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The Effects of a Code-switching within SGDs on Language Discourse in Bilingual People with Aphasia

by

Andrea L. Silva Martinez

Idaho State University

A thesis

submitted in partial fulfillment

of the requirements for the degree of

Master of Science in the Department of Communication Sciences and Disorders

Idaho State University

Summer 2022

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Committee Approval

To the Graduate Faculty:

The members of the committee appointed to examine the thesis of Andrea Silva find it satisfactory and recommend that it be accepted.

____
Kristofer Brock, PhD, CCC-SLP
Committee Chair

____
Victoria Scharp, PhD, CCC-SLP
Committee Member

____
Carmen Febles, PhD
Graduate Faculty Representative

Human Subjects Committee Approval

May 26, 2021

Kristofer Brock
College of Rehabilitation Comm Sciences
1311 E. Central Drive
Meridian, ID 83642

RE: Study Number IRB-FY2021-214 : The Effects of a Code-switching within SGDs on Language Discourse in Bilingual People with Aphasia

Dear Dr. Brock:

Thank you for your responses to a full-board review of the study listed above. Your responses are eligible for expedited review under FDA and DHHS (OHRP) regulations. This is to confirm that I have approved your application.

Notify the HSC of any adverse events. Serious, unexpected adverse events must be reported in writing within 10 business days.

You may conduct your study as described in your application effective immediately. The study is subject to renewal on or before May 25, 2022, unless closed before that date.

Please note that any changes to the study as approved must be promptly reported and approved. Some changes may be approved by expedited review; others require full board review. Contact Tom Bailey (208-282-2179; email humsubj@isu.edu) if you have any questions or require further information.

Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

Acknowledgements

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Abstract-Thesis

This study examines the effects of a newly designed language toggle feature, allowing for more fluid code-switching within an SGD, on several discourse outcome measures and picture description tasks in two bilingual individuals with aphasia. A counterbalanced, within-subject design was used. Participants' language proficiency in Spanish and English confirmed their bilingual status and gathered the participants' self-reported level of language mixing. The Quick Aphasia Battery and the Bilingual Aphasia Test confirmed a diagnosis of aphasia severity. Participants were counterbalanced across three storytelling conditions: English, Spanish, and code-switching. Participants were shown each picture for 3-minutes, then prompted to tell the story. Language micro and macrostructures were examined for each condition. Preliminary data suggests language proficiency plays a role in code-switching and may impact language outcomes, such as words per minute and story structure. Code-switching may improve total different words and symbols, story structure, and coherence. The data must be interpreted with extreme caution due to the toggle feature's increased cognitive demand for effectively toggling, the AAC device's disassociation of the two languages, and the MAIN's intended population. Paucity in several areas warrants further research (i.e., advancing current AAC technology, aphasia research, culturally and linguistically diverse populations) and a shift in current AAC perspectives.

Key Words: Speech-generating devices, Aphasia, bilingual, code-switching

The Effects of a Code-switching within SGDs on Language Discourse in Bilingual People with Aphasia

Aphasia affects about two million Americans and is described as an acquired neurological disorder that affects receptive and expressive language tasks (National Aphasia Association, 2019; Hallowell, 2017). More specifically, aphasia represents an impairment in the access of stored linguistic representations, not necessarily the stored representations themselves (Hallowell 2017). Within this population, there is a smaller subset of approximately 45,000+ individuals in the United States who are bilingual and have aphasia (Paradis, 2001). Paradis's (2001) data is likely an underestimate by today's standards, Bialystok et al. (2012) noted that approximately 20% of the individuals within the United States and Canada speak a language at home other than English. Regardless of language(s) spoken, 25% of people with aphasia are diagnosed with a severe, chronic disorder that makes communication almost impossible for the remainder of their lives (Russo et al., 2017).

To participate in various settings, people with chronic aphasia may use augmentative and alternative communication (AAC) systems such as speech degenerating devices (SGDs) to replace or supplement their natural speech production (Russo et al., 2017; Koul, 2011). However, there is a paucity of research investigating the effectiveness of multilingual device features that enhance communication for individuals with aphasia who are bilingual (Lorenzen & Murray, 2008; Tönsing et al., 2019). Compounding this lack of research is the predominately white (92%), monolingual (93.5% versus 6.5% bilingual) base of speech-language pathologists (SLPs) with limited cultural competency training (American Speech, Language, and Hearing Association [ASHA], 2019a; ASHA, 2019b; Lorenzen & Murray, 2008). Therefore, the purpose of this study is to investigate the effects of a new SGD bilingual feature that allows individuals to effectively switch between languages for communication purposes.

Bilingual Aphasia

Bilingualism is a growing trait in U.S. residents, with 67.3 million people in the United States speaking a language other than English (Zeigler & Camarota, 2019). Vespa et al. (2020) reports that in the next several decades, those who are biracial, or more are estimated to be the fastest-growing racial or ethnic group in the United States. It is projected to increase by 200% by the year 2060. The Hispanic and Asian populations are projected to double by 2060 (Vespa et al., 2020). Given these national trends, it can be inferred that there will be a growing subset of individuals who experiences a cerebrovascular accident, traumatic brain injury, or tumor with a subsequent diagnosis of aphasia and who are also bilingual/multicultural.

As a result of the increased bilingualism and minority population growth, SLPs are more likely to work with clients who speak more than one language (Faroqi-Shah et al., 2010). However, providing treatment to clients who speak more than one language may pose challenges to SLPs (Faroqi-Shah et al., 2010; ASHA, 2019b). Santhanam and Parveen (2018) composed a table summarizing previous literature about the challenges reported practicing SLPs when providing services to culturally and linguistically diverse services. Some of these challenges included lack of knowledge about bilingualism, difficulties collaborating with client's family members, understanding their belief systems, lack of normative data, and lack of cultural and linguistic knowledge (Santhanam & Parveen, 2018). One specific challenge not easily overcome includes the variability in bilingualism, specifically the recovery patterns in bilingual aphasia (Faroqi-Shah et al., 2010; Lorenzen & Murray, 2008; Khachatryan et al., 2016; Paradis, 1977).

Bilingualism in and of itself is highly variable with several languages in the United States as well dialectal variations. Therefore, factors contributing to recovery are highly individualized and must be addressed on a case-by-case basis. Previous research has reported that several variables account for language recovery or lack thereof: (a) frequency of languages spoken throughout a single day (e.g., 50% language one (L1) and 50% Language two (L2) in one day), (b) methods by which language was acquired (e.g., L1 acquired at home, L2 acquired academically), (c) age of second language acquisition (e.g., L1 from birth v L2 acquired in early adulthood), and (d) language proficiency before and after injury (Khachatryan et al., 2016; Lorenzen & Murray, 2008; Faroqi-Shah et al., 2010). Other variables must also be considered, for instance, patterns of impairments in languages of bilingual persons with aphasia.

Khachatryan et al. (2016) describes three different patterns of impairment in bilingual persons with aphasia, parallel, differential, and selective. A parallel pattern of impairment indicates each of the client's languages is impaired. Contrastively, a differential pattern of impairment indicates that one language is impacted more than another. Lastly, a selective pattern of impairment indicates that one language is preserved after the injury (Khachatryan et al. 2016). Within these patterns of impairment, research also suggests that the recovery patterns of bilingual persons with aphasia is highly variable.

Bilingual persons with aphasia also display variability in recovery, and these patterns may be different from monolingual counterparts (Paradis, 1977; Lorenzen & Murray, 2008). Recovery patterns, like impairment patterns, include parallel, differential, and other patterns. A parallel recovery pattern attempts to mirror pre-injury language abilities, the language that was considered "stronger" or more proficient will return to be stronger post-injury (Lorenzen & Murray, 2008). In differential patterns of recovery, one language recovers more than the other language, even when compared to pre-injury language abilities. Other recovery patterns include an antagonistic pattern of recovery. Essentially an antagonistic pattern flip flops language availability. One language is available initially, but as the other language recovers, the initial language starts to diminish and ultimately disappears (Lorenzen & Murray, 2008).

Another version of an antagonistic pattern is coined alternating antagonism, which is a cycle of one language being readily available only to disappear as the other comes back; these episodes can last anywhere from 24 hours to months at a time (Lorenzen & Murray, 2008). Another pattern of recovery is called successive recovery. This pattern involves one language recovering before the other languages. Lastly, there is a blending recovery, easily confused with code-switching. Bilingual persons with aphasia with blending recovery are unable to control the mixing of both languages; thus, words and syntax of each language are intertwined involuntarily (Lorenzen & Murray, 2008). One important reason to differentiate blending recovery from code-switching is that code-switching does not imply that bilingual persons with aphasia cannot control the language switching. Previous research describes that clients can use code-switching as a strategy to cue themselves to retrieve the correct word in either language and or to improve communication in general (Grosjen, 1989; Lorenzen & Murray, 2008; Muñoz et al. 1999). One way to look at the effects of code-switching on language is to investigate its role in language discourse for bilingual persons with aphasia.

Bilingual Discourse in Aphasia

While standardized language assessments give a snapshot of a client's skill on different language tasks, they fail to provide details of communication outside the assessment context (Paplikar, 2016). Discourse tasks allow clinicians to analyze language in a more contextualized way when compared standardized assessments. Currently, there are several different methods to elicit discourse, some of which include conversation, role-playing, and procedural description (e.g., how to tie your shoes) (Paplikar, 2016). However, this study will focus on narrative retell.

In addition to different types of discourse tasks, there are several ways to analyze narrative retells and picture descriptions. This study will focus on measures of verbal productivity (e.g., type token ratio; [Paul et al., 2018]), measures of coherence (e.g., local and global coherence; Kempler & Goral, 2011), Multilingual Assessment Instrument for Narratives (MAIN) scoring rubric that contains metrics for story structure, structural complexity, and internal state terms (Gagarina et al., 2019), total story time (seconds), number of total words and symbols and different words and symbols, total words and symbols per minute, and number of code switching instances. Discourse analysis can expand SLPs' view of the client's language skills (Paplikar, 2016).

Kempler and Goral (2011) use local and global coherence as discourse variables that this study will utilize to measure narrative structures. Global coherence utilizes a broader view of the utterance topic relationship. Global coherence measures whether each utterance correlates/is relevant to the overall topic of the discourse. Whereas local coherence investigates the relevance of each utterance to the previous elicited utterance. This relationship between utterance can be done by focus, elaboration, sequencing, etc. (Kempler & Goral, 2011; Paplikar, 2016).

Type token ratio (Paul et al., 2018) will be utilized to investigate bilingual adults' discourse with aphasia who utilize SGDs. Type token ratio is a method of measuring the variability in vocabulary within a client's speech and or a piece of written text. This will be a gauge to look at bilingual adults with aphasia's variability in their vocabulary. Another critical area that is important to investigating bilingual adults with aphasia is the concept of code-switching, what is it, is it normal, and how bilingual adults with aphasia utilize code-switching.

Code-Switching

For bilingual persons, code-switching, or using multiple languages in one utterance (Neumen et al. 2017), is used by bilingual persons regardless of aphasia. As Lerman et al. (2019) noted, bilingual individuals often code-switch in social and pragmatic situations. For bilingual individuals with aphasia, the reasons for code-switching are still not clear and may be complicated (Lernman et al., 2019; Neumen et al., 2017). Some researchers indicate that code-switching is a compensatory strategy to improve communication (Neumen et al., 2017; Paplikar, 2016; Lerman et al., 2015). Muñoz et al. (1999) found that bilingual people with aphasia used code-switching more than bilingual people without aphasia. However, some researchers suggest that code-switching could be a pattern of recovery, suggesting that the cognitive control mechanism was damaged secondary to the stroke, resulting in the involuntary control of code-switching (Lerman et al., 2019; Lorenzen & Murray, 2008). According to Neumen et al. (2017), viewing code-switching as pathological is not a generally held view. Therefore, assuming bilingual speakers with aphasia use code-switching to decrease communication breakdown, language mixing could be employed as a treatment strategy (Lerman et al., 2019). However, those individuals with severe aphasia who utilize an SGD to communicate have been left behind because code-switching is almost impossible. Overall, there is a paucity of innovation and research investigating the effectiveness of multilingual device features that enhance communication for individuals with aphasia who are bilingual (Lorenzen & Murrary, 2008; Tönsing et al., 2019).

SGDs Toggle in Bilingual Aphasia

Innovation and research investigating the effects of SGD for non-English speaking persons with aphasia is lacking (Lorenzen & Murrary, 2008; Tönsing et al., 2019). Despite a proliferation of consumer technologies for AAC purposes (Koul, 2011), SGD manufacturers have poorly addressed multicultural considerations. Specific to this study is the lack of an effective code-switching method for individuals with aphasia. Currently, popular SGDs such as Lingaphica allow users to change the language settings. However, at the onset of the study, that process included a series of five mouse clicks that must be recalled in the midst of conversation, essentially bringing communication to a halt. Moreover, because of the time it takes to change the SGDs' language, bilingual individuals with aphasia may not be able to use code switching as a compensatory mechanism. This is problematic because code-switching has been a documented treatment strategy that enhances communicative competence and provides the individual with a tool to self-prompt (Neumen et al., 2017; Paplikar, 2016).

In sum, current technological innovation in AAC is limited with respect to minority populations. Code-switching in SGDs is likely non-existent in the clinical population given how difficult it is to change the language settings mid-conversation. However, an easy-to-use language toggle feature that facilitates code-switching may enhance discourse outcomes for bilingual individuals. Therefore, the main purpose of this study is to examine the effects of a newly designed language toggle feature, allowing for more fluid code switching within an SGD, on several discourse outcome measures and picture description tasks.

Previous research indicates that code-switching is a compensatory strategy used to improve communication (Neumen et al., 2017; Paplikar, 2016; Lerman et al., 2015). Muñoz et al. (1999) found that bilingual people with aphasia used code-switching more than bilingual people without aphasia. Thus, we can assume that some bilingual speakers with aphasia use code-switching to decrease communication breakdown and increase fluency; therefore, language mixing could be employed as a treatment strategy (Lerman et al., 2019). The use of the code-switching toggle feature on an SGD may increase narrative language micro and macrostructure discourse outcomes of people who are bilingual and have aphasia, and the narrative language discourse outcomes (e.g., coherence, MAIN, TTR) will be better in the code-switching condition than in the English or Spanish conditions.

Method

Participants, Setting, Experimenter

Two bilingual adults with aphasia were recruited from the Lingraphica research database. Inclusion criteria for the participants included the following: (a) diagnosis of nonfluent aphasia as a result of a single stroke (b) at least a moderate aphasia severity rating, (c) at least 6 months post-onset with no uncorrected hearing or vision impairments, (d) no other neurological diagnoses, (e) bilingual Spanish-English speakers, and (f) had a Lingraphica Touch Talk SGD. All study procedures were conducted through Zoom® video conferencing to comply with COVID-19 social distancing orders. The experimenters included a trained graduate student at Idaho State University under supervision from a licensed and ASHA certified speech-language pathologist working as a tenure track professor. All procedures were approved by the university Institutional Review Board.

Table 1

Participant Demographics

						BAT				
	Age	Sex	Lang Prof.	Lang Mix.	QAB Severity	PN	VF	CN	SC	PD
P1	54	F	English	Increased	Moderate	15/20	0/6	17/20	9/25	5/5
P2	59	F	Spanish	Increased	Moderate	19/20	4/6	18/20	20/25	4/5

Note. Lang prof= Language Proficiency Questionnaire, language proficiency result; Lang mix= Language Mixing Questionnaire, language mixing post stroke; QAB= Quick Aphasia Battery; BAT=Bilingual Aphasia Test; PN= Narrative; VF=verbal fluency; CN=confrontational naming; SC= sentence construction; PD= picture description

Design

A counterbalanced, repeated measures design was utilized to investigate the effects of a newly designed language toggle feature on several language discourse outcome measures. Participants were engaged in three experimental language conditions: English, Spanish, and code-switching. Three picture story cards were selected from the MAIN (Gagarina et al., (2012) and randomly assigned to an experimental language condition to elicit a story from the participants. The language conditions were counterbalanced to mitigate possible order effects.

The outcome variables included local and global coherence, total story time (seconds), number of total words and symbols, number of different words and symbols, total words and symbols per minute, type-token ratio (TTR), and (g) number of code-switching instances.

Materials

Assessments

This study utilized various assessments to establish moderate-to-severe non-fluent aphasia and determine bilingualism within the participants. The *Quick Aphasia Battery* was utilized to confirm aphasia for monolingual speakers and severity for bilingual speakers. The *Bilingual Aphasia Test (BAT*) provided a culturally and linguistically appropriate test to evaluate the presence of aphasia in client's who are bilingual. The *Language Experience and Proficient Questionnaire (LEAP-Q)* was used to collect information about each participant's proficiency in language one and language two and to confirm each client is bilingual. The *Language mixing Questionnaire* (Paplikar, 2016) was utilized to determine the participants self-reported level of the language mixing such as age of acquisition, method of acquisition, and language spoken at home and with others.

Story Stimuli

The MAIN picture story cards stimulus was used to elicit language, in the form of a narrative, from the participants. Three story cards were selected from MAIN: (a) Baby Bird, (b) Baby Goat, and (c) Dog. The story cards were randomly assigned to an experimental condition with Baby Bird in English, Baby Goat in Spanish, and Dog in the code-switching condition.

While the MAIN picture card sets were meant for children between 3 and 10 years of age, there were several reasons why they were included in this study. First, the picture cards were culturally and linguistically appropriate, psychometrically valid, and included parallel storylines (Gagarina et al. 2012). Kong (2009) stated that there is a lack of culturally appropriate stimuli for language elicitation, thus using the MAIN picture cards was more culturally appropriate for bilingual adults with aphasia than other description tasks such as the Cookie Theft picture from the Boston Diagnostic Aphasia Examination (BDAE) (Goodglass et al., 2001). Second, each story was determined to be cognitively and linguistically similar, which is required to maintain control in a repeated measures research design (Gagarina et al. 2012). One caveat to using the MAIN picture sets is the fact that they were meant for children between the ages of 3 and 10 years; however, persons with nonfluent aphasia may have similar syntactic sentence structures as some children. Therefore, the MAIN picture sets were an ideal choice for this study.

SGD

The Lingraphica TouchTalk SGD (9.65” x 5.88”) was utilized in this study because the company’s software development team was in the beginning stages of creating a language toggle feature based on the survey results from Hung et al. (under review). Specifically, Hung et al. found that SLPs wanted a toggle feature to take advantage of code-switching as a compensatory mechanism for bilingual persons with aphasia. The toggle feature utilized separate “trees” which is essentially having two separate devices in one, one in English and the other in Spanish. At the time of this study, the trees were not connected, which made for separate programming of each device and no interconnectivity between the two languages. Too activate the toggle feature, participants were trained to access the settings menu, click on the toggle icon, and subsequently navigate back to the specific page they were on before code-switching. Updates from Lingraphica reduced the number clicks to toggle languages from five to three clicks to get back to the specific grid display depicting a story.

The research team created four topic grid displays. One of the grid displays was used to train participants how to locate symbols and construct messages using symbols. The remaining three grid displays corresponded to a MAIN story card set. Grids were created collaboratively by the research team until consensus was reached. Consensus was determined when both researchers agreed that each individual element or word from the three-story card sets were represented by a graphic symbol within the grid. There were 62 symbols in the Baby Bird condition, 53 in the Baby Goat condition, and 52 and 53 in the dog condition (see Figures 1-4). The symbols were activated via direct selection with the intent that participants could create a symbol-by-symbol sequence or use a symbol as a tool to facilitate natural speech. Upon activation, symbols were placed in the message workspace and synthetically spoken. Symbols were 1/2 x ½ inches on the experimenter's SGD; however, size of the symbols on the participant's SGDs have may varied because they used their own Lingraphica SGD. Additionally, not all the symbols fit within the SGD's screen boundary, and participants had to scroll up or down to access all the symbols.

Figure 1

Figure 1 Code-switching (Spanish) AAC board; Dog picture stimuli.

Figure 2

Figure 3 Code-switching (English); Dog picture stimuli

Figure 3

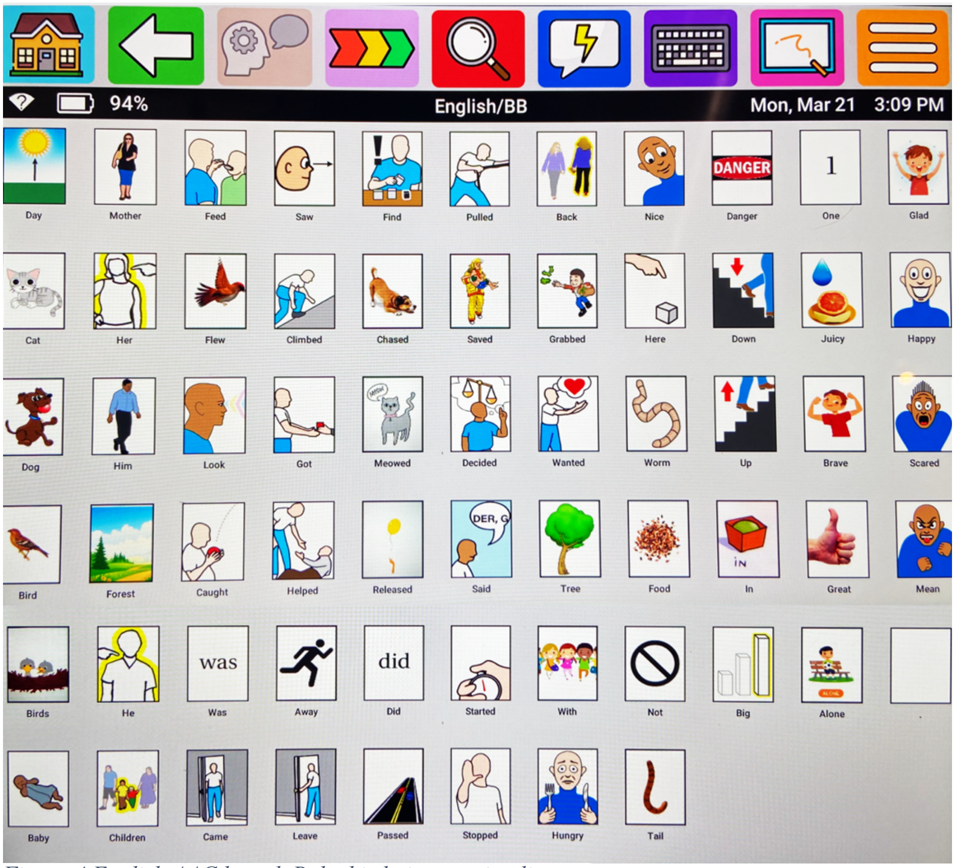

Figure 4 English AAC board, Baby bird picture stimuli

Figure 4

Figure 7 Spanish AAC Board; Baby goat picture stimuli

Procedures

Prior to conducting research, examiners received written consent from the participants. The research was gathered over two days. Prior to day one of data collection, The *LEAP-Q and the Language mixing Questionnaire* was emailed/sent to the participants to be filled out at home with assistance from family members or the researchers if needed. Day one of data collection included administration of The *Quick Aphasia Battery* This assessment was utilized to confirm the presence of aphasia and type and severity if aphasia is present. Five subtests of the *Bilingual Aphasia Test (BAT*) were utilized to ensure cultural reliability in the confirmation, type, and severity of aphasia; these subtests included picture description, generative naming, confrontational naming, story construction, and personal conversation narrative.

Day 2 of data collection included a pre-assessment trial prior to beginning experimental story trials. Given a story card set not used in the experiment proper, participants were instructed to locate five different symbols to ensure the participant had the ability to scan the device for different symbols as well as create five subject, verb, object sentences using the symbols provided on the SGD. The research team modeled how to create symbol-by-symbol sequences by pointing to symbols with their computer mouse via Zoom. Participants were then asked to produce five symbol sequences with 100% accuracy and correct syntactic order (subject-verb-object) before beginning experimental trials.

Before the codes-switch condition was administered, researchers trained the participants to enable and use the toggle feature. Participants were told they would be able to use English and Spanish during this condition and that the toggle feature would allow them to toggle back and forth between languages on their devices. Next, participants were given verbal instruction with visual aids to train the navigation of the toggle feature. Once the participants stated they felt comfortable utilizing the feature, researchers had the participants independently navigate the toggle feature twice before beginning the code-switch condition.

The participant had three minutes to study the story card set before the clinician removed the picture stimulus and prompted the participant to tell the story they just saw. The participants were instructed that all symbols on the device can be used to tell the story. The participants were instructed that they can use speech, the device, or both. Instructions were as follows: “I am going to show you a picture. You have three minutes to look at the story. You will tell me the story about the pictures you just saw. You can tell me the story by speaking, using the symbols on your computer, or both. All the pictures on your computer are part of the story and can help you tell the story.”

Each retell was elicited with a short break between the next elicitation picture set was presented. Both days of data collection were recorded for later analysis. The picture story sets elicitations were evaluated for local and global coherence, MAIN scoring rubric that contained metrics for story structure, structural complexity, and internal state terms (Gagarina et al., 2019), (c) total story time (seconds), (d) number of total words and symbols and different words and symbols, (e) total words and symbols per minute, (f) type-token ratio (TTR) (Paul et al., 2018) and (g) number of code switching instances with inter-rater reliability. Participants who complete day one of the study received a $10 gift card to Walmart. Participants who complete day one and two receive a $50 gift card to Walmart.

Reliability

Inter-rater reliability was implemented for 100% of the total participants. An unblinded, second researcher viewed and independently scored all experimental tasks completed resulted in 100% agreement. The inter-rater reliability scores included percent accuracy for the following tasks: local and global coherence, Multilingual Assessment Instrument for Narratives (MAIN) scoring rubric that contains metrics for story structure, structural complexity, and internal state terms (Gagarina et al., 2019), total story time (seconds), number of total words and symbols and different words and symbols, total words and symbols per minute, type-token ratio (TTR) (Paul et al., 2018) and number of code switching instances. Procedural integrity data was collected for 20% of the participants to ensure uniform experimental task administration and resulted in 100% agreement.

Data Analysis

Given the small sample size of this initial pilot study, no parametric or nonparametric statistical analyses were conducted. Rather, this study provided descriptive statistics to analyze potential trends in the data while also focusing on how to improve this new toggle technology.

This study included seven dependent variables: (a) MAIN scoring rubric that contains metrics for story structure, structural complexity, and internal state terms (Gagarina et al., 2019), (b) global and local coherence (Kemlpler & Goral, 2011), (c) total story time (seconds), (d) number of total words and symbols and different words and symbols, (e) total words and symbols per minute, (f) type-token ratio (TTR) (Paul et al., 2018) and number of code switching instances.

The MAIN is used to assess narrative skills in mono or bilingual children (Gagarina et al., 2019); however, it was applicable to the current study using adults. The MAIN allows for analysis of comprehension as well as productions of narratives in a multitude of languages with a variety of elicitation methods (Gagarina et al., 2019). Additionally, the MAIN contains four picture description stories, which are more culturally appropriate and relevant than most picture description tasks currently available. The scoring sheets for each story contain two sections: production and comprehension.

Production scores were broken down further into three sections: story structure, structural complexity, and internal state terms. First, story structure examined the participants' ability to convey the story settings, initiating event, goals, attempts, outcomes, and reactions. The setting was scored on a 0, 1, or 2 scale while the remainder of the structural elements were scored as either a 0 or 1. Participants could earn a story structure score between 0 and 17 (higher scores indicate more complete story structure). Second, structural complexity examined the production of partial and complete episodes within the narrative task. Complete episodes were defined as multimodal utterances that included a goal (G), attempt (A), and outcome (O); hereafter called GAO sequences. Participants could also score points for partial episodes that included attempt (A) and outcome (O) sequences (i.e., AO sequences), G sequences, GA/GO sequences. For analysis purposes, a frequency count was employed for each partial and full episode. The third subtest of production examined internal state terms and included a frequency count of appropriate terms. Internal state terms include verbs such as mental and linguistic verbs, emotional, consciousness, physiological, and perceptual state terms (e.g., say, think, happy, alive, thirsty, see) (Gagarina et al., 2019). Appendix A, B, and C provides the MAIN scoring rubric for each picture set.

Lastly, coherence can be classified as local or global coherence. Global coherence was used to determine whether each utterance related to the overall topic of the discourse. Local coherence investigated the relevance of each utterance to the previous elicited utterance. This relationship between utterances can be done by focus, elaboration, sequencing. This study utilized Kemlpler and Goral's (2011) three-point scale to measure local and global coherence (1= unrelated, 2= possibly related, and 3=clearly related) to measure narrative retells and picture description tasks because it allows for a concise measure of the relationships between symbols or spoken messages produce on SGD.

To accurately analyze participant story responses, the Systematic Analysis of Language Transcripts (SALT) (Miller & Iglesias, 2019) software was utilized. The software was utilized because it allows for reliable multimodal (e.g., natural speech and aided communication) language analysis of essentially any speaker (Miller and Iglesias, 2019). Specifically, the total story time (seconds), the number of total words, total number of symbols, total number of different words and symbols, total words and symbols per minute, and type-token ratio (TTR) were analyzed in SALT.

Code Switching, the use of two languages in a single utterance, was accounted for throughout all conditions, English only, Spanish only, and code-switching conditions. A tally of each instance of code-switching was recorded. Code switching was recorded in either spoken language and symbol communication generated through the SGDs

Results

Macrostructure

MAIN

The MAIN was utilized due to its culturally and linguistically diverse, extensive piloting, parallel storyline, and cognitive and linguistic complexity (Gagarina et al., 2012). Although the MAIN was originally created for children, Kong (2009) states that there is a lack of culturally appropriate stimuli for language elicitation; thus, using MAIN would be more appropriate for bilingual adults than adult picture tasks that are not culturally sensitive (e.g., Cookie theft). The MAIN scoring rubric (see Appendix A, B, and C) contained metrics for story structure, structural complexity, and internal state terms. (Gagarina et al., 2019).

In Table 2, each participant's scores are outlined by overall story structure score, structural complexity score (e.g., number of GAO sequences), and internal state items per story. Normative data could not be recorded due to researchers alternating the MAIN scoring sheets and story stimuli to fit the means of this study. However, both participants received a score of zero for GAO utterances in all conditions. The participants' highest-scoring structural complexity element was goal (G) utterances when compared to OA, GO, and GA utterances. For participant one (P1), the code-switch condition resulted in a higher story structure score when compared to the Spanish and English conditions. Participant two’s (P2) highest scoring condition was Spanish, with the code-switch condition coming second, followed by the English condition. For P1 and P2, the internal state items were more frequently used in the code-switching than all other conditions.

Table 2

Multilingual Assessment Instrument for Narratives Scoring across Experimental Conditions

			Structural Complexity					
	Condition	Story structure	OA	G	GO	GA	GAO	Internal state
Participant								
	English	4	0	2	0	1	0	1
P1	Spanish	3	0	0	0	0	0	0
	Code switching	7	1	1	1	0	0	3
	Total	14	1	3	1	1	0	4

	English	6	1	2	0	2	0	3
P2	Spanish	9	1	1	1	0	0	2
	Code switching	7	0	1	1	0	0	2
	Total	21	2	4	2	2	0	7

Note. OA= outcome attempt sequence; G= goal, GO= goal outcome sequence; GA=goal attempt sequence; GAO=goal attempt outcome sequence

Local and Global Coherence

Local and global coherence as discourse variables were evaluated for both participants (Kempler & Goral, 2011). Global coherence measures whether each utterance correlates/is relevant to the overall topic of the discourse. In contrast, local coherence investigates the relevance of each utterance to the previous elicited utterance. This relationship between utterances can be done by focus, elaboration, sequencing, etc. (Kempler & Goral, 2011; Paplikar, 2016). In Table 3, participants' scores for each condition can be seen. Both participants' overall global coherence score was higher than local coherence scores. Both participants showed the code-switching condition as the highest or a tied overall score. Participant one highest local and global coherence score was the code-switching condition. In comparison, participant two's highest was English condition but had a tied score for Code-switching condition for global coherence and a two-point difference in the local coherence portion of the data.

Table 3

Local and Global Coherence

	Story	Local Coherence	Global Coherence
Participant			
	Code switching	48	54

P1	Spanish	21	24
	English	19	24
	Total	88	102
	Code switching	58	63
P2	Spanish	33	38
	English	60	63
	Total	151	164

Microstructure

To measure verbal productivity, this study examined microstructures such as the type-token ratio, total story time (minutes and seconds), number of total words and symbols, total number of different words and symbols, total words and symbols per minute, and number of code-switching instances. P2 had the highest instances of code-switching during the code-switching condition. While only demonstrating one use of the toggle feature, P2 verbally code-switched nine times throughout the story retell. P2 had zero instances of code-switching in the Spanish condition and one verbal code-switch during the English condition, utilized for word-finding difficulties. P1 demonstrated five verbal switches during the Spanish condition; utilized for word-finding difficulties, zero code-switching instances in the English condition, and three in the code-switching condition; two verbal switches and one toggle feature switch. Both participants' longest total story time was the code-switch condition. In terms of total words and symbols, P1's code-switching condition had the highest totals, while P2's highest was English, with code-switching two behind. For total of different words and symbols, both participant's codes-witching conditions demonstrated the highest number of different words and symbols.

Table 4

Microstructure

Participant	Condition	Story time*	Total words and symbols	Total different words and symbols	WPM	TTR	Code-switch frequency
P1	Code switch	10:29	93 (W)** 12 (S)**	51 (W) 10 (S)	17.10	.55	2 Verbal 1 Toggle
	Spanish	6:44	51 (W) 8 (S)	(36 W) 7 (S)	9.65	.71	5 Verbal
	English	4:12	59 (W) 6 (S)	(30 W) 5 (S)	22.14	.51	0
P2	Code switch	3:51	156 (W) 1 (S)	81 (W) 0 (S)	67.79	.59	9 Verbal 1 Toggle
	Spanish	1:52	96 (W)	63 (W)	86.79	.66	0
	English	2:53	158 (W)	65 (W)	81.5	.47	1 Verbal

Note. * = Story time was measured in minutes and seconds. **(W) and (S) = words and symbols, respectively.

Discussion

To date, there is a paucity of research investigating the effects of interface design variables for persons with aphasia (Light et al., 2018). One such interface design variable includes the code-switching toggle feature for bilingual individuals with aphasia. This study is the first to examine the effects of a newly designed AAC language toggle feature, allowing for more fluid code switching within an SGD, on several discourse outcome measures. These outcome variables included macrostructure and microstructure outcomes as well as the MAIN scoring rubric that contains metrics for story structure, structural complexity, and internal state terms (Gagarina et al., 2019). Results indicated that the code-switch condition had an increased total of different words and symbols. For participant one, the code-switch condition had the highest number of total words and symbols, total number of different words, the highest score for local and global coherence, structural complexity, internal state items, outcome/attempt, and goal outcome. For participant two, the English condition had two more words/symbols than the code-switch conditions, but the code-switch condition had a higher total of different words and symbols.

The results should be interpreted with extreme caution secondary to small sample size. Additionally, the MAIN stimuli were originally utilized with children and the story structure may have been too simplistic for the participants to engage in code-switching as a compensatory strategy. Finally, participants were required to navigate to engage the toggle feature in the SGD settings. The working memory demand associated with three clicks to successfully toggle between languages as well as the disconnect between the language trees may have prevented code-switching within the SGD; however, this pilot study provided important data on how to improve SGD toggle features that enhance code-switching in adults with bilingual aphasia.

Macrostructure and Microstructure

Macrostructure and Microstructure measures are crucial to assess because current technological innovation in AAC is limited with respect to minority populations. While by no means conclusive, this study suggests that an easy-to-use language toggle feature that facilitates code-switching may enhance discourse outcomes for bilingual individuals. When interpreting the results, many outcomes need to be carefully considered.

All microstructure and macrostructure variables in this study were likely impacted by the three-clicks required to toggle between languages. The clicks were required because software developers had yet to connect the language trees for a seamless language transition.

Therefore, the working memory demands required to pause mid-conversation, toggle, navigate to the appropriate topic display, and resume communication likely negated some of the toggle benefits. For example, Brock et al. (2017) investigated the effects of visual scenes and grid displays on communication outcomes in persons with aphasia. They found that participants' communication outcomes (e.g., conversational time, syntactic complexity, and conversational turns) were superior in the scene display condition when compared to the grid display condition. Brock and colleagues reasoned that visual scene displays require very little navigation, thereby allowing persons with aphasia to focus on aided or naturally spoken language rather than extraneous operational competencies. Thus, the grid displays used in this study are likely not the ideal interface design for people with aphasia. We hypothesize that incorporating visual scenes could positively impact the macrostructure and microstructure variables used in the current study.

When evaluating macrostructure, P1 code-switching condition contained the highest story structure scores of all three conditions. In the *Language Mixing Questionnaire and the LEAP-Q,* P1 reported utilizing both languages and having an increase in the frequency of language-mixing after her stroke and reported mixing words or sentences from the two languages. P1 also had the highest internal state items and variation in structural complexity for outcome attempt, goal outcome, and local and global coherence. The increased instances of code-switching post-stroke may have influenced P1's language outcomes. P2's *Language Mixing Questionnaire and LEAP-Q* revealed that the participant sometimes mixes words or sentences from the languages but indicated a four on a scale where one indicates mixing is very rare and five indicates mixing is very frequent for both English and Spanish. P2 reported that language mixing with family members post-stroke happens sometimes and reports a higher level of proficiency in Spanish but still utilizing English often. This is evident in internal state items, structural complexity, and story structure. P2's highest score for story structure included the Spanish condition followed by the codeswitching condition with comparable internal state times in both conditions. Therefore, language proficiency and mixing post-stroke may have impacted macrostructure language outcomes.

Another variable impacting language outcomes is language proficiency and comfortability. P2 indicated having a higher level of proficiency and feeling more comfortable using Spanish compared to English. The microstructure outcome data supports this because P2 performed better in the Spanish condition for words per minute and type-token ratio and demonstrated no instances of code-switching. The code-switching condition for P2 had the next highest outcomes for type-token ratio and had the highest amount of different total words, with ten instances of code-switching (i.e., nine verbal and one toggle). When explicitly told participants were allowed to code-switch, P2 demonstrated an increased frequency of code-switching (10 instances) compared to one other single instance of codeswitching in another condition, compared to P1, who demonstrated only three instances of code-switching in the code-switching condition and five in another condition. P1 reported having increased language mixing, while P2 sometimes indicated language mixing. As reported in the language mixing questions, instances of language mixing could have impacted both macro and microstructures.

In contrast, P1 reported that English was most proficient and comfortable language. The code-switch condition second-best outcomes in type-token ratio and words per minute. Although she demonstrated a higher type of token ratio in the Spanish condition, P2 demonstrated decreased words per minute and increased frequency of code-switching (five verbal instances). Previous research indicates that code-switching is a compensatory strategy used to improve communication (Neumen et al., 2017; Paplikar, 2016; Lerman et al., 2015). If participants felt less comfortable or proficient throughout the experimental conditions, they could employ code-switching (i.e., verbally and toggle feature) to improve communication.

Therefore, indicating language proficiency, mixing, and comfortability may have impacted language outcomes and shown that code-switching may increase microstructure language outcomes in the less proficient language.

The final variable that could have impacted the results was the MAIN story stimuli. While culturally appropriate with parallel structures and linguistically similar content, the baby goat story (i.e., code-switch condition) had three characters compared to the four characters in the other two conditions. This may have reduced the cognitive and linguistic demand of storytelling, increasing the macrostructure and microstructure outcomes in condition. P1's story structure, internal state items, structural complexity for outcome attempt, goal outcome, local and global coherence were highest in the code-switching condition. While global coherence, story structure, structural complexity for goal outcome were the highest in this condition for P2. Overall, it appears that the picture sets themselves, AAC usage/competences prior to the study, and language proficiency likely impacted the outcomes rather than the SGD toggle feature.

Working Memory Demands of the Current Toggle Feature

One crucial component of implementing code-switching into AAC treatment is the technology barriers limiting usability. Innovation and research investigating the effects of SGD for non-English speaking persons with aphasia are lacking (Lorenzen & Murrary, 2008; Tönsing et al., 2019). Despite a proliferation of consumer technologies for AAC purposes (Koul, 2011), both high and low tech, SGD manufacturers have poorly addressed multicultural considerations. Specific to this study is the lack of an effective code-switching method for individuals with aphasia. Lingaphica, the SGD utilized in this study, has developed a toggle feature that allows users to toggle between languages without changing the language, voice, or symbols. However, the process includes a series of three mouse clicks that must be recalled during conversation, essentially bringing communication to a halt. The toggle feature also reverts the device back to the home screen and not the page the participants toggled away from, creating increased working memory demand for the client to recall the specific page they were at and where communication left off. This is due to the toggle being on two separate "trees" within the same software program for English and Spanish; essentially, the toggle is creating a Spanish and an English device. This disconnect between the two trees likely increases the working memory demands for persons with aphasia using AAC and creates increased demand for clinicians/communication partners who are configuring the device because they must program the system twice. According to Brock et al. (2017), the successful use of SGDs also relies on adequate working memory resources. Without working memory resources or an increased cognitive demand participants may have a more difficult time successfully navigating the toggle feature. Brock et al. (2017) also spoke on the impact of dual task demands, such as communication and AAC display navigation. In this study, participants had an increased display navigation demand to locate, utilize the toggle feature, find the page they left off at, and then continue communication. Thus, placing higher working memory demands on the participants possibly impacting the communicative outcome measures; specifically, the infrequent use of code-switching.

The navigation required to use the toggle feature may have been partly responsible for increased story time as well as negatively impacting words per minute. Thistle and Wilkinson (2013) state that it has been increasingly recognized that aided AAC systems impose certain demands on individuals who use them and failure to examine these demands may contribute to systems that continue to be unintentionally and unnecessarily difficult to use. While not assessed prior to the data collection, AAC usage/competencies of both participants could have impacted language discourse outcomes. For example, P2 relied heavily on natural speech and utilized the SGD infrequently compared to P1. This suggests that the toggle feature was indeed inefficient for P2, P1 had a higher level of competence in AAC than P2, or that P1's aphasic language was so severe that she needed the additional AAC support to tell the story; hence her increased use of symbols when compared to P2.

Limitations and Future Directions

Due to COVID-19 and the specificity of inclusion criteria, participants were difficult to recruit, reducing the power of this study. There were some inherent difficulties with data collection through tele-practice methods as well. The examiner was not able to set up the device manually and relied on the participant themselves, a caregiver, and a Lingraphica representative to send and upload the experimental grids to the participant's device. Another limitation included the novelty of Lingraphica's toggle feature. Bilingual individuals had never seen this function before. Additionally, toggling between languages required three clicks to resume storytelling, contributing to the outcomes of this study.

More research is needed to better understand bilingual persons with aphasia who utilize SGDs and to better understand bilingual SGD use. AAC manufacturers need to continue developing and improving toggle features to allow for a more seamless toggle that allows individuals to toggle between languages without increasing cognitive demand (i.e., working memory, joint attention, asking communication partners more time, continuing conversation). Future directions for this study include investigating code-switching toggle features utilizing a visual scene displays with a greater number of participants. Other directions need to focus on diversifying the field to increase multilingual/multicultural clinicians who feel competent in evaluating, treating, and supporting diverse clients. Research should be conducted with a higher number of participants to confidently say that a toggle feature that allows participants to toggle between one language or another increases language discourse. Lastly, a shift of the perceptions of SGD use needs to shift from the last resort use to an aid that can be used to support, compensate, and or restore communication.

Clinical Implications

Following the cessation of data collection, Lingraphica has made several changes to their device interface that has big implications for clinicians and bilingual speakers using AAC. Lingraphica has since reworked their toggle feature to a translation button. This allows users to translate symbols within the device without toggling and seeing all translated symbols on display. This decreases the need to program two separate trees or two devices due to the toggle features lacking interconnectivity. This feature now integrates the separate trees into one, increasing interconnectivity decreasing programming time for clinicians, family members, or the client themselves. The translate feature is now on the main interface, decreasing utilization of the feature from three clicks to one click. Thus, decreasing physical and cognitive demands of utilizing the toggle feature, scanning and utilizing the symbol of choice, and continuing or repairing discourse with a communication partner. Implementation of the translate button allows monolingual SLPs to teach the use of this feature without the linguistic demand of knowing the client's other language and programming a culturally and linguistically appropriate device.

The utilization of this translate feature allows bilingual AAC users to effectively code-switch languages with less physical and cognitive decline. In addition, due to the paucity of bilingual SLPs, only 6.5% identifying as bilingual, a translate button allows 93.5% of monolingual SLPS American Speech, Language, and Hearing Association [ASHA], 2019a; ASHA, 2019b; Lorenzen & Murray, 2008) to implement and train a translate button for cultural and linguistically diverse clients.

In "AAC is Not a Last Resort," a podcast by Dr. Kris Bock, he and Dr. Dietz discuss the perception that AAC has been seen as a last resort by many clients and SLPs. They discuss that shift is needed to switch the perspective of AAC as a last resort to one of assistive technology, such as someone utilizing a cane or walker to help ambulate (Brock, 2021). This shift in perspective could increase early adoption of SGDs as well as utilization of the device as a *support* and a tool for language *rehabilitation*.

Conclusion

This study aimed to investigate the effects of a new SGD bilingual feature that allows individuals to switch between languages for communication purposes effectively. While this research exposed serval gaps in the literature, technology, and access, preliminary data suggests that code-switching may increase discourse outcomes in people with aphasia in terms of total number and total different number of words and symbols and have higher or equal local or global coherence numbers. Further advancement of current AAC technology to improve toggle features that allow for more seamless switching is needed to capture the full extent of code-switching outcomes in discourse. Further research in culturally and linguistically diverse populations is also warranted to fill in the paucity of research in several fields such as working memory, AAC implementation/treatment, SLP competence in working with these populations, and knowledge of aphasia in the bilingual brain, and the effects of code-switching.

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Appendix A

MAIN Scorning Sheet for Dog

MAIN – Revised version in English

Scoring sheet for Dog

Section I: Production

A. Story Structure; B. Structural complexity; C. Internal State Terms (IST)

A. Story Structure

		Examples of correct responses[6]	Score
A1.	Setting	Time and/ or place reference, e.g. once upon a time/ one day/ long ago… in a forest/ in a park/ in a meadow/ in a field/ by a tree/ near a tree/ by the road	0 1 2[7]
		Episode 1: Dog (Episode characters: dog and mouse)	
A2.	IST as initiating event	**Dog** was playful/ curious **Dog** saw a mouse	0 1
A3.	Goal	**Dog** wanted to catch/ get/ chase the mouse/ play with the mouse (In order) to + VERB (catch, get, play with)	0 1
A4.	Attempt	**Dog** jumped forward/ up **Dog** chased/ started to chase **Dog** tried to + VERB (catch, get, grab, take)	0 1
A5.	Outcome	**Dog** bumped his head/ bumped into the tree/ did not get the mouse/ was not quick enough **Mouse** escaped/ ran behind the tree/ was too quick	0 1
A6.	IST as reaction	**Dog** was disappointed/ angry/ hurt **Mouse** was happy/ glad/ relieved	0 1
		Episode 2: Boy (Episode character: boy)	
A7.	IST as initiating event	**Boy** was sad/ unhappy/ worried about his balloon **Boy** saw the balloon in the tree	0 1
A8.	Goal	**Boy** decided/ wanted to get his balloon back (In order) to + VERB (get) back	0 1
A9.	Attempt	**Boy** was/is pulling/ tried to pull the balloon down from the tree **Boy** jumped after the balloon/ reached for (the balloon)/ was/is climbing (the tree)	0 1
A10.	Outcome	**Boy** got his balloon back/ again **Balloon** was saved	0 1
A11.	IST as reaction	**Boy** was glad/ happy/ satisfied/ pleased/ relieved (to get/have his balloon back)	0 1
		Episode 3: Dog (Episode character: dog)	
A12.	IST as initiating event	**Dog** saw/ noticed the sausages (in the bag) **Dog** was hungry/ curious/ keen on the sausages	0 1
A13.	Goal	**Dog** wanted/ decided to get/ grab/ eat/ have/ steal the sausages (In order) to + VERB (eat, get)	0 1

[6] If in doubt or the response of the child is not on this scoring sheet consult the manual.
[7] Zero points for wrong or no response, 1 point for one correct response, 2 points for reference to both time and place.

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MAIN – Revised version in English

A14.	Attempt	**Dog** was/is grabbing/pulling/ taking/ stealing the sausages **Dog** grabs/pulls/takes the sausages (out of the bag)/ reached for the sausages **Dog** tried to + VERB (get, take)	0	1
A15.	Outcome	**Dog** ate/ got the sausages	0	1
A16.	IST as reaction	**Dog** was satisfied/ glad/ pleased/ happy/ not hungry (any more)	0	1
A17.		**Total score out of 17:**		

B. Structural complexity

Number of AO sequences	Number of single G (without A or O)	Number of GA / GO sequences	Number of GAO sequences
B1.	B2.	B3.	B4.

C. Internal State Terms (IST)

C1.	Total number of IST in tokens. IST include: **Perceptual state terms** e.g. *see, hear, feel, smell;* **Physiological state terms** e.g. *thirsty, hungry, tired, sore, hurt(ing)*; **Consciousness terms** e.g. *alive, awake, asleep*; **Emotion terms** e.g. *sad, happy, glad, angry, worried, disappointed; afraid, scared, proud, brave,* (feel) *safe, pleased, surprised;* **Mental verbs** e.g. *want, think, know, forget, decide, believe, wonder, have/ make a plan*; **Linguistic verbs/ verbs of saying/ telling** e.g. *say, call, shout, warn, ask.*

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Appendix B

MAIN Scorning Sheet for Baby Birds

MAIN – Revised version in English

Scoring sheet for Baby Birds

Section I: Production

A. Story Structure; B. Structural complexity; C. Internal State Terms (IST)

A. Story Structure

		Examples of correct responses[11]	**Score**
A1.	Setting	Time and/ or place reference, e.g. once upon a time/ one day/ long ago... in a forest/ in a meadow/ in a garden/ in a field/ in a bird's nest/ up a tree	0 1 2[12]
Episode 1: Mother/ Bird (Episode characters: mother bird and baby birds)			
A2.	IST as initiating event	**Baby birds** were hungry/ wanted food/ cried for food/ asked for food **<Mother/ Bird/ Parent, etc.>** saw that baby birds were hungry/ wanted food	0 1
A3.	Goal	**Mother bird** wanted to feed baby birds/ to catch/ bring/ get/ find food/ worms (In order) to + VERB (get food)	0 1
A4.	Attempt	**Mother bird** flew away/ went away/ looked for food/ was fetching food **Mother bird** tried to + VERB (get food)	0 1
A5.	Outcome	**Mother bird** got/ caught/ brought/ came back with food/ a worm/ fed the babies **Baby birds** got food/ a worm	0 1
A6.	IST as reaction	**Mother bird** was happy/ satisfied/ pleased **Baby birds** were happy/ satisfied/ pleased/ not hungry any more Text	0 1
Episode 2: Cat (Episode characters: cat and baby bird(s))			
A7.	IST as initiating event	**Cat** saw mother flying away/ saw that baby birds were all alone/ saw that there was food **Cat** was hungry/ thought "yummy"	0 1
A8.	Goal	**Cat** wanted to eat/ catch/ kill baby bird/-s (In order) to + VERB (eat, catch, kill, get)	0 1
A9.	Attempt	**Cat** was/ is climbing up the tree **Cat** tried to reach/ get baby bird **Cat** climbed/ jumped up (the tree)	0 1
A10.	Outcome	**Cat** grabbed/ got baby bird **Cat** nearly/almost + VERB (caught, got)	0 1
A11.	IST as reaction	**Cat** was happy **Bird/-s** was/ were scared/ crying/ screaming with pain	0 1
Episode 3: Dog (episode characters: dog, cat and baby bird(s))			
A12.	IST as initiating event	**Dog** saw that the bird was in danger/ saw that cat caught/ got the bird **Bird/-s** was/were in danger	0 1
A13.	Goal	**Dog** decided/ wanted to stop the cat	0 1

[11] If in doubt or the response of the child is not on this scoring sheet consult the manual.
[12] Zero points for wrong or no response, 1 point for one correct response, 2 points for reference to both time and place.

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MAIN – Revised version in English

		Dog decided/ wanted to help/ protect/ save/ rescue the bird(-s) (In order) to + VERB (stop, rescue, help)	
A14.	Attempt	**Dog** was/is pulling/ dragging the cat down/ biting/ attacking the cat/ grabbing the cat's tail **Dog** tried to + VERB (pull, drag, get down) **Dog** pulled/ dragged the cat down/ bit/ attacked the cat/ grabbed the cat's tail	0 1
A15.	Outcome	**Dog** chased the cat (away)/ scared the cat off/ away **Cat** let go of the baby bird/ ran away **Bird/-s** was/ were saved/ rescued	0 1
A16.	IST as reaction	**Dog** was relieved/ happy/ proud (to have saved/ rescued the baby bird) **Cat** was angry/ disappointed/ feeling bad/ mad/ scared/ in pain/ cat's tail hurt **Bird/-s** was/ were relieved/ happy/ safe **Mother bird** was relieved/ happy	0 1
A17.		**Total score out of 17:**	

B. Structural complexity

Number of AO sequences	Number of single G (without A or O)	Number of GA / GO sequences	Number of GAO sequences
B1.	B2.	B3.	B4.

C. Internal State Terms (IST)

C1.	Total number of IST in tokens. IST include: **Perceptual state terms** e.g. *see, hear, feel, smell;* **Physiological state terms** e.g. *thirsty, hungry, tired, sore, hurt(ing)*; **Consciousness terms** e.g. *alive, awake, asleep*; **Emotion terms** e.g. *sad, happy, glad, angry, worried, disappointed, afraid, scared, proud, brave,* (feel) *safe, pleased, surprised;* **Mental verbs** e.g. *want, think, know, forget, decide, believe, wonder, have/ make a plan*; **Linguistic verbs/ verbs of saying/ telling** e.g. *say, call, shout, warn, ask.*

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Appendix C

MAIN Scorning Sheet for Baby Goat

MAIN – Revised version in English

Scoring sheet for Baby Goats

Section I: Production

A. Story Structure; B. Structural complexity; C. Internal State Terms (IST)

A. Story Structure

		Examples of correct responses[16]	**Score**
A1.	Setting	Time and/ or place reference, e.g. once upon a time/ one day/ long ago... in a forest/ in a meadow/ in a field/ by a lake/ at the lake/ at the pond	0 1 2[17]
Episode 1: Mother/ Goat (episode characters: baby goat and mother/ goat)			
A2.	IST as initiating event	**Baby goat** was scared/ in danger/ needed help/ cried (for help)/ called the mother **<Mother/ Goat/ Parent, etc.>** saw that the baby goat was scared/ in danger/ drowning/ couldn't swim **<Mother/ Goat/ Parent, etc.>** was worried about the baby goat in the water	0 1
A3.	Goal	**Mother goat** wanted to help the baby/ to save/ rescue the baby/ to push the baby out of the water/ to get it out of the water (In order) to + VERB (rescue, help) the baby	0 1
A4.	Attempt	**Mother goat** ran/ went into the water **Mother goat** is pushing/ helping **Mother goat** tried to + VERB (help, push)	0 1
A5.	Outcome	**Mother goat** pushed the baby out of the water/ saved/ rescued/ helped the baby out **Baby goat** was saved/ out of the water	0 1
A6.	IST as reaction	**Mother goat** was happy/ relieved **Baby goat** was relieved/ satisfied/ happy/ glad/ not scared any more	0 1
Episode 2: Fox (episode characters: fox and baby goat)			
A7.	IST as initiating event	**Fox** saw mother looking away/ saw that the baby was alone/ saw that there was food **Fox** was hungry/ thought "yummy"	0 1
A8.	Goal	**Fox** wanted to eat/ catch/ kill the baby goat (In order) to + VERB (eat, catch, get, kill)	0 1
A9.	Attempt	**Fox** jumped up/ out/ jumped towards the baby goat **Fox** tried to reach/ grab/ catch the baby goat	0 1
A10.	Outcome	**Fox** got/ grabbed/ caught the baby goat **Fox** nearly/almost + VERB (got, caught)	0 1
A11.	IST as reaction	**Fox** was happy **Baby** goat was scared/ crying/ screaming with pain	0 1
Episode 3: Bird (episode characters: bird, fox and baby goat)			
A12.	IST as initiating event	**<Bird, Crow, etc.>** saw that the goat was in danger/ saw that the fox caught/ got the goat **Baby goat** was in danger	0 1

16 If in doubt or the response of the child is not on this scoring sheet consult the manual.

17 Zero points for wrong or no response, 1 point for one correct response, 2 points for reference to both time and place.

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A13.	Goal	**Bird** decided/ wanted to stop the fox **Bird** decided/ wanted to help/ protect/ save the baby goat (In order) to + VERB (stop, rescue, help)	0 1
A14.	Attempt	**Bird** was/is biting/ dragging the fox's tail/ the fox **Bird** bit/ dragged/ got the fox's tail/ attacked the fox **Bird** tried to + VERB (get fox off)	0 1
A15.	Outcome	**Bird** chased the fox (away)/ scared the fox off/ away **Fox** let go of the baby goat/ ran away **Baby goat** was saved/ rescued	0 1
A16.	IST as reaction	**Bird** was relieved/ happy/ proud (to have saved/ rescued the baby goat) **Fox** was angry/ disappointed/ feeling bad/ mad/ scared/ in pain/ fox's tail hurt **Baby goat/ -s** was/were relieved/ happy/ safe **Mother goat** was relieved/ happy	0 1
A17.		**Total score out of 17:**	

B. Structural complexity

Number of AO sequences	Number of single G (without A or O)	Number of GA / GO sequences	Number of GAO sequences
B1.	B2.	B3.	B4.

C. Internal State Terms (IST)

C1.	Total number of IST in tokens. IST include: **Perceptual state terms** e.g. *see, hear, feel, smell;* **Physiological state terms** e.g. *thirsty, hungry, tired, sore, hurt(ing)*; **Consciousness terms** e.g. *alive, awake, asleep*; **Emotion terms** e.g. *sad, happy, glad, angry, worried, disappointed, afraid, scared, proud, brave,* (feel) *safe, pleased, surprised;* **Mental verbs** e.g. *want, think, know, forget, decide, believe, wonder, have/ make a plan*; **Linguistic verbs/ verbs of saying/ telling** e.g. *say, call, shout, warn, ask.*