Procedural Discourse Analysis in Children with Specific Learning Disorder (SLD)

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Procedural discourse production in children with specific learning disorder (SLD)

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Abstract

Background: The term 'Specific Learning Disorder' which is commonly used in federal and state law, the Diagnostic and Statistical Manual of Mental Disorders (DSM) interferes with a student's ability to listen, think, speak, write, spell, or do mathematical calculations. Procedural discourse can be defined as a goal-oriented monologue in which a series of steps are involved in a specifiable manner (conceptual or chronological). **Aim:** The present study aims at investigating the Macro and Micro Structural production of Discourse elicited through a procedural task using a video given lemonade preparation. **Method:** 10 individuals with Specific Learning Disorders ages ranging from 7 to 12 years and 10 age-matched typically developing children who has Tamil as their native mother tongue and whose medium of instruction is English were enrolled in the study. To assess their discourse skills, participants were engaged in a Procedural task on 'preparation of a lemonade procedure". All the samples were transcribed orthographically and divided into communication units following which the macro and microstructural analyses were carried out. The comparison of raw scores between both the groups was subjected to statistical analysis for obtaining significant values. **Results:** The individuals with Specific Learning disorders underperformed neuro-typical individuals in complex structures per utterance, relevant pieces per utterance, and Information Adequacy. **Conclusion:** It is evident from the present study that Specific Learning Disorder has an effect on Procedural performance and this, in turn, has an effect on the language performance in an individual.

Key Words: Specific Learning Disorder, Procedural, Discourse, Macro, Micro-structural

1. Introduction

Discourse is the use of language in the social context in either written or spoken form. A narrowed definition refers to discourse as language beyond the simple sentence (Ulatowska et al., 1983). The genre of discourse can be broadly classified as interactive and non-interactive. One such example of interactive is the conversational discourse, which requires aspects such as topic shift rules, eye contact, turn-taking, etc. On the other hand, non-interactive discourses such as monologues include narrative and procedural discourse (Snow et al., 1997). Typically, procedural discourse can be defined as a goal-oriented monologue in which a series of steps are involved in a

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specifiable manner (conceptual or chronological). It involves a task that tells how something is done. The individual information units are known as steps (Cannito et al., 1988). These steps are classified as essential, optional, and target steps. Essential steps consist of the action required to complete the task, whereas optional steps add more clarity to the procedure with better clarification and details. Finally, completion of a procedure is indicated by the target step. (Ulatowska et al., 1983). The degree to which information is judged is classified as explicit or implicit. Steps that are implied within explicit steps are called implicit steps. Even though a simplified classification system is basic for the purpose of analysis, the hierarchical differentiation of steps is not distinctive in typical individuals. Similarly, there are unexplored analyses of discourses in children with Specific Learning disorders, especially using a procedural task.

Compromised procedural learning has been proposed as one of the possible causes of developmental dyslexia (DD) and specific language impairment (SLI). Specific Learning Disorder (SLD) is a neurological disorder in which basic psychological processes involved in the use of language are deficient. It is formerly known as Learning Disability. These children may have difficulty in understanding and learning academic skills such as reading, writing, and mathematics. A few general characteristics include inattentiveness, language problems, and auditory perceptual problems such as poor auditory memory, recall, recognition, and sequential memory (Rachamalla, 2016). They have a poor procedural memory but an intact declarative and non-sequential memory (West et al., 2019). One of the risk factors widely known to be present in language learning disorders is impaired procedural learning (West et al., 2018)

The procedural memory system controls the acquisition, consolidation, and atomization of motor, perceptual and cognitive skills (Lum, Gelgic, & Conti-Ramsden, 2010). Repetitive skills learned through sensorimotor and cognitive habits embody procedural memory. In language, it underpins the literacy of a 'Mental Grammar', which is concerned with the rule-grounded procedures that govern the discrepancies of language (Chomsky, 1980; Ullman, 2004). The procedural deficit hypothesis suggests that it is a deficit in procedural sequence learning that is a critical cognitive risk factor for dyslexia and language impairment (Nicholson & Fawcett, 2010). Age-related changes that happen for better declarative and procedural memory vary in children. Neuroimaging data suggest subtle differences in development may be observed after late childhood, as its stable until then. However, procedural memory stabilization occurs at a point during maturation although accurately uncertain (Bouyeure & Noulhiane, 2020).

Procedural tasks manifest the use of long-term memory and its prime importance lies around "how to do", rather than "what to do" or "who does it". This ability to understand and produce steps is crucial for these children, in order to carry out basic procedural activities This has great implicature of linguistic markings in many languages that serve as communicative functions. Unlike the declarative memory systems, procedural memory

incorporates sensorimotor and cognitive skills and regulates the process of atomization. The deficit in sequential procedural learning is remarkably a cognitive risk component in specific learning disorders (West et al., 2018).
Discourse analysis is the study of human communication using various models and constructs. A very few procedural discourse studies exist with SLD children and therefore, this study applies new constructs to study the microstructure and macrostructure language abilities of children with Specific Learning Disorder via a procedural task.

2. Methodology

2.1. Participants

A total of 20 children [10 typically developing children (TDC); 10 children with Specific Learning Disorder] were included in the crossectional study. The study aimed in investigating the Macro linguistic and Micro linguistic aspects using procedural discourse tasks in children with learning disabilities strictly adhering to the age range 7 - 12 years.

2.2. Materials

The Samples and data required were collected using,

1. A general demographic data form including Name, Age/Gender, contact number, Name of the school the child is attending, Current grade/ class the child is studying, Medium of instruction in school, Age of identification of learning disability, Nature of learning disability and the other rehabilitative services attended were also documented.
2. A 10- item checklist with options 'yes' or 'no', adapted from DSM-V criteria for Specific Learning Disorder (Table 1), was obtained from the parents.
3. An informed consent was obtained from all the parents of SLD.
4. A pre-recorded "lemonade" preparation video was used to elicit the procedural discourse.

Table 1.
Parental Checklist for Specific Learning Disorder

1.	The child exhibits poor eye contact and is inattentive.	YES	NO
2	The child has difficulty to follow multiple commands.	YES	NO
3.	The child exhibits difficulty to remember things.	YES	NO
4.	The child exhibits difficulty to follow the lines and read.	YES	NO
5.	The child has difficulty in pronouncing multi syllabic words.	YES	NO

6.	The child exhibits reversal of letters when writing.	YES	NO
7.	The child jumbles the words and do not space them appropriately.	YES	NO
8.	The child has a very poor hand writing.	YES	NO
9.	The child has difficulty to recall the instances from past and narrate them cohesively.	YES	NO
10.	The child has difficulty in using the language to communicate effectively.	YES	NO

2.3. Procedure

The Entire procedure was carried out on an online video communication platform. Initially, informed consent were collected from parents. The parents were asked to fill the demographic data form to acquire all the necessary general details about the child. Then, the close-ended checklist was administered to the parents to document the children's academic and communication abilities. After obtaining all the data, Discourse sample collection was carried out. The children were shown a pre-recorded video of lemonade preparation without verbal information. After the lemonade video was played, every child was asked by the clinician to "Tell me all the steps involved in making a lemon juice". The samples were audio and video recorded with the consent of the parents. The recorded samples were transcribed later for analyzing their Macrostructural and Microstructural linguistic abilities in procedural discourse.

Table 2.
Domains and Subdomains of Macrostructure and Microstructure

S. No	Domains	Subdomains
1.	Macrostructure	i. Total number of steps ii. Content a) Objects required for the procedure b) Actions required for the procedure c) Level of Detailing iii. Clarity of the narration iv. Topic management v. Information
2.	Microstructure	i. Total number of words (TNW) ii. Total number of different words (TDW) iii. Total number of content words (NCW) iv. Total number of functional words (NFW) v. Number of bound morphemes (NBM)

vi. Number of free morphemes (NFM)
vii. Total number of morphemes (TM)
viii. Proportion of content words (PCW)
ix. Proportion of functional words (PFW)
x. Proportion of morphemes (PM)
xi. Complex structure per utterance (CSU)
xii. Relevant pieces per utterance (RPU)
xiii. Mazes per utterance (MPU)
xiv. Number of pronouns (NP)
xv. Number of ambiguous pronouns (NAP)
xvi. Cohesion percentage (CP)

2.4. Macrostructural Analysis

The macrostructural analysis is subjected to analyzing the ability to initiate the topic and maintain it. It also focuses on the ability of the individual to convey the intended message. Overall organization and delivery of the message is explored. These parameters are examined mainly for their presence or absence in each discourse. Four main domains namely "Number of steps involved, content, clarity of the narration, topic management, and information adequacy" were analyzed from the sample we obtained.

A total number of steps involved to narrate the procedure was counted. Three Subdomains - "Objects required for the procedure, actions required for the procedure, and Level of Detailing" in content was analyzed using a 4-point rating scale. The domain "clarity of the narration" was analyzed using a 3-point rating scale. Topic management and information adequacy were analyzed using a 5- point rating scale as provided (Ulatowska et al., 1983). The scales of each domain are mentioned in the **Appendix 1**. Rating basis and instructions for each domain are explained in **Table 3**.

Table 3.
Rating of the macrostructural discourse based on the instructions for each domain Microstructural Analysis

S. No	Domain	Instructions for rating
1	Total number of steps involved	The total number of steps it took for the child to narrate the procedure
2	Content	
	a. Objects required for the procedure	Naming all the essential ingredients and properties.
	b. Actions required for the procedure	Describe all the essential actions involved in the activity.

	c. Level of Detailing	Narrating the procedure with explicit detailing is sufficient for the listener to understand.
3	Clarity of the narration	The language of the child while narrating the procedure is rated.
4	Topic management	Narration of the procedure while maintaining a topic without any deviations.
5	Information adequacy	Length of utterances it took for the child to convey the information

2.5. Microstructural Analysis

The microstructural analysis is more focused on the fine-drawn elements of the discourse such as lexical diversity, the structure of the sentence, and referential cohesion. In a discourse, linguistic features of the language are represented as the narrative microstructure such as the usage of morphemes, and different types of words (content and functional words). The diversity of the discourse is achieved by the fine usage of microstructural features.

A total number of words, different words, content words, functional words, pronouns, mental state words, bound morphemes, and free morphemes were manually counted from the transcribed sample. The proportion of content words, functional words, and morphemes were acquired by dividing the domain of interest by different words. Ambiguous pronouns, mazes (disfluencies), complex structure, and relevant pieces per utterance were determined based on their language- sentence formation, mean length of utterance, and the overall comprehensibility. The cohesion percentage was calculated by dividing the number of ambiguous pronouns by the total number of pronouns.

2.6. Statistical analysis

The raw data obtained for macrostructural and microstructural aspects were documented in Microsoft Excel 2010 and were subjected to statistical analysis using SPSS Version 21. Mann- Whitney test, Wilcoxon W test, and Z test were carried out.

3. Results

The mean age of 10 children with Specific Learning Disorder was 8.9 years. From the parental checklist for learning difficulty characteristics, 7 (70%) of them exhibit difficulty in following the lines, reading, and reversal of letters

when writing. 6 (60%) of them have difficulty pronouncing multi-syllabic words and 5 (50%) have difficulty following multiple commands and jumbling words and not spacing them appropriately. 3 (30%) of them have difficulty using the language to communicate effectively. 1 (1%) of them exhibit poor eye contact, is inattentive, and have very poor handwriting.

The mean and standard deviation of each domain has been listed in the tabular column from both macrostructural and microstructural analysis.

In **Macrostructural parameters**, the mean for total number of steps involved for carryout out the task for SLD group were 6.7 and 6.8 for TDC. Though the children with SLD underperformed in their macrostructural aspects, the domains except for the information adequacy did not show a significant difference. The value of p exact is less than 0.05 indicates that there is a statistical significance between the TDC and children with SLD on information adequacy.

Table 4.
Macrostructural statistical analysis

Group		N	Mean	SD	P Value
Objects required for the procedure	TDC	10.00	4.00	0.00	.317
	SLD	10.00	3.90	0.32	
Actions required for the procedure	TDC	10.00	3.40	0.52	.796
	SLD	10.00	3.30	0.67	
Level of detailing	TDC	10.00	3.10	0.74	.744
	SLD	10.00	3.20	0.79	
Clarity of the narration	TDC	10.00	2.60	0.52	.084
	SLD	10.00	2.00	0.82	
Topic management	TDC	10.00	4.40	0.52	.796
	SLD	10.00	4.30	0.67	
Information Adequacy	TDC	10.00	4.60	0.52	.001*
	SLD	10.00	3.40	0.52	

Note: *p= <0.005 significant difference

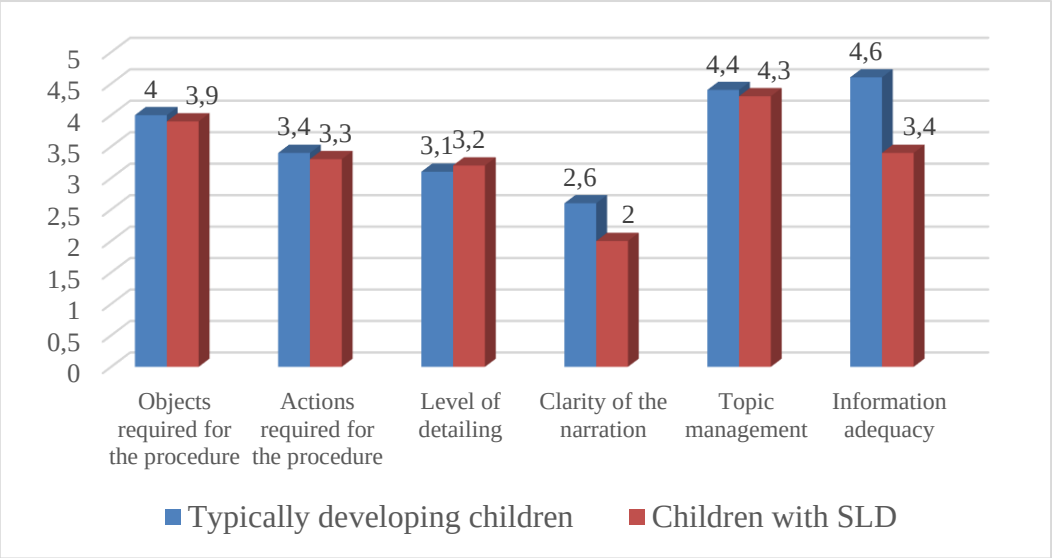

Figure 1: Mean average of macrostructural domains in Typically developing children and in children with Specific learning disorder

In **Microstructural analysis**, the value of $p<0.05$, rejects the null hypothesis This indicates that there is a significant statistical difference between the typically developing children and Specific Learning Disorder groups for the domains "complex structure per utterances" with a quantitative value of 3.0 and 1.01 and "relevant pieces per utterances" with the value of 3.3 and 1.10 respectively. The values for each domain are documented in Table 5.

Table 5.
Microstructural statistical analysis

Group		N	Mean	SD	P Value
TNW	TDC	10.00	33.60	13.33	0.60
	SLD	10.00	30.50	12.35	
TDW	TDC	10.00	19.80	3.91	0.36
	SLD	10.00	18.60	7.06	
NCW	TDC	10.00	12.90	2.64	1.00
	SLD	10.00	14.20	7.15	
NFW	TDC	10.00	6.50	2.88	0.13
	SLD	10.00	4.40	2.12	
NBM	TDC	10.00	0.50	0.71	0.20
	SLD	10.00	0.40	1.26	
NFM	TDC	10.00	32.20	14.75	0.85
	SLD	10.00	30.50	12.35	
TM	TDC	10.00	32.70	15.15	0.82
	SLD	10.00	30.90	13.30	
PCW	TDC	10.00	0.66	0.11	0.10
	SLD	10.00	0.75	0.11	
PFW	TDC	10.00	0.34	0.11	0.17
	SLD	10.00	0.30	0.21	
PM	TDC	10.00	1.02	0.02	0.16

	SLD	10.00	1.01	0.02	
CSU	TDC	10.00	3.00	1.15	0.01*
	SLD	10.00	1.10	1.52	
RPU	TDC	10.00	3.30	1.77	0.01*
	SLD	10.00	1.30	1.57	
MPU	TDC	10.00	3.40	2.22	0.28
	SLD	10.00	5.30	3.97	
NP	TDC	10.00	1.60	1.17	0.50
	SLD	10.00	1.20	1.03	
NAP	TDC	10.00	0.00	.000	1.00
	SLD	10.00	0.00	.000	
CP	TDC	10.00	1.00	0.000	1.00
	SLD	10.00	1.00	0.000	

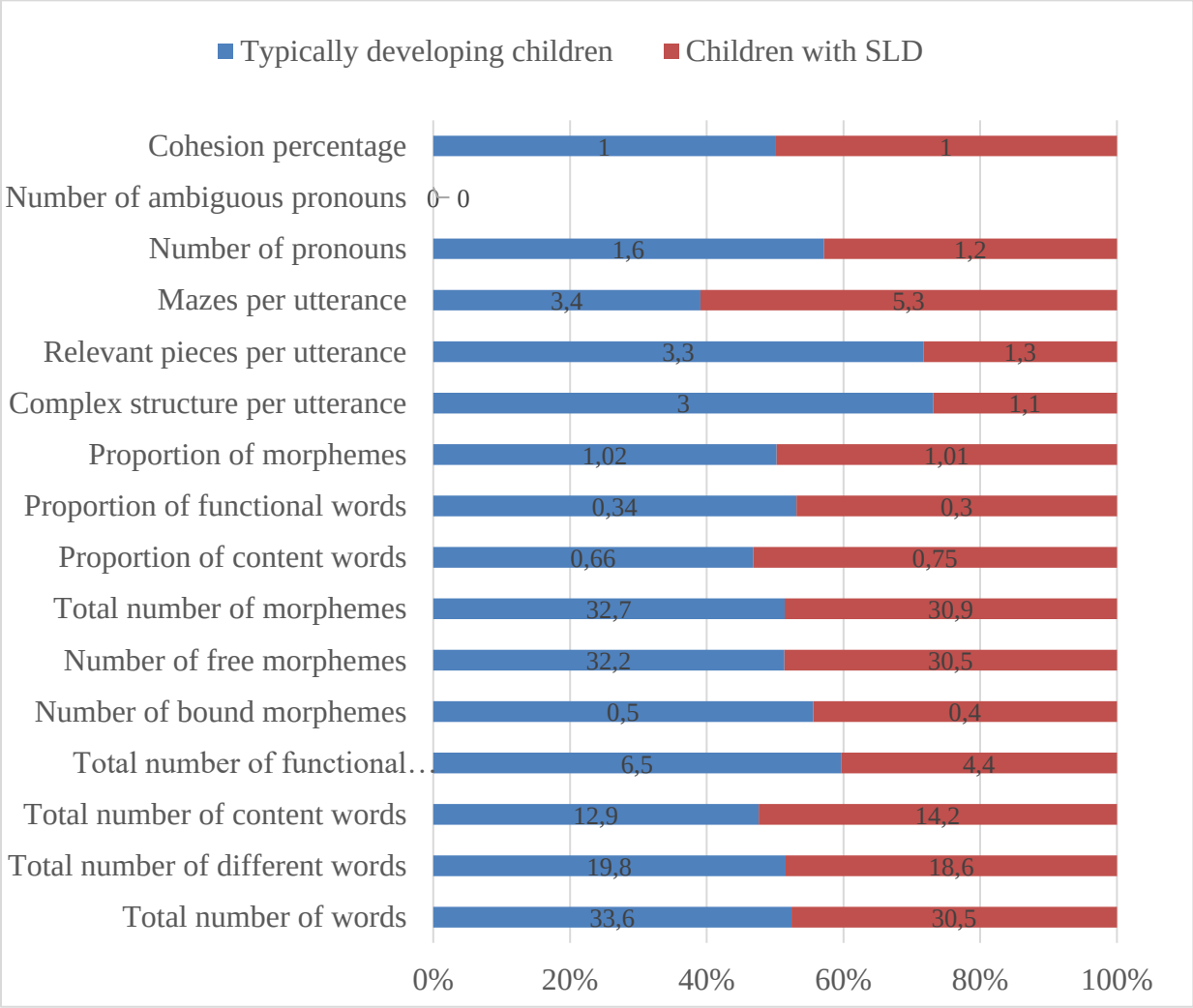

Figure 2: Mean average of microstructural domains in Typically developing children and in children with Specific learning disorder

4. Discussion

Procedural analysis using microstructural parameters revealed significant differences for complex structure per utterance and relevant pieces per utterance. Children with SLD have fewer words with a small proportion of pronouns. However, the lemonade preparation task did not involve many uses of pronouns and thus, no significant differences are noted. They also have few units of ideas with less syntactically complex sentences. Studies also suggest that the explanations provided by these children were inadequate and not explicit enough for the listener's needs. In fact, the use of conjunctions hinders the cohesiveness that is used to link pieces together (Ripich & Griffith, 1988). Nevertheless, these children did not have big significant differences for other parameters as they exhibit many intact learning systems that allow them to perform on par with the non-disabled children. One such reason that's widely quoted is an intact visual short-term memory and long-term memory (MY & MJ, 2008). This is in support of the studies that proved the rate of learning on visual-visual paired associates learning was equivalent to age-matched peers. Our findings results have a very strong correlation with this fact, as the stimuli were presented in the visual mode, in the form of a video. However, they have a poor verbal short-term memory and the rate of learning is slow compared to age-matched peers with verbal-visual and verbal-verbal mappings (Krishnan et al., 2016).

There were similar findings for macrostructural analysis as Information adequacy showed the statistical difference. Studies support that SLD children demonstrated problems with the organization of events and formulation of structures. Some of the reasons hypothesized were due to inefficient processing and organizational abilities. However, the parameters such as content, clarity, and topic management did not have statistical differences as TDC performed marginally better. The ability to recall a gist of information was significantly less than non-disabled children (FP & NJ, 1986). A series of embedded episodes places more demands on the cognitive system and this has resulted in more sequential and detailed steps. The episodic memory is more responsible for the number of information differences. In addition to these, children with SLD are intervened using various approaches with collaboration and many instructions (Bulgren & Carta, 1992). As these children receive special education services, who use more of an instructional approach, has made them follow each step from the video.

5. Conclusion

Specific Learning Disorder (SLD) is a neurological disorder in which basic psychological processes involved in the use of language are deficient. One of the risk factors widely known to be present in children with SLD is impaired procedural learning. In procedural discourse analysis done between Typically developing children and SLD children, a very discernible difference was seen between the two groups in almost all the domains of microstructural and

macro structural features. Out of the common, children with specific learning disorder performed on par with typically developing children in all the macrostructural domains except information adequacy as there is difficulty with the organization of events and formulation of structures. In microstructural domains, complex sentences per utterance and relevant pieces per utterance were the two domains that the typically developing children outperformed the children with SLD. This infrequent result was due to the fact that children with SLD have good visual short-term memory and an intact declarative and non-sequential memory.

6. Future directions

The current study has focused on eliciting discourse using a visual stimulus which has shown very few differences between the children without SLD and children with SLD. The uncommon findings between the two groups instigate the reasons behind the differential data as there is a customary trend of belief for the SLD population to perform poorer. Considering the underlined factors responsible for the outperformance, there is a greater quest for undertaking far-fielded research to explore other strengths that would help them to fill in for their deficient areas. Thus, future studies could be done based on this premise, using a larger sample size with added aims and objectives. To be more precise, the comparison can be done using video-only and audio-only stimuli shown to the children. The recall gap can also be varied with timed intervals as the memory recall would also be tapped. Studies can be done by emphasizing the outcomes and documentation of the procedural discourse with stimulus given in both visual and verbal modalities.

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Appendices

MACROSTRUCTURE ANALYSIS RATING SCALE FOR PROCEDURAL DISCOURSE:

i. **The total number of steps involved for the child to narrate the procedure**

ii. **Content:**

a. Are the objects necessary for performing the task clear?

4 Yes

3 For the most part

2 Not for the most part

1 No

b. Are the actions necessary for carrying out the task clear?

4 Yes

3 For the most part

2 Not for the most part

1 No

c. Was the amount of information given detailed enough to complete to perform the task?

4 Yes

3 For the most part

2 Not for the most part

1 No

iii. **How comprehensible is the language of the procedure?**

3 Ready, effortless

2 To a great extent; language presented with some difficulties

1 Not at all; language presented extreme difficulties

iv. **Topic management**

1. Provides no elaboration of the topic

2. Provides very minimal elaboration with the rapid shift from the given topic

3. Provides minimal elaboration with a gradual shift from the given topic

4. Provides minimal elaboration still staying within the given topic
5. Provides adequate elaboration and stays within the given topic

v. **Information Adequacy**

1. Completely inadequate
2. Word level
3. Two-word phrases
4. Single sentences
5. Uses complex and multiple sentences

DISCOURSE SAMPLE ANALYSIS

Lemon juice…first we must squeeze lemon and then some sugar….some sugar add some salt mix water…mint put and drink

/lɛmən//ʤus/…..
/fərst//vi//məst//skwiz//lɛmən//ænd//ðɛn//səm//ʃugər//səm//ʃugər//æd//səm//səlt//mıks//wa:tər/..../mınt//pʊt//ænd//drıŋk/

1.	**Macrostructure**	Total number of steps (squeeze lemon, some sugar, add some salt, mix water, mint put and drink)	6
		Content	
		Objects required for the procedure	4
		Actions required for the procedure	3
		Level of Detailing	2
		Clarity of the narration	2
		Topic management	4
		Information	3
2.	**Microstructure**	Total number of words (Lemon, juice, first, we, must, squeeze, lemon, and, then, some, sugar, some, sugar, add, some, salt, mix, water, mint, put, and, drink.)	22
		Total number of different words (lemon, juice, first, we, must, squeeze, and, then, some, sugar, add, salt, mix, water, mint, put, drink)	17
		Total number of content words (lemon, juice, squeeze, sugar, add,	11

	salt, mix, water, mint, put, drink)	
	Total number of functional words (first, we, must, and, then, some)	6
	Number of bound morphemes	0
	Number of free morphemes (lemon, juice, first, we, must, squeeze, lemon, and, then, some, sugar, some, sugar, add, some, salt, mix, water, mint, put, and, drink.)	22
	Total number of morphemes (lemon, juice, first, we, must, squeeze, lemon, and, then, some, sugar, some, sugar, add, some, salt, mix, water, mint, put, and, drink.)	22
	Proportion of content words (No. of content words/ No. of different words = 11/17)	0.64
	Proportion of functional words (No. of functional words/ No. of different words = 6/17)	0.35
	Proportion of morphemes (Total No. of morphemes/ Total No. of words = 22/22)	1
	Complex structure per utterance (Lemon juice first we must squeeze lemon and then some sugar some sugar add some salt mix water mint put and drink)	1
	Relevant pieces per utterance (Lemon juice first we must squeeze lemon and then some sugar some sugar add some salt mix water mint put and drink)	5
	Mazes per utterance (pauses)	3
	Number of pronouns (we)	1
	Number of ambiguous pronouns	0
	Cohesion percentage	100%