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Grammar intervention using graduated input type variation (GITV) for pre-primary children: A single-case experimental design study

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Abstract

Purpose: This study examined the early efficacy of a new theory-driven principle of grammar intervention, graduated input type variation (GITV).

Method: Three Cantonese-speaking children, aged between 4;01 and 5;10, with oral language difficulties participated in this single baseline within-participant single case experimental study. The children received a total of 300 teaching episodes of the target serial verb construction via focused stimulation and recast over 10 30- to 45-minute sessions. The 30 exemplars of the target included low type variation of the verbs in each of the first five sessions, followed by high type variation in the remaining sessions.

Result: Visual analysis revealed that all children improved their performance in the target construction but not the control vocabulary in the probes, suggesting a treatment effect. Maintenance of treatment effects was also observed in all children. Positive results in across-behaviour generalisation to the untrained construction were observed in all children. Generalisation to other less structured linguistic contexts and to the narrative retell discourse context was minimal and observed in one child only.

Conclusion: Preliminary evidence suggested early efficacy of GITV as a principle for grammar intervention. Modifications in the research methodology are recommended for future studies involving children with developmental language disorder.

Keywords: children; grammar intervention; single case experimental design; Cantonese; Chinese

Introduction

Complex syntax emerges early, from about 3 to 4 years of age in typically developing children (Frizelle et al., 2019). Sentences are generally considered complex when they contain multiple clauses (Diessel, 2004). Since speakers do not necessarily produce complete sentences in conversation, utterances that contain only an isolated dependent clause can also be considered complex syntax (Barako Arndt & Schuele, 2013). In a study of a child with developmental language disorder (DLD)¹ from 3 to 7 years

of age, Schuele & Dykes (2005) reported a delay in the emergence of complex syntax that was noticeable at 3 years. It is at about the same time when errors in grammatical morphemes are observed in children with DLD (Johnston & Schery, 1976). While treatment evidence for grammatical morphemes for young children with DLD accumulates, an evidence-based practice review reported that only five treatment studies targeted complex syntax forms and adopted complex syntax as an outcome measure (Wisman Weil & Schuele, 2019). We conducted an early efficacy study of a theory-driven principle, graduated input type

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variation (GITV), that was designed for grammar intervention including complex syntax.

Input frequency and the development of syntactic constructions

Proponents of usage-based theories (e.g. Lieven, 2019) argue that language input provided during social interactions is the major driving force to language development and use. A corpus analysis of mothers' speech by Goldberg et al. (2004) revealed that mothers' use of each of the three target constructions was typically exemplified in a relatively higher frequency of one prototypical verb, suggesting a skewed input. For example, the verb *go* was the verb used most frequently among the 39 verbs observed in the 15 mothers' use of the subject-verb-object construction. The prototypical exemplar verb whose meaning overlaps strongly with the overall meaning and function of the construction in child-directed speech acts as the child's path breaker to the construction. Analysis of production data from children revealed that their learning of constructions is initially organised around particular words (e.g. Tomasello, 1992). The one study that directly examined the correlation between adult input and child productions in adult-child dyads is Diessel (2004). Mothers were found to use finite complement clauses predominantly with three verbs (i.e. *think*, *know*, and *see*), and these same three verbs also took up the majority of the five children's use of finite complement clauses.

Effects of skewed input on the learning of syntactic constructions

To test for a causal relationship between adults' use of prototypical exemplar verbs in a particular construction and children's learning of the construction, Goldberg and colleagues examined the learning of a meaningful but novel syntactic construction in two input conditions in typical English-speaking young adults (Goldberg et al., 2004) and pre-primary and early-primary children (Casenhiser & Goldberg, 2005). The construction that carries the meaning of disappearance involved two known nouns and a nonsense verb in the form of noun phrase¹ + noun phrase² + nonsense verb. In the adult study and one of the child studies, the construction included the morphological cue *-o* after the nonsense verb. Participants heard either skewed or balanced input of the construction together with video clips that illustrated the meaning of the construction in one 10-minute session. In the skewed input group, 50% of the eight exemplars of the construction involved one particular verb (i.e. an exemplar verb), hence a lower type variation. That is, one of the verbs occurred in four exemplars while the other four verbs occurred only once, in the form of 4-1-1-1. In the balanced input group, the five verbs were more evenly distributed across the exemplars, in the form of 1-1-2-2-2.

The control group watched the same silent video clips without language input. All groups watched the eight videos twice, with a total of 16 exemplars of the construction. Both experimental groups performed significantly better in a comprehension task on the novel construction than those in the control group. Notably, participants receiving skewed input significantly outperformed those in the balanced input group.

There have been no studies examining the effects of skewed input in children with DLD. Results from several studies from the second-language teaching literature were mixed (see Zhang & Mai, 2020, for a narrative review). In a set of studies, Goldberg et al. (2004) and Casenhiser and Goldberg (2005) only provided evidence from a comprehension task on the effects of skewed input in the early phase of learning a syntactic construction after a brief period of exposure. This study was the first one to examine the effects of skewed and balanced input provided at different phases of development over time, and the first one to use a production task as the outcome measure.

Graduated input type variation (GITV) as a principle of grammar intervention

Constructions are "learned pairings of form with semantic or discourse function" (Goldberg, 2006, p. 5). They can be relatively simple (e.g. the English past-tense morpheme *-ed*) or relatively complex (e.g. the English passive construction *X was verb-ed by Y*; Tomasello, 2003). According to Tomasello's (2003) usage-based theory, children go through three phases in the development of constructions. First, they produce highly functional constructions that are rote learned from the input (e.g. *What's that?*; *I want milk*). Then, they produce constructions in the form of lexical frames, where at least one element is a specific lexical item (i.e. a word or a morpheme; e.g. *wanter want wantee*). Last, they produce constructions with elements that are highly variable (e.g. *Mummy kissed the baby*; *I kicked Daddy*) suggesting the presence of a fully abstract representation of the constructions (e.g. subject verb object). Abstract constructions, and the abstract categories that make up these constructions, develop continuously and at a relatively slow pace. While evidence is available to ascertain that constructions in young children are lexically bound (see Kidd et al., 2006, 2010), it is unclear from Tomasello's (2003) theory how children develop abstract constructions by analogising and schematising across stored lexical frames that share a similar form-meaning or function relationship (Ambridge & Lieven, 2011).

Nevertheless, this proposed developmental progression suggests that children might benefit from type variations in the adult input that are in synchrony with their phases of learning and that this might have clinical benefit as well. To elucidate, in the early phase of learning when children have no or

limited knowledge of the form and meaning mapping of a construction, they need adult input that contains low type variation (i.e. skewed input) of the key elements, particularly the verbs, in order to develop an initial representation of the construction. This initial representation, however, only allows children to produce sentences that include one or a few verbs that are lexically specified. The ultimate goal of learning, however, is for children to reach a level of productivity with the construction that allows them to produce novel sentences of the construction with a wide range of verbs for everyday use. In the next phase of learning, children therefore need adult input that contains high type variation of the verbs (i.e. balanced input) to develop a more abstract representation of the construction. In this abstract representation, individual words are not specified. Instead, elements in the construction are represented in abstract categories (e.g. verbs, nouns). This proposed relationship between language input and learning observed in typical development has informed the principle of graduated variation of input type (GITV), which may lead to efficacious intervention of grammar constructions for children with DLD.

Language problems in Cantonese-speaking preschoolers with DLD

Cantonese-speaking preschool children with DLD are reported to have difficulties with function words, including modal auxiliaries (Leonard et al., 2007) and aspect markers (e.g. Fletcher et al., 2005). Unlike English, many of these function words are not syntactically obligatory, but are semantically or pragmatically motivated. In terms of syntax, Cantonese-speaking children with DLD have difficulties with passive constructions (Leonard et al., 2006) and who-object questions (Wong et al., 2004). A recent study reported that they also have difficulties with serial verb constructions (SVC; Wong et al., 2021), the trained targets for children in this study.

Serial verb constructions in Cantonese

Like many isolating languages with no inflexional morphemes, serialisation is highly productive in Cantonese (Matthews, 2006). SVCs are defined as “a sequence of several verbs act[ing] together as one unit ... [they] form one predicate and contain no overt marker of coordination, subordination, or syntactic dependency of any sort (Aikhenvald, 2006, p. 1). Whether SVC should be considered complex syntax in Cantonese is a matter of debate. It depends on how complexity is defined in the absence of formal finiteness marking on the verbs, and the linguistic devices that will distinguish coordinate and subordinate clauses (Wong, 2023). In Cantonese, there are at least eight SVC subtypes defined by semantics and complexity, and some are developed earlier than

others (Fung, 2011). The following gives an example of a simple SVC of the benefactive subtype.

maa4maa1 bong1 sai3lou2 zoek3 haai4²

mother help younger-brother put-on shoe

mum helps the younger brother to put on his shoes

SVCs emerge shortly after 2 years of age (Fung, 2011). They show a substantial increase in use by children between 3 and 4 years (Tse et al., 2002) and are observed in most 6-year-old children (Wong et al., 2004). SVCs involve packaging of subevents or subactions (e.g. helping the younger brother to put on his shoes) into a single overall event or action, and so they are cognitively complex, both from a conceptual and a processing point of view. Each of the subevents or subactions is denoted by a verb phrase, forming a compound predicate that shares the same subject (e.g. mother). The verb phrases need to be in the proper order. For each verb in the predicate, decisions must be made as to whether an object argument is required and what semantic role that argument should play. So, it is not just cognitive complexity but also structural complexity that might make it difficult for children with DLD to learn and use SVCs. This paper reports on an early efficacy study that was designed to examine production outcomes in the learning of SVCs given an initial phase of skewed input followed by a phase of balanced input over 10 sessions in three young Cantonese-speaking children with oral language difficulties. Three SVC subtypes (benefactive, instrumental, and purpose SVCs) were selected as potential targets, as they were developmentally appropriate and more picturable in probes. This study aimed to address the following questions:

- (1) Did GITV result in an increased use of the trained SVC relative to the control words?
- (2) Did GITV promote the generalisation of learning to the untrained SVC?
- (3) Were gains from intervention generalisable from structured probes to other linguistic contexts?

Hypothesis

Based on previous work by Casenhiser and Goldberg (2005), a positive answer was predicted for the first question. All children would show gains in their trained SVC and remain at the same low level of performance for the control words. The answer for the second question would also be yes, given that the untrained constructions are also SVCs but of a different semantic type. A partially positive answer would be predicted for the third question. Only children who demonstrate a high and stable level of performance in the probes would be able to generalise the use of the trained SVC in more demanding linguistic contexts.

Method

The study was approved by the Faculty Research Ethics Committee of the University of Hong Kong. Oral assent and signed written consent were obtained from the participating children and their parents respectively. This single case experimental study adheres to the SCRIBE reporting standard (Tate et al., 2016), and the checklist is included in Appendix A.

Participants

Fifteen Cantonese-speaking children who had a suspected language disorder according to school and parent report, and no reported hearing loss, autism, cognitive deficits, or global developmental delay, were recruited from three preschools in Hong Kong. Three children (1 boy, 2 girls), aged between 4;01 to 5;10, were confirmed as participants. They spoke Cantonese as their primary language and were able to fully commit to the 5-week intervention and relevant assessment. They also scored no higher than 20% on the trained target, the untrained generalisation item, and the control words in all three baseline probes without any significant upward trend. The other 12 children were excluded from the study as they performed above this criterion regarding baseline performance. Due to COVID-19, the norm-referenced Hong Kong Test of Preschool Oral Language—Cantonese (TOPOL; Hong Kong Department of Health Child Assessment Service, 2019) was successfully administered to just one child, who performed just above the diagnostic cut-off of a standard score of 85. All three children were referred to as children with oral language difficulties. Demographic data and assessment results of the three children are reported in Table I.

Study design

This study used a single baseline design with three phases (see Table II): the baseline phase (three sessions 1-week prior to intervention), the intervention phase (10 sessions twice a week for 5 weeks), and the follow-up phase (two sessions in 3 weeks). All phases were conducted online via Zoom.

The GITV intervention protocol

Each child received 10 30- to 45-minute individual online therapy sessions at home on the trained SVC

consistently from one of the authors. The clinician used two to three different play-based thematic activities presented via PowerPoint slides to create contexts for the child to receive input on the target. An example of an activity and instructions for the purpose SVC was as follows. “See what we have: a spiderman movie! We will work and get all the 30 tokens we need, and then we can watch the movie together. Look! These are the tasks we must do on the farm: gather the grapes, feed the animals, etc. Some tasks give us more tokens than others. Which tasks would you do first? No preference? Let’s see. How about, um ... gather the grapes? Look, there are grapes in the farm!” This prompt, which can either be a statement like this one or a question, alerts the child that there is an opportunity to attempt the trained target, in this case the purpose SVC. Note that the clinician’s prompt provided a model of the relevant verb phrase *gather the grapes* and noun *farm* for the construction. If the child provided a relevant response (e.g. *lung4coeng4 saau1 tai4zi1, farm gather grapes*), the response would serve as a platform utterance for the clinician’s subsequent recast (Cleave et al., 2015). In the example where the response was grammatically incorrect, the missing verb *heoi3 (go)* would be added in the recast. If a relevant platform utterance was not forthcoming, the clinician would produce the target construction (i.e. *heoi3 lung4coeng4 saau1 tai4zi1, go farm gather grapes* [go to the farm to gather grapes]) following the focused stimulation procedure (Bruinsma et al., 2020). Each instance of recast or focused stimulation was considered a teaching episode. A teaching episode is defined according to Warren et al. (2007) as an act from the intervention agent that is “hypothesised to lead a child directly towards a given intervention goal” (p. 71).

The choice of the intervention procedure for the delivery of a teaching episode was at the discretion of the clinician with a goal to keep the child-clinician interaction as naturalistic as possible. To mitigate the less spontaneous and more adult-directed activities delivered online, the clinician engaged in brief conversation and games between the delivery of each teaching episode as part of the PowerPoint presentation. Thirty teaching episodes of input were delivered per session, with a frequency of two sessions per week for 5 weeks. The total number of teaching episodes was 300.

In the first five sessions, skewed input was provided. A prototypical verb, which occurs as the

Table I. Participant demographic data and their average baseline performance on the trained and untrained serial verb construction (SVC) and control vocabulary.

Child pseudonym	Age	Sex	Trained target	Untrained item	Control vocabulary
Adam	4;09	M	Instrumental SVC 0%	Purpose SVC 5.57%	0%
Belle	5;10	F	Purpose SVC 0%	Instrumental SVC 0%	0%
Cathy	4;01	F	Instrumental SVC 0%	Purpose SVC 2.78%	0%

Table II. Data collection schedule during baseline, intervention, and follow-up phases.

	B1	B2	B3	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	F1	F2
Trained SVC	✓	✓	✓	✓		✓		✓		✓		✓		✓	✓
Untrained SVC	✓	✓	✓				✓				✓		✓	✓	✓
Control words	✓	✓	✓		✓		✓		✓			✓		✓	✓
SVCs in story retelling samples	✓													✓	✓

Note. B = baseline; T = treatment; F = follow-up; SVC = serial verb constructions.

second verb in the instrumental and the purpose SVCs (e.g. go to the farm to *gather* grapes), was used in 10 trained SVC exemplars that were either clustered together or scattered with the other 20 exemplars, depending on the planned activities of the session. The first verb for the instrumental SVC is typically *jung6* (*use*) and for the purpose SVC, the first verb is *heoi3* (*go*). These are the constant for all 30 exemplars. The other 20 exemplars involving 10 verbs were each used twice. In the last five sessions, balanced input was used where 15 verbs were each used twice in a total of 30 trained SVC exemplars. Due to practical constraints the number of sessions, the cumulative intervention frequency, and the timing of the switch from skewed input to balanced input were predetermined.

Selection of the SVC for intervention

Of the three candidate SVCs, benefactive *bong1* SVC was not chosen as the trained target as all children showed an accuracy higher than 30% at the baseline phase, suggesting early development. Hence, the trained target was therefore chosen between purpose *heoi3* SVC and instrumental *jung6* SVC. The verbs *heoi3* and *jung6* are the most common first verb in their respective SVC constructions and hence remained constant in the input. The SVC for which the child received the lowest average accuracy score across the three baseline sessions was chosen as the trained target, and the remaining SVC was chosen as the untrained item. Table I reports on the trained target for each child. The fact that the three children did not have the same trained SVC allowed an evaluation of the GITV approach on treatment and generalisation effects across SVCs.

Primary outcome measures and their administration

The primary outcome measure was percentage correct in the 12-item structured picture probes for the trained SVC target, the untrained SVC item, and the control words. The probes were presented online using PowerPoint slides at the beginning of the session according to a predetermined schedule given in Table II. The same probes for the two SVCs and the control words were used each time they were administered. To minimise any practice effects, the order of the items in each probe was randomised. The two SVC probes began with the clinician showing a picture and describing a scenario that would support the

use of the SVC concerned. In this context, the clinician modelled one sentence with the SVC to the child. For example, for instrumental SVC, the clinician would say: “Sometimes we use different tools to do certain things. For example, scissors, a comb, and a ruler are some of the tools we can use. Let us take a look at these people and see how they use tools to do different things. Here is a key, dad wants to open the door, what will he do? We can say *jung6 so2si4 hoi1 mun4*” (*use key open door* [open the door using a key]). The child was then given a practice trial after which corrective feedback would be given. Each SVC probe had 12 items and the presence of the picture was used to support the child’s attempt of an SVC construction. To make sure that the child’s response to the probe items was not affected by his/her unfamiliarity with the verbs and nouns involved in the formulation of the SVC construction, many of these words were modelled to the child when the clinician introduced the probe item, as illustrated in the clinician’s model given above. Note that all the words except the first verb *jung6* (*use*), which is the typical first verb used in the instrumental SVC, has been provided in the adult’s introduction. In the same way, in the purpose *heoi3* SVC, the first verb *heoi3* (*go*) is the typical first verb in the construction. A point to note is that between two to eight verbs used in the trained SVC probes were used in intervention for the three children. Among them, the verb *maat3* (*wipe*) was mistakenly used as a prototypical verb in Session 4 in the skewed input stage for two of the children who were both trained on the same instrumental SVC³. In addition, three verbs in the untrained SVC probe were used in the intervention of the trained SVC.

To ascertain that gains in the trained SVC were a result of intervention but not maturation or other confounding factors, a vocabulary probe was individually designed for each child. The initial pool included 30 Tier 2 words, which are seldom used by preschoolers but accessible via early book reading. For each child, the 12 words that s/he consistently scored zero during baseline were included in the control vocabulary probe. The clinician first modelled a response for two scenarios, which were followed by two practice trials for the child. The child was then asked to provide the word after the clinician described the scenario with support of an illustration. For example, to elicit the word *daam1sam1* (*worried*), the clinician said: “Mum could not fall asleep because she was thinking about her brother’s fever. How does mum feel?” All the probes were piloted on five senior

undergraduate speech pathology students and one typically-developing 4;05 child, who all provided the expected responses.

Secondary and distal outcome measures and their administration

The secondary outcome measure was the child's spontaneous production of the trained target SVC during intervention. The child's production of his/her target SVC was confirmed in a subsequent video review by one of the authors who did not work with the child. Percentage correct spontaneous use (PCSU) in each session was calculated using this formula: number of correct spontaneous use divided by the total number of input $\times 100\%$. To examine the child's productivity of the trained SVC, the number of different verbs (the second verb) in the child's spontaneous production of the trained SVC was also recorded.

Two distal outcome measures were included to examine the child's generalisation of gains to other linguistic contexts. One measure was the number of spontaneous uses of the trained and untrained SVCs in a 10-minute dynamic probe, in which the clinician engaged the child in a semi-structured online game. The clinician followed the child's lead, but occasionally modelled relevant verbs and nouns when there was an opportunity for a meaningful attempt of the SVCs. The other distal measure was the number of spontaneous trained and untrained SVCs used in a story retelling task. Two parallel stories from the Multilingual Assessment Instrument for Narratives (MAIN) protocol (Chan et al., 2020) that have a similar storyline and comparable levels of structural complexity were used, one at the baseline and one at the follow-up phase. To capture the child's performance adequately, the story scripts were modified to include two additional purpose and instrumental SVCs.

The probes and tasks for the distal measures were administrated at the beginning of the session according to the predetermined schedule in Table II. There were three data points at baseline for the trained and untrained SVCs and the control words. During the intervention period, each child was given no more than two probes to avoid fatigue. In the intervention period, there were five data points for the trained SVC, three for the untrained SVC, and four for the control words. One week and weeks after the intervention period, the child received the probes again to evaluate maintenance effects.

Scoring criteria

Each spontaneous use of the SVCs in the probes in the story retell tasks and during intervention was scored using a stringent criterion, which required accurate use of both the syntax and semantics of the SVC construction. Using this criterion, the response

jung6 so2si4 hoi (use key open) would be considered incorrect as the object noun door for the verb *open* was not provided, even though it could be retrieved from context and object drop is common in Cantonese utterances. Irrelevant responses were considered incorrect. For the control vocabulary items, only the exact words would receive a correct score.

Procedural fidelity and reliability

Two of the authors who did not provide training to the child observed the administration of all probes and the delivery of the intervention either live or from the video recordings. For procedural fidelity in probes, the observer monitored whether the clinician provided (a) a demonstration trial and a practice trial, (b) the necessary words for forming a sentence with SVC, and (c) neutral feedback. Fidelity was calculated by dividing the number of probe items that deviated from the administration protocol by the planned number of probe items. Procedural fidelity in probes for the three children were all 100%. For procedural fidelity in intervention, the rater coded whether the clinician (a) delivered 30 teaching episodes of input in the session, (b) obtained attention from the children before delivering each teaching episode of recast or focus stimulation, and (c) avoided using verbs in the probes during intervention. The number of delivered teaching episodes that deviated from the intervention protocol was deducted from a total of 30 teaching episodes for the session. Procedural fidelity in intervention ranged from 80.7% to 97.3% for the three children. For scoring reliability, the ratings of the two trained independent observers on the child's productions were correlated with a reported coefficient ranging from .98 to .99 for the three children.

Data analysis

The percentage correct use of the trained and the untrained SVCs and the control words in the probes were calculated for each child. Visual analysis was conducted to observe trends and changes in levels across the baseline, intervention, and maintenance phases. Note the intervention phase included both the skewed and balanced input stages. Appropriate single case experimental design statistical analyses, such as Tau-U, were not conducted on this primary outcome measure due to the lack of power. The baseline phase had only three measurement points, which was less than the minimum of five required (Fingerhut et al., 2021). The secondary and distal measures were described quantitatively.

Result

Results are presented to address each of the three research questions in turn. To address the first question on the early efficacy of GITV, we refer to Figure 1 on the child's performance of the trained SVC and the control words in probes, and to Figure

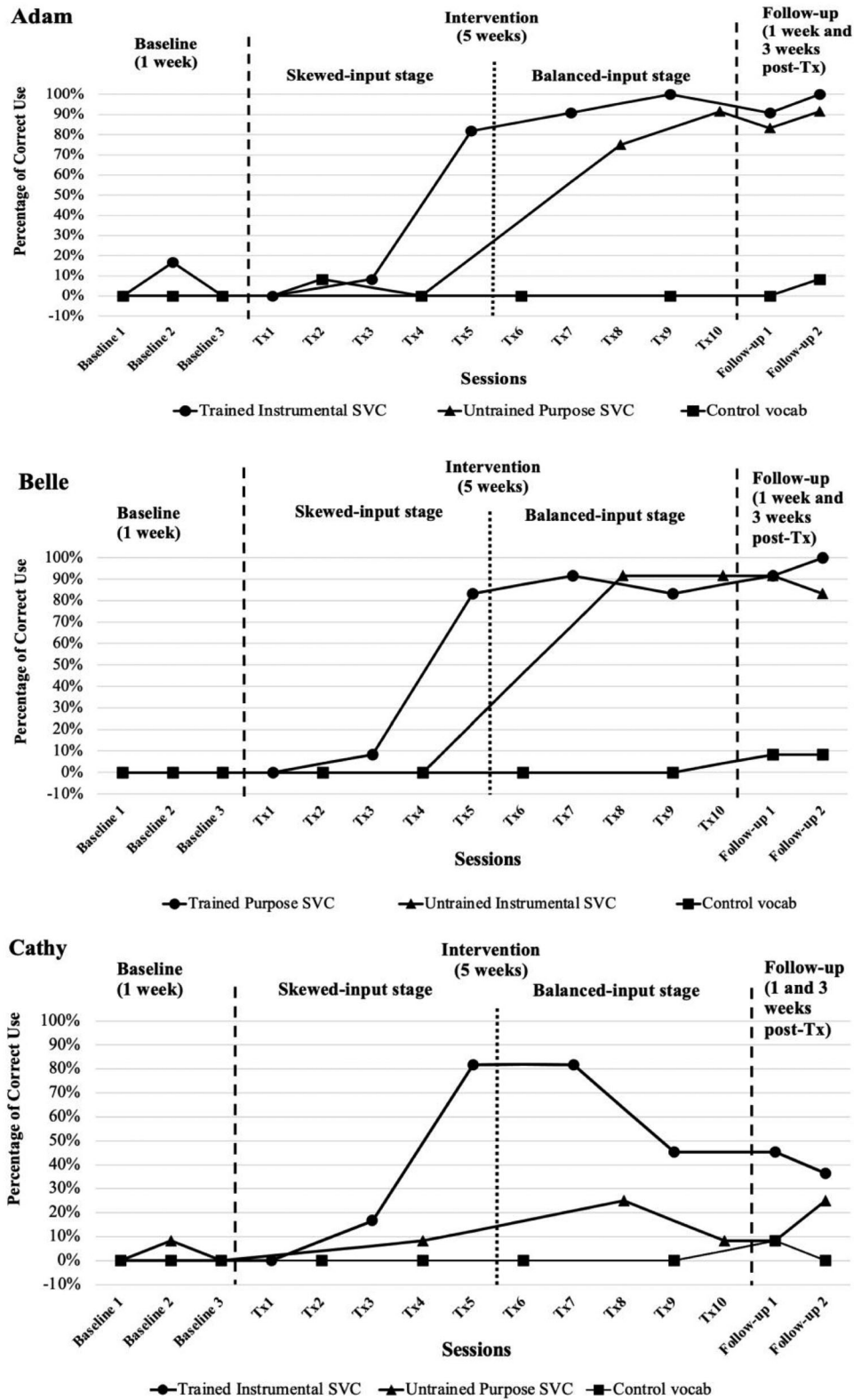


Figure 1. Percentage of correct spontaneous use of the trained serial verb constructions (SVC), the untrained SVC, and the control words as tested in probes across all phases for each child.

2 on his/her percentage correct spontaneous use (PCSU) of the trained target during intervention for the trained SVC. To address the second question on generalisation to the untrained SVC, we refer to Figure 1 again and report on the child's performance

in probes. To address the third question on generalisation to the use of the trained SVC to other linguistic contexts, we report on the child's production in the dynamic probe and the story retelling task presented in Table III.

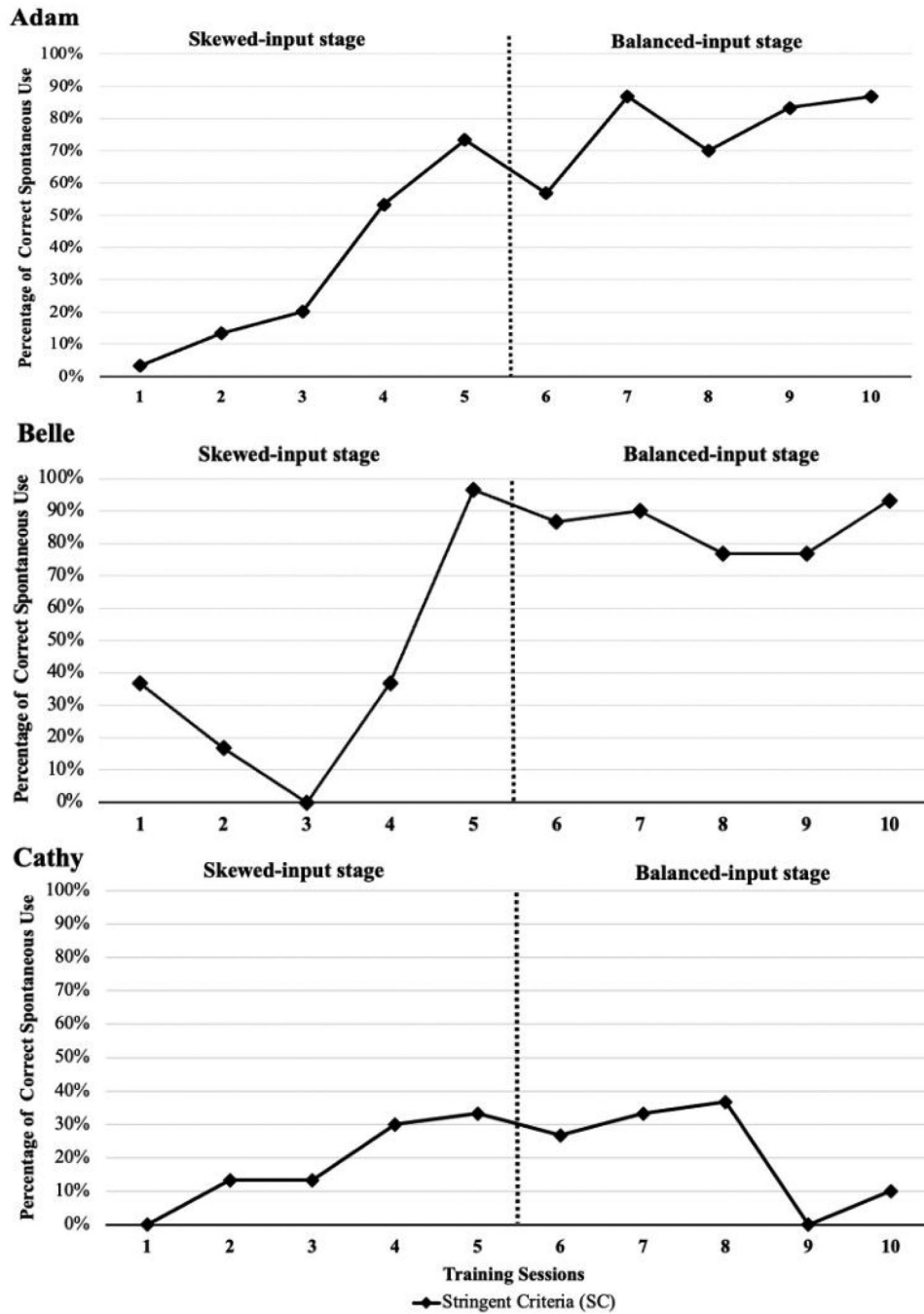


Figure 2. Percentage of correct spontaneous use of the trained serial verb constructions (SVC) during the two stages of the intervention phase for all children.

Table III. Number of correct spontaneous productions of the trained serial verb construction (SVC) in the two distal measures before and after intervention for all children.

	Dynamic probe		Story retelling	
	Pre	Post	Pre	Post
Adam	0	0	0	0
Belle	0	6	0	0
Cathy	0	0	0	0

Adam (Trained target: Instrumental SVC)

Adam scored 5.6% on average on the trained SVC and 0% on control vocabulary in the three probes at baseline (see Figure 1). At the intervention phase,

there was a sharp increase in his use of the trained SVC. In the follow-up phase, the trained SVC demonstrated maintenance effects at both time points (>80%). In contrast, the control item remained at floor at the baseline and intervention phases, suggesting an intervention effect.

During the 10 intervention sessions, 300 teaching episodes of the trained SVC were delivered with 86 different verbs. As seen in Figure 2, at the skewed input stage, Adam demonstrated a steep learning curve with PCSU of the trained SVC rising from 3% to 73.3%. Fluctuations in performance was observed in the balanced input stage, which still ended at a level higher than that in the skewed input stage, that

is 86.7%. Overall, Adam used the trained SVC with 72 different verbs during intervention.

Regarding generalisation to the untrained SVC, following the floor performance (0%) at baseline (see Figure 1), positive gains in the probes were observed during the intervention phase. Good maintenance of the untrained SVC was also observed in the follow-up phase (>80%). Generalisation of learning of the trained SVC to the dynamic probe and the story retelling task was not observed in Adam.

Belle (Trained target: Purpose SVC)

At baseline, Belle showed floor level performance in the probes of the trained SVC and the control words (see Figure 1). In the intervention phase, an increase in the accuracy of the trained SVC up to 90% was observed in the probes. Accurate production of the trained SVC was maintained and further improved to 100% at follow-up. Accuracy of the control words consistently remained at 0% in all data points during baseline and intervention, suggesting that intervention for the trained SVC was efficacious and maturation alone was not likely to explain Belle's improved accuracy in its use.

Given 300 teaching episodes involving 79 unique verbs in 10 sessions, Belle demonstrated an overall increase in PCSU of the trained SVC to a maximum of 96.6% in the last session of the skewed input stage and 93.3% in the last session of the balanced input stage (see Figure 2). Belle experienced a drop in performance from the first to the third session, before a sharp gain to almost ceiling performance. Like Adam, however, Belle showed a slight drop in PCSU from Session 5 to Session 6, and then some fluctuations in the balanced input stage. Belle's SVC productions involved the use of 47 different verbs.

Regarding generalisation to the untrained SVC, following a floor baseline in the probes, a positive trend was noted (see Figure 1). There was also adequate maintenance of gains 1 week and 3 weeks after intervention. Belle was able to generalise the use of the trained SVC outside the probe and training contexts to the dynamic probe and an unplanned conversation after intervention. Spontaneous use, however, was not observed in story retelling.

Cathy (Trained target: Instrumental SVC)

Cathy showed an overall gain in the trained SVC in the probes (see Figure 1). At baseline, Cathy showed floor level performance in the trained SVC and the control words. Unlike Adam and Belle, who showed an upward trajectory for the trained SVC during the entire intervention phase, Cathy's accuracy dropped in the fifth and last probe. Despite this, Cathy's performance at follow-up maintained at around 45%, suggesting retention of learning. Scores from the control vocabulary probes remained at floor throughout the phases. Despite her unsteady performance, Cathy

demonstrated learning of the target SVC that could not have been explained by maturation alone.

Cathy's 300 teaching episodes of the trained SVC included 83 different verbs. As seen in Figure 2, Cathy's PCSU of the trained SVC increased across sessions in the skewed input stage to 33.3% and then it dropped to 26.7% in Session 6, observed in the first balanced input session. The other two children also showed a drop after the switch in input type. In Session 9, Cathy's PCSU dropped dramatically to 0% and it went back up slightly to 10% in Session 10. Cathy used the trained SVC spontaneously with 24 different verbs during the entire intervention phase at a much lower number than the other two children. Her maximum PCSU was 36.7%.

Regarding generalisation to the untrained SVC, Cathy's average score in probes was below 20% (see Figure 1). During the intervention phase, the upward trend was rather modest. Regarding generalisation of the trained SVC to other linguistic contexts, Cathy received a score of zero before and after intervention.

Summary of results

Data from three young Cantonese-speaking children with oral language difficulties using a single baseline within-participant single case experimental design were analysed. Visual analysis revealed that all three children demonstrated an overall increase in the spontaneous use of their trained construction during intervention. Their improved performance in the trained construction versus no change in the control words as observed in the probes suggested a treatment effect. Maintenance of the treatment effect 1 and 3 weeks after intervention was also observed in all children. Regarding generalisation to the untrained construction, positive results were observed in all children. Generalisation to the other less structured linguistic context and to the narrative retell discourse context was minimal and observed in one child only.

Discussion

This study was an early efficacy study of a theory-driven principle (GITV) for grammar intervention, particularly the intervention of syntactic constructions. Preliminary evidence from visual analyses suggested early efficacy of GITV. The findings of this study are informative for future research using statistical analysis to confirm the efficacy of this principle for children with a diagnosis of DLD.

Effects of input type variation on the learning of syntactic constructions

Effects of input type variation were most apparent in the children's performance in the treatment sessions. All children demonstrated an overall strong and relatively steady positive trend in the production of their trained SVC in the skewed input stage, suggesting that prototypical exemplars were likely to facilitate

initial learning. These exemplars make it easier for the children to detect the SVC construction that underlies them, and to map the SVC onto the shared meaning observed across the exemplars. In this stage, the trained SVC, however, was entrenched with the use of a limited set of verbs, suggesting that the children's learning of SVC was item-based. For example, among the 44 unique verbs introduced in the skewed input stage, Adam used 26 of them (59%) in his 49 productions of the trained SVC. In the 49 productions, 14 included one of the four prototypical verbs. Data from the other two children, however, showed that there were individual differences in the extent that their productions were item specific.

In the balanced input stage, the learning trajectory was rather different and unsteady for the three children. Fifteen unique verb types were introduced twice in each session and no verb type stood out as the prototypical exemplar. All three children experienced a drop in performance in the treatment sessions immediately after the switch in stages. After this drop, all three children's performance went up again in one or two sessions. Two children, Adam and Belle, eventually scored at a high level when intervention ended, suggesting that they were able to move beyond concrete exemplars to form a more abstract representation of their trained SVC with higher productivity under balanced input. This point about productivity is supported by the observation that Adam used his target SVC with more unique verb types ($n = 58$) in the balanced than in the low-skewed stage ($n = 26$). This suggests that Adam was developing a more abstract schema for the target SVC through generalisation and schematisation. Another piece of evidence that suggests productivity was Belle's performance. Towards the end of the treatment period from Session 7, she began to expand the noun phrase and verb phrase in her production of the trained SVC. These expansions were not modelled by the clinician.

Generalisation effects

Generalisation in terms of use of the target SVCs in the dynamic probe and in story retelling was suggestive in one child but minimal in the other two. There are at least two explanations for limited generalisation to novel contexts. First, the total number of teaching episodes provided in treatment was not sufficient for the formation of an abstract representation of the trained SVC that was robust enough for generalisation. Second, the unfamiliar and less structured dynamic probe and the more complex story retelling task posed too high a cognitive and processing demand on the child's successful production of the trained SVC, especially when the representation of the SVC was incomplete or unstable.

Across-behaviour generalisation was clearly observed in all three children. They demonstrated gains in the probes on the untrained SVC. This

makes sense as the purpose and instrumental SVCs are aligned in structure and functionally inter-related (Fung, 2011). It is therefore possible that the children discovered the underlying similarities between them and therefore generalised the construction by categorisation and schematisation (Markman & Gentner, 1997). The fact that the two SVCs were tested using probes that shared a similar structure could also support across-behavior generalisation.

Structural alignment and functional inter-relation, however, also led to undesirable transfer from the untrained SVC to the trained SVC in Cathy, the child who did not perform as well as the other two children. When the accuracy in the untrained purpose SVC probe further increased in Session 8, Cathy started overgeneralising the use of *heoi3* (*go*; i.e. the first verb in purpose SVC) in the trained instrumental SVC, demonstrating an error pattern of Verb 1 (*heoi3*) + instrument + Verb 2 + object. As purpose SVC is used more frequently and precedes instrumental SVC in language development (Fung, 2011), Cathy might find purpose SVC easier to produce perhaps due to limitations in cognitive resources and processing capacities.

Timing of the switch in input types

Examination of the children's spontaneous production during intervention revealed that Cathy had a learning trajectory that was different from the other two children. Cathy's production of the trained SVC in the treatment sessions never went over 50% across the two stages, and in the last two sessions it dropped to below 20%. One possible explanation is the timing of the switch from one input type to the other. Cathy's PCSU of the trained target during intervention was 33.3% in the last session at the skewed input stage, while the other two children obtained a PCSU of 73.3% (Adam) and 96.6% (Belle). These two children's PCSU ended up at 86.7% (Adam) and 93.3% (Belle) at the end of the balanced input stage with some fluctuations. The number of teaching episodes needed to show gains can vary from individual to individual (Nicholas et al., 2019). It is probable that Cathy was still at an earlier developmental phase. Her lexical frames for the trained SVC were not stable or complete enough for the next phase of abstraction needed for productive use. Therefore, an extended skewed input stage with a higher number of teaching episodes might have been more favourable for her.

Vocabulary size and knowledge

Vocabulary and grammar are inter-related in development in school-aged children (Tomblin & Zhang, 2006). It is plausible that familiarity of the words required in the formulation of the target SVC in the probes and during intervention influenced the children's performance. This vocabulary effect was

stronger in Cathy, who had a documented weakness in the expressive vocabulary subtest in TOPOL scoring -1.5 *SD* below the mean. In Sessions 9 and 10, less familiar instruments (e.g. fishing hook, stethoscope) were introduced. It could be that this made it more difficult for her to incorporate these unfamiliar words in the production of the instrumental SVC. She also frequently demonstrated phonological, semantic, and syntactic errors in her productions. Effects of her poor vocabulary were exacerbated in the balanced input stage when there was an increase in the variability of verb types in the absence of a prototypical exemplar, making it more difficult for her to identify and extract the underlying SVC from the 30 highly variable exemplars. This explanation is consistent with Nicholas et al. (2019) finding that children with weak vocabulary were less likely to learn with high variability input due to their greater attention to the vocabulary instead of grammar. Cathy was also the most active of the three children and demonstrated frequent off-task behaviours. This too could have contributed to her poorer performance.

Intervention target and error patterns

Recall that Adam and Cathy were only 4 years of age. Although SVCs are learned actively and used frequently in the preschool years, there is no solid evidence on the age each type of SVC is learned by most children. It is plausible that Adam and Cathy's trained instrumental SVC is not present in most of their typically-developing age peers. Intervention on constructions that they were not cognitively and/or linguistically ready could have led to poorer effects. Regarding error patterns, those observed in younger typically-developing children (Fung, 2011) were also observed in the three children with oral language difficulties. Examples of erroneous productions from Adam included semantic errors (e.g. use of inaccurate verbs or nouns), single-verb sentence or phrase (e.g. missing nouns), ungrammatical errors (e.g. additional verb), inappropriate type (e.g. mixing the use of two SVCs), and irrelevant responses.

Limitations and directions for future research

Preliminary evidence suggested early efficacy of GITV as a principle for grammar intervention. This study, however, had two limitations. First, the number of data points at the baseline and intervention phase were too small, leading to inadequate power to ascertain statistical significance in effect size. The two data points at the maintenance phase were also insufficient to document successful learning and consolidation. Second, although there is no consensus on the length of a baseline phase and the number of data points, the disproportional frequencies of three baseline data points over 1 week compared to five intervention data points in 10 sessions over 5 weeks

cannot allow firm conclusions about treatment efficacy.

The following methodological modifications are recommended in future research for children with DLD. First, extending the baseline period with five data points and increasing the number of data points in the intervention phase for the trained target, the untrained items, and control items will give the study more power for the examination of effect size using statistical analysis. Second, making the frequency of measurement in the baseline and the intervention phases more comparable (e.g. one data point over 1 week in each phase) will allow a more reliable interpretation of changes as result of intervention. Third, use of a multiple rather than a single baseline design will address whether performance improvement is a result of probe test or intervention. Fourth, the timing of the switch from the skewed to the balanced stage should be individually determined and criterion-based to make sure that the child has an adequate representation of the construction before the next stage. Finally, the order of the skewed and the balanced stages should be manipulated for more robust testing of the principle of graduated variations of input type.

Conclusion

This study provided preliminary evidence of the early efficacy for GITV from visual analysis. Modifications of the research methodology in future research with children with DLD may confirm the efficacy of GITV using statistical analysis. As a principle, the fact that GITV can be applied to the intervention of syntactic constructions as well as grammatical morphemes makes it attractive for children with DLD who are learning languages as typologically different as English and Cantonese. In English, inflexional morphemes play a great part but in Cantonese they are absent. Further research on GITV will increase speech-language pathologist's capacity to provide theory-driven and evidence-based grammar intervention for young children with DLD across a variety of languages.

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Notes

1. The term developmental language disorder (DLD; Bishop et al., 2017) is used throughout this article when referring to children who were identified as having specific language impairment (SLI), despite reported differences in the criteria used to define these children.

2. The Linguistic Society of Hong Kong Cantonese Romanization Scheme (1993) is used here. The number at the end of each syllable denotes one of the six lexical tones.
3. The item with the verb *maat3* (*wipe*) was removed from the probe from Session 5. The number of items in this probe was then reduced to 11.

Disclosure statement

The authors have no real or potential conflicts that could be seen as having an influence on the research reported here. The authors have no financial or other non-professional benefits that might result from the manuscript.

References

- Ambridge, B., & Lieven, E. V. M. (2011). *Child language acquisition: Contrasting theoretical approaches*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511975073>
- Aikhenvald, A. Y. (2006). *Serial verbs*. Oxford University Press. <https://doi.org/10.1093/oso/9780198791263.001.0001>
- Barako Arndt, K., & Schuele, C. M. (2013). Multiclausal utterances aren't just for big kids: framework for analysis of complex syntax production in spoken language of preschool- and early school-age children. *Topics in Language Disorders*, 33(2), 125–139. <https://doi.org/10.1097/TLD.0b013e31828f9ee8>
- Bishop, D. V., Snowling, M. J., Thompson, P. A., & Greenhalgh, T., and the CATALISE-2 Consortium. (2017). Phase 2 of CATALISE: A multinational and multidisciplinary Delphi consensus study of problems with language development: Terminology. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, 58(10), 1068–1080. <https://doi.org/10.1111/jcpp.12721>
- Bruinsma, G., Wijnen, F., & Gerrits, E. (2020). Focused stimulation intervention in 4- and 5- year-old children with developmental language disorder: Exploring implementation in clinical practice. *Language, Speech, and Hearing Services in Schools*, 51(2), 247–269. https://doi.org/10.1044/2020_LSHSS-19-00069
- Casenhiser, D., & Goldberg, A. (2005). Fast mapping between a phrasal form and meaning. *Developmental Science*, 8(6), 500–508. <https://doi.org/10.1111/j.1467-7687.2005.00441.x>
- Chan, A., Cheng, K., Kan, R., Wong, A. M.-Y., Fung, R., Wong, J., Cheng, T., Cheung, A., Yuen, K., Chui, B., Lo, J., & Gagarina, N. (2020). The multilingual assessment instrument for narratives (MAIN): Adding cantonese to MAIN. *ZAS Papers in Linguistics*, 64, 23–29. <https://doi.org/10.21248/zaspil.64.2020.553>
- Cleave, P. L., Becker, S. D., Curran, M. K., Van Horne, A. J. O., & Fey, M. E. (2015). The efficacy of recasts in language intervention: A systematic review and meta-analysis. *American Journal of Speech-Language Pathology*, 24(2), 237–255. https://doi.org/10.1044/2015_AJSLP-14-0105
- Diessel, H. (2004). *The acquisition of complex sentences*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511486531>
- Fingerhut, J., Xu, X., & Moeyaert, M. (2021). Selecting the proper Tau-U measure for single-case experimental designs: Development and application of a decision flowchart. *Evidence-Based Communication Assessment and Intervention*, 15(3), 99–114. <https://doi.org/10.1080/17489539.2021.1937851>
- Fletcher, P., Leonard, L. B., Stokes, S. F., & Wong, A. M.-Y. (2005). The expression of aspect in Cantonese-speaking children with specific language impairment. *Journal of Speech, Language, and Hearing Research: Jslhr*, 48(3), 621–634. [https://doi.org/10.1044/1092-4388\(2005\)043](https://doi.org/10.1044/1092-4388(2005)043)
- Frizelle, P., Thompson, P., Duta, M., & Bishop, D. V. (2019). Assessing children's understanding of complex syntax: A comparison of two methods. *Language Learning*, 69(2), 255–291. <https://doi.org/10.1111/lang.12332>
- Fung, S. S.-H. (2011). The emergence of serial verb constructions in child Cantonese [Unpublished MPhil thesis]. The University of Hong Kong. https://doi.org/10.5353/th_b4786997
- Goldberg, A. E., Casenhiser, D. M., & Sethuraman, N. (2004). Learning argument structure generalisations. *Cognitive Linguistics*, 15(3), 289–316. <https://doi.org/10.1515/cogl.2004.011>
- Goldberg, A. E. (2006). *Constructions at work: The nature of generalization in Language*. Oxford University Press.
- Hong Kong Department of Health Child Assessment Service. (2019). *The Hong Kong test of preschool oral language (Cantonese) (TOPOL)*. Department of Health, Hong Kong SAR Government.
- Johnston, J. R., & Schery, T. K. (1976). The use of grammatical morphemes by children with communication disorders. In D. M. Morehead and A. E. Morehead (Eds.), *Normal and deficient child language* (pp. 239–258). University Park Press.
- Kidd, E., Lieven, E., & Tomasello, M. (2006). Examining the role of lexical frequency in the acquisition of sentential complements. *Cognitive Development*, 21(2), 93–107. <https://doi.org/10.1016/j.cogdev.2006.01.006>
- Kidd, E., Lieven, E., & Tomasello, M. (2010). Lexical frequency and exemplar-based learning effects in language acquisition: Evidence from sentential complements. *Language Sciences*, 32(1), 132–142. <https://doi.org/10.1016/j.langsci.2009.05.002>
- Leonard, L. B., Deevy, P., Wong, A. M.-Y., Stokes, S. F., & Fletcher, P. (2007). Modal verbs with and without tense: A study of English- and Cantonese-speaking children with specific language impairment. *International Journal of Language & Communication Disorders*, 42(2), 209–228. <https://doi.org/10.1080/13682820600624240>
- Leonard, L. B., Wong, A. M.-Y., Deevy, P., Stokes, S. F., & Fletcher, P. (2006). The production of passives by children with specific language impairment acquiring English or Cantonese. *Applied Psycholinguistics*, 27(2), 267–299. <https://doi.org/10.1017/S01421716406060280>
- Lieven, E. (2019). Input, interaction and learning in early language development. In V. Grover, P. Uccelli, M. Rowe, & E., Lieven, (Eds.), *Learning through language: Towards an educationally informed theory of language learning* (pp. 19–30). Cambridge University Press. <https://doi.org/10.1017/9781316718537.003>
- Markman, A. B., & Gentner, D. (1997). The effects of alignability on memory. *Psychological Science*, 8(5), 363–367. <https://doi.org/10.1111/j.1467-9280.1997.tb00426.x>
- Matthews, S. (2006). On serial verbs in cantonese. In Y. Alexandra Aikhenvald & R. M. W., Dixon, (Eds.), *Serial verb constructions: A cross-linguistic typology* (pp. 69–87). Oxford University Press.
- Nicholas, K., Alt, M., & Hauwiler, E. (2019). Variability of input in preposition learning by pre-schoolers with developmental language disorder and typically developing language. *Child Language Teaching and Therapy*, 35(1), 55–74. <https://doi.org/10.1177/0265659019830455>
- Schuele, C. M., & Dykes, J. (2005). Complex syntax: A longitudinal case study of a child with specific language impairment. *Clinical Linguistics & Phonetics*, 19(4), 295–318. <https://doi.org/10.1080/02699200410001703709>
- Tate, R. L., Perdices, M., Rosenkoetter, U., Shadish, W., Vohra, S., Barlow, D. H., Horner, R., Kazdin, A., Kratochwill, T., McDonald, S., Sampson, M., Shamseer, L., Togher, L., Albin, R., Backman, C., Douglas, J., Evans, J. J., Gast, D., Manolov, R., ... Wilson, B. (2016). The single case reporting guideline in behavioural interventions (SCRIBE) 2016 statement. *Journal of School Psychology*, 56, 133–142. <https://doi.org/10.1016/j.jsp.2016.04.001>
- The Linguistic Society of Hong Kong (1993). The Linguistic Society of Hong Kong Cantonese Romanization Scheme. <https://lshk.org/jyutping-scheme/#>
- Tomasello, M. (1992). *First verbs: A case study of early language development*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511527678>

- Tomasello, M. (2003). *Constructing a language: A usage-based theory of language acquisition*. Harvard University Press. <https://doi.org/10.2307/j.ctv26070v8>
- Tomblin, J. B., & Zhang, X. (2006). The dimensionality of language ability in school-age children. *Journal of Speech, Language, and Hearing Research: Jslhr*, 49(6), 1193–1208. <https://doi.org/10.1017/S0305000900009302>
- Tse, S. K., Chan, C., Kwong, S. M., & Li, H. (2002). Sex differences in syntactic development: Evidence from Cantonese-speaking pre-schoolers in Hong Kong. *International Journal of Behavioral Development*, 26(6), 509–517. <https://doi.org/10.1080/01650250143000463>
- Warren, S. F., Fey, M. E., & Yoder, P. J. (2007). Differential treatment intensity research: A missing link to creating optimally effective communication interventions. *Mental Retardation and Developmental Disabilities Research Reviews*, 13(1), 70–77. <https://doi.org/10.1002/mrdd.20139>
- Wisman Weil, L., & Schuele, M. (2019). Complex syntax interventions for young children with language impairments. *EBP Briefs*, 13(5), 1–9. [https://doi.org/10.1044/1092-4388\(2004/086\)](https://doi.org/10.1044/1092-4388(2004/086))
- Wong, A M-Y, Au, C W-S., & Stokes, S. (2004). Three measures of language production for Cantonese-speaking school-age children in a story-retelling task. *Journal of Speech, Language, and Hearing Research: Jslhr*, 47(5), 1164–1178. [https://doi.org/10.1044/1092-4388\(2004/107\)](https://doi.org/10.1044/1092-4388(2004/107))
- Wong, A. M.-Y. (2023). *Understanding development and disorder in Cantonese using language sample analysis*, (ISBN: 978-0-367-42419-0). Routledge.
- Wong, A. M.-Y., Leonard, L. B., Fletcher, P., & Stokes, S. F. (2004). Questions without movement: A study of Cantonese-speaking children with and without specific language impairment. *Journal of Speech, Language, and Hearing Research: Jslhr*, 47(6), 1440–1453. [https://doi.org/10.1044/1092-4388\(2004/107\)](https://doi.org/10.1044/1092-4388(2004/107))
- Wong, A. M.-Y., Ng, A. K.-H., Chan, D. L.-H. (2021). Difficulties with serial verb constructions in Cantonese speaking children with DLD. Talk presented At the Symposium Early Syntactic Development at the Triennial Conference for the International Association for the Study of Child Language (IASCL) (online), July.
- Zhang, X., & Mai, C. (2020). Impact of constructional complexity and intralingual influence on the effect of skewed input. *Language Teaching Research*, 27(5), 1217–1245. <https://doi.org/10.1177/1362168820981395>