Story Retelling Therapy for Improving Spoken Discourse in Very Mild Aphasia: A Single-Case Feasibility Study

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Running Head: Story Retelling for Very Mild Aphasia

Story-retelling therapy for improving spoken discourse in very mild aphasia: A single-case feasibility study[1]

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Conflict of Interest: The authors declare no conflicts of interest related to this study.

[1] This manuscript was prepared with the assistance of OpenAI's ChatGPT (GPT-4, April 2024), which was used solely for refining grammar and improving clarity of expression. The author independently verified the accuracy and meaning of all content.

Abstract

Purpose: Individuals with poststroke aphasia often experience difficulties with spoken discourse. While existing treatments typically focus on linguistic impairments, they may not fully address limitations in verbal working memory. Story Retelling Therapy (SRT) was developed as a discourse-based language intervention using stories as the treatment material. Given its documented association with verbal working memory, story retelling may also engage cognitive processes in addition to targeting story retelling ability. This study explored the feasibility of implementing SRT with individuals with poststroke aphasia.

Methods: This study employed a pre-post feasibility design. Participants received nine one-hour sessions of story retelling therapy, delivered in person by the principal investigator. Three assessments were administered: a pre-test (Test 1), an immediate post-test (Test 2), and a delayed post-test (Test 3), conducted seven weeks after treatment.

Results: Results from the SRP-A suggested a 12% increase in Information Units (IUs) from pre-test to Test 2, and an additional 13.73% increase by Test 3. Percent IUs per minute (%IUs/min) increased by 81.25% from pre-test to Test 2, followed by a 24.14% decline after Test 3. Treated stories showed a mean IU increase of 78.4%. WAB-R AQ scores improved beyond the clinical aphasia threshold, indicating potential functional gains. Working memory scores exhibited slight improvements in subtraction span, alphabet span, and total scores. Neuroscreening results increased modestly and remained stable.

Conclusions: SRT may contribute to improvements in story retelling ability and discourse efficiency, as reflected in IU increases and changes in WAB-R scores. While working memory outcomes showed modest fluctuations, small gains were observed, possibly indicating short-term cognitive effects. These preliminary findings suggest that SRT is a feasible intervention for

aphasia and may hold promise in addressing both discourse-level language and verbal working memory.

Key Words: aphasia; story retelling; verbal working memory

Introduction

Spoken discourse plays a pivotal role in everyday communications. Impaired spoken discourse production is a particularly challenging symptom in individuals with post-stroke aphasia. To improve spoken discourse production, various treatment approaches have been implemented in individuals with aphasia, including constraint-induced aphasia treatment (CIAT) (Goral & Kempler, 2009), treatment of underlying forms (TUF) (Murray et al., 2007), modified response elaboration training (RET) (Wambaugh et al., 2013), semantic feature analysis (SFA) (Peach, & Reuter, 2010), oral reading for language in aphasia (ORLA) (Cherney et al., 2010a; Cherney et al., 2010b), and script-based therapy (Cherney et al., 2008; Cherney & Halper, 2008; Lee et al., 2009). These studies have focused on either single-word production (SFA: Antonucci, 2009; Falconer & Antonucci, 2012; Gordon, 2007; Greenwood et al, 2007; Focused discussion with RIPP: Nickels et al, 2016), sentence production (ORLA: Cherney, 2010a; Cherney et al., 2010b; CIAT: Goral & Kempler, 2009; TUF: Murray et al, 2007; RET: Wambaugh et al, 2013; Script: Cherney et al, 2008; Cherney & Halper, 2008; Lee et al, 2009; Other) or combinations (Carlomagn et al, 1991; Hickin et al, 2015; Marini et al, 2007; Milman et al, 2014; Penn and Beecham, 1992; Hoover et al, 2015, Whitworth, 2010; Whitworth et al, 2015; Dietz et al, 2018; McCall et al, 2009) in therapy. Although these interventions have revealed significant linguistic improvements, their limited generalization to everyday communication highlights the need for treatments targeting broader cognitive mechanisms underlying discourse production.

Limitations of Existing Aphasia Treatments

While current aphasia therapies offer clear benefits, they are limited in addressing the broader challenges experienced by individuals with mild aphasia. Although these individuals may present with only mild naming impairments, they often continue to struggle with retrieving, organizing, and conveying information effectively through discourse. This highlights the need for interventions that go beyond word retrieval and support holistic communication.

Traditional naming therapies have shown item-specific improvements in individuals with anomic aphasia; however, generalization to untrained items and functional everyday communication remains limited (Kiran & Thompson, 2003; Boyle, 2010). Furthermore, most existing treatments primarily target linguistic deficits, assuming that discourse production difficulties stem mainly from impaired linguistic representations. Consequently, they overlook the contribution of cognitive resources, such as working memory, despite growing experimental evidence linking these cognitive factors to discourse production in individuals with aphasia.

Discourse Therapy in Aphasia Research

There were more directly related to discourse therapy in aphasia research (Cherney et al., 2008; Cherney & Halper, 2008; Lee et al., 2009 for Script Therapy; Wambaugh et al., 2013 for Modified RET; Hoover et al., 2015 for Personal Narrative Treatment; Whitworth et al., 2015 for NARNIA). The discourse-based treatments reviewed in the comparison table are characterized by relatively naturalistic communication, which enhances their applicability to everyday life. However, these approaches tend to place lower demands on verbal working memory because of the manner in which tasks are presented and structured. In contrast, Story Retelling Therapy

(SRT) in the current study involves listening to short stories and retelling them from memory, a task format that inherently requires high verbal working memory engagement. This design makes the treatment qualitatively different in terms of cognitive load, as it directly stimulates verbal working memory through the memory-based reproduction of discourse. Among the treatments considered, NARNIA (Whitworth et al., 2015) most closely resembled the present study in structural format. However, NARNIA relies on a constructive discourse generation approach, in which participants generate discourse using macrostructure scaffolds and visual prompts. Therefore, although both treatments emphasize discourse-level structures, the present study's approach differs fundamentally in that it trains participants to recall and reconstruct entire narratives from memory, directly activating verbal working memory during discourse production. Given the high demands that story retelling places on working memory compared to other discourse-based interventions, examining the specific role of working memory in SRT is critical.

The Relationship Between Story Retelling and Working Memory

Spoken discourse production is closely linked to an individual working memory capacity (Cahana-Amitay & Jenkins, 2018; Yoo et al., 2019). Robust correlations between story-retelling performance and verbal working-memory test scores have been observed (Yoo et al., 2019). Additionally, auditory serial position effects have been found in story-retelling by individuals with aphasia (Brodsky et al., 2003). These findings suggest that challenges in spoken discourse for individuals with aphasia are not confined solely to linguistic aspects; rather, they could be linked to capacity issues or limited temporarily available resources.

The involvement of working memory in spoken discourse tasks can depend on the nature of the task (See Supplementary Table S1). Different discourse tasks engage distinct memory components, influencing cognitive load and processing demands differently. A picture description task primarily relies on visual processing, as individuals use the provided image as a reference. The image serves as an external prompt, reducing the reliance on memory-dependent retrieval. Because visual information remains available throughout the task, speakers can describe elements flexibly without placing significant demands on working memory.

By contrast, a story-retelling task imposes a greater burden on verbal working memory. Without continuous visual support, individuals must retain, organize, and reproduce the narrative in a structured and coherent manner. This process requires temporarily storing linguistic information, maintaining the sequence of events, and integrating key details when constructing grammatically and semantically appropriate sentences. Moreover, the cognitive load associated with story retelling varies based on factors such as the complexity of the story, length of the narrative, and level of detail required.

As a result, different spoken discourse tasks engage in distinct aspects of working memory (See Supplementary Table S2). While picture description primarily relies on visual processing and external references, story-retelling depends more on verbal working memory for information retrieval and reconstruction. This distinction highlights the varying cognitive demands imposed by different discourse tasks and the manner in which memory resources are allocated accordingly.

Correct Information Unit (CIU) as a Functional Outcome Measure in Story Retelling Therapy

Many existing studies on aphasia treatment have primarily focused on linguistic features such as the Mean Length of Utterance (MLU), grammatical accuracy, syntactic complexity, coherence and cohesion, lexical variety, and thematic units as key outcome measures. Although these metrics provide valuable insights into language production, they do not fully capture the cognitive demands involved in effective communication, particularly the role of memory in discourse processing. Story retelling is inherently a highly demanding cognitive task**,** requiring participants to retrieve, organize, and sequence information from memory without relying on external cues. However, existing discourse-level treatment approaches for aphasia have not sufficiently acknowledged how memory supports discourse production and, therefore, have not effectively incorporated it into therapy.

The Correct Information Unit (CIU), initially developed by Nicholas and Brookshire (1993), offers a more comprehensive and functional measure by assessing the accuracy, relevance, and informativeness of spoken content, rather than simply focusing on the quantity of words produced. The CIU per minute, in particular, is an especially valuable metric as it calculates the number of accurate and meaningful information units conveyed within a given timeframe, reflecting the efficiency of spoken communication (Nicholas & Brookshire, 1993). This measure not only captures the quantity of information produced but may also indirectly reflect an individual's cognitive load management and working memory efficiency. In the context of story-retelling therapy, CIU serves as an ideal metric because it requires the use of memory to retrieve and organize details coherently (Nicholas & Brookshire, 1993; Boyle, 2011). Furthermore, by focusing on CIUs per minute (CIUs/min), we capture not only the quantity of meaningful information conveyed, but also the efficiency with which cognitive resources are utilized (Nicholas & Brookshire, 1993; Wright & Fergadiotis, 2012). This makes CIUs/min a particularly sensitive metric for assessing therapeutic progress as it reflects improvements in memory-driven discourse coherence and overall communication efficiency (Mayer & Murray, 2012; Wright & Fergadiotis, 2012). Higher CIUs per minute indicate that the individual is communicating more efficiently, reflecting improvements in discourse informativeness and efficiency (Nicholas & Brookshire, 1993; Boyle, 2011). This is critical because story-retelling therapy aims to enhance both the quality and efficiency of communication, a goal that traditional metrics such as fluency or word retrieval cannot fully address (Boyle, 2011; Whitworth et al., 2015). Taken together, these considerations underscore the need for aphasia interventions that explicitly address both the linguistic and cognitive challenges faced by individuals with very mild aphasia. Story retelling-based therapy directly addresses these challenges by simultaneously engaging with multiple cognitive and linguistic processes. Unlike traditional treatments, which focus primarily on lexical retrieval, this approach supports discourse-level communication by integrating working memory, sequencing, and coherence-building mechanisms. A sensitive outcome measure is required to effectively capture these complex cognitive-linguistic interactions. The Correct Information Unit (CIU), particularly CIUs per minute, serves as an ideal metric, as it not only reflects the accuracy and informativeness of speech but also accounts for cognitive efficiency by incorporating time as a factor. In this study, we used the information unit (IU) and IUs per min, which the original Story Retelling Procedure has, instead of using CIUs. According to McNeil et al. (2001), CIUs are defined through extensive transcription and scoring rules to capture the semantic essence of language samples, particularly when the expected content is unknown. In contrast, IUs are pre-defined based on the story stimulus and exclude non-story-specific information, offering a more efficient and precise measure. Unlike CIUs, IUs do not require full transcription or post hoc judgment, allowing for quicker and more consistent scoring. While CIUs and IUs differ in scoring methods—CIUs require post-hoc transcription and judgment, and IUs are predefined and stimulus-bound—they share similar conceptual underpinnings in measuring discourse informativeness. Therefore, we adopted the conceptual framework of CIUs while operationalizing our outcome as IUs for efficiency and consistency with the original story retelling procedure (SRP) protocol.

The purpose of the current study was twofold: (1) to assess the feasibility of story-retelling therapy (SRT) in individuals with very mild aphasia, and (2) to preliminarily explore changes in verbal working memory performance following SRT and their possible relation to discourse improvements. This approach acknowledges the potential contribution of cognitive resources beyond linguistic factors alone to discourse performance.

Method

Design

This study employed a pre-post design to examine the feasibility of story-retelling therapy (SRT). All procedures were conducted face-to-face by the Principal Investigator (PI). Our participants received nine sessions of story-retelling treatment, each lasting 1 h. Three assessments were conducted: a pre-test (Test 1), immediate post-test (Test 2), and delayed post-test conducted 7 weeks later (Test 3). The interval between the immediate post-test (Test 2) and delayed post-test (Test 3) was extended from the planned 4 weeks to 7 weeks because the participant experienced a fall. All assessments and treatments were conducted at the XXX University. The current study was approved by the Institutional Review Board (IRB) at XXX University (IRB Protocol #2219727), and our participant provided informed consent prior to participation.

Participants

The participant was a 70-year-old, right-handed, native English-speaking female who was diagnosed with aphasia by her neurologist in 2022. She had 17 years of formal education and retired from a staff position at a local university. At the time of participation in this study, she was 34 months post-stroke. The inclusion and exclusion criteria were as follows. Our participants met all of the following criteria for the current study: (a) mild to moderate aphasia determined by the assessment, (b) at least 6 months post-stroke onset, (c) aged 18 years or older, (d) primary language is English, (e) right-handed prior to stroke, (f) normal visual acuity with or without aids, and (g) at least 12 years of education. *Exclusion* criteria included the following: (a) presence of neurological symptoms or recent history of neurological events other than stroke; (b) history of multiple strokes; (c) severe or global aphasia; (d) left-handed dominance prior to stroke; (e) current participation in other therapies or similar studies; and (f) no sign of moderate to severe apraxia of speech (AOS). The descriptive information for our participants is shown in Table 1.

[Insert Table 1 about here]

Treatment Materials & Procedures

Story Retelling Therapy (SRT)

Structures of Story Retelling Therapy (SRT) SR treatment was provided for one hour per session. Each session utilized each story out of nine stories (SRP B/C/D categories: three stories each; https://computerizedrevisedtokentest.com/srp-stories/). The overall procedures and structure of the 1-hour Story Retelling Therapy (SRT) sessions are presented in Tables 2 and 3. Table 2 summarizes the treatment timeline and assessment schedule, and Table 3 outlines the within-session therapy components implemented during each treatment session. Each session started with retelling the assigned story and ended with the same story retelling. Between 50 min were dedicated to treatment, which included structured activities, such as training on core vocabulary, expressions, and content. The treatment also included a picture arrangement for understanding a story, mini-story retelling, progressing from mini-to whole-story retelling, filling in story details, and practicing the entire story retelling.

[Insert Table 2-3 about here]

Supplementary Table S3 provides a detailed description of each stage of Story Retelling Therapy (SRT) and outlines how different components of working memory are involved in each step.

Outcome Variables and Measurements:

- Main outcome measure: IUs and IUs/min from the SRP-A type (three stories)
- Descriptive measures:
  - Cognition: Montreal cognitive assessment (MoCA); Working Memory (WM): Alphabet and Subtract-2 Span tasks
  - Language: The Western Aphasia Battery-Revised (WAB-R) (Kertesz, 2006)

Data Analysis and Evaluation Procedures The main outcome variables for the story retelling procedure, IUs, and IUs/Min, were obtained from the SRP-A averaged results and compared between pre and post-tests. Other descriptive testing results, including the WAB-R, two working memory tasks (alphabet span and subtraction span tasks), and the MOCA, were compared using the same process.

Results

Post-test 1 results from SRP-A showed a 12.00% increase in Information Units (IUs) compared with pre-test results. From Post-test 1 to Post-test 2, the number of IUs increased by an additional 13.73% (Figure 1).

[Insert Figure 1 about here]

From pre-test to post-test 1, the Percentage Information Units per minute (%IUs/min) substantially increased by 81.25% (from 0.48 to 0.87). After seven weeks, the %IUs/min decreased by 24.14% (from 0.87 to 0.66) (Figure 2).

[Insert Figure 2 about here]

For the nine treated stories (from SRP-B/C/D), there was an average 78.4% increase in IUs, comparing story retelling at the start of treatment with final retelling after treatment (Figure 3).

[Insert Figure 3 about here]

The WAB-R AQ scores showed slight improvement (92.7 at pre-test, 94.8 at post-test 1, and 96.4 at post-test 2) (Figure 4). This improvement brought the participants within the normal range starting from post-test 1, indicating that they were no longer classified as having aphasia.

[Insert Figure 4 about here]

Working memory composite scores showed minor fluctuations across testing periods, slightly decreasing from pre-test (4.13) to post-test 1 (3.75), and subsequently increasing at post-test 2 (4.25), without a clear directional trend (Figure 5). The MoCA scores showed a modest increase from pre-test to post-test 1, and remained stable thereafter (20 at pre-test, 21 at post-test 1, and 21 at post-test 2).

[Insert Figure 5 about here]

Discussion

The present study aimed to explore the feasibility of Story Retelling Therapy (SRT) using Story Retelling Procedures (SRP) to enhance spoken discourse production in individuals with mild aphasia. Additionally, this study sought to investigate the effects of SRT on working memory performance in individuals with aphasia following a stroke. The findings demonstrated improvements in Information Unit (IUs) and WAB-R AQ scores following treatment, indicating that SRT may hold promise as a potentially effective intervention for enhancing narrative discourse in individuals with aphasia. However, because these findings stem from a single-case feasibility study, further evidence is required.

The primary outcome of this study was a notable improvement in IUs across pre- and post-test measurements. The 12% increase in IUs from pre-test to post-test 1, followed by an additional 13.73% increase at post-test 2, indicates that the participant not only benefited from the therapy, but also exhibited further improvement after the therapy had ended. This pattern suggests that the effects of SRT may extend beyond the immediate intervention period, possibly reflecting ongoing consolidation or delayed improvements, as the participant continued to practice narrative skills in daily communication. Furthermore, improvements were also observed in untrained stories (SRP-A) that were used only during the assessment sessions and were not included in the treatment. This provides preliminary evidence for stimulus generalization, suggesting that the effects of Story Retelling Therapy may extend beyond trained content and potentially facilitate broader discourse-level gains (Boyle, 2010; Peach & Reuter, 2010). The consistent improvement across the nine treated stories further supports the potential efficacy of the SRT in facilitating discourse-level language processing. Nevertheless, such interpretations should be approached cautiously because of the single-participant design of the study.

In contrast, the decrease in %IUs/min from Post-test 1 to Post-test 2 may indicate a reduction in efficiency during story retelling. This observed decline appears to be primarily attributable to the increased duration required for storytelling during the delayed post-test (Post-test 2). This may be due to a change in the participant's condition between Post-test 1 and 2; specifically, the participant experienced a fall, extending the interval between assessments from the planned 4 weeks to 7 weeks. Considering the relationship between falls and slower cognitive processing speed in older adults (Davis et al., 2017), this incident might have temporarily slowed the participants' processing speed. Interestingly, despite the reduction in processing speed, the total quantity of Information Units (IUs) produced increased. Thus, the decrease in speech processing speed does not reflect a regression in language recovery; rather, it likely indicates a temporary fluctuation in performance speed resulting from external factors, such as physical or mental fatigue following the fall.

Working memory scores demonstrated slight fluctuations across sessions, possibly reflecting short-term variability or temporary cognitive resource depletion and recovery. According to Cognitive Load Theory (Sweller, 1988), cognitively demanding tasks can temporarily exhaust working memory resources, causing short-term performance declines—referred to as the "depletion effect" (Chen et al., 2018, 2021, 2022, 2024). Specifically, this depletion occurs during intensive cognitive tasks, followed by gradual recovery after rest periods. In this study, working memory resources appeared to recover and even showed a slight improvement compared with the initial measurement (pre-test). This pattern suggests the possibility of adaptive cognitive reorganization within the participant's cognitive system, potentially enhancing the efficiency of cognitive processing. Previous research supports the notion that the temporary depletion and subsequent recovery of working memory resources may reflect such adaptive processes (Mayer & Murray, 2012; Wright & Fergadiotis, 2012). This cognitive reorganization could play a crucial role in facilitating efficient information processing and storage, possibly serving as an underlying mechanism for linguistic improvements observed in Story Retelling Therapy (Raymer et al., 2008; Crosson et al., 2019).

Although this remains a preliminary observation from a single-case study, it offers a plausible hypothesis regarding the cognitive mechanisms that may support discourse gains in aphasia rehabilitation. Further studies with larger sample sizes are necessary to confirm whether the observed working memory fluctuations consistently reflect adaptive cognitive mechanisms across individuals, particularly in relation to linguistic-processing outcomes.

The subtle fluctuations observed in the working memory measures may have significant clinical implications. Specifically, the variability in working memory performance observed in this study may not represent random or meaningless changes; rather, it could serve as indirect evidence that Story Retelling Therapy (SRT) actively stimulates participants' working memory. The temporary depletion of working memory resources observed during treatment, followed by subsequent recovery, likely represents a natural cognitive phenomenon wherein the brain actively utilizes and reorganizes cognitive resources in response to demanding tasks. Thus, the slight fluctuations in working memory observed in this study can be interpreted clinically as meaningful indicators that SRT engages and challenges cognitive functions, including working memory, along with improving discourse production. These findings highlight the necessity of considering cognitive resource utilization, such as working memory, in addition to linguistic factors when designing future aphasia rehabilitation strategies.

Furthermore, the minimal changes in the MoCA scores suggest that the observed language improvements were not directly driven by changes in global cognitive function, reinforcing the notion that SRT primarily targets linguistic processes rather than domain-general cognitive abilities.

Although preliminary, this feasibility study provides initial support for Story Retelling Therapy (SRT) in targeting language abilities, while also highlighting potential considerations such as the impact of fatigue on outcomes. Considering that intensive treatment schedules can lead to cognitive resource depletion, it is important to manage fatigue by incorporating adequate rest periods between the sessions. Gradually increasing the task difficulty while allowing the brain to adapt may be a more effective approach for sustaining treatment results (Kleim & Jones, 2008). Although memory performance can recover over time, strategies to manage fatigue are crucial for optimizing long-term therapeutic outcomes. Another important implication of this study is that the post-test, conducted 7 weeks after treatment, revealed not only sustained but also further enhanced performance. This suggests that the therapeutic effects for patients with aphasia may take longer to manifest than initially expected. This preliminary finding tentatively underscores the importance of incorporating extended follow-up periods and continuous monitoring in future studies, as language improvements might manifest or stabilize over a longer time frame.

This feasibility study provides preliminary evidence that Story Retelling Therapy (SRT) may enhance spoken discourse production in individuals with mild aphasia, as indicated by improvements in Information Units (IUs), discourse efficiency, and WAB-R AQ scores. Despite temporary fluctuations in the working memory measures, follow-up assessments revealed sustained cognitive improvements, suggesting potential long-term cognitive benefits. Given these findings, future research with larger controlled samples is warranted to validate the efficacy of SRT. Additionally, investigating cognitive mechanisms through neuroimaging techniques, such as functional near-infrared spectroscopy (fNIRS; Ferrari & Quaresima, 2012; Mihara & Miyai, 2016) could further elucidate the cognitive-linguistic interplay involved (Mayer & Murray, 2012; Wright & Fergadiotis, 2012). Understanding these mechanisms may inform the optimization of therapeutic protocols for aphasia rehabilitation (Kleim & Jones, 2008; Raymer et al., 2008).

Limitations

The current feasibility study was limited to a single participant with very mild aphasia, which limits the generalizability of the findings. Future research with larger sample sizes, including age-matched neurotypical controls, is necessary to further investigate the efficacy of Story Retelling Therapy. Additionally, future studies could explore whether online delivery yields comparable effectiveness, which would broaden the potential clinical applicability of SRT. However, this remains to be empirically tested.

Clinical Implications

The findings of this feasibility study have several preliminary implications for clinical practice. First, the observed changes in working memory and discourse performance suggest that therapy schedules should account for cognitive fatigue by incorporating rest periods and gradual progression of task difficulty. Second, while this study was conducted in person, future adaptations of Story Retelling Therapy for remote or hybrid delivery could enhance accessibility for individuals with mobility or transportation barriers. Third, the delayed gains observed in follow-up highlight the importance of including extended post-treatment monitoring and potentially booster sessions to sustain and optimize the outcomes. These considerations can inform both individualized clinical planning and future protocol development.

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Disclaimer

The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the XXX University.

Data Availability Statement

The data that support the findings of this study are not publicly available due to participant privacy and ethical restrictions. Data may be available from the corresponding author on reasonable request and with appropriate IRB approval.

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Supplementary

[Insert Supplementary Table S1-S3 about here]

Table 1. Participant Information

Age	70
Gender	Female
Years of Education	17
Post-Onset Time (POT)	34 months

Note. Post-Onset Time (POT) refers to the duration between the stroke event and the initiation of the study intervention.

Table 2. Treatment Timeline and Assessment Schedule

Test1: Pre-test	SRP Treatment	Test2: Post-test1	Test2: Post-test2
SRP-A (Main Variable) WAB-R MOCA WM	1 hour of story retelling therapy using SRP B/C/D (9 stories) Total 9 sessions	SRP-A (Main Variable) MOCA WAB-R WM	SRP-A (Main Variable) MOCA WAB-R WM
1 day	About 3 weeks	1 day	1 day (After 7 weeks from Test2)

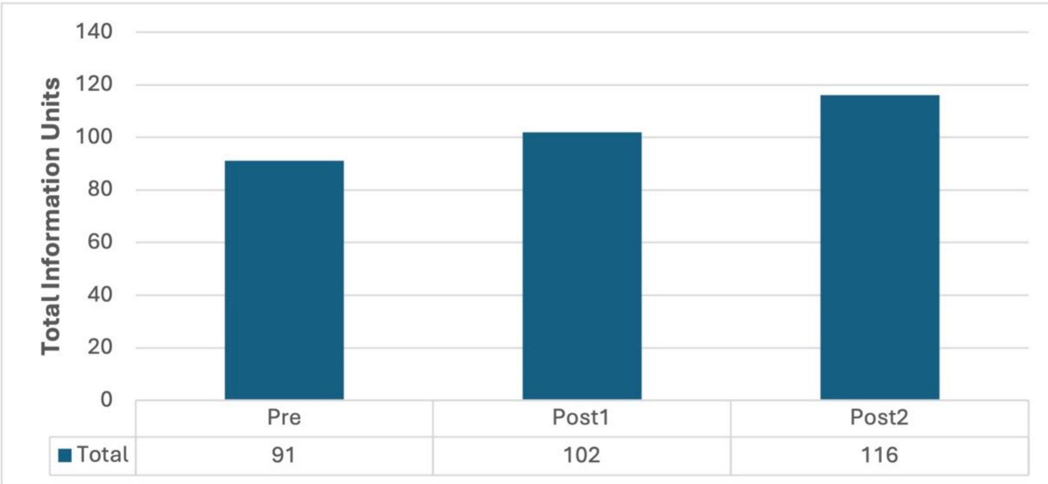
Note. SRP = Story Retelling Procedure; WAB-R = Western Aphasia Battery-Revised; MOCA = Montreal Cognitive Assessment; WM = Working Memory.

Table 3. Within-Session Therapy Components

Orders	Assigned Time		Detailed Description
Introduction	5 min		Each story was presented, and the participant retold the story immediately after listening to it.
Treatment	Total 50 min:		Each story was utilized as treatment material for each session.
	Understanding a story: -Picture arrangement -Summary of the story	5 min	To understand a story: Each story was presented, and the participant arranged the pictures of the story and retold the story. Summary: The characters and main events were reviewed.
	Core VOCA/expressions: -Repetition -Reading Words -Writing key words/expressions Core Contents: -Fill-in-the-blank -True/False -Story Sequence Arrangement	20 min	A list of core vocabularies/phrases (expressions) of each story was reviewed including synonyms. Core content was reviewed through the following activities: • Fill-in-the-Blank: Recall key details and reinforce understanding of story structure. • True/False: Assess understanding of events. • Story Sequence Arrangement: Enhance understanding of story structure and organization at a deeper level.
	Core Contents: Beginning-Middle-End	10 min	-To talk through each part of the story -To strengthen Middle Part -To try to use the core vocabularies/phrases (expressions)

	Mini-Story Retelling to Whole Story Retelling • Retelling two to three sentences. • Filling in the details of the story. • Gradually progressing to retelling the entire story.	10 min	-To dissect the story into small sections and practice retelling each section. -To dissect the story into medium to large sections and practice retelling each one. -Pictures can be utilized for prompting.
	Practice Whole Story Retelling	5 min	To practice a whole story to retell
Session Closure	5 min		Each story was presented, and the participant retold the story immediately after listening to it.

Note. Assigned time reflects approximate allocation per therapy component within each session.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40
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0
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Post2
Total
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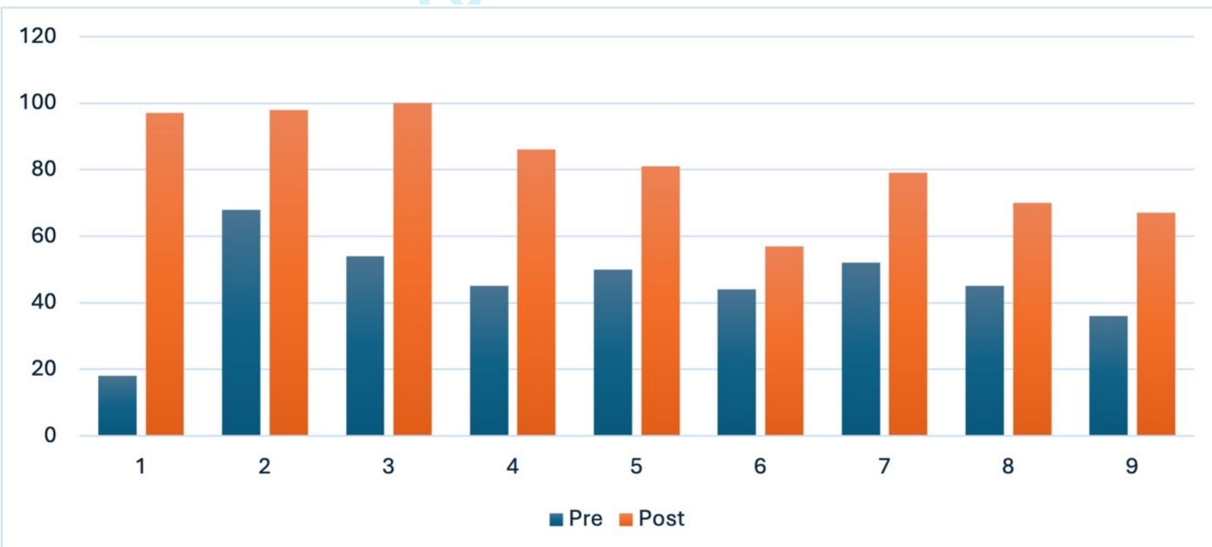
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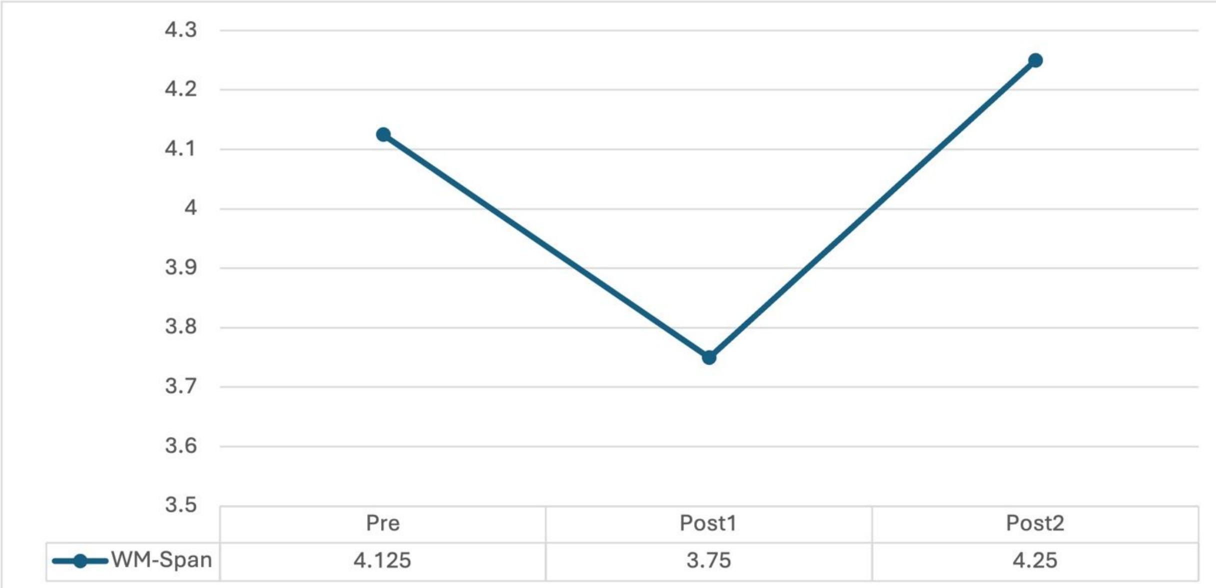
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4.2
4.1
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3.6
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Pre
Post1
Post2
WM-Span
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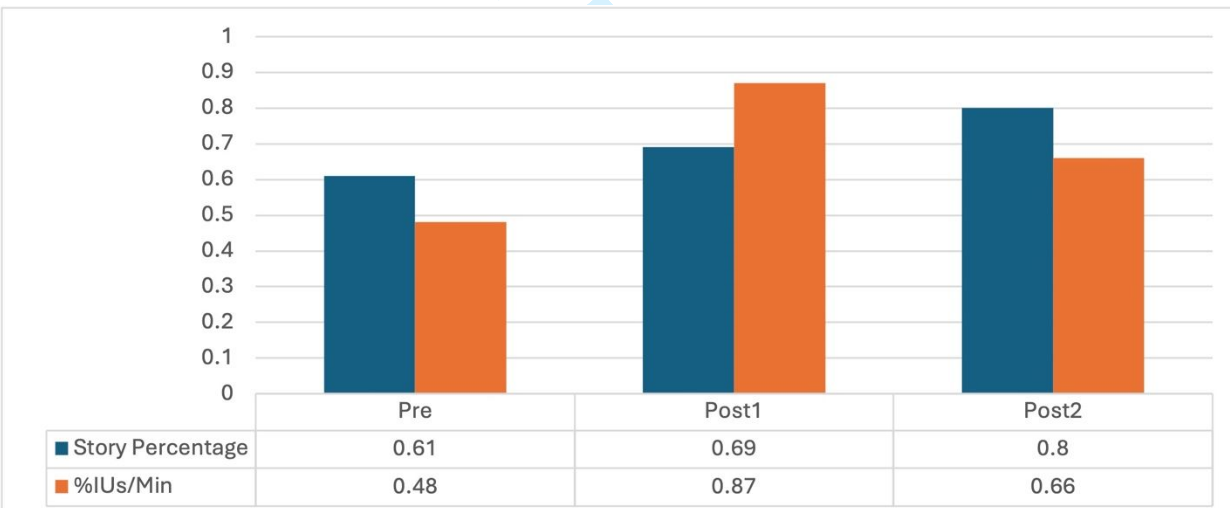
3.75
4.25


1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Pre
Post1
Post2
Story Percentage
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0.69
0.8
%IUs/Min
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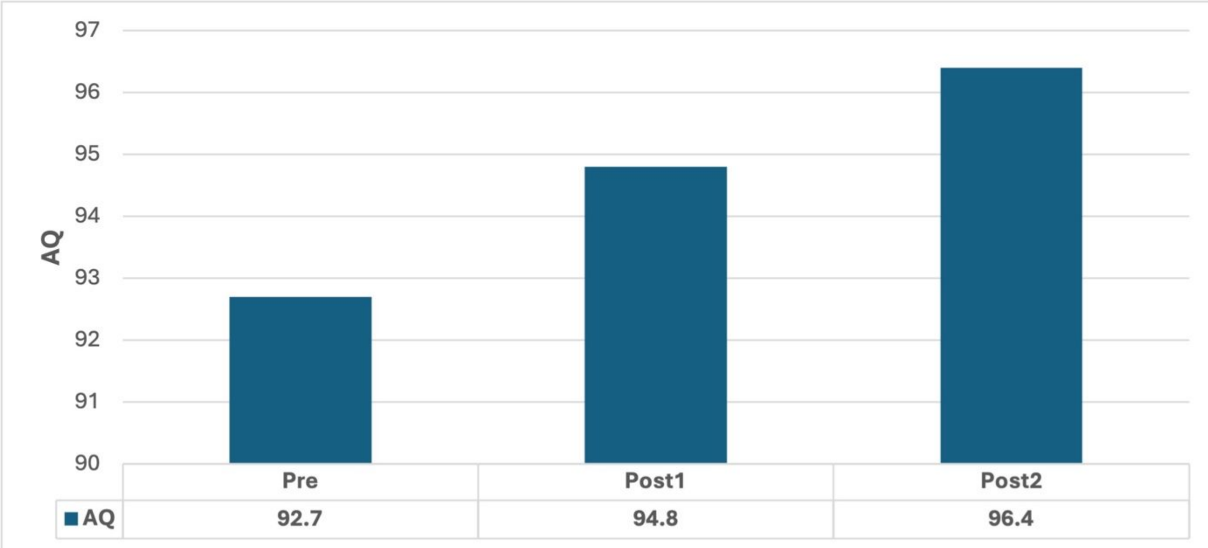
0.87
0.66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92
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90
AQ
Pre
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94.8
96.4

Table S1. Different Features between Picture Description Task and Story Retelling Procedure

Feature	Picture Description Task	Story Retelling Task
Primary Processing Mode	Visual processing (relies on external cues)	verbal working memory (requires internal memory retrieval)
Memory Dependence	Low (relies on external cues)	High (requires recall from memory)
Cognitive Load	Lower (simpler task, less mental effort)	Higher (requires maintaining sequence and integrating details)
Information Retrieval	Directly from the provided image (external reference)	From memory, requiring recall and organization of narrative
Task Flexibility	Flexible description (descriptions can be rearranged)	Requires Maintaining Sequence (narrative structure must be kept)
Linguistic Demand	Moderate (describing images with basic language)	High (requires coherence, integration of multiple details)
Example Task	Describing a scene in a picture	Retelling a previously heard story

Comparison of cognitive and linguistic features between Picture Description Task and Story Retelling Procedure.

Table S2. Comparison of Baddeley's Working Memory Model in Picture Description and Story Retelling Procedure

Baddeley's Model Component	Picture Description Task	Story Retelling Task
Central Executive	Directs attention to visual details and organizes description.	Directs attention to maintaining narrative sequence and recall.
Phonological Loop	Less involved (focuses on visual, not verbal memory).	Highly involved (organizes verbal information, maintains narrative flow).
Visuospatial Sketchpad	Highly involved (holds and manipulates visual information).	Less involved (unless visualizing scenes in the story).
Episodic Buffer	Minimal involvement (focuses on single visual task).	Highly involved (integrates verbal information and organizes story events).

Comparison of Baddeley's working memory model components utilized in Picture Description Task and Story Retelling Procedure.

Table S3. Working Memory Involvement in Story Retelling Therapy

Orders	Assigned Time	Detailed Description	Working Memory Involvement
Introduction	5 min	Each story was presented, and the participant retold the story right after listening to it.	Phonological Loop: Temporary storage of auditory-verbal information from the story. The participant holds the details of the story in working memory for the retelling, relying on rehearsal for accurate recall.
Understanding a Story	5 min	Each story was presented, and the participant arranged the pictures of the story and retold the story.	Visuospatial Sketchpad: Visualizing and arranging the pictures of the story requires processing spatial information. Central Executive: Organizes and sequences events accurately. Phonological Loop: Rehearses the verbal aspects of the story while arranging the images.
Summary of the Story	5 min	The characters and main events were reviewed.	Episodic Buffer: Integrates visual, auditory, and conceptual information to summarize the key events of the story. Central Executive: Focuses on key story elements for summarization and recall.
Core VOCA/expressions	20 min	A list of core vocabularies/phrases (expressions) of each story was reviewed, including synonyms. Core content was reviewed through fill-in-the-blank, true/false, and story sequence arrangement activities.	Phonological Loop: Holds and processes verbal information, especially when recalling and rehearsing key words or phrases. Central Executive: Directs attention to relevant vocabulary for active recall and fills in missing information. Episodic Buffer: Integrates verbal cues with stored vocabulary.
Core VOCA Repetition		Immediate repetition of vocabulary.	Phonological Loop: Temporarily stores auditory-verbal information for immediate rehearsal to strengthen retention.

Reading Words		Reading vocabulary aloud or silently.	Phonological Loop: Temporarily holds phonological information. Central Executive: Manages cognitive resources for word recognition and meaning retention.
Writing Key Words/Expressions		Writing core vocabulary and expressions.	Visuospatial Sketchpad: Maintains visual representations of words and letters. Central Executive: Coordinates retrieval and integration of visual-linguistic information.
Fill-in-the-blank		Completing sentences with appropriate words.	Central Executive: Retrieves relevant stored information, integrating contextual clues. Episodic Buffer: Combines long-term memory and immediate context to complete sentences accurately.
True/False		Judging accuracy of statements based on story details.	Episodic Buffer: Integrates stored story details and immediate context. Central Executive: Manages attention and verifies statement accuracy through recall.
Story Sequence Arrangement		Organizing events chronologically.	Visuospatial Sketchpad: Temporarily maintains and manipulates visual-spatial event arrangements. Central Executive: Coordinates logical reasoning and sequencing skills to ensure coherent chronological ordering.
Core Content: Beginning-Middle-End	10 min	To talk through each part of the story and strengthen the middle part, using core vocabularies/expressions.	Central Executive: Controls the flow of information from the phonological loop and visuospatial sketchpad to ensure the beginning, middle, and end are organized. Episodic Buffer: Integrates components of the story to form a coherent structure. Phonological Loop: Rehearses key phrases and expressions.
Mini-Story Retelling to Whole Story Retelling	10 min	Retelling two to three sentences, filling in the details, and gradually progressing to retelling the entire story.	Phonological Loop: Holds and manipulates verbal information (e.g., recalling sequences of sentences). Visuospatial Sketchpad: Supports visualizing key events while retelling the story. Central Executive: Manages cognitive load, shifting attention between smaller sections and the full story.

Mini-Story Practice	5 min	Dissect the story into small sections, practice retelling each section, and use pictures for prompting.	Central Executive: Directs attention to focus on smaller sections of the story. Visuospatial Sketchpad: Helps visualize events and their spatial relationship for accurate retelling. Phonological Loop: Rehearses verbal components of each section for accurate recall.

Detailed working memory components involved in each stage of Story Retelling Therapy, based on Baddeley's working memory model.