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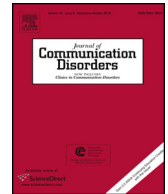
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Exploring the use of dynamic language assessment with deaf children, who use American Sign Language: Two case studies

Wolfgang Mann^{a,b,*}, Elizabeth D. Peña^b, Gary Morgan^a

^a City University London, United Kingdom

^b The University of Texas at Austin, United States

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ABSTRACT

We describe a model for assessment of lexical-semantic organization skills in American Sign Language (ASL) within the framework of dynamic vocabulary assessment and discuss the applicability and validity of the use of mediated learning experiences (MLE) with deaf signing children. Two elementary students (ages 7;6 and 8;4) completed a set of four vocabulary tasks and received two 30-minute mediations in ASL. Each session consisted of several scripted activities focusing on the use of categorization. Both had experienced difficulties in providing categorically related responses in one of the vocabulary tasks used previously. Results showed that the two students exhibited notable differences with regards to their learning pace, information uptake, and effort required by the mediator. Furthermore, we observed signs of a shift in strategic behavior by the lower performing student during the second mediation. Results suggest that the use of dynamic assessment procedures in a vocabulary context was helpful in understanding children's strategies as related to learning potential. These results are discussed in terms of deaf children's cognitive modifiability with implications for planning instruction and how MLE can be used with a population that uses ASL.

Learning outcomes: The reader will (1) recognize the challenges in appropriate language assessment of deaf signing children; (2) recall the three areas explored to investigate whether a dynamic assessment approach is sensitive to differences in deaf signing children's language learning profiles (3) discuss how dynamic assessment procedures can make deaf signing children's individual language learning differences visible.

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1. Introduction

Over the last decades, dynamic assessment (DA) of language skills has seen growing interest by clinicians as an alternative to standardized testing methods (Tzuruel, 2000). DA is particularly useful as a diagnostic tool for work with children from non-mainstream backgrounds, whose cultural and linguistic experiences may differ from those represented by the standard test content. It has been shown that through mediation, children can learn how to develop and apply linguistic skills within language-related tasks (Peña, Reséndiz, & Gillam, 2007). This process can reduce possible effects of

* Corresponding author at: Division of Language & Communication Science, City University London, Northampton Square, London EC1V 0HB, UK.
Tel.: +44 20 7040 0189; fax: +44 20 7040 8577.

E-mail address: wmann08@austin.utexas.edu (W. Mann).

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test bias on children from diverse cultural and linguistic backgrounds. Despite its growing popularity and recognition, DA of language is still fairly new and most research to date has been carried out on typically hearing children. Work with children with hearing impairment is limited and has mainly focused on assessment of children's cognitive skills (e.g., Keane, 1987; Olswang & Bain, 1996; Katz, 1984; Lidz, 2004; Tzurriel & Caspri, 1992). More recently, this work has been extended to the use of DA within a language-learning context related to this population by Asad, Hand, Fairgray, and Purdy (2013), who evaluated spoken English narrative language learning in English by three children with hearing impairment between the ages of 7 and 12 years. The authors applied DA to successfully differentiate language learning profiles, using a narrative task, among three children with reduced input due to hearing loss. Two of the children demonstrated pre-post changes on oral narrative, but one did not. The child who demonstrated no pre-post changes also demonstrated low responsivity to mediation and low modifiability during the teaching phase of the DA. In this paper, we build on that work to apply DA to the assessment of deaf children, who use American Sign Language (ASL). This offers an alternative for assessing language learning potential in linguistic minority groups where little normative data are available.

1.1. Challenges in assessing deaf children's language

Two major challenges in appropriate language assessment of deaf children, who use sign language, include variability in input/environment and shortage of appropriate sign language assessments. The environment and language experience of children who are deaf may vary considerably, ranging from signing deaf parents to hearing parents who communicate only through speech. Additionally, there are few reliable and valid tests available to examine deaf children's signed language abilities.

Approximately 5–10% of deaf children grow up with at least one deaf parent (Mitchell & Karchmer, 2004). These children generally receive regular and consistent exposure to language (i.e., sign) from a very young age and are able to reach early developmental milestones at rates that are comparable to typically developing hearing children (see Chamberlain, Morford & Mayberry, 2000; Morgan & Woll, 2002; Schick, Marschark & Spencer, 2004; Woolfe, Herman, Roy, & Woll, 2010, for reviews). The remaining 90–95% of deaf children are born into hearing families with little or no previous experience with deafness, who require different kinds of supports to provide their children with access to signed or spoken language (Lederberg, Schick, & Spencer, 2013). In the early years these children tend to receive no or little sign language exposure (if parents decide to use signed communication approaches), which results in delays in their sign language development in general and sign vocabulary development specifically (Lederberg & Spencer, 2009). Many children show growing ability to perceive auditory information and acquire spoken language as a result of earlier intervention and identification of hearing loss and improved technologies (e.g., digital hearing aids, cochlear implants). Yet, a considerable number of these children remain significantly delayed in spoken language (Lederberg, et al., 2013). Thus, a particular challenge in the context of early language acquisition is determining the extent to which lack of exposure/quality of language input and/or access to alternative models contributes to sign language-learning difficulties.

In contrast to the large number of tools available for assessing spoken languages, there are very few tests (e.g., British Sign Language-Receptive Skills Test, Herman, Holmes, & Woll, 1999; British Sign Language-Productive Skills Test, Herman et al., 2004) that have been designed specifically for deaf children, who use sign. This shortage along with the gap between assessment and intervention limits clinicians and teachers in their efforts to accurately determine children's levels of language ability, to diagnose additional disabilities, and to design appropriate support measures (Mann, Roy, & Marshall, 2013). The lack of available measures is mainly due to difficulties in test development and standardization related to the size and heterogeneous nature of the population of deaf signers. Existing standardized tests for spoken/written language, which have been developed and normed on hearing children, are of questionable validity when used with children who have not yet mastered a consistent and effective means of communication (Lidz, 2004) or who grow up with sign language as their first language.

An additional concern regarding the use of standardized tests with deaf signing children is the potential bias introduced when differences (or low performance) are interpreted as disorders. For instance, even the act of test-taking itself, requires a child to have sufficient language to comprehend the test instructions enough to know what s/he is supposed to do. Given the language delay many deaf signing children experience, their awareness/familiarity with the content and/or wording of tests may be affected. Findings from a recent study on the effects of ASL as accommodation for deaf/hard of hearing takers of standardized math/reading assessment tests showed no significant differences between those who did and did not receive ASL accommodations (Cawthon, Winton, Garberoglio, & Gobble, 2011). These findings suggest that mere translation of test instructions of tests designed for a hearing population is unlikely to address the underlying lack of experience with the language of test instruction.

Even when sign language assessment is specifically developed for deaf children, who sign, some challenges remain, including the varying signing skills of the test administrator and the question of availability of the test norms.

Professionals conducting language assessments in ASL are not usually native signers, and many do not have a well-developed knowledge of the language (Mann & Prinz, 2006). As a result, they may misinterpret signs they do not recognize as incorrect. This is particularly problematic on tests that assess productive skills. Test norms of a sign language assessment may not be equally appropriate for all test takers, given the variability in deaf children's signed language experience. For instance, sign language tests that have been developed and normed on children with natural sign language input from birth may be less accurate in distinguishing children who began learning sign language (e.g., ASL) later or those using artificial

signed systems representing spoken language (e.g., Sign-Supported English, Sign-Supported German, Signing-Exact English), from children with true language learning impairments. Here we propose that the mediated learning approach utilized in DA can complement existing measures and help to reduce effects of limited experience on performance.

1.2. Dynamic assessment

One of the main characteristics of DA is its focus on individual achievement under supported conditions. Via mediated learning, children receive feedback and training which enables them to show differences in progress when solving cognitive and/or linguistic tasks (Elliott, 2003; Haywood & Lidz, 2007; Sternberg & Grigorenko, 2002). In DA a test-mediation-retest approach can capture change in response to mediated learning. During the mediated learning session, the mediator additionally makes observations about the child's use of cognitive-linguistic strategies such as problem solving, flexibility, motivation, response to feedback, and task orientation (Peña et al., 2007). These emerging skills and strategies along with the level of support children need from others for learning a new skill are also referred to as modifiability. A highly modifiable child demonstrates positive learning behaviors (e.g., understanding of the task, motivation, problem-solving skills) and this is often accompanied by improvement in post-testing. Observations of modifiability have been shown to be very good indicators of language ability (e.g., Peña, Gillam, Malek, Felter, Reséndiz, & Fiestas, 2006; Peña, Iglesias, & Lidz, 2001; Ukrainetz, Harpell, Walsh, & Coyle, 2000).

One reason the DA model has some potential for use with deaf children who sign is its emphasis on the process of learning (the *how*) rather than the result (the *what*). With the information obtained from DA, the mediator can make hypotheses regarding a child's response to instructional strategies and/or future intervention instead of emphasizing normative comparisons. Such normative comparisons can be used alongside the DA and provide information about the child's possible need for additional assessment.

Many deaf signing children, whose language performance may differ from school expectations regarding language usage, are at risk of being over-identified as having cognitive or social impairments if they have limited experience with the language in which they are tested. Addressing this issue requires an extension of currently used assessment practices that takes individual students' strengths and weaknesses for language learning into consideration. In line with this, we have designed a DA model to explore changes in signing deaf students' strategic behavior during "mediated learning experiences" (MLE) (Feuerstein, Rand, & Hoffman, 1979; Feuerstein, Rand, Hoffman, & Miller, 1980). Our goal was to explore the feasibility of using DA to differentiate individual language learning profiles of deaf children, who use ASL. We approached this by using a case study design with focus on three areas: first, we observed the time it took children to complete each activity/session. Because the sessions were scripted but carried out individually, we reasoned that observation of the time it took to work through all the components of the mediation would provide one index of modifiability. Clinical observations indicate that children with language impairments tend to need more repetitions to learn; they have slower response times on language tasks. Our extension of these findings is to hypothesize that the more time it takes deaf signing children to complete an activity/session the more it might indicate impairments in learning language. We did not include any pretest-post-test measures in our design because the main aim of this study was to investigate participants' response to MLE in order to evaluate if this approach could work for ASL.

Next, because previous studies have demonstrated that mediator effort is inversely related to the language ability of a child (e.g., Peña, Iglesias, & Quinn, 1992; Kapantzoglou, Restrepo and Thompson, 2012), we examined the level of effort required by the mediator for each participant during the mediations. Last, on the basis of studies that show that modifiability is a strong indicator of language learning ability (e.g., Peña et al., 2007), we examined whether MLEs revealed individual differences in deaf signing children's ability to learn, specifically with regard to how they interacted with the mediator during learning, measured in observations of modifiability by the mediator. Categorization was chosen as the mediation topic based on the importance of children's ability to organize lexical items within semantic networks for successful language acquisition (Marshall, Rowley, Mason, Herman, & Morgan, 2013; Ukrainetz et al., 2000).

2. Method

2.1. Participants

Two children were recruited from a residential school for deaf children in Central Texas where the mode of communication is ASL and English. Both children were sequential bilinguals who learned ASL in the home from their deaf parents and had formal exposure to English upon entering preschool or elementary school. Informed consent was obtained from parents prior to data collection.

Child 1 (B), a male aged 7;4 (1st grade) at time of testing, had a bilateral sensorineural hearing loss at the severe to profound level that was detected at birth. He was not using any amplification in either ear. Both of his parents were deaf and he was exposed to signing from birth. Home communication was in ASL, which also was his preferred language at school. B entered preschool at age 3 at the school for deaf children that he still attended at the time of testing.

Child 2 (G), a female aged 8;6, attended 2nd grade at the time of the testing. She had bilateral sensorineural hearing loss at the profound level that was diagnosed at birth. G wore hearing aids in both ears. She had a history of deafness in her family, with two deaf parents. Home communication was in English and ASL, although G's preferred means of communication was

ASL. G entered preschool at age 3 at the school for deaf children. G had been diagnosed with Attention Deficit Hyperactive Disorder (ADHD) by the school psychologist when she was in first grade.

2.2. Baseline measurements of cognitive and language performance

Baseline measures of nonverbal intelligence and language parameters were taken using assessments against which DA and MLE results could be compared (see Table 1).

Non-Verbal Intelligence Measures: Both children completed the brief form of the *Universal Nonverbal Intelligence Test (UNIT)*, which is composed of Cube Design and Symbolic Memory (Bracken & McCallum, 1998). The *UNIT* is given non-verbally and studies demonstrate that this is an appropriate measure for deaf children (Krivitski, Mcintosh, Rothlisberg, & Finch, 2004). As indicated in Table 1, B received a score of 126 and G a score of 132 on the composite measure. These scores indicate normal nonverbal IQ.

Language Performance Measures: To assess children's signed vocabulary knowledge, participants completed four tasks, which measured the degree of strength of different mappings between phonological form and meaning for signs in the core ASL lexicon. These tasks were administered by a deaf native signer, who worked as a substitute teacher at the school. The tasks involved meaning recognition, form recognition, form recall and meaning recall. They had been originally developed for British Sign Language (BSL) (Mann & Marshall, 2012) and were adapted for ASL by the hearing first author, who is fluent in ASL, in collaboration with a team of deaf native/near-native signers. The BSL version of the task is currently being standardized on a larger sample. So far, average scores on three tasks are available for 64 children (Mann et al., 2013). The tasks allow analysis of a number of different aspects of vocabulary knowledge beyond the number of signs produced (or recognized). Both participants also completed the ASL Receptive Skills Test (Enns & Herman, 2011), which assesses understanding of syntactic and morphological aspects of ASL. The test, which is also in the process of being normed, consists of a Vocabulary Screener and a video-based receptive test. This test was administered by the school's hearing speech language pathologist, who uses ASL every day. The test is computer-based and includes pre-recorded instructions in ASL by a deaf native signer.

Participants' language scores are also displayed in Table 1. For interpretive purposes we compared their scores to preliminary norms of same-age children who were ASL-English bilinguals. B scored highest on the meaning recognition task (95%) where he performed above the mean. His performance was similar on the form recognition task (82.5%) and the form recall task (80%) on both of which his scores were within 1SD below the mean. B demonstrated particular difficulty on the meaning recall task (46.25%) where his score was more than 1SD below the mean for same-age children. His performance on the ASL Receptive Skills test + Vocabulary Screener (Enns & Herman, 2011) was above average.

G performed at 95% on the meaning recognition task, at 80% on the form recognition task, at 76.25% on the form recall task, and at 42.08% on the meaning recall task. With the exception of meaning recognition, all of these performances were within 1SD below the mean. G's score on the ASL Receptive Skills test was within 1SD of the mean and more than 1SD below the mean for the Vocabulary Screener.

Teacher Reports of Language Proficiency/Speech Language Pathologist Concerns: Independent of mediator observations, each child's teacher ($N = 2$) rated their signed comprehension and production skills via the Sign Language Proficiency Assessment Scales (SLPAS), adapted for ASL from Haug (2011). The two scales rate overall proficiency in sign language perception and production. Both teachers, one deaf, and one hearing, self-assessed their own ASL skills using these scales and rated their signing proficiency as high (5 out of 5). Both met the high standards for sign language proficiency by the school and state and were qualified to assess deaf students.

Additionally, we used a Sign Language Proficiency Rating Scale (SLPRS), adapted from Peña et al. (2007). This demographic survey contains questions related to children's sign proficiency with particular regard to vocabulary, comprehension, sentence production, and grammatical accuracy. Both scales are depicted in Table 2.

B's total score of 10 on the SLPAS indicated a high level of fluency in ASL. His score of 23 on the SLPRS indicated high levels of proficiency across vocabulary, comprehension, sentence production, and grammatical accuracy. Based on the information

Table 1
Baseline measures of nonverbal intelligence and language performance.

Measures	Child B	Child G
<i>Universal Nonverbal Intelligence Test (UNIT)</i>		
FSIQ	126	132
<i>American Sign Language Vocabulary Tasks (ASL-VT)</i>		
Meaning recognition task	35 (out of 40)	35 (out of 40)
Form recognition task	33 (out of 40)	32 (out of 40)
Form recall task	32 (out of 40)	30.5 (out of 40)
Meaning recall task	55.5 (out of 120)	50.5 (out of 120)
<i>American Sign Language Receptive Skills Test + Vocabulary Screener</i>		
Receptive Skills	39 (out of 42)	32 (out of 42)
Vocabulary Screener	20 (out of 20)	14 (out of 20)

Table 2
Baseline ratings of sign language proficiency by children's teachers.

Focus	Rating	Child B	Child G
<i>Sign Language Proficiency Assessment Scale (adapted for ASL from Haug, 2011)</i>			
ASL Comprehension	0–5	5	2
ASL Production	0–5	5	2
<i>Sign Language Proficiency Rating Scale (SLPRS) (adapted for ASL from Peña et al., 2007)</i>			
Vocabulary use			
At home/school	0–3	3/3	X ^a /1
Sign proficiency	0–5	5	3
Sentence production			
Proficiency	0–5	5	1
Grammatical proficiency	0–5	5	3
Comprehension proficiency	0–5	5	3

^a Missing data.

from these sources and no concerns by the school's speech language pathologist regarding B's communication behavior, he was judged to have typical language learning ability.

G's signing level on the SLPAS was rated as intermediate (2) by her deaf teacher. Her total score on the SLPRS was 11. Reasons for this low score included G's infrequent use of words she learned at home and at school, her limited ability to produce well-formed sentences in ASL when conversing or telling a story, and her problems understanding other peoples' ASL. G's English skills were described as "very delayed" by her teacher. Observations showed that G rarely initiated interactions in class although she responded to requests or acknowledged others responding to her. She was identified as a weak language learner based on the information from the surveys and concerns by the teacher and the speech language therapist about her academic language.

2.3. Intervention

2.3.1. Mediated learning experience

Following baseline assessment, both children participated in two individual, 30-minute mediated learning experience (MLE) sessions within a 3-week period. A hearing, Master ASL interpreter, who had been recommended by the school, conducted the mediation sessions. The mediator was trained by the second author on how to use the MLE script and how to rate child modifiability and mediator effort. This training was completed through the use of videotaped examples of previous clinicians' MLE sessions. The mediator watched the videotaped examples to practice, using the MLE Rating Scale (Lidz, 1991), which operationalizes components of MLE that constitute the teaching portion of the dynamic assessment (e.g., intentionality, transcendence, meaning, and competence). Further experience and practice were provided during training sessions until the mediator was confident in implementing the procedure.

The mediator was blind to both children's baseline measures. All sessions were carried out in ASL. For both sessions, a general script was prepared to provide consistency across participants although the specific interactions varied depending on the individual responses of the two participants. The goal for each session was to increase children's awareness of categorization as a way to group objects and/or persons, and to help them make use of categories as a way to faster accessing vocabulary. All sessions were video-recorded, using a CANON HD digital video camera.

Development of the MLE Intervention for Categorization: The mediation format we used was based on the principle of MLE introduced by Feuerstein et al. (1979, 1980) and extended by Lidz (1991), with the focus on categorization. Categorization was selected based on both children's low performance on the meaning recall task during the baseline measures. MLEs consisted of 4–6 activities presented in ASL within two 30-minute sessions. For fidelity purposes, we developed scripts for each session. Because signed languages, including ASL, do not have a traditional or formal written form, we used glossed notation, a commonly used means of referring to signs in writing is glossed notation whereby signs are presented in their natural order by upper case words taken from their nearest word equivalents (though not as true definitions or translations) (Zhao et al., 2000). This approach enabled us to minimize the demand on the mediator to translate the script from English to ASL 'on the spot' during the MLE session. During the first of two stages, a hard-of-hearing post-graduate student, who was fluent in ASL and had a background in linguistics, prepared the glossed 'ASL' version of the scripts. These glossed scripts were reviewed during the second stage by the mediator, who made any changes or additional notes, where appropriate. Because the main purpose of these glossed scripts was to provide an approximation of the ASL session for someone, who is familiar with the language, they included little linguistic form encoding (e.g., non-manual features such as raising eyebrows). This had the advantage that the scripts could be prepared within a short amount of time. (Appendix A includes one of the ASL 'transcripts' to provide the reader with an idea what these glossed scripts looked like).

The MLE activities were adapted from one of the curricula of *Bright Start* (Haywood, Brooks, & Burns, 1992), an educational program developed for young children to acquire, elaborate, and apply fundamental thinking skills that are essential for learning the academic material of the primary grade. They included sorting shapes based on different dimensions (e.g., size, color, shape), matching objects based on two dimensions, classing objects in smaller subgroups (subordinate) and/or larger,

more general groups (superordinate), and grouping signs based on their relation with each other (including signs of the same class and across word class).

The tasks consisted of a variety of matching activities with different materials, including paper shapes, pictures, and a set of pre-recorded ASL signs, which were presented on a laptop computer. During Session 1, the mediator and the child discussed the general meaning of special groups and engaged in a number of activities that involved the grouping of objects and pictures as well as an activity with signs. Session 2 had a similar format with a stronger focus on using special groups with language. The MLE scripts were designed to teach children to understand the reasons for using groups, the fact that they could class objects in various ways, and to make connections between the particulars of each session and the way these groupings could be applied to language. They were written to incorporate the five mediation strategies of intention to teach, mediation of meaning, mediation of transcendence, competence, and mediation of transfer (Lidz, 1991).

Each session started with the mediator introducing the goal of the activity (intention to teach) and the purpose of the activity (mediation of meaning):

Today, we're going to play with shapes, figures, and signs. We will think about how to discuss the way things, people, or signs can be grouped. So, what do we discuss today? [elicit "Groups"]

The mediator continued the introduction, relating the categorization activity to the children's home and school activities (mediation of transcendence):

So how are groups beneficial to us? [elicit "They help me to find things easy"] For example, in your classroom, all books tend to be together and all blocks tend to be together. Now suppose, this gets messed up and there is a book here and another over there. Why is this going to make things difficult? [elicit "Because you first have to look for a book"]

Next, the mediator assisted the children with going through the process of organizing objects into groups according to some common characteristics or features (mediation of competence).

"Now look. Are these two things the same? [elicit "No"]. How are they different? [elicit "Because of their size/shape/color"]. So how can you group them? Can you group them by shape? How do you figure out the right group? What are the criteria? [elicit "Pay attention to shape"] Is it possible to group (them) like this? {put objects with different shapes in the same group} [elicit "No!"] Why not? [elicit "They are not all the same shape"] Suppose I group them like this here {arrange by color}. Can they be grouped? [elicit "Yes!"] Why? [elicit "Because they have the same color"] Now, imagine what things you can group in your classroom?"

At the end of the session, the mediator reviewed the activities and discussed any changes observed in the children's ability to form/use categories (mediation of transfer):

"Well done! What did we (just) do? [elicit "Put things together"] What did we think about? [elicit "Special groups"] You did really well! At the beginning, you weren't quite sure how to group but then you thought about it and were able to group the shapes."

The video recordings of all MLE sessions were translated to English in order to document children's performance during the activities and to allow a closer examination of children's responses to the efforts by the mediator. The translations were prepared independently by two graduate students both near-native signers, one a child of a deaf adult (CODA) and the other a sibling of a deaf child (SODA). The students were given instructions to indicate any syntactical errors observed in children's ASL in the English translation.

2.3.2. Modifiability measures

The mediator completed two scales to measure participants' modifiability: the Mediated Learning Observation (MLO; Peña & Villarreal, 2000) and the Modifiability Scale (based on Lidz, 1991).

Mediated Learning Observation: The Mediated Learning Observation is used to observe and record participants' learning behavior during each MLE session. It differentiates between internal (e.g., anxiety) and external social-emotional behavior (e.g., responsiveness to feedback) and also distinguishes between cognitive features of arousal (e.g., task orientation) and elaboration (e.g., problem solving) (Peña et al., 2007). The form contains 12 items, which are rated by the mediator using a 5-point scale. A higher score indicates an increased need for mediator support while a low score means that the child is able to use a strategy independently. Scores range from 12 to 60, with a high score overall suggesting maximum mediator support during MLE and low scorers requiring minimal support. This form was completed by the mediator at the end of each session.

Modifiability Scale: The Modifiability scale consists of three rated items, including child responsivity (child's flexibility while learning), mediator effort (amount of support provided), and transfer (child's ability to transfer new knowledge throughout the MLE session). Both child responsivity and mediator effort are scored on a 4-point scale while transfer is scored on a 3-point scale, yielding a total score from 0 to 11. A high score indicates high child modifiability and a low score indicates low modifiability. Each participant was rated by the mediator at the end of the second MLE session for a summative evaluation of child modifiability.

2.3.3. Fidelity of intervention

In order to document consistency of MLE implementation, fidelity of treatment was rated by two fluent signers, using the Mediated Learning Experience Rating Scale (Lidz, 1991). This scale consists of four MLE components, which include

intentionality, transcendence, meaning, and competence. Each component is rated on a 4-point rating scale from 0 to 3 for a total possible score of 12. A score of 0 indicates no evidence of inclusion, a rating of 1 means that the component is present but unelaborated, a rating of 2 indicates consistency in the use of the component while providing elaborations and a rating of 3 demonstrates the highest level of mediation where elaboration may expand the information about the activity or object and/or include hypothetical or inferential thinking. The mean rating was 2.63 across all sessions for both children by both raters, indicating that the mediator consistently implemented MLE during the sessions. The overall item level point-to-point agreement was 87.5% and agreement within 1 point was 100%.

3. Results

The data collected from each participant are described below. For each child, we report the time durations for completing an activity, the mediator report of her effort, and her judgment of overall child modifiability. In addition, we provide examples to illustrate different ways the children interacted with the mediator during learning.

3.1. Time for task completion

To explore participants' response to the mediation, we first compared their time durations for completing each activity. On average, G required more time compared to B on an activity during MLE 1. For instance, it took her more than half as long to complete the sorting task (B: 4:41 – G: 7:31) and almost twice as long to select related objects on the picture task (B: 2:42 – G: 5:12) during MLE 1. In addition to the time spent on each activity, the transition time between each activity for G was almost twice that for B. During transition, the mediator reviewed the principle and purpose of categorization and/or promoted cognitive bridges between tasks to help move the participant from the perceptual to the conceptual. During MLE 2, the times to complete an activity and the transition times were more closely aligned for both participants. For example, G completed a leaf task (described below) in almost exactly the same time as B (B: 2:19; G: 2:20) and finished faster on one of the activities involving ASL (B: 2:47; G: 1:45), related to the sign OLD. This faster time course demonstrates G's increasing engagement in the tasks and her growing familiarity with the concept of grouping.

3.2. Mediator effort

At the end of each of the two mediated learning session, the mediator rated children's modifiability during the mediation, using the Mediated Learning Observation (MLO). Table 3 depicts these ratings for each participant.

The ratings indicate that B and G responded differently to the mediations. B seemed to understand the goal of using categories quickly and easily, was aware of most of his errors, and showed evidence of use of strategies during the mediations. His MLO ratings were 15 for MLE 1 and 19 for MLE 2 (out of 60) with an average rating/item between 1.25 and 1.58. In comparison, G's ratings (out of 60) were 36 for MLE 1 and 25 for MLE 2 with an average rating/item between 2.08 and 3. One example of the increased effort she required is the activity of sorting cutouts at the beginning of MLE 1. Here, she wouldn't accept color as an alternative sorting strategy until demonstrated by the mediator. Another example, taken from

Table 3
Mediator's ratings of children's modifiability using the mediated learning observation (Peña & Villarreal, 2000).

Focus	Child B		Child G	
	MLE 1	MLE 2	MLE 1	MLE 2
<i>Internal social-emotional (1–5)</i>				
Anxiety	Calm (1)	Calm (1)	Fidgety (2)	Calm (1)
Motivation	Enthusiastic (1)	Ambivalent (3)	Guarded (4)	Enthusiastic (1)
Tolerance to frustration	Persistent (1)	Persistent (1)	Tentative (3)	Persistent (1)
<i>Cognitive arousal (1–5)</i>				
Task orientation	Completely understands (1)	Mostly understands (2)	Rudimentary understanding (4)	Mostly understands (2)
Metacognition	Aware of most errors (2)	Aware of most errors (2)	Unaware of any errors (5)	Unaware of most errors (4)
Non-verbal self-reward	Not observed	Not observed	Not observed	Not observed
<i>Cognitive elaboration (1–5)</i>				
Problem Solving	Systematic & efficient (1)	Systematic & efficient (1)	Organized but inefficient (2)	Sketchy plan (3)
Verbal mediation	Talks occasionally (3)	Talks occasionally (3)	1–2 word utterances (4)	1–2 word utterances (4)
Flexibility	Has preferred strategies but can change (2)	Has preferred strategies but can change (2)	Persists with one strategy regardless of outcome (5)	Recognizes limitations but cannot see alternatives (4)
<i>External social-emotional (1–5)</i>				
Response	Very positive (1) to feedback	Positive but hesitant (2)	No response (3)	No response (3)
Attention	Attentive and focused (1)	Attentive and focused (1)	Focused but distractible at times (2)	Attentive and focused (1)
Compliance	Cooperative (1)	Cooperative (1)	Hesitant (2)	Cooperative (1)

Note: (A higher score indicates an increased need for mediator support).

MLE 2, is the mediator fingerspelling L-E-A-F to demonstrate that all leaves on the sheet could be grouped together as “leaves” after G did not respond to the ASL sign for leaves. These results suggest that B shows signs of high responsivity while G appears to struggle with learning new strategies and information.

This difference in mediator effort is also reflected in the administration time for each session. In particular during the first session, the mediator spent considerably more time providing guidance/directions to G (36:17) compared to B (23:48). During the second session, the effort required by the mediator was notably less for both students, who completed all activities at similar times (i.e., B (17:15) and G (13:36)). During the second mediation G started showing subtle signs of change/improvement, as documented by her lower MLO ratings. These signs included an increased motivation to engage in the activities and a better focus on the task at hand. In addition, she exhibited an increased understanding of the discussed concepts (i.e., special groups) and also seemed to be more aware of some of her own errors. More importantly, her initial persistence to maintain one strategy during the first session began to change and she was willing to recognize limitations of these strategies (e.g., responding “I don’t know”) when asked to provide an alternative sign that can be put in the same group as OLD.

3.3. Evidence for change

In addition to the MLO, we used the Modifiability Scale as summative observation of child modifiability during the MLE sessions. These scores showed that B demonstrated high responsivity (3), needed minimal mediator support (1), and had a high degree of transfer (2). In comparison, G evidenced only slight responsivity (1), required considerable support from the examiner (2), and also showed maximum transfer (2).

3.4. Evidence for individual differences in children's ability to learn

To better understand and interpret mediator reports of modifiability, we examined interaction between each participant with the mediator during learning by reviewing the translations of the video-recorded MLE sessions.

In the first example taken from the beginning of the first session, B demonstrates immediate understanding of the activity (i.e., sorting cutouts) by commenting on the differences between the cutouts. G, on the other hand appears to struggle with the task even after repeated prompting. Excerpts of the translations in written English are provided to illustrate the ways that each child interacted with the mediator (where A = Mediator and B/G = Child).

Example 1: Sorting cutouts.

Child B

- A: (Spreads cutouts on the table) Are all of these the same?
B: No, they're different. Some are squares, some circles.
A: Good! What else? Are they all the same color?
B: No, they're different.
A: Good! We also have different colors – yellow, blue, purple, etc.
[pause...grabs random group of shapes] Are these all the same? Do they belong in a group together?
B: No, they are different colors and shapes.

Child G

- A: (Spreads the cut outs on the table) Look! Are these the same or different?
G: (Student looks at the cutouts)
A: Are they the same or different?
G: They're different.
A: How are they different?
G: Different...what did you say?
A: Why are they different?
G: Why...different, different, different, different...circle...different...rectangle...different...box...different...triangle...different...(starts repeating types of shapes)

Next is another example taken from the first MLE session that shows how B attends to the task (i.e., grouping pictures) with minimal prompting. He is able to justify his responses by describing the differences between the animals based on visual cues (i.e., “different whiskers”, “teeth like this and a bobbed tail”). G, in comparison, while demonstrating clear understanding of the difference between animals by naming them (i.e., “it’s a cat”, “it’s a rabbit”) does not provide any

additional information unless prompted by the mediator (e.g., “what do you notice about these that makes it a dog”, “what do you notice about the ears”). Even then, some of her explanations were vague (i.e., “they can smell and know who a person is”).

Example 2: Grouping pictures I.

Child B

- A: They are dogs. They may have different muzzles and different ears, but they are still dogs, right? They all match. Why can't you match this one? (points at a cat)
- B: Different whiskers.
- A: It's a cat.
- B: It also has a long tail and ears.
- A: Right. What about this one? (points at another picture)
- B: It is a rabbit.
- A: A rabbit.
- B: It has teeth like this and a bobbed tail. See there?

Child G

- A: (points at a different picture) Is this one a dog?
- G: It is not. It is a cat.
- A: (points at another picture) What about this one?
- G: It is a rabbit.
- A: But these two you noticed were dogs, how?
- G: What did you say?
- A: So you throw out the cat because it is not a dog and you threw out the rabbit, so what do you notice about these that makes it a dog?
- G: They can smell and know who a person is.
- A: They can smell. Yes. And what do you notice about the ears?
- G: They are floppy and sized like this.
- A: So you can see that even though the dogs may look different, they can be grouped together.
- G: Same.

The next pair of examples is taken from the second learning session. At the beginning of the second session, B responds to the mediator's questions with minimal prompting and explains his response, using visual cues from the images (e.g., “has many points”). G continues to show her understanding of the activity at a basic level (i.e., similarity/difference between two leaves) and even at a more abstract level (i.e., all leaves are the same) after additional prompting by the mediator (e.g., “how do you think of them as L-E-A-F?”).

Example 3: Grouping pictures II.

Child B

- A: (points to 2 different leaves) Are these the same?
- B: Different.
- A: How are they different?
- B: One has many points and the other is just a regular leaf.
- A: That's right, they have different shapes but they're both leaves. In a group of leaves, there can be different shapes and sizes, but they're all leaves.
- B: (nods head)

Child G

- A: Now take a look at the sheet. Can you tell me which leaves can go in the same group?
- G: (points at one picture)

- A: Only this one?
G: No (points at another picture)
A: Why those 2?
G: They're the same.
A: That's right. Both have a sharp edge. (points at another picture) How about this one?
G: No
A: I see. How about this one (points at a picture)?
G: (points at a matching picture)
A: (nods, then points at a new picture)
G: (looking at the pictures, searching for a possible match, then shakes head) Nothing.
A: Nothing matches. I'm curious (points at each picture), are all these leaves the same?
G: Yes
A: So they all can be put in the same group.
G: (shakes head)
A: Ok, how about if you think of them as (spells) L-E-A-F
G: Same

In the later part of the second session, B demonstrates his understanding of grouping in the context of language by quickly picking the antonym (NEW) when asked to select one of the four signs related to the stimulus (OLD). Furthermore, he accepts alternative strategies when explained by the mediator. G's performance on this activity shows her improved understanding of the concept of grouping. This is reflected, in part, by the ability to make simple analogies and to explain her response (e.g., "when you're old, you get sick"). In addition, she shows growing acceptance to alternative strategies suggested by the mediator (e.g., "OLD and NEW are opposites, aren't they?").

Example 4: Grouping signs.

Child B

- A: This is the sign for OLD. Which (of the) signs goes with it?
B: NEW. It is the opposite of OLD.
A: Good job! NEW and OLD are opposites. I wonder, can OLD and BROKEN (one of the other sign videos) go together?
B: BROKEN and OLD? No.
A: Ok, let's try to think about this. Do you have a bicycle?
B: Yes
A: If you ride your bicycle for a long time, it may become old and break. So could OLD and BROKEN go together?
B: No, but maybe your tire would become flat.
A: Ok, a flat tire would mean that it's broken (pause)...what about SICK (another sign video) and OLD?
B: (shakes head emphatically)
A: Do old people become sick sometimes?
B: (nods head) Child G

Child G

- A: Do SICK and OLD match?
G: (does not respond & keeps looking at the screen)
A: (taps G on the shoulder to get attention) Do SICK and OLD match?
G: Yes
A: Why?
G: When you're old, you get sick.

- A: How about NEW (and OLD)?
G: (shakes head)
A: How about BROKEN (and OLD)?
G: (shakes head)
A: How about CLEAN (and OLD)?
G: (shakes head)
A: Why not?
G: OLD and SICK.
A: OLD and SICK match, that's right. Now, OLD and NEW are opposites, aren't they?
G: (nods)

4. Discussion

Two deaf children, one shown by baseline measures a priori as a typical language learner, the other as a weaker language learner, completed a set of ASL vocabulary tasks and participated in two mediated learning experiences with a focus on categorization. The degree to which participants showed both positive learning behaviors and positive responses to instruction was measured during each session. Findings revealed considerable differences between children's approaches to the activities and their responses to mediation.

4.1. *Is DA sensitive to differences in deaf children's vocabulary learning?*

We found evidence of such sensitivity for all three criteria: ability to learn, time to complete an activity/session, and the level of mediator effort required. Each participant differed in the way they approached the MLE activities: B was focused and remained motivated for most of the sessions. Furthermore, he was very responsive to questions, showed good problem-solving skills, and adapted to alternative/different strategies, offered by the mediator. Overall, he required little effort from the mediator to carry out any of the activities. The other participant, G, was tentative, seemed initially unmotivated and distracted (by the camera), and repeatedly had to ask for clarification. This included the spelling of simple signs (i.e., T-O-Y). At the same time, she was less inclined to accept alternative strategies offered by the mediator. These differences are reflected in the time it took both participants to complete an activity/session, specifically for MLE 1, which took considerably longer for G. They are also in line with the effort that was required from the mediator for each child, which was much greater for G. These efforts included additional clarifications, repeated instructions, and more extended transitions between activities.

Because the focus of this study was on the applicability and validity of the use of mediated learning experiences (MLE) with deaf signing children, we did not carry out any posttest measures. However, we did notice some subtle changes in G's learning behavior over the course of the two MLEs. For instance, during her second session, G engaged in the activities in a more motivated and focused manner and seemed to have a better overall understanding of the tasks. While she continued to remain unaware of most of her errors, this may not be too surprising, given that both children received only two MLEs. The observed changes in G's learning behavior are reflected in G's modifiability scores, specifically her motivation, tolerance to frustration, and task orientation, which increased by roughly one-third during the second session.

In comparison, B's modifiability scores remained high (i.e., low ratings) over the course of both sessions and only showed a slight decrease in motivation during session 2. A possible explanation is that both sessions took place during summer school and he might have been less enthusiastic about being pulled out of summer class than during the regular term.

4.2. *Implications for theory*

The findings from the current study are consistent with the hypothesis that modifiability – the combined measure of learner characteristics displayed during a mediation session – reliably differentiates stronger and weaker language learners. Furthermore, they are in line with previous work by Peña and colleagues on the use of principles of mediated learning for word learning in hearing minority groups to differentiate between children with language differences and disorders (Peña et al., 2001; Peña & Quinn, 1997; Peña, Quinn, & Iglesias, 1992). These studies consistently showed the significance of mediator judgment of child modifiability, based on observation during the mediation. Similarly, Peña et al. (2007) report that children's self-awareness of their own performance and errors along with their ability to change strategies in response to feedback from the mediator were highly predictive of their language ability.

The current study demonstrates the feasibility of the use of DA measures as an alternative way of examining language learning in young deaf children, who use ASL. We suggest that DA can be extended from the work of Peña and colleagues on vocabulary learning (Peña et al., 2001; Peña & Quinn, 1997; Peña, Quinn, & Iglesias, 1992; Ukrainetz et al., 2000) to deaf signing children, to sign language, and to another language task.

4.3. Implications for clinical practice

Findings from our study have clinical implications for detecting differences in signing deaf children's learning profiles. The information provided by DA measures could be used complementary to current norm-referenced and descriptive testing practices. This would aid speech language pathologists and teachers in identifying specific difficulties a child may experience when approaching a new task and enable them to make more valid conclusions regarding language-learning ability in this target group. Our findings are in line with previous work by Peña et al. (2007), who demonstrated the utility of clinician ratings of child modifiability. Clinicians, blind to children's language ability, were able to make accurate judgments of ability after providing mediation through scripted interventions within a fairly short amount of time. Furthermore, our research underscores the benefit of closely examining signing deaf children's language learning behaviors, as suggested by Asad et al. (2013), to inform judgments of intervention need, given the heterogeneous nature of this group.

While teaching within the context of DA is primarily used for assessment, we agree with Asad et al. (2013) that the reported observations from the mediations could prove useful to teachers/clinicians by enabling them to make hypotheses about how children may respond to future intervention. In addition, teachers/clinicians may draw from the scripted interventions, which focus on identifying specific learning targets; the scripts provide clear guidelines for teaching when developing individual intervention plans.

4.4. Limitations

This study provides valuable preliminary data on the use of DA procedures with deaf signers, which needs to be replicated with a larger sample to allow/substantiate any conclusive statements. A larger sample will also allow to compare children with highly similar language-skill-scores and then apply DA to reveal if the scores are the likely result of language differences or lack of signed exposure and a language-learning problem. Given the limited data available on deaf signing children with language impairments none of which has been collected by using a DA approach, we believe that our data nonetheless makes a significant contribution.

Second, the presented pilot study explored the applicability and validity of using mediated learning experiences (MLEs) with signing deaf children to demonstrate how MLE can be used with a population that uses ASL. As a next step to substantiate the effectiveness of dynamic assessment for this population, children's response to mediation needs to be examined within a pretest, MLE, post-test context.

Finally, at the time this study took place, there were currently no standardized vocabulary tests available for ASL. In order to meet this need, we adapted a set of vocabulary tasks, developed by the first author for BSL (Mann & Marshall, 2012) to ASL. Although we feel confident in the assessment of the children described in this paper, we acknowledge that more data needs to be collected to establish average scores for the vocabulary tasks. Furthermore, we agree with Shield and Meier (2012) that the lack of instruments that are appropriate for use with signing deaf children remains a limiting factor for this research. Follow-up studies using larger participant numbers, comparing children's pretest and posttest performance on one or more language measures and reporting posttest performance in response to MLE when compared to a no-mediation control would help to further strengthen the reported findings.

4.5. Conclusions

Deaf signing children represent a highly diverse population with unique language experiences. These experiences make the evaluation of children's language learning ability particularly challenging. The use of DA offers a more diversified perspective of its application to identify language learning potential in linguistic minority groups, including deaf signers, where little normative data are available. The recognition of many deaf children as being at risk of language deprivation, an international lack of standardized sign language assessments, and the emerging evidence from studies on sign language impairments warrant the use of alternative assessments in combination with point-in-time test scores with this group. The present study highlights the utility of DA procedures to detect differences in the language learning profiles of deaf signing children and to demonstrate children's capacity for learning in spite of their low performance scores on static language assessments. DA provides information about the learner that is complementary to static assessments, which suggests the use of both types of assessments in conjunction. As such, it has the potential to be particularly useful with deaf children, who begin learning sign later. Here, DA might help us tell the difference between low score and good potential and low scores with more needed support. Our aim is to establish a baseline for the progression of research to further explore the nature of these differences. Future work on signing deaf children's response to DA measures may provide insights about modifiability in signers in general but also about specific behaviors and changes in deaf signing children with language impairment.

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Appendix A. ASL transcript of examples of MLE components

Intention to teach + mediation of meaning

TODAY PLAY WITH SHAPES, PICTURES, SIGNS. WANT THINK-
ABOUT, DISCUSS WAY++ GROUP THINGS, PEOPLE, SIGNS.
TODAY, DISCUSS WHAT? [elicit "GROUP++"]

Mediation of transcendence

BENEFIT GROUP++ HOW? [elicit "HELP-ME FIND THINGS EASY"].
EXAMPLE, CLASSROOM, BOOKS TEND TOGETHER, BLOCKS TEND
TOGETHER.
SUPPOSE MESS-UP, BOOK IXa-there, IXb-there, HARD DO-ACTIVITY
WHY? [elicit "FIRST MUST SEARCH-FOR BOOK"]

Mediation of competence

NOW LOOK-AT-2h THINGS. SAME? [elicit "NO"].
DIFFERENT HOW? [elicit "SIZE, SHAPE, COLOR"].
GROUP IX-pl HOW? SHAPE GROUP++ CAN?
HOW FIGURE-OUT RIGHT GROUP? FOR GROUP, PICK RIGHT THING
HOW? [elicit "PAY ATTENTION SHAPE"]
POSSIBLE GROUP LIKE IX-point {put objects with different shapes in same
group}. [elicit "no"] WHY-NOT? [elicit "SHAPE NOT SAME"]
SUPPOSE THIS GROUP IX-point {arrange by color}, GROUP CAN?
[elicit "YES"] WHY? [elicit "COLOR SAME"].
NOW, IMAGINE CLASSROOM WHAT THINGS CAN GROUP++?

Mediation of transfer

GOOD JOB! RECENT DO-DO? [elicit "PUT THINGS TOGETHER"].
THINK-ABOUT WHAT? [elicit "SPECIAL GROUPS"].
YOU DO GOOD. BEGIN, DOUBTFUL, NOT SURE HOW GROUP++
BUT CONSIDER, PAH CAN GROUP++ SHAPES

IX = index; 2h = 2 hands; point = pointing.

Appendix B. Continuing education questions

1. One of the primary challenges in appropriately assessing deaf children's signed language skills is that hearing parents only use spoken language and don't sign with their deaf children. True or False?
2. The lack of available language assessments for deaf children is due to...
 - a) the difference in sign languages across countries.
 - b) the small size of the population of deaf signers.
 - c) the lack of test developers who are native signers.
 - d) the large number of deaf children with hearing parents.
3. One of the benefits of dynamic assessment for use with deaf signing children is that it enables clinicians and teachers in making hypotheses regarding a child's response to instructional strategies and/or future intervention. True or False?
4. One reason the Dynamic Assessment model has some potential for use with deaf children who sign is
 - a) its success with deaf children with cochlear implants.
 - b) its use of sign-supported language.

- c) its emphasis on the process of learning.
 - d) its flexible set up and time-effective administration.
5. What is the main clinical implication of the study?
- a) The information provided by DA measures can be used complementary to norm-referenced and descriptive tests.
 - b) The information provided by DA makes the use of standardized tests obsolete because of its focus on the learning process.
 - c) The information provided by DA measures helps to detect similarities in signing deaf children's language profiles.
 - d) The information provided by DA can be used to support clinicians' diagnosis of deaf children's sign language ability.

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