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Using Animated Action Scenes to Remotely Assess Sentence Diversity in Toddlers

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Language assessment with toddlers who are at risk for developmental language disorder (DLD) is challenging for several reasons. To characterize a toddler's language abilities relative to same-age peers, a variety of constructs should all be assessed, including language comprehension and production, vocabulary size and composition, speech sound development, diversity of communicative functions, and use of communicative gestures and spontaneous imitation (cf. Olswang et al., 1998; Paul, Norbury, & Gosse, 2018). Comprehensive language assessments with toddlers typically require in-person evaluation in an unfamiliar setting or the presence of unfamiliar clinicians in the family's home. This can be challenging for both toddlers and parents, as has been especially evident during COVID-19 (Krogh-Jespersen et al., 2022). Toddlers generally have short attention spans, requiring frequent breaks. They also may be non-compliant, refusing to respond to examiner prompts or becoming fatigued or frustrated with the assessment activities. To complete a comprehensive assessment battery while toddlers are well-rested and emotionally regulated, multiple breaks and/or multiple sessions are usually needed, increasing the time and travel burden on families and clinicians. This is of particular concern for under-resourced populations who may have more difficulty reliably attending lab visits (e.g., due to inability to miss work, lack of childcare for other children), contributing to non-representative samples and detracting from generalizability.

Ongoing assessment has been recommended to improve estimates of a toddler's risk for DLD. That is, patterns of language growth over time can help determine when a toddler's pattern of language development shows recovery from an early language delay or signs of increased risk for DLD (Girolometto et al., 2013; Hadley & Holt, 2006; Hadley et al.,

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2016; Paul, 1996; Thal et al., 2013). Parent report measures and spontaneous language sampling can be used to monitor language growth and neither require the toddler to comply with standardized assessment tasks. Parents can complete parent report measures at their convenience without the need for travel to a clinic or lab. For example, the *MacArthur-Bates Communicative Development Inventory* (CDI; Fenson et al., 2007) is a valid and widely used measure of toddlers' expressive vocabulary, demonstrating high correlations with scores from standardized tests and spontaneous language sampling (Dale, 1991; Dale et al., 1989; Heilmann et al., 2005). However, vocabulary measures obtained from spontaneous language sampling have been shown to be better predictors of later language outcomes than comparable vocabulary measures obtained from parent report (Hadley et al., 2016).

Language sampling is a child-friendly method for obtaining repeated measures of global language production, such as the number of different words and mean length of utterance. Importantly, language measures obtained remotely via video chat are comparable to those collected in person (Manning et al., 2020). However, it can be challenging for clinicians to create sufficient opportunities for children to produce grammatical structures that occur less frequently (Hesketh, 2004; Rice et al., 1995), which is especially important for clinical assessment of grammatical structures affected by DLD. This challenge is likely to be exacerbated when parents serve as the conversational partner (Hadley, Rispoli., Holt, Papastratakos et al., 2017). Lastly, because language samples are time-consuming to transcribe, clinicians rarely conduct language sample analysis (Kemp & Klee, 1997; Pavelko et al., 2016).

Structured elicitation protocols offer clinicians an alternative for ongoing assessment using practical methods (Morris et al., 2020). Structured protocols have the potential to elicit many different exemplars of language structures in a shorter amount of time (Eisenberg, 1997; Eisenberg & Guo, 2013; Eisenberg et al., 2012; Evans & Craig, 1992; Hesketh, 2004; Landa & Olswang, 1988; Rice et al., 1995; Washington et al., 1998). Structured protocols also are well-suited for standard delivery across administrators, children, and time points, allowing for comparison between children and measurement of growth over time for an individual child (Landa & Olswang, 1988). Structured elicitation protocols also reduce the amount of clinician time required for transcription, while providing comparable results (Rice et al., 1995).

Several structured protocols have been successfully developed for use with toddlers and young preschoolers (Bain & Olswang, 1995; Eisenberg & Guo, 2013; Eisenberg et al., 2012; Landa & Olswang, 1988; Olswang & Bain, 1996; Wetherby & Prizant, 2002). For example, the *Communication and Symbolic Behavior Scales* (CSBS, Wetherby & Prizant, 2002) includes a structured behavior probe that is useful for measuring early communicative functions, gestures, word use, and symbolic behavior for infants and toddlers age 6-24 months, or older children up to 72 months whose language abilities are in this range. Olswang and colleagues (Bain & Olswang, 1996; Landa & Olswang, 1988; Olswang & Bain, 1995) developed and validated structured protocols for use with 2-year-olds to assess early semantic relations, specifically entity-attribute, entity-location, possessor-possession, agent-action, action-object, and action-location. Most recently, Eisenberg and colleagues (2012) developed a picture description task to elicit complete sentences from 3-year-olds

in a time efficient manner. These protocols demonstrate the utility and convenience of using structured elicitation protocols with young children. However, no structured protocol to date has focused specifically on the emergence of sentence structure; that is, the basic relationship between subject and verb.

In this article, we present the Sentence Diversity Priming Task (SDPT), a structured protocol to remotely assess development of sentence diversity. Sentence diversity is operationalized as the number of different subject-verb combinations in active declarative sentences. The ability to produce diverse sentences is a critical developmental expectation by age 3 (cf. Hadley et al., 2018). That is, toddlers developing language at a typical rate can produce subject–verb–object (SVO) and subject–verb (SV) sentences between 24 and 26 months of age and nearly all toddlers can produce SVO and SV sentences by 30 to 32 months of age (i.e., Klee & Gavin, 2010; Lee, 1974). Difficulty with the acquisition of sentence structure is a core diagnostic feature of language disorders (American Psychiatric Association, 2013). Rispoli, Hadley, and colleagues (Hadley, 2020; Hadley et al., 2018; Rispoli & Hadley, 2011; Rispoli et al., 2018) have argued that the diversity of sentences children can produce reflects the strength of the underlying representation of sentence structure in the mental grammar (for an extended discussion about the evidence linking sentence diversity measures to sentence production via grammatical encoding, see Rispoli, 2018; Rispoli & Hadley, 2011).

We also designed the SDPT for remote administration via video chat platforms (i.e., Zoom, Skype, BlueJeans) to reduce the travel burden on families, clinicians, and researchers and the transcription burden of play-based language sample analysis on clinicians and researchers. Not only does creating valid structured protocols for language assessment reduce burden and create research opportunities for families who may be less able or comfortable traveling to a lab or clinic, it also enables research during the COVID-19 pandemic (Krogh-Jespersen et al., 2021).

This article describes the SDPT, the protocol's feasibility for use as a remotely delivered assessment tool, and its utility for revealing individual differences in toddlers' ability to produce diverse sentences. Compliance data is presented from toddlers with average language abilities. We discuss future clinical and research directions for using the protocol to assess sentence diversity and measure children's growth over time. Finally, we provide recommendations and tips for developing and remotely administering structured protocols, with an emphasis on encouraging parent/caregiver involvement and increasing toddler compliance. In this article, we refer to parents because all adult partners in this study were the children's parents.

SENTENCE DIVERSITY PRIMING TASK

We developed the SDPT to efficiently assess sentence diversity in toddlers via video chat platforms. The SDPT was created for a longitudinal project investigating language and related factors in toddlers with and without risk for DLD (Norton & Wakschlag, 2018-2023). The project's research plan includes a comprehensive language assessment for toddlers at approximately 24 months of age and a comprehensive outcome assessment at approximately

54 months of age. In addition, measures of word learning, language processing efficiency, nonword repetition, and vocabulary and grammar from language samples are gathered at the target ages of 24 and 36 months of age in the lab. A language sample at approximately 30 months of age also is included because measures of language growth help reveal when an individual toddler's pattern of language development begins to show signs of recovery from the early language delay or indicators of increased risk for DLD. To eliminate the need for families to travel to the lab, we collected 30-month parent-toddler language samples via remote assessment following the procedures of Manning et al. (2020). We also needed a remote alternative to the examiner-child language sampling protocol that created play-based opportunities for toddlers to produce sentences with diverse subjects and verbs typically completed in the lab. To address this research need, we created the SDPT.

The SDPT is an adaptation of an animated priming task originally designed to measure the effects of verb diversity on use of auxiliary *is* in 27–46-month-olds (Krok & Leonard, 2018). The SDPT consists of 24 prime-target pairs in which the adult and child alternate turns describing brief (10s) animations. The animations were created using paid subscriptions to online animation tools (see Creating Animations section below for additional information). The Krok and Leonard priming task used subject and verb variability to facilitate children's production of auxiliary *is* (Gómez, 2002; Gómez, & Maye, 2005; Hadley, Rispoli, Holt, Papastratakos et al., 2017; Hadley, Rispoli, & Holt, 2017; Hsu et al., 2017; Plante et al., 2014). The high subject-verb variability built into the priming task also created numerous opportunities for children to produce sentences with unique subject-verb combinations, making it a potential tool for measuring sentence diversity.

To assess sentence diversity remotely, we adapted the Krok and Leonard (2018) priming task in three major ways. First, the original task used 24 transitive verbs in its prime-target pairs. For the SDPT, we reduced the transitive pairs to 12 and added 12 intransitive prime-target pairs in alternating blocks (see Appendix A). This created opportunities for children to produce diverse SV as well as SVO sentences. Although toddlers' verb lexicons include more transitive verbs than intransitive verbs, intransitive verbs promote grammatical development for toddlers with early language delays (Hadley, 2020; Olswang et al. 1997). Intransitive verbs also play a critical role in increasing subject diversity, given their tendency to combine with inanimate, non-agentive subjects (e.g., *tower, box, ball*; Bowerman, 1973; Rispoli et al., 2018).

Second, we designed the SDPT as an animated picture book, with a parent serving as the child's primary interactive partner. We chose a picture book format to simulate a parent-child interaction context common to many families. The third major difference from the original task is that the SDPT is delivered remotely. The animated picture book is shared with the parent and child using screen sharing features of online video chat. The examiner controls progression through the task by remotely turning the pages as the parent and child take turns describing animations in the picture book. The examiner provides a brief training for the parent before beginning the assessment task and monitors the assessment for fidelity and flow, and the entire protocol is video and audio recorded.

Administration of the SDPT

The SDPT begins with a description of the task to the parent and administration of practice items with feedback as necessary. The examiner explains that the parent and child will take turns describing animations in an interactive picture book designed to provide multiple opportunities for their child to produce words or sentences. The parent is assured that any response related to the animation is acceptable. If their child does not respond as expected to any single item, there are additional animations throughout the task for the child to describe. To preserve a standard administration format and maintain the child's attention to the task, the parent is instructed to follow the script that appears on the screen via screenshare. After describing the task, the examiner guides the parent through two practice items and then begins the task.

On the first page of each item set (Figure 1), the parent points to the animation and reads the prime sentence as written in the picture book (*The baby is drinking*). The examiner pauses for 3s to ensure the child has viewed the animation and then turns the page to the next animation. On the second page within the set, the animation shows a similar action with a different actor. The parent points to the animation and reads the first prompt, "*What's happening here?"* If the child responds with a sentence (*kitty drink*), a verb (*drink*), or a verb phrase (*drink milk*) related to the animation, the examiner turns the page to the next item set. If the child responds with a noun (*kitty*) or noun label (*it's a kitty*) or does not provide an intelligible or related response within 5s, the parent reads the second prompt, "*Tell me about the kitty.*" To maintain standard and efficient administration and avoid frustrating the child, no additional prompts or comments are provided after the second prompt; the examiner advances to the next item set, regardless of the child's response. If necessary, the examiner may occasionally remind the parent to use the prompts and follow the written script. The examiner also may provide encouraging comments throughout the task as needed to maintain engagement.

Levels of Support

Multiple types of support are built into the SDPT, specifically priming of sentence structure, verb overlap, and a structured prompting hierarchy. The purpose of providing this much support is to help children produce active declarative SV(O) sentences with 3rd person subjects. A child who cannot produce diverse SV(O) sentences despite the maximum level of support likely has a very weak mental representation of sentence structure (Hadley, Rispoli, Holt, Papastratakos, et al., 2017). These are the children we expect to be at increased risk for persistent DLD.

Structural priming serves as the first type of support in the SDPT with the parent description of the first animation in each item set serving as a prime sentence. In traditional priming tasks, children tend to repeat the structure of prime sentences in subsequent utterances, even in the absence of overlapping words (Bencini & Valian, 2008; Bock, 1986; Huttenlocher et al., 2004; Shimpi et al., 2007). The prime sentence activates the underlying structure, increasing the child's likelihood of producing the same structure in their own target descriptions.

Our interpretation of priming as a form of support during assessment is consistent with Leonard and colleagues' (in press) view of priming as a component of language intervention. Leonard and colleagues argue that adult models used in language intervention essentially serve as primes, facilitating children's use of the targeted structure. We agree with this clinical application of priming and here, extend its use to language assessment. Primes are expected to facilitate use of the targeted sentence structure when the child has a sufficiently strong mental representation of that structure. The SDPT uses a prime-target format to assess children's ability to produce SV(O) sentences. For a child with a strong mental representation of SV(O) sentences, the parent description serves as a prime sentence, activating the structure, and increasing the child's likelihood of producing the same structure in their target response. If the child has a weak mental representation, the prime sentences are less likely to facilitate production of SV(O) sentences.

Verb overlap between the prime and target sentences provides the second type of support in the SDPT (Krok & Leonard, 2018). The 24 lexical verbs in the parent prime sentences (e.g., prime = *The baby is drinking*) always match the intended verb in the child target sentences (target = *The kitty is drinking*). This verb overlap activates the verb in the child's mental lexicon through comprehension, reducing the burden of lexical retrieval and increasing the potential for verb diversity in the child's responses. However, we hypothesize that a child with a small parent-reported verb lexicon will be less able to benefit from the support provided by the verb overlap in the prime sentences and use fewer unique verbs in their target descriptions. For example, a child whose parent reports only three verbs (e.g., *go, eat, fall*) may be able to imitate a new verb (e.g., *drive*). However, this child would be less likely to produce a new sentence using that verb, even following a prime.

A structured prompting hierarchy serves as the final type of support in the SDPT (Bain & Olswang, 1995; Olswang & Bain, 1996). Within each item set, the parent provides up to two prompts to elicit an active declarative SV(O) sentence with a 3rd person subject. The first prompt, (*What's happening here?*) promotes the child's use of an SV(O) sentence in their target description. This open-ended question with broad scope creates a discourse context for an SV(O) response whereas closed questions (*What is the kitty doing?*) and sentence completion prompts (*The baby is drinking and the kitty is __*) allow for single-word or phrase-level responses. If the first prompt is not sufficient to elicit an SV(O) response, the adult provides a higher level of support with the second prompt (*Tell me about the kitty*). This second prompt activates the target noun for use as the subject of the target sentence. It is important to note that the second prompt only activates the word, not its grammatical role as a sentence subject. Following administration of the second prompt, the sentence structure, verb, and subject noun are all available to the child. A child who cannot produce diverse sentences given the maximum support provided in the design of the SDPT likely has a weak representation of sentence structure in their mental grammar. During scoring, the examiner notes whether the child needed additional prompts for each item.

Scoring of the SDPT

Because the SDPT is designed to efficiently assess one specific target (sentence diversity), it is quick and easy to administer, transcribe, and score. The SDPT takes approximately 15

min to administer. To reduce the demands of simultaneous administration and scoring, the entire video chat session is recorded for later transcription and scoring. The standard format of the task allows for use of a transcription template, greatly reducing transcription time requirements.

For each item, only the child's first scoreable response that follows a valid adult prompt is recorded. Scoreable responses contain at least one spontaneously produced intelligible word related to the target animation. Utterances not related to the target animation are not scoreable (e.g., *I am tired, I don't know, look)*. Although the task creates opportunities for children to produce a variety of subjects and verbs, the goal of the task is not to elicit these specific subjects and verbs. That is, child responses that use any noun, pronoun and/or verb that is related to each animation are acceptable. Valid adult prompts are delivered as instructed on each slide and are designed to elicit a sentence-level response from the child. After transcribing the child's scoreable responses, the examiner counts the number of items in which the child produced a different SV(O) sentence and calculates a sentence diversity score. Sentence diversity is operationalized as the number of different combinations of subjects and verbs in active declarative sentences. Most SDPT sessions can be transcribed in 30-45 min and scored in under 20 min. In contrast, play-based language samples require more time to transcribe and code. In our experience, a 30 min language sample typically requires 2 hours or more to transcribe and code. If desired, more traditional language sample measures such as number of different words, number of different verbs, mean length of utterance, or accuracy of grammatical morpheme use could be obtained from administration of the protocol.

Child Compliance

To increase child compliance on the SDPT, the task was designed to be age-appropriate and motivating (Ambridge & Rowland, 2013). Compliance should not be confused with a child's language ability. Rather, compliance reflects the child's willingness to attempt a response and is affected by the child's engagement, attention, and motivation. The interactive picture book format of the SDPT simulates an activity that is familiar and enjoyable to many toddlers. The animations in the SDPT are colorful and brief, depicting familiar actions that are interesting and sometimes surprising to toddlers. Compliance is further enhanced when adult questions in structured tasks create a genuine communicative context for toddler responses (Ambridge & Rowland, 2013; Grosse & Tomasello, 2011). The prompting hierarchy also helps children respond to items at their own developmental level and feel successful throughout the task, further increasing compliance.

To determine whether toddlers with average language abilities would comply with the SDPT, Buchheit (2021) conducted a preliminary study of 32 children (17 males) selected from the larger research study sample (see Table 1). Toddlers were selected for the preliminary study on the basis of age, nonverbal abilities, and expressive vocabulary. First, all toddlers were required to be between 30 and 35 months of age at the time of SDPT administration. Second, all toddlers had nonverbal abilities above the 5th percentile on the *Mullen Scales of Early Learning* (MSEL) visual reception subtest. Consistent with the Catalise consortium (Bishop et al., 2017), children with nonverbal IQs in the broad range

of average who did not meet the definition for Intellectual Disability were included. And finally, all toddlers had parent reported expressive vocabulary abilities between 300 and 600 words on the CDI expressive vocabulary checklist (M = 480.41; SD = 92.20). This vocabulary range corresponds with average vocabulary abilities (i.e., 30th to 70th percentile) for 30-month-olds. Although some of the children were older than 30 months at the time of CDI administration (M = 32.50, SD = 1.39, range = 29-33), no child's expressive vocabulary abilities exceeded a 30% delay on the CDI[1], a criterion used for early intervention eligibility in Illinois where the study took place. In summary, children with a range of language abilities were included to assess the task's capability to reveal individual differences in children's capacity to produce sentences.

To evaluate the toddlers' engagement in the task and the appropriateness of the SDPT's length, Buchheit examined compliance, defined as the ability to provide task-related responses to the first 12 items and the second 12 items. Task-related responses were defined as any verbal attempt to describe the target animation. Responses in which the child did not respond to any parent prompts, responded with "no" or "I don't know," or responded with an off-topic comment (e.g., "I want a snack") were considered non-compliant. Completely unintelligible responses were not considered non-compliant. There were no differences in compliance between the first and second half of items, indicating the task was of appropriate length. Moreover, the vast majority (94%) of the toddlers provided task-related responses to more than 90% of the items (Figure 2). Only two young boys at the low end of the age range, 30- and 31-months-old, demonstrated numerous instances of non-compliant behavior. One responded with "*I don't know*" on 10 occasions and the other did not respond on six occasions. Nevertheless, these two boys completed the task and produced 14 and 16 task-related responses, respectively. Overall, compliance was high and unrelated to sentence diversity scores, (r_S = .137, p = .228, one tailed). Toddlers with a wide range of language abilities, from single-word users to sentence producers, were able to produce task-related responses to most of the items without becoming frustrated. In short, the task appears to be engaging and appropriate for most 30- to 35-month-old toddlers, even those with average language abilities. Parents also appear to enjoy the task. Most parents maintained a positive affect throughout the task, laughing at the animations and engaging their children as they might during natural book reading activities, further increasing child compliance throughout the task. Furthermore, informal observations suggest that with a brief introductory training and occasional reminders from the examiner during the task, most parents adhered to the written script and prompts.

INDIVIDUAL DIFFERENCES

The SDPT was designed to reveal individual differences in sentence diversity among toddlers. Table 2 presents descriptive statistics for the 32 toddlers in the Buchheit (2021) sample for CDI vocabulary and grammatical complexity and for sentence diversity. Substantial variability was observed in the toddlers' ability to produce unique subject-verb

[1]To calculate percent delay, we identified the "language age" (LA) corresponding to the 50th percentile for the child's expressive vocabulary score from the CDI manual, sexes combined, and computed a percent delay relative to chronological age (CA) using the following formula: (LA-CA)/CA.

combinations in active declarative sentences (range of raw scores = 1-22; $M = 12.87$, $SD = 5.93$, possible range 0-24).

We first explored the association of sentence diversity with age and CDI vocabulary and grammatical complexity scores in the preliminary sample of 32 toddlers. Spearman correlations were used to account for a moderate negative skewness of −0.61 ($SE = 0.43$) in vocabulary scores. Given the narrow age range, sentence diversity was not predicted to be correlated with age and this was confirmed ($r_s = .283$, $p = .058$). However, for typically developing toddlers, sentence diversity was predicted to be positively correlated with vocabulary and grammatical complexity (Hadley et al., 2018). As expected, sentence diversity showed moderate positive correlations with CDI vocabulary ($r_s = .422$, $p = .008$) and CDI grammatical complexity ($r_s = .551$, $p < .001$, all Spearman, one-tailed). Theoretically, the latter relationship is important because language-specific grammatical complexity rests on a strong representation of sentence structure (Hadley, Rispoli, & Holt, 2017).

To illustrate the variety of scores and individual differences, the responses from three toddlers are presented in Table 3 along with their MSEL and CDI scores. The three toddlers were 31 to 32 months of age at the time of the SDPT administration. They were chosen to reflect the range of total words reported on the CDI in the preliminary sample, 300 to 600 words.

Child A, who had the lowest CDI vocabulary and grammatical complexity scores, produced primarily single-word nouns throughout the task with a few word combinations. Only three responses were subject-verb combinations (i.e., *lady got; pop wash; apple fly*) for a sentence diversity score of 3. Child A also made verb substitutions (i.e., *got/carry, fly/roll*) and was unable to produce the SVO structure with its obligatory direct object for the transitive verbs *got* and *wash.* However, it should be noted that these substitutions and omissions did not affect the child's sentence diversity score. In contrast, Child B produced 10 unique subject-verb combinations, with eight different subjects and 10 different verbs. Seven verbs matched the verbs in the parent prime sentences; three were verb substitutions (i.e., *fly/go; go/drink; move/spin*). Child B's sentences can be characterized as diverse, but child-like because she omitted grammatical structures that are obligatory in General American English. Although present progressive *-ing* was beginning to emerge, auxiliary *is* was absent. Finally, Child C, the child with the highest CDI vocabulary and grammatical complexity scores, produced 15 unique subject-verb combinations, including 15 different subjects and 11 different verbs. Nine verbs matched the verbs in the parent prime sentences, with seven verb substitutions (i.e., the child substituted *move* for *drive, roll,* and *spin; come* for *go* and *cook*; *fall* for *come*; and *like* for *feed*). At the same time, the majority of Child C's sentences included advanced grammatical structures, with productive use of both present progressive *-ing* and auxiliary *is*.

OTHER APPLICATIONS

The original aim of this work was to create a remotely delivered, child-friendly tool to reveal individual differences in sentence diversity in approximately 30-month-old toddlers in a time-efficient way. Although the target sentences were developed with child speakers

of English in mind, the sentence is a fundamental unit of syntax in all human languages (Ambridge & Lieven, 2011). As such, we believe assessment of sentence diversity is relevant to speakers of all varieties of English and languages of the world.

The profiles of the individual children in Table 2 demonstrate that the SDPT reveals differences among children who can produce diverse sentences (e.g., Child B and Child C) from those with limited sentence diversity (e.g., Child A). Recall that Child A displayed limited sentence diversity and errors in sentence structure (e.g., *lady got*) and lexical choice (e.g., *fly/roll*) despite the high levels of support built into the task with the priming of sentence structure, verb overlap, and prompting hierarchy. This suggests that Child A would likely have limited sentence diversity in a less supported, conversational language sample as well. Comparisons of sentence diversity measures obtained from the structured protocol and from authentic language samples are needed to test this prediction. Crucially, this task is unique in its ability to provide structured opportunities for children to produce diverse subject-verb combinations, which few other standardized tasks or unstructured language samples allow.

Once children produce sentences with a variety of subjects and verbs, the SDPT could be used to assess later-developing grammatical structures. For example, the emergence of progressive *–ing* and auxiliary *is* would not be expected for children with limited sentence diversity such as Child A. This is because children need a strong representation of sentence structure to learn how the grammatical features of aspect and tense are encoded in sentence structure. However, as children's sentences become more diverse, growth in the productivity of the aspect marker progressive –ing, followed by productivity of auxiliary *is*, a marker of tense and agreement, would be expected (Hadley, Rispoli, & Holt, 2017). By administering the SDPT every three to six months, clinicians could determine whether later-developing grammatical structures are emerging in a predictable sequence (Rispoli et al., 2012) or if unexpected delays are observed between sentence diversity and the emergence of progressive *–ing* and auxiliary *is.* Older children's responses also could be evaluated for grammaticality, characterizing the percentage of grammatical sentences (Eisenberg & Guo, 2013, 2015; Lee, 1974). Evidence of protracted grammatical development could indicate increasing risk for persistent DLD.

Repeated administrations of the SDPT also can be used to measure treatment progress in language intervention. We are currently using this task as part of an ongoing clinical trial, re-administering it every three months from 30 to 48 months of age (Kaiser et al., 2018-2023). Repeated administrations of the task have revealed meaningful change in children's language production over time as children transition from single words and verb phrases to child-like sentences that lack obligatory grammatical structures to well-formed adult-like sentences (Hadley, 2014). We also have observed children increase their intelligibility, replace pronouns with nouns, and use more specific verbs over time. The use of the same animations on repeated administrations, rather than alternative forms, allows clinicians and parents to easily recognize growth and change in children's performance over time. Importantly, the four-year-old preschoolers enjoy talking about the animations as much as the 30-month-old toddlers, even though they have completed the same version of the task multiple times before.

TIPS FOR REMOTE DELIVERY

After administering this task with many parent-child dyads using video chat platforms, we have adapted our procedures to promote more successful outcomes. Below, we share some lessons learned and tips for creating and administrating a similar protocol.

Creating Stimuli

When creating stimuli, clinicians should keep in mind that the SDPT is not designed to assess toddlers' ability to produce specific nouns and verbs. The goal is to assess toddlers' ability to produce the greatest number of unique subject-verb combinations possible. The variability built into the task gives children an opportunity to produce a different subject-verb combination in each target description. Each animation should represent a different character or object performing or undergoing a unique action. To further encourage use of a variety of subjects and verbs, prime-target sentence pairs should be constructed using nouns and verbs that are familiar to most 30-month-old children. Evidence that 30-month-old children produce the targeted subject nouns and verbs can be obtained using the Wordbank item trajectories (Frank et al., 2016) and the CHILDES-db frequency counts (Sanchez et al., 2019).

For the current version of the SDPT, prime-target sentence pairs used third person singular subject nouns and present progressive verbs presented in the active declarative voice (e.g., *The mom is feeding the baby*, see Appendix A). All but four target subject nouns (*farmer, hotdog, leaf, wheel*) and four target verbs (*come, move, roll, spin*) were selected from the CDI. A Wordbank (Frank et al., 2017) analysis indicated that, on average, 89% (SD = 14%, range = 47-99%) of 30-month-old children produce the target subject nouns and 84% (SD = 7%, range = 65-96%) produce the target verbs found on the CDI. Frequency counts from the CHILDES-db database provided evidence that 30-month-old children use the target words not found on the CDI with similar frequencies as those words found on the CDI.

Creating Animations

The SDPT was developed using online animation tools and presented in Microsoft PowerPoint. Readers interested in creating a similar protocol can access the online animation tools through paid subscriptions to Animaker (https://www.animaker.com) and Vyond (https://www.vyond.com). Each 10s animation should clearly highlight the targeted subject and verb (and object) with minimal background distractions. We have found that children can be distracted by certain features in the animations, such as facial expressions (e.g., angry face, blinking eyes), background weather (e.g., rain), special effects (e.g., smoking grill), and busy scenes (e.g., car repair shop). Completed animations can be inserted into a Microsoft PowerPoint slideshow designed to resemble a picture book, with parent instructions displayed on the left and animations displayed on the right side of each page.

Technical Instructions

The examiner should discuss technology suggestions and concerns with the parent prior to the session. When scheduling the session, allow extra time for troubleshooting technology issues, child breaks, and unexpected interruptions. The task works best if only the child and

one parent are present during administration. Instruct the parent to select a quiet, distraction-free location for completing the task. If possible, the parent should use a medium- to large-screened tablet or computer to ensure the child can clearly see the animations. Discourage parent use of earbuds or headphones during the task because this will reduce the audio quality of the child's responses. Following administration of the practice items, the examiner should mute their audio and video to reduce distractions and encourage a more natural parent-child interaction. Because it is difficult to administer and score the task simultaneously, the entire session should be recorded for later scoring. To prevent data loss, it is recommended that examiners collect a backup audio recording as well as a video chat session recording.

Parent Support During Task Administration

It is important for the parent to understand the purpose of the task before moving to the first item set. This purpose is to provide multiple opportunities for the child to attempt SV(O) sentences with the standard prompting hierarchy, not to elicit a sentence by prompting again and again in different ways. Explain the instructions carefully and take your time on the practice items to ensure the parent understands the task and knows to follow the script provided, as written. To minimize the time required to complete the task and reduce child frustration, instruct parents to pause for 3-5 s after the first prompt, then move to the second prompt if the child does not provide a target response. Help the parent understand that if the child does not respond or is frustrated with an item, you will move on to the next item. Assure them that there will be many opportunities for the child to say something later. Assure the parent that there are no correct answers. Remind the parent to treat the task as a natural, interactive picture book experience rather than as a "test".

Although the parent is the child's primary interaction partner, the examiner controls the pace of this task. Ensure the child has sufficient time to view the animations and hear the parent prompts while advancing efficiently through each item. Pause briefly after turning the page before beginning the next animation to allow time for an internet lag on the family's device. Item sets may be repeated in the event of a software glitch, or if the child is not attending to the task. To avoid off-task conversations and extending the length of the task, turn the page as soon as the child provides a scorable response.

Maintain a positive and encouraging attitude when providing feedback to the parent. Be flexible and understanding if the child or parent becomes frustrated with the task. Offer time for a short break until the child is ready to begin again.

CONCLUSION

The SDPT is a child-friendly measure of sentence diversity for young children. It creates multiple opportunities for young children to produce diverse sentences in a short amount of time. It can be administered via videochat platforms, increasing its usefulness for ongoing assessment and use in telepractice for clinical and research purposes. Responses on the SDPT indicate whether a child can produce diverse sentences under high levels of support, a reasonable expectation for toddlers between 30 and 36 months of age. The task can also be

used to assess broader aspects of grammatical development, and to monitor language growth and treatment progress over time.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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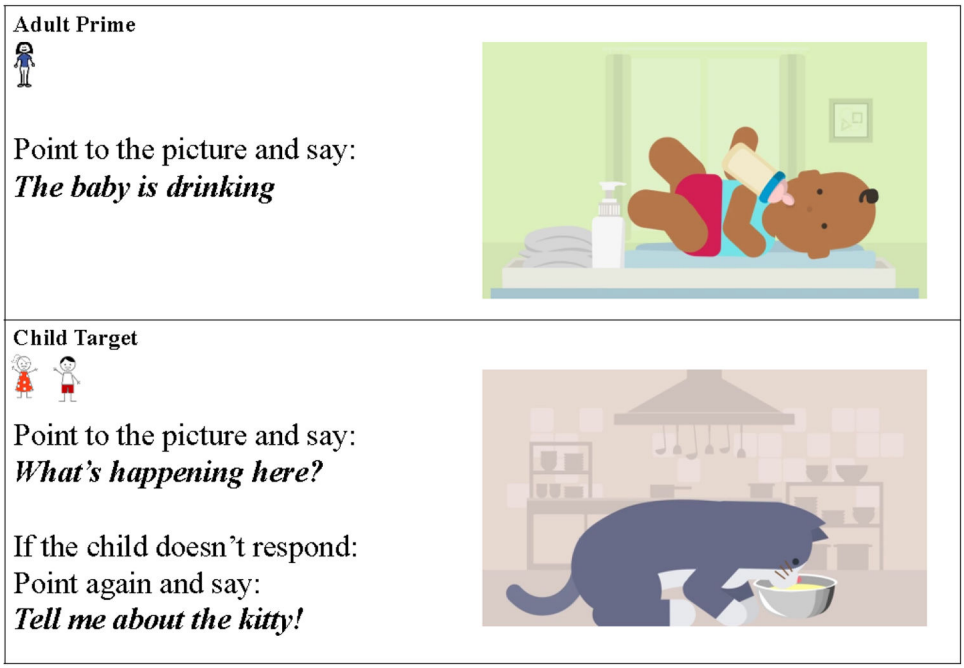

Figure 1. Sample Item Set

Note. The adult prime and child target slides are shown separately. For each item pair, the adult prime sentence and animation are displayed first. Then the examiner turns the page to display the prompts and child target animation.

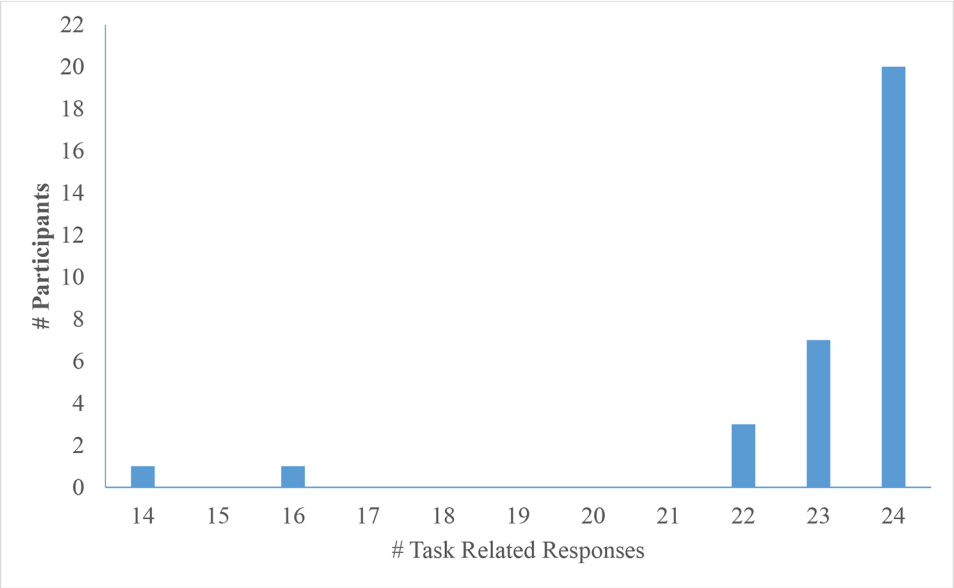

Figure 2.
Compliance Measures

Table 1

Participant demographics.

	Participants Not in Subsample (*n* = 378)	Participants in Subsample (*n* = 32)			
	Frequency (%)	**Frequency (%)**	**χ^2**	**df**	***p***
Child Gender					
Female	173 (45.8)	15 (46.9)	.01	1	.904
Male	205 (54.2)	17 (53.1)			
Child Race/Ethnicity					
Hispanic	92 (24.4)	5 (15.6)	11.58	3	.009
Non-Hispanic African American	85 (22.6)	1 (3.1)			
Non-Hispanic White/Caucasian	163 (43.2)	23 (78.9)			
Non-Hispanic Other	37 (9.8)	3 (9.4)			
SES Status Low Income	86 (22.8)	2 (6.3)	4.77	1	.029
Mother's Education					
Less than High School	2 (0.6)	0 (0.0)	6.95[a]	1	.008
High School or GED	27 (7.5)	0 (0.0)			
Associate's Degree/Trade School	33 (9.2)	2 (6.3)			
Some College (No Degree)	65 (18.2)	2 (6.3)			
Bachelor's Degree	113 (31.6)	9 (28.1)			
Graduate Degree	118 (33.0)	19 (59.4)			

Note. Participants not in subsample = participants from When to Worry project who were not included in the preliminary SDPT study; participants in subsample = participants who were included in the preliminary SDPT study.

[a]Test to compare Bachelor's or Graduate degree versus others; $p = .0565$ from Fisher's exact test with all categories.

Table 2

Descriptive statistics for language measures (n = 32).

	Minimum	Maximum	*M*	*SD*
CDI Total Words	300	596	480.41	92.20
CDI Grammatical Complexity	0	35	19.13	9.71
Sentence Diversity	1	22	12.87	5.93

Note. Parent report measures from Buchheit (2021) data; CDI = Communicative Development Inventory; Sentence Diversity = number of different subject-verb combinations on the Sentence Diversity Priming Task.

Table 3

Responses for three children.

	Child		
	A	**B**	**C**
Child Gender	Female	Female	Male
Child Race	Multi-Racial	White	White
MSEL VR	21st percentile	99th percentile	16th percentile
CDI [a]			
Total Words	333 (10th percentile)	410 (20th percentile)	552 (55th percentile)
Complexity	0 (5th percentile)	10 (15th percentile)	26 (45th percentile)
SDPT Age (Months)	31	31	32
Sentence Diversity	3	10	15
Primary Response Type	Single Words *n* = 17	Child-like Sentences *n* = 10	Adult Sentences (aux + verb/ing) *n* = 12
Responses	color	her xx flower	what she do/ing?
	%meowmeow high	†**cat** *climb/ing* up ladder	† a **squirrel**/*'s climb/ing* up the ladder
	no	(boy big) big house	†the **monkey**/*'s throw/ing* snow
	cow	(that) that a truck	†(the) the **wheels** *move*
	†**lady** : *got*	*get* a box	the lady [im]
	†**pop** *wash*	xx that car	*wash/ing* the car
	boat	†**airplane** *fly* up sky	†another **airplane** *is come/ing* up
	ball	(football is) **football** down	†**football**/*'s fall/ing* down down{down}
	flower <:> wet	**water** on : flower	†the **flower**/*'s get/ing* wet
	leaf [im]	†**leaf** *fall/ing* on bees	†the **leaf** *is fall/ing* down
	milk	†**it** *spill* too	†the **water**/*'s spill/ing* out
	†**apple** <:> *fly*	†**apple** *roll* too	†the a**pple**/*'s move/ing*
	boy [im]	no mommy	†**boy** : *build/ing* a sandcastle
	water	(h*) horsie drink xx xx	the dog is xx xx
	horsie	†**horse** *go* play	what's happen here [im]?
	{voc} cow	†**cat** *chase/ing* a bunny	the dog is xx
	yellow	his	†the **farmer**/*'s like* the chickens
	penguin	†**penguin** *take* bath	†**turtle**/*'s take/ing* a bath
	hotdog [im]	†**it** *cook/ing*	†**it** *come/ing* (ou* ou*) out
	xx	stoplight	a truck [im]
	train	choochoo_train	†a **choo_choo train** *is move/ing*
	knock knock	xxx	†the **window** *is close/ing*
	<xx xx>	the xx xx a nest	(the the) the **tree** is broken
	wheel [im]	†**that** *move/ings*	(the car) the **wheel**/*'s move/ing*

Note. MSEL VR = Mullen Scales of Early Learning Visual Reception; CDI = MacArthur-Bates Communicative Development Inventories; SDPT = Sentence Diversity Priming Task; Sentence Diversity = number of different subject-verb combinations on the SDPT.

[a] CDIs were collected within 2 months (*SD* = 1) of SDPT administration, on average.

Subjects are in bold; verbs are italicized.

[†] Indicates a unique subject-verb combination.

Transcription conventions used in this sample include: parentheses = sentence disruptions; [im] = child imitation of the adult's previous utterance; {voc} = vocalization; : = pause; < > = overlapping utterances; xx = unintelligible syllable. For illustrative purposes, responses provided above include utterances excluded from scoring (i.e., non-compliant response, imitation, unintelligible, question).