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## 20Q: Language Intervention for Children With or At Risk of Developmental Language Disorder: Defining the Active Ingredients

Pauline Frizelle, Cristina McKean

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### From the Desk of Ann Kummer



Pediatric speech-language pathologists (SLPs) frequently treat children with characteristics of developmental language disorder. However, some SLPs are better than

others in achieving progress with this population. So what is their secret? I am totally convinced that the Drs. Frizelle and McKean provide the key to this secret in this 20Q article.



In this article, the authors discuss an important active ingredient of language therapy, which is “dose.” The authors define dose as “the number of properly administered teaching episodes during a single intervention session.” They also note that dose has three sub-components: the average rate of teaching episodes per unit of time; the length of the intervention session; and the distribution of episodes over the session. (Interestingly, these principles are consistent with research on motor learning theory, which applies to speech therapy).

Let me introduce you to these authors:

Pauline Frizelle, PhD, is a lecturer at University College Cork and a former speech and language therapy manager, with over 20 years of experience working with children with a wide range of speech, language and communication needs. In 2008 she was the first speech and

language therapist in Ireland to be awarded the (Health Research Board) HRB fellowship for the therapeutic professions, to complete her PhD 'Investigating relative clauses in children with specific language impairment'. In 2015 Pauline was awarded an ASSISTid Marie Curie Fellowship to begin the development of an electronic assessment of complex syntax at the University of Oxford. She has since built on this work comparing assessment methodologies and developing a robust and engaging assessment of complex syntax. Dr. Frizelle is particularly interested in collaborative research projects with clinicians in the community and in the development of new, robust, theoretically-driven interventions, that will result in an equitable public health approach to speech-language pathology for all children. Dr. Frizelle's current program of research includes the 1) impact of dosage on intervention effectiveness for children with DLD 2) optimal use of technology when assessing children with DLD 3) the development and implementation of interventions for children with Down syndrome 4) optimal use of key-word signing in schools.

Cristina McKean, PhD, is Professor of Child Language Development and Disorders at Newcastle University UK, Honorary Research Fellow at the Murdoch Children's Research Institute, Melbourne and Adjunct Research Fellow, Griffith University, Queensland. In 2010, after a 20-year career as a Speech and Language Therapist, she completed her PhD at Newcastle University focused on understanding lexical and phonological development in children with SLI and was appointed Lecturer in Speech Pathology. She was awarded a three-year post-doctoral fellowship as part of the NHMRC funded Centre of Research Excellence in Child Language in 2013. She leads epidemiological research with global reach which develops and evaluates public health practices for children with and at risk of developmental language disorders. Her work aims to develop equitable, comprehensive public health practices to promote robust language development for all children. This agenda is underpinned by principles of social justice, interdisciplinary collaboration, and co-design. Professor McKean's current program of research focuses on effective identification of children at risk, interventions, and service delivery design and is informed by four cross-cutting themes: 1) developmental change, 2) the child's social context, 3) cross-cultural diversity and 4) the power of co-design.

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*Ann W. Kummer, PhD, CCC-SLP, FASHA, 2017 ASHA Honors  
Contributing Editor*

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## **20Q: Language Intervention for Children With or at Risk of Developmental Language Disorder: Defining the Active Ingredients**

**Learning Outcomes**

After this course, readers will be able to:

- Define 'active ingredients' that can be described qualitatively and quantitatively
- Describe the qualitative framework of 'dose form' and each of its components
- Describe the quantitative aspects of dosage
- Discuss best practice with respect to 'active ingredients' when planning language interventions for children with DLD



Pauline Frizelle



Cristine McKean

### **1. I have heard the term 'active ingredient.' What does it mean in relation to my clinical practice?**

There is no universally agreed consensus as to what we mean when we talk about the 'active ingredients' of an intervention. In simple terms, it refers to the specific actions taken by the clinician to effect change with respect to a particular target or goal. At first, describing and defining these seems a very

simple task however as soon as you try to unpack a given therapy approach or session then complexities emerge. Does the context in which the teaching occurs affect change? Does the order in which trials are presented? Does the amount of variability over the session? Essentially, we see it as relating to those aspects of the intervention which are manipulated by the SLP which then affect change for the child.

### **2. Have researchers tried to define and describe the active ingredients of intervention in the past?**

The idea of 'active ingredients' has been considered in the past when researchers have been considering issues of dosage. Warren and colleagues, in 2007, proposed five dosage characteristics to describe intervention intensity. Four of these refer to aspects of the intervention that can be measured quantitatively: *dose*; *dose frequency*; *total intervention duration*; and *cumulative intervention intensity*.

A fifth, qualitative characteristic, *dose form*, was also proposed which can be conceptualized as aiming to capture some or all of the active ingredients of the interventions. They defined it as 'the typical tasks or activities within which the teaching episodes are delivered'.

We have expanded and developed the definition described by Warren and colleagues (2007) and Proctor-Williams (2009).

### **3. Can you explain what is meant by each of the quantitative dosage components?**

*Dose* refers to "the number of properly administered teaching episodes during a single intervention session," such as the number of recasts given to a child. Dose has three sub-components:

- the average rate of teaching episodes per unit of time (e.g., 1 recast every 30 seconds versus one recast every minute)
- the length of the intervention session (e.g., 30 minutes)

- the distribution/density of episodes over the session (e.g., 15 recasts given in 15 minutes versus 15 recasts given in 30 minutes)

*Dose frequency* refers to the number of intervention sessions per unit of time (i.e. per day, per week, per month); *total intervention duration* is the total period of time for which the intervention is provided e.g. 6 weeks, and *cumulative intervention intensity* is the product of the previous three components i.e. Dose x Dose Frequency x Total Intervention Duration. Therefore, a client who receives 30 recasts in 30-minute sessions, given 3 times weekly for 6 weeks, would have a cumulative intervention intensity of 540.

#### 4. Could you describe the key components of *dose form* in your framework?

In our framework, we have broken the components down into techniques, procedures, methods of instruction, and intervention contexts.

**Techniques:** These are the specific actions/teaching behaviors thought to be of benefit or to effect change.

**Procedures:** Procedures refer to the combination and order of technique delivery. In some instances, the technique order is pre-defined by what a child can do. For example in relation to phonology, stimulability would need to be established before the production of sound contrasts. However, order is not always pre-determined. Most interventions include a number of techniques that might be presented in differing orders.

**Methods of Instruction:** Interventions can be implemented implicitly, that is, where children are required to induce a particular rule or pattern, or with explicit instruction, where children are given information about the rule underlying the teaching target. Usually, interventions that are given with explicit methods of instruction also incorporate an implicit element, as every component of an intervention is rarely made explicit. Interventions given implicitly can however occur without any explicit instruction.

**Intervention Contexts:** In our framework, *intervention context* has three subcomponents 1) the activity (which can be highly structured or more functionally meaningful) within which the technique/teaching behavior is being delivered 2) where the activity sits in the child-centered, clinician-directed continuum and 3) the degree of variability/uniformity in the linguistic input or materials used.

#### 5. Could you give some examples of different components of dose form we might use in clinical practice?

The different components of dose form differ depending upon the target of the interventions. We have put some examples for each component in the table below and how they might be applied in interventions for vocabulary, morphosyntax, and phonology.

Component	Vocabulary	Morphosyntax	Phonology
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Component	Vocabulary	Morphosyntax	Phonology
<b>Techniques</b>	<p>Exposing children to target words</p> <p>Providing word definitions</p> <p>Using visual supports such as gestures</p> <p>Emphasizing target words</p> <p>Using a slower speech rate</p>	<p>Imitation, modeling</p> <p>Recasting, priming, and the use of expansions</p>	<p>Establishing stimulability, minimal and maximal sound contrasts</p> <p>Auditory bombardment</p> <p>Meta-phonology</p>
<b>Procedures</b>	<p>Word exposures and repetition with visual supports, followed by definitions of target and related words (e.g., Steele et al., 2013)</p>	<p>Modeling followed by recasting and cueing (e.g., Smith-Lock et al., 2015)</p>	<p>Stimulability, followed by the production of minimal sound contrasts</p>
<b>Methods of instruction</b>	<p>Explicit: Providing detailed definitions of targeted words or providing synonyms with follow-up discussions of how they relate to the target words</p> <p>Implicit: Exposing children to target words through a story reading activity, while using slowed speech, gestures, or emphasis to highlight the words of interest</p>	<p>Explicit: The grammatical rule is specifically stated by the therapist (e.g., in relation to past tense the therapist might say, 'Whenever you talk about something that already happened, you have to add -ed to the action')</p> <p>Shape coding is considered primarily explicit but does usually incorporate implicit elements</p> <p>Implicit: Exposing children to target words through a story reading activity, while using slowed speech, gestures, or emphasis to highlight the words of interest</p>	<p>Explicit: Interventions focusing on phonological awareness</p> <p>Implicit: Using minimal meaningful contrasts or auditory bombardment</p>

Component	Vocabulary	Morphosyntax	Phonology
<p><b>Intervention contexts</b></p>	<p>Meaningful Activity: Interactive book reading</p> <p>Child-centered/Clinician-directed: choosing vocabulary/books that relate to the child's interests, rather than those that are only developmentally focused</p> <p>Degree of Variability: Target words can be presented repeatedly with little linguistic variation (many examples of few words) or with greater variability (few examples of many words). In addition, how target words are presented visually can have different degrees of variability. For example, the same picture representing an <i>apple</i> may appear repeatedly in a book or <i>apple</i> may be represented by a number of different images throughout the book.</p>	<p>Meaningful Activity: A play-based activity using the child's toys or items of interest.</p> <p>Child-centered/Clinician-directed: allowing the child to choose what the play-based activity is and integrating the targets accordingly, rather than more drill-based card game activities chosen by the therapist, although the latter may be more appropriate for less commonly occurring morphosyntactic forms.</p> <p>Degree of Variability: Techniques such as recasting, or modeling can be easily adapted to a play-based activity and noun and verb variability can be manipulated within the models or recasts provided by the clinician.</p>	<p>Meaningful Activity: Embedding targets within a more social context (moving away from decontextualized drills).</p> <p>Child-Centered/Clinician-directed: Basing the targets on words that the child uses frequently in their daily lives (e.g., family member names rather than purely theoretically or developmentally driven.)</p> <p>Degree of Variability: Maximal (rather than minimal) opposition would reflect a more varied approach by exposing children to the greatest number of phonological features.</p>

**6. Is there evidence that these components are important for the effectiveness of interventions for children with DLD?**

Yes, research has shown that all these components are important for the effectiveness of interventions for children with DLD. However, because research directly comparing one technique, procedure, method of instruction, intervention context to another (while controlling for other important variables such as dosage) is relatively rare, we cannot yet conclude which are the most impactful or efficient dose form components used in interventions.

## **7. What does the evidence tell us about which *techniques* are more effective than others?**

In relation to vocabulary, teaching with a phonological versus a semantic focus has been compared (Korat et al., 2019) as well as teaching with different levels of semantic support (e.g. using dictionary support versus giving explanations in the context of the story). However, the relative effects of these techniques haven't been established and appear to be dependent on how learning was assessed as well as the language level of the child. The use of gestural supports appears to be advantageous in the short term (van Berkel-van Hoof et al. 2019; Vogt & Kaushke, 2017a, 2017b) but we do not know if these effects are maintained in the long term. The use of visual supports has also been manipulated in phonological training (in the form of video) but improved non-word repetition was the only advantage found. In relation to morphosyntax, studies have compared enhanced conversational recasting vs. recasting, cueing vs. recasting, prompted elicitation with either recasting or modeling vs. recasting alone, and recasting and modeling vs. recasting alone. However, studies have been too dissimilar to categorically state that one technique is more effective than another. Regardless of the technique used, whether the child gets an opportunity to produce the target appears to be key in improving outcomes.

## **8. What does the evidence tell us about which procedures (combinations and order of techniques) are more effective than others?**

Order effects have not been systematically examined in relation to phonology or vocabulary interventions, and are relatively under-researched with respect to morphosyntax, for children with DLD. However, initial findings do suggest that the order of techniques affects morphosyntactic treatment outcomes. Auditory bombardment has been found to be more beneficial after enhanced conversational recast treatment than before (Plante et al., 2018) and more effective as a therapeutic procedure than recasting on its own. In addition, beginning treatment with harder to inflect verbs (less frequent, more phonologically complex, and those that describe an action that is not complete e.g., dropped versus rolled) has been found to increase the accuracy of past tense production on both treated and generalization verbs compared to beginning treatment with verbs that were easier to inflect. The use of this kind of 'complexity-based' approach is a considerable move away from the more traditional developmental model.

## **9. What does the evidence tell us about effective methods of instruction with respect to explicit versus implicit approaches?**

A comparison of methods of instruction has not been carried out in relation to phonology or vocabulary for children with DLD. With respect to morphosyntax, study findings suggest a learning advantage for explicit instructions given to children with an average age of 7 years. Children who were given explicit instruction learned not only to use new target morphemes across a greater number of items but also did this more quickly and with less intervention than those who were given the intervention with an implicit approach only (Finestack & Fey 2009; Finestack 2018). However, we do not know how the method of instruction interacts with age or treatment progression. It may also be the case that explicit methods of instruction are more beneficial at the earlier stages of learning, while implicit methods may be more beneficial later, during the generalization and consolidation phases of learning (Ebbels, 2014).

## **10. What should I keep in mind when choosing effective intervention *contexts* in terms of evidence-based practices?**

Intervention contexts have been found to interfere with as well as facilitate children's learning. In relation to the activity within which the techniques are being delivered, video and static stories have been found to be equally effective for word learning but, unless presented as a song, the presence of music and sounds has been found to interfere with children's learning (Kouri & Winn, 2006; Smeets et al., 2012). Increasing the variability in the linguistic input, or materials used, also seems to be advantageous in children's vocabulary learning. Varying how new words are represented (for example, using different objects or pictures to represent the same lexical item) has the potential to improve children's ability to generalize their word knowledge and to increase the efficacy of the associated intervention. In addition, giving children the opportunity to retrieve word names also appears to enhance word learning with respect to both nouns and adjectives (Leonard, Karpicke et al., 2019; Leonard, Deevey et al., 2019).

Variability in the linguistic input is also thought to facilitate grammatical morpheme learning, the theory being that it helps children extract the morphosyntactic rules. Plante et al. (2014) compared the effects of high (24 unique verbs presented once) and low variability (12 unique verbs presented twice) treatment and found that only those who received the high variability showed a treatment effect. Building on this work, Krzemien et al. (2020) found that when learning to generalize constructions, gradually increasing variability in the input may be more beneficial for children with DLD, than using maximum variability at the outset. Therefore, clinically, it may be beneficial to use less common verbs (which inadvertently increases variability), when working on morphosyntactic targets but ensure that not all elements of the sentence are highly varied, particularly in the early stages of treatment.

## **11. Is more always better when it comes to quantitative dosage?**

Studies show that more is not always better. In relation to word learning, Storkel and colleagues (2017) found that 36 word exposures were optimal for 5 to 6-year-old children with DLD but following 48 exposures fewer children responded to treatment. With respect to morphosyntax, an intervention for past tense production by Meyers-Denman & Plante (2016) showed that the longer children received the intervention (the duration of which was between 4 and 44 days) the less accurately they produced the verbs. These findings are in keeping with deficient processing theories which suggest that when material being learned becomes overly familiar or part of a very lengthy intervention, children's attention levels decrease (Cepeda et al., 2006).

If we measure outcomes based on composite language measures, frequent interventions (2/3 times per week) that target language goals for short periods (2 minutes) or less frequent interventions (1 per week or fortnight) targeting language goals for longer (20 minutes) have been found to yield the best outcomes (Schmitt et al., 2016) See Frizelle et al., (2021a) for a systematic review of quantitative intervention dosage on oral language outcomes for children with DLD.

## **12. Why might the spacing or dose frequency of intervention techniques be important to consider?**



One theory suggests that learning is more efficient when the same number of teaching episodes is distributed over several sessions than when they are concentrated into one or a few sessions. We know that children with DLD have difficulty encoding new information (Alt & Plante, 2006) and consolidating information in their memory (Archibald & Gathercole, 2006). If encoding is their primary difficulty, then we would expect that the dose per session or cumulative dose would be more important than the dose frequency, as children would have multiple opportunities to encode and re-encode new information. However, if consolidation is the primary obstacle to learning then we would expect dose frequency to have a greater impact on intervention outcomes. Even if the new information is only initially partly encoded, perhaps learning can be consolidated in memory by building on how the partially encoded information is represented, each time it is re-visited.

### **13. What does the evidence suggest about spacing out interventions versus offering them intensively?**

Our review of the literature suggests that it is the overall dose that has a greater impact on children's learning than the frequency of the treatment schedule. There is now cumulative evidence suggesting that there is no learning advantage for a between-session spaced rather than a more concentrated treatment schedule when overall dose is controlled. The importance of dose is also highlighted by Plante and colleagues who manipulated within-session dose (24 recasts in 15 min vs. 24 recasts in 30 min) and found no differences in children's outcomes. Although further research with larger samples is needed to validate this finding, this could mean that similar effects could be achieved in shorter treatment sessions, as potentially within-session dose is more important than the session length.

### **14. Is there a relationship between quantitative dose and dose form in terms of contributing to positive child language outcomes?**

Yes, there is a relationship between quantitative dosage and dose form, however, our knowledge with respect to how they interact is in its infancy. We do have some evidence that manipulation of the *intervention context* and *method of instruction* aspects of dose form can result in positive changes in language outcomes with lower levels of quantitative dose. Aguilar and colleagues (2018) found that by increasing the variability of how an object was represented (e.g., three different images of a *hinge* rather than the same image used repeatedly) preschool children with DLD learned new words with fewer exposures than previously reported in the literature. Findings also suggest that given the same receptive exposure dose, children will learn words more easily, if given the opportunity to use rather than just hear them (Leonard, Karpicke et al., 2019). With respect to morphosyntax, the addition of an explicit method of instruction (where the rule is specified) appears to outweigh the benefits of a higher input dose using an implicit approach only for children with an average age of 7 years (Finestack & Fey, 2009). Overall, we need a greater level of detail when reporting on the quantitative aspects of dosage to really begin to examine the relationship between dosage and dose form.

### **15. Why is it so difficult to identify the impact of each of these aspects of dose form on effectiveness?**

Firstly, there are considerable differences in how techniques are implemented (imitation training and modeling are just two examples of this - see Eisenberg et al., 2020) and inconsistencies with respect to how they are combined. Secondly, studies that directly manipulate dose form do not always provide information on the quantitative aspects of dosage and therefore quantitative dosage

becomes a potential confound when attempting to interpret the results. Dose form manipulation studies that do report on quantitative dosage, vary significantly in the level of detail provided. Some papers report planned dose only and others provide information on the discrepancy between planned and received dose. It is also the case that some studies control for one aspect of dosage (such as dose) but not another (such as dose frequency). It is noteworthy that none of the papers that we reviewed purely manipulated dose form (while controlling for all quantitative aspects of dose). This makes it difficult to ascertain exactly which effects are purely driven by the dose form and which are because of variation in quantitative dosage. In contrast, studies in which quantitative aspects of dosage are manipulated implement the same intervention (with the same dose form components) but at different dosage levels. This makes it easier to be clearer about what is driving quantitative dosage effects.

**16. When planning how often I will deliver my intervention, is there a model of best practice in relation to dose (number of teaching episodes in a session) and dose frequency (how often I see the child)?**

Our review of the literature suggests that several models of intervention can work effectively. The practice of weekly or fortnightly sessions is acceptable but only if the dose per session is high (Justice et al., 2017; Schmitt et al., 2016). This means that therapists need to ensure that sessions contain high levels of the 'active ingredients' of the intervention. It is also the case that little and often is a potentially effective approach and ideally intervention schedules would be planned so that they are acceptable to parents and educational practitioners, working in partnership with SLPs. Our review also highlights that there are minimum cumulative intervention dosages required for children to achieve their intervention goals. If the dosage does not meet the minimum requirement to affect change then this has implications regarding the ethicality of removing a child from pre/school or burdening parents to bring children to therapy. SLPs also need to be aware that too high a dose may result in diminishing returns. While we cannot recommend a 'magic number' regarding dose and dose frequency across language domains, it is clear that SLPs need to move away from the practice of delivering a set number of pre-determined intervention hours that have become standard practice in their local area. We cannot continue to give interventions that do not have a realistic chance of success.

**17. When monitoring each child's language intervention program, what quantitative dosage and dose form features should I track?**

Using the classification system put forward by Warren and colleagues (2007) should facilitate SLPs tracking of the quantitative aspects of dosage. The literature suggests that within-session dose, as well as cumulative dose, are particularly important to track. Establishing 'what is a dose?' is therefore central to tracking your treatment program. For example, are you considering input dose (from the therapist) and output dose (from the child) to be 'active ingredients' or is it only when the child is required to do or say something that you are counting it as key to your intervention? With respect to dose form features, our framework is designed to facilitate your tracking of techniques, procedures, methods of instruction, and intervention contexts. Techniques are perhaps the most difficult of these to document as there is considerable inconsistency in the literature when using labels to describe techniques. For example, labels such as *prompting* and *cueing* are commonly used but can incorporate a range of techniques such as *imitation*, *questioning*, and *commenting* and these are not

always specified when describing interventions. Therefore, it is important for SLPs to make explicit what techniques they are using and to describe each element of those techniques so that the intervention can be replicated at home and in other contexts.

**18. How do I relate the therapy session features I am tracking to the child's progress?**

It is important to monitor children's progress over the course of therapy and continue until the child reaches a predetermined criterion of success rather than simply providing the number of sessions which are custom and practice in a given service. It may be helpful to vary the within-session dose while monitoring the impact on children's learning. However, if progress plateaus the intervention targets should be changed to ensure that resources aren't wasted. It is also important to be cognizant of how and when success is measured. Testing on target probes versus generalization items is significantly different in relation to what children have learned, and there are examples in the literature where no learning advantage is shown, for example, on target items but is shown when measuring generalization outcomes (e.g., Aguilar et al., 2018; Van Horne et al., 2018). Testing immediately post-intervention is also measuring a different type of learning than testing following a break from working on a particular target. Immediate testing is measuring children's ability to encode new information whereas delayed testing is accounting for levels of decay or consolidation that may have occurred. Findings from Storkel and colleagues (2019) highlighted the significance of this when they reported a 40% drop in word learning just 5 to 6 days post-intervention.

**19. Do you think your framework fully captures all of the 'active ingredients' which might affect change in language interventions for children with DLD?**

In our framework, we attempted to capture 'active ingredients' that we judged to be missing from previous descriptions of dose form. However, while our framework provides a structure from which to consider these ingredients, it is not so granular as to define the specific techniques used by SLPs. Given that the same labels are often applied to different techniques in the literature, this needs to be addressed. What we need now is a consensus on how techniques are defined, as without this we cannot accurately compare dose form mechanisms to establish the relative effectiveness of specific approaches. In addition, without an international consensus on intervention terminology, the development of any framework cannot fully address the problems in the literature and progress will remain piecemeal and slow.

**20. Does it matter? What would we gain if we're able to consistently describe the active ingredients of our interventions in research and practice?**

If we could consistently describe the active ingredients of our interventions, this would lead to greater consistency in how different aspects of dose form are implemented. Therapists who wish to implement an intervention, for which effectiveness has been shown in the literature, could do so with greater fidelity. It would also allow us to ascertain which components of an intervention are more efficient in affecting change. In the context of research, consistent and detailed descriptions would facilitate the accumulation of evidence across reviews such that data pooling and meta-analyses could be completed. This, in turn, would serve to accelerate the rate of discovery within the field of speech-language pathology, so that we can deliver more effective and efficient interventions to those who live their lives with DLD.

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