or different? e.g., 1. HLH'cake'-HLH'cake'; 2. HLH'honey'- LHL'honey', etc.
New Intonation Input Form	Same or different? e.g., 1. HL - HL 'honey' (same); 2. HLH-LHL 'tea', (different).
Old Interaction Output Form	Imitation task: e.g., HL 'one', LH 'two' etc.
Old Affect Output Form	Imitation task: e.g., HLH 'no', LHL 'yes' etc.
New Intonation Output Form	Imitation task: copy exactly the way it's said (e.g., LH 'honey', LHL 'milk' etc.)
Conversation	What do you like doing on a computer/at weekends?
Old Chunking Input Function	2 items or 3? Recorded stimuli, e.g., coffee-cake and tea; coffee, cake and tea ; etc. Either 2 or 3 prosodic boundaries.
New Chunking Input Function	Point to the picture that fits: recorded stimuli, e.g., 1. pink&black and green socks 2. fish, fingers and fruit. Boundary after 1st or 2nd lexical item
Old Chunking Output Function	Say what you see (picture-strips showing either 2 or 3 items e.g., coffee-cake & tea; coffee, cake and tea)

Table 1. *(Continued)*

Task	Abbreviated instructions and examples
New Chunking Output Function	Say what you see: picture-strips, e.g., 1. pink and black&green socks 2. fish-fingers and fruit. Boundary after 1st or 2nd lexical item
Old Focus Input Function	Which item was forgotten? recorded stimuli, e.g., 'I wanted **choc**olate and cake'/'I wanted chocolate and **cake**'
New Focus Input Function	Which item was forgotten? recorded stimuli, e.g., 'I wanted **red** and blue socks'/'I wanted red and **blue** socks'
Old Focus Output Function	Say the picture you want to match a picture you have: e.g., 'I want a green **car'** in response to 'How about a green boat?'
New Focus Output Function	Correct the commentator: 'No the **red** cow's got the ball/the red **sheep**'s got it'
Old Chunking Input Form	Same or different? e.g., 1. coffee-cake and tea - coffee-cake and tea; 2. coffee-cake and tea - coffee, cake and tea, etc.
Old Focus Input Form	Same or different? e.g., 1. '**choc**olate and cake' - **choc**olate and cake'; 2. **choc**olate and cake - chocolate and **cake**', etc.
New Prosody Input Form	Same or different? e.g., 1. 'red and **blue** socks - red and **blue** socks' (same) 2. 'red and black&pink socks - red&black and pink socks' (different)
Old Chunking Output Form	Imitation task: copy exactly the way it's said (e.g., 90, 1, 2; 91, 2).
Old Focus Output Form	Imitation task: e.g., '3,2,1'; '3, **2**,1' '**1**,4,6'
New Prosody Output Form	Imitation task: copy exactly the way it's said e.g., 1. 'green and red&black socks' 2. '**green** and blue socks'.

depicted and are familiar to most children are however limited in number, and lack of familiarity meant that the vocabulary check had (time-consumingly) to include a large number of food-items used only in this task. Failure to remember what the item was could lead to hesitation, a potentially confusing variable in chunking prosody, so labels were placed underneath the images as reminders: this gave an advantage to good readers. Furthermore, the use of numbers in the output form task was inadvisable in view of the fact that some people have difficulty with numbers.

The new task includes pictures of different-coloured socks, an idea adapted from materials used in studies by Beach, Katz and Skowronski (1996), involving the grouping of coloured rabbits. In the revised PEPS-C task, two pictures each showing two pairs of socks are used, e.g. a pair of black socks with red tops plus a pair of pink socks in one group ('black-and-red and pink socks'), and a pair of black socks plus a pair of red socks with pink tops ('black and red-and-pink socks') in the second. The variations of colour-grouping may be considered more a task of syntactic chunking than the naming of fixed lexical items such as food. The colours green, red and pink are well-differentiated on the greyscale to allow no disadvantage for colour-blindness, and included in the vocabulary-check.

The revised version comprises half food-items and half socks, in random order. A smaller number of food-items entails a shorter vocabulary check and no necessity for written labels, but the inclusion of both socks and food provides variety within the task and holds attention. For the output form task, sock and food items are used: there are no items involving numbers.

Focus tasks

There are several problems in recognizing and producing accent-placement, although it is axiomatic in prosodic studies that it can be done, and as a task the production of accent-placement features in most prosody assessment procedures.

In the original PEPS-C, accent on the final item ('I wanted strawberries and **cream**', 'I want a black **boat**') could be confused between final narrow focus and broad focus. In the revised accent is never on the final item, e.g. 'I wanted red and **black** socks' (input function). For output function, the original 'Lotto' task ('How about a white car?' 'I want a **black** car/I want a white **boat**') took a long time to explain and administer, and was out of line with other tasks both lexically and in allowing four, not two, options for accent-placement. It has been replaced by 'animal football': a recorded commentator announces (with neutral accenting) 'Now the white cow's got the ball' while the testee sees a white sheep or a black cow with the ball (two different items) and corrects the commentator: 'No, the white **sheep**'s got the ball', or 'No, the **black** cow's got it'. Final accent-placement is avoided by the inclusion of the words 'got it/the ball', as is the possibility of accenting anxiliary verbs ('the white cow **has** got the ball'). This makes for less variation in response and scoring and thus greater reliability of results. It is also possible for the testee to hear the (randomly-ordered) stimuli through headphones, thus enabling the tester to make a judgement about accent-placement without hearing the stimulus.

The original version and revisions are summarized in Table 1.

Availability and computerization of test, and further research

The procedure will soon be available on a shareware basis from the QMUC website http://sls.qmuc.ac.uk/research/Autism/autism_project.htm#PEP-C or via any of the authors. It has been computerized (but is also available in paper format). Advantages of the computerized procedure are that:

- the computer records and stores judgements, responses and administrative details, and converts responses into scores. This reduces the possibility of human error;
- materials appear more quickly on the screen than a tester can produce cards, so assessment time is reduced;
- randomization of order of stimuli and tasks is simple: this is not possible with stimuli on audiocassette.

The revised PEPS-C (unpublished) is currently being used in a study at Queen Margaret University College, Edinburgh, which involves 30 children with autism aged between 7 and 13, with 70 controls, and is being administered in computerized form. So far, 20 children with autism have completed the test and no administrative

problems have emerged. Data collection for this study should be complete by summer 2003. The project includes workshops in assessing prosody for clinicians, and plans to devise therapy strategies for increasing children's awareness and attention to prosodic features, and for capitalizing on prosodic strengths.

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