

INVITED PAPER

Park Play: A picture description task for assessing childhood motor speech disorders

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Abstract

The purpose of this study was to develop a picture description task for eliciting connected speech from children with motor speech disorders. The Park Play scene is a child-friendly picture description task aimed at augmenting current assessment protocols for childhood motor speech disorders. The design process included a literature review to: (1) establish optimal design features for child assessment, (2) identify a set of evidence-based speech targets specifically tailored to tax the motor speech system, and (3) enhance current assessment tools. To establish proof of concept, five children (ages 4;3–11;1) with dysarthria or childhood apraxia of speech were audio-recorded while describing the Park Play scene. Feedback from the feasibility test informed iterative design modifications. Descriptive, segmental, and prosodic analyses revealed the task was effective in eliciting desired targets in a connected speech sample, thereby yielding additional information beyond the syllables, words, and sentences generally elicited through imitation during the traditional motor speech examination. Further discussion includes approaches to adapt the task for a variety of clinical needs.

Keywords: *Assessment, children, motor speech disorders.*

Introduction

The appropriateness and effectiveness of speech-language intervention rest upon a comprehensive assessment of a child's abilities and impairments. Assessments serve numerous functions including determining the presence of a disorder, eligibility for services, and intervention goals, as well as monitoring progress (Skahan, Watson, & Lof, 2007). For motor speech disorders specifically, assessment may also contribute to determining the site of lesion or disease, establishing severity and treatment focus (McNeil & Kennedy, 1984), and/or identifying the relative contributions of motoric and linguistic influences to the disorder (Strand, McCauley, Weigand, Stoeckel, & Baas, 2013). Arguably the most significant function of the childhood motor speech assessment, however, is to differentiate between speech and language (e.g., phonological) disorders and across motor speech disorders (e.g., sub-types of dysarthria, childhood apraxia of speech; Strand & McCauley, 1999).

Although it is important to assess speech production at various levels of complexity, a connected speech sample is the most useful context for observing the integrated function of all components of speech (Duffy, 2005). Given that perceptual judgements of speech and voice characteristics

inform diagnosis of motor speech disorders (Darley, Aronson, & Brown, 1969, 1975; Duffy, 2005), connected speech yields critical diagnostic information, such as syllable/word shape use, consistency of error patterns across differing levels of complexity and varying contexts, rate of speech, and the presence of prosodic abnormalities (Strand & McCauley, 1999). Moreover, observation of speech breakdown with increasing task complexity can point to motor programming deficits consistent with apraxia of speech (Duffy, 2005; McNeil, Robin, & Schmidt, 1997; Yorkston, Beukelman, Strand, & Hakel, 2010).

Task performance may vary depending on the method used to elicit a connected speech sample (Lowit-Leuschel & Docherty, 2001). For example, unlike reading or imitation, spontaneous speech requires formulation which draws upon greater cognitive and linguistic resources, and, indeed, has been shown to elicit less intelligible speech than more constrained elicitation tasks (Kempler & Van Lancker, 2002). On the other hand, spontaneous productions allow for observation of prosody, intelligibility, and speech sound production across contexts. Therefore, striking a balance between an information-rich spontaneous sample and a purely motoric task such as word and phrase repetition is critical for assessing speech motor planning and execution.

A scene description task has the dual benefit of constraining the target stimuli while engaging the child in individual interpretation and spontaneous descriptions (Limbrick, McCormack, & McLeod, 2013). The construction of such a task for children with motor speech disorders is complex and multifaceted given that there needs to be careful consideration of developmental factors and concomitant impairments to literacy, cognition, language, and attention. While some standardized tests include pictures to elicit connected speech from children to assess articulation and/or phonology (e.g., *Diagnostic Evaluation of Articulation and Phonology*; Dodd, Zhu, Crosbie, Holm, & Ozanne, 2002), to our knowledge, a standard picture scene specifically populated with targets known to aid in the diagnosis and differentiation of childhood motor speech disorders (e.g., dysarthria, CAS) is lacking.

To address this need, we developed the Park Play scene, a picture description task aimed at eliciting connected speech from children with motor speech disorders. This paper focuses on the design and development of the scene and highlights the breadth of clinical information that can be gleaned based on a pilot group of children with motor speech disorders.

Development of the scene

The design process included determining key principles for childhood assessment and identifying a set of evidence-based speech targets specifically tailored to the diagnosis and differentiation of motor speech disorders. The process began with a review of the relevant literature to develop an inventory of core design principles, such as ensuring the scene was engaging, illustrated in a child-friendly manner, evoked a familiar theme that would be accessible to a diverse group of children, consisted of tokens whose labels span the phonetic range, and included a small set of sub-scenarios that would generate lengthier narratives. Secondly, within the context of the basic design features, speech targets that would tax the motor speech system were identified. In addition to a review of the extant literature, traditional motor speech evaluations (e.g., Duffy, 2005; Robbins & Klee, 1987; Strand & McCauley, 1999) and standardized speech evaluations (e.g., *Test of Children's Speech*; Hodge, Daniels, & Gotzke, 2009; *Goldman-Fristoe Test of Articulation-Second Edition*; Goldman & Fristoe, 2000) were also examined to promote consistency between the scene and other tools whenever possible.

Design principles

Aesthetic appeal was a fundamental tenant of the design process in that the scene needed to be accessible and engaging to a broad range of children with respect to age, cultural background, speech impairment severity, and cognitive skills. The following guidelines informed the development of the Park Play scene:

A theme that would be engaging and familiar across cultures

Assessment measures of communication disorders have been criticized for a lack of cultural appropriateness (Laing & Kamhi, 2003; Limbrick et al., 2013). Although no task can meet the criteria of universal cultural appropriateness, careful consideration was given to identifying a commonly occurring theme that would be engaging and relatable to a broad population of children from diverse cultural backgrounds. Further attention was given to depict people from various ethnicities.

A scene that is visually interesting and appealing to children

The appearance of and likelihood that a task would be enjoyable to a child are important factors when speech-language pathologists choose assessment tools (Limbrick et al., 2013). This constraint required selection of relevant and interesting content that could be presented in an engaging manner while being comprehensive in coverage.

A set of sub-scenarios to elicit narrative descriptions

The use of sub-scenarios within a larger scene help focus the child's attention to various locations within the scene. This organization encourages clinicians to follow the child's lead, as well as elicit related targets. Narratives relating to familiar routines, mishaps, and emotionally provoking events are included to appeal to a broad range of children and to elicit diverse communication functions.

A comprehensive yet selective inventory of targets

Pictured items were deliberately selected to include vocabulary appropriate across a broad developmental span in terms of parts-of-speech, syllable shapes, phonetic complexity, and word frequency and familiarity.

Specific speech targets

Decisions about the content of the scene were based on established evidence in childhood motor speech disorders (cf. ASHA, 2007; Hodge, Brown, & Kuzyk, 2013; Love, 1992; Strand & McCauley, 1999). The following guidelines informed the inclusion of specific pictured tokens:

Comprehensive repertoire of phonemes

While comprehensive coverage of consonants, vowels, and clusters is ideal to assess speech production, formal assessment tools do not necessarily assess a broad range of sounds (Limbrick et al., 2013). Comprehensive evaluation of speech sounds is important, however, as imprecise consonants characterize most dysarthria sub-types (Darley et al., 1969; Duffy,

2005), and phonetic errors can be revealing about both articulator involvement (Kent, Weismer, Kent, & Rosenbek, 1989) and motor planning/programming (Duffy, 2005; Ogar, Willock, Baldo, Wilkins, Ludy, & Dronkers, 2006). Surveying vowel productions was deemed particularly important for childhood motor speech disorders. Vowel errors can impact speech intelligibility in dysarthria (Bunton, Leddy, & Miller, 2007; Hodge et al., 2013; Kent et al., 1989; Weismer & Martin, 1992) and are observed in childhood apraxia of speech (Nijland, Maassen, Meulen, Gabreels, Kraaimaat, & Schreuder, 2002; Pollock & Hall, 1991; Walton & Pollock, 1993). Despite these findings, vowel inventories are rarely addressed in standard speech assessments (Limbrick et al., 2013), nor in intervention (Speake, Stackhouse, & Pascoe, 2012).

Inclusion of a variety of syllable and word shapes

Even for typically-developing children, production errors are reduced in monosyllables relative to multisyllabic words (Vance, Stackhouse, & Wells, 2005; see James, van Doorn & McLeod, 2008 for a review), suggesting the need to observe sound production in words of varying length to gain a comprehensive understanding of speech production abilities across task complexity.

Inclusion of prosodic targets

Prosodic insufficiency, characterized by slow rate, abnormal pausing, equalized stress, and restricted or altered pitch, duration, and loudness variation (Duffy, 2005), forms a deviant speech cluster in the Mayo Clinic classification of dysarthria (Darley et al., 1969, 1975). Abnormal prosody has been documented in childhood dysarthria secondary to cerebral palsy (Love, 1992; Pennington, Smallman, & Farrier, 2006; Workinger & Kent, 1991), Down syndrome (Stojanovik, 2011), and traumatic brain injury (Campbell & Dollaghan, 1995), and is a core characteristic of childhood apraxia of speech (ASHA, 2007). Despite being a pervasive characteristic of motor speech disorders, prosodic disturbances are often overlooked in motor speech assessment protocols (Patel, 2010). Therefore, the scene description task was designed to enable observation of prosodic performance by including words with varying (e.g., iambic, trochaic) lexical stress. Additionally, the very nature of the connected speech sample facilitates the observation of utterance level prosody. The scene also included scenarios depicting emotion (e.g., girls arguing and crying; dog running away with the carrot) that would be likely to elicit emotional prosody.

Examination across the speech sub-systems

Examining speech production through the lens of speech sub-systems is an essential component of the motor speech evaluation (Duffy, 2005; Yorkston et al., 2010), thus targets were identified to assess respiratory/phonatory, velopharyngeal, and oral

articulatory systems. Respiratory performance was addressed through the comparison of voicing in long vs short utterances, and the observation of breath groups. To examine phonatory performance, voiced and unvoiced cognates were included. Oral–nasal and oral-only phoneme combinations were included to evaluate velopharyngeal performance. Finally, the assessment of the oral articulatory sub-system was addressed through phonotactic coverage that included targets representing place/manner of articulation (e.g., bilabials stops/fricatives to evaluate lip function; alveolar/velar stops and fricatives to evaluate tongue function) and the inclusion of phonetically complex words.

Tasks to inform motor planning and programming abilities

A number of tasks were included in the scene to facilitate the differentiation of motor planning/programming and motor execution deficits, a key goal of the childhood motor speech assessment (Strand & McCauley, 1999). Words of increasing length can indicate motor planning impairment, as adults with apraxia of speech are documented to increase errors with words increasing in length and/or phonetic complexity (Duffy, 2005; Ogar et al., 2006). Multiple repetitions of a word or utterance may also provide useful diagnostic information by revealing motor planning deficits, as both adults (McNeil et al., 1997; Wertz, LaPointe, & Rosenbek, 1984) and children with apraxia of speech produce repeated words inconsistently (Davis, Jakielski, & Marquardt, 1998; Marquardt, Jacks, & Davis, 2004). Lastly, the comparison of performance in automatic vs formulated speech can also reveal motor planning/programming deficits (ASHA, 2007; Strand & McCauley, 1999).

Rendering the scene and supplementary materials

Systematic implementation of the principles described above, coupled with identification of specific motor speech targets resulted in the Park Play scene. Table I provides a description of the scene attributes, rationale for inclusion, and examples of specific targets within the scene. A children's book illustrator¹ produced iterative designs of the Park Play scene (see Supplementary Appendix A to be found online at <http://informahealthcare.com/doi/abs/10.3109/17549507.2014.894124> for final version) based on feedback from children and clinicians. For example, several revised illustrations of *baby* and *caterpillar* were necessary to elicit spontaneous productions from children.

Supplementary materials to support clinical implementation of the picture description task were also developed. These included an Examiner Response Sheet (Supplementary Appendix B to be found online at <http://informahealthcare.com/doi/abs/10.3109/17549507.2014.894124>) to guide

Table I. Rationale for targets included in the Park Play scene.

Passage attribute	Rationale	Occurrence in scene
Broad appeal	To create a scene appealing across range of cultures, ages, speech and developmental abilities	Familiar theme of going to the park; includes individuals from diverse racial backgrounds
Sub-scenarios	To focus attention and provide topics to elicit narratives	<i>Familiar routines/objects:</i> having a picnic, playing with Mr Potato head; parents on bench; flowers, common animals <i>Mishaps:</i> boy walking up slide, bike/toys on ground <i>Emotional:</i> girl fighting/crying, dog stealing carrot
Broad representation of phonemes	Consonants/vowels observed across manner, place, voicing and word positions for representative inventory of errors	Consonants (all but δ), vowels (all), clusters (l-, r-, and s-blends)
Words of varying syllable shapes	To assess and compare ability to produce words across complexity range	V* (eye), C*-V (bee, two), C-V-C, (e.g., hat, dog), bisyllables (e.g., apple, balloon), multisyllabic words (e.g., caterpillar, butterfly) * v = vowel, c = consonant
Broad coverage of parts of speech	To assess productions across varying contexts, including semantic categories	Verbs (e.g., crying, running), nouns (dog, butterfly), and adjectives (e.g., yellow)
<i>Examination of prosody</i>		
Lexical stress	Prosodic deficits characterize dysarthria and childhood apraxia of speech (CAS)	Words with contrasting lexical stress: e.g., APple vs balLOON; BAby vs poTAto; CARrot vs baNAna
Emotional stress		Emotionally provocative sub-scenarios (e.g., girls fighting, girl crying, boy walking UP slide)
Overall prosodic modulation		Observation of connected speech allows judgements of pitch, loudness, duration, stress
<i>Examination across speech sub-systems</i>		
Respiration & phonation	Respiratory/phonatory deficits can be characteristic of dysarthria	Observation of breath groups in connected speech; Comparison of voiced/unvoiced tokens
Velopharyngeal	Hypo- and hypernasality can be characteristic of dysarthria	Oral/nasal (banana, ten) and primarily nasal (nine) targets
Oral articulatory	Tongue, lips, and jaw frequently impaired in dysarthria	Broad phonotactic coverage across place and manner
<i>Motor planning/programming tasks</i>		
Words of increasing length	Increased errors on increasing length words in apraxia/CAS	sock/soccer ball, foot/football, cat/caterpillar, dog/hot dog, sun/sunflower, flower/sunflower
Repeated words	Inconsistent errors seen in apraxia/CAS	flower
Automatic speech	Fewer errors on automatic than volitional speech in CAS	counting the flowers (1–10)

clinicians through the elicitation task and to record responses. Note that the Summary Scoring Sheet (Supplemental Appendix C to be found online at <http://informahealthcare.com/doi/abs/10.3109/17549507.2014.894124>) can be used offline, to consolidate and summarize the results.

Proof of concept

Participants

Five children (2 Male; 3 Female; age range = 4;3–11;1 years; mean age = 7;9) with motor speech disorders were recruited to assess the feasibility and effectiveness of the task in eliciting target stimuli and a connected speech sample. Additional inclusionary criteria were adequate cognitive, language, and visual skills to complete the task. Table II provides a

description of the participant characteristics. Each participant was diagnosed by the certified speech-language pathologist collecting the data, and diagnosis was confirmed by an additional certified speech-language clinician based on the findings from the motor speech/structural-function evaluation, a written case history provided by the caregiver, and speech samples from the scene description task. Duffy's (2005) guidelines were used to diagnose dysarthria, while the participant with childhood apraxia of speech (CAS1) was diagnosed based on the presence of the ASHA Technical Paper core criteria (ASHA, 2007) of inconsistent errors in repeated productions and lengthened and disrupted transitions between sounds and syllables. Severity of speech disorder was judged by the second author, based on the motor speech evaluation, scene description task, and conversational samples.

Table II. Description of participant characteristics.

Participant	Sex	Age, years; months	Medical diagnosis	Speech diagnosis	Speech disorder severity
DYS1	F	4;3	Peri-natal stroke	Dysarthria	Mild
DYS2	M	5;11	Down syndrome	Dysarthria	Mild–moderate
DYS3	F	7;0	Down syndrome	Dysarthria	Moderate–severe
DYS4	M	11;1	Cerebral palsy	Dysarthria	Moderate
CAS1	F	10;9		Childhood apraxia of speech	Mild

Procedure

Three speech-language clinicians at an outpatient paediatric clinic and the second author administered the protocol. Data were collected in a quiet room and the participants were audio-recorded using a Roland R-05 Studio WAVE/MP3 Recorder, placed ~ 12 inches from the participant's mouth.

After undergoing a motor speech/structural-function examination, participants were shown an earlier version of the Park Play scene which contained 52 speech targets. The prompt "tell me about the stories you see in the picture" was used to elicit the speech sample. Some clinicians included a labeling task, where the child was prompted to "tell me what you see in this picture". The clinicians were instructed to elicit all of the targets and, therefore, to use prompts, including questions, or, as a last resort, provide an imitative model.

Audio-recordings were analysed offline by the second author using Audacity 1.2.6. Target productions were transcribed and the occurrences of targets produced in imitation were recorded. In addition, the first 20 connected speech utterances produced by each participant were transcribed and analysed using an adaptation of established guidelines (Lund & Duchan, 1983; Rice, Smolik, Perpich, Thompson, Rytting, & Blossom, 2010). One participant (DYS3) produced only 11 utterances and, therefore, her analysed sample was limited. The following measurements were derived for each participant: time to complete the task; the number of targets produced with/without imitation; speech rate (averaged across

utterances; including intra-utterance pauses but excluding inter-utterance pauses); mean-length-of-utterance (MLU); the number/type of syllable shapes produced; number/type of speech errors (including distortions and substitutions) produced; word level lexical stress; utterance level speech prosody rated on the five-point scale (Duffy, 2005), and the occurrence of automatic speech.

Findings

All five participants generated connected speech to complete the picture description task in less than 10 minutes and attempted almost all targets (92–100%), either spontaneously or with prompting (82–100%). Table III illustrates individual participant performance across a number of measures, highlighting the type of information that may be elicited from the Park Play scene. Participants varied in their rate of speech (1.29–3.03 words/second) and MLU (1.8–6.3). Notably, DYS3 produced limited connected speech, likely reflecting her significant communication impairment. Simple syllable shapes (V, C-V, C-V-C) comprised 76–85% of each participant's connected speech sample. Visual inspection suggested that the prevalence of speech errors was related to the severity of speech impairment, as DYS3 produced the most errors and also had the most impaired speech, while participants judged least severe (DYS1 and CAS1) produced the fewest errors. Additionally, occasional vowel errors were noted only for those participants with more severe speech impairment.

Table III. Summary of participant performance.

Measure	Participant				
	DYS1	DYS2	DYS3	DYS4	CAS1
Time to complete task (minutes, seconds)	9m, 56s	9m, 47s	6m, 35s	9m, 43s	7m, 24s
# of 52 targets produced	52	51	51	50	48
# targets produced spontaneously or with prompt (no imitation)	52	49	42	45	45
Speech errors					
• # consonant errors	14	22	41	18	9
• # vowel errors	0	4	3	2	0
Rate of speech (words/second)	2.33	1.56	1.29	3.03	2.70
Mean-Length-of-Utterance	6.3	3.0	1.8	3.5	5.9
Syllable shapes in connected speech					
• V, C-V, V-C^	47%	43%	*	50%	38%
• C-V-C	29%	36%	*	35%	39%
• bisyllable	23%	18%	*	15%	19%
• multisyllable	1%	2%	*	0%	3%
Lexical stress	appropriate	occasional equal stress	appropriate	appropriate	appropriate
Utterance level prosody ratings+					
• Pitch (monopitch, excess variation)	0	0	0	1	1
• Loud (monoloud, excess variation)	0	0	0	1	0
• Stress (excess, equal, reduced)	0	1	0	1	0
Motor planning/programming tasks					
• Errors on words with increasing length	No change	Consonant deletion with ↑ length	No change	No change	"caterpillar" only
• Consistency across repeated words	consistent	consistent	consistent	consistent	consistent
• Produced automatic speech (counting)	yes	yes	yes	yes	yes

*speech sample not large enough to calculate.

^v = vowel, c = consonant.

+ 0 = normal; 1 = mild; 2 = moderate; 3 = marked; 4 = severe deviation; from Duffy (2005, p. 90).

Three participants demonstrated mild prosodic abnormalities (DYS2, DYS4 and CAS1). Of the tasks designed to determine the contribution of a motor planning component (observation of errors on words of increasing length, consistency across repeated words, comparison of automatic vs formulated speech), only production of words of increasing length elicited errors (DYS2 and CAS1) in this limited cohort.

Discussion

A spontaneous sample of connected speech provides fundamental information for differential diagnosis of motor speech disorders (Duffy, 2005). Perceptual judgements of speech production have a long-standing tradition in assessment and treatment (Darley et al., 1969, 1975). Many of the distinguishing features of the dysarthrias and apraxia of speech/CAS may only reveal themselves in connected speech, and perhaps only in speech formulation tasks. For the assessment of childhood motor speech disorders, key diagnostic information such as syllable shape use, error patterns across varying complexity and contexts, and the presence of prosodic abnormalities (Strand & McCauley, 1999) are ideally observed during such a task. This information affords complementary data to the sound, word, and utterance imitation tasks of traditional motor speech evaluations (Duffy, 2005; Robbins & Klee, 1987; Strand & McCauley, 1999), resulting in a comprehensive basis for clinical decision-making. However, a child-appropriate tool for eliciting a connected speech sample targeted to motor speech disorders has not been generally adopted.

To address this need, we sought to develop a broadly appealing child-friendly picture description task that specifically taxed the motor speech system. While the principles of optimal assessment were reviewed (Eisenberg & Hitchcock, 2010; McCauley & Strand, 2008), trade-offs between comprehensiveness and efficiency were paramount considerations in the final design. We began with a set of design principles and aligned them with evidence-based target stimuli. The process culminated in a version of the Park Play scene, which was trialed on a group of children with motor speech disorders. Participant errors and feedback from the children and clinicians were essential to the iterative design modifications.

The feasibility study demonstrated that the Park Play scene provides clinically relevant data across an heterogeneous group to facilitate the assessment of childhood motor speech disorders. Despite the range of ages and speech, language, and developmental abilities, the task was successful in eliciting speech targets within a connected sample of spontaneous or prompted productions from all participants. Even the most impaired speaker (DYS3) was able to complete the task, demonstrating feasibility across severity levels. Furthermore, clinicians noted the scene was comprehensive and could be efficiently administered within a clinical setting.

The Park Play scene is versatile in that it can be adapted for a variety of clinical needs. For instance, the scene can be used as a labelling task for children with severe speech impairment and/or limited language. For other children, performance across both labelling and scene description tasks would allow for comparison of word and utterance-level speech production. Although we opted for a comprehensive target list, clinicians may customize the stimuli to focus on specific sound combinations or client goals. In fact, elements of the scene and target list were modified in response to feedback from the feasibility study.

While further research is needed to determine which targets are most beneficial for differential diagnosis, speech samples elicited using the Park Play scene were more naturalistic than imitated productions, thus providing an opportunity to observe language formulation, prosody, motor planning, and speech production in varying phonetic contexts. This paper describes our process for applying an evidence-based approach to the design of a broadly applicable picture description task for eliciting a connected speech sample from children with motor speech disorders. It is encouraging that initial findings and clinician reports indicated the Park Play scene was effective, engaging, and supplemented traditional assessment protocols for childhood motor speech disorders.

Note

1. Carrie Hartman – http://www.carriehartman.com/Portfolio/HOME_.html

Acknowledgments

We are grateful for the creative and enthusiastic contributions of Kathleen Malone, Jennifer Justus, Paige Burke, Christi Berglund, Renee Stapleton, Soneth Yem, and Diana Franco in the development of the first iteration of the scene. We also appreciate the assistance of the clinicians at Braintree Rehabilitation Pediatric Outpatient Clinic for their assistance with recruitment and data collection and the participant families for their time, effort, and feedback. Finally, we acknowledge Carrie Hartman's exceptional talent in taking our ideas and constraints and patiently working with us to render the Park Play scene.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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Supplementary material available online

Supplementary Appendix A to C be found online at <http://informahealthcare.com/doi/abs/10.3109/17549507.2014.894124>