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STORY GRAMMAR ANALYSIS OF CINDERELLA NARRATIVES IN ADULTS WITH AND WITHOUT TRAUMATIC BRAIN INJURY

BY

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THESIS

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ABSTRACT

STORY GRAMMAR ANALYSIS OF CINDERELLA NARRATIVES IN ADULTS WITH AND WITHOUT TRAUMATIC BRAIN INJURY

By

Melanie Pond

University of New Hampshire

Background: Narrative organization, as measured by story grammar analysis, is often impaired in individuals with traumatic brain injury (TBI). However, existing analyses for adults with TBI use relatively simple stories and typically capture the proportion of tangential contributions, rather than organization itself.

Aim: This study's aim was to expand upon existing analyses by comparing story grammar organization in a complex story, Cinderella, told by individuals with TBI versus non-brain injured (NBI) individuals. Expanded analyses addressed narrative length in episodes and story grammar elements, episodic completeness and elaboration, and the proportion of non-story grammar (NSG) elements (e.g., tangents).

Methods: Transcripts of Cinderella narratives for 29 adults with TBI and 29 age- and sex-matched adults with NBI were retrieved from TalkBank. Codes corresponding to story grammar or NSG elements were assigned predominantly at the clause level. Codes were used to identify complete episodes, containing one of each basic element (initiating event, attempt, direct consequence), and elaborated episodes, containing elements beyond the basic three (multiple basic elements, mental states, setting statements).

Results: Mann-Whitney U-tests revealed that the TBI group produced significantly fewer episodes, story grammar elements, and elaborate-complete episodes, and significantly more NSG elements than the NBI group.

Conclusions: On average, individuals with TBI produced shorter narratives with fewer episodes, less elaboration, and more elements that were tangential or off-topic than NBI counterparts. This study's measure of episodic completeness and elaboration expanded on existing analyses to generate a more accurate and specific image of narrative deficits in those with TBI.

INTRODUCTION

Traumatic brain injury (TBI) often results in a multitude of deficits across language and communication, including tangential and disorganized discourse, making social communication with others difficult (Jorgensen & Togher, 2009). These discourse deficits are especially apparent while telling stories or narratives (Coelho, 2002), as narratives rely on complex language production, social communication, and cognitive organizational processes. Individuals with TBI have difficulty organizing and sequencing content during storytelling and often struggle with determining what information is appropriate and relevant to provide to the listener while telling the story (Brookshire et al., 2000; Cannizzaro & Coelho, 2002; Hartley & Jensen, 1991; Ylvisaker et al., 2005). Thus, analysis of narratives allows clinicians to identify linguistic and cognitive strengths and deficits across multiple language features using a single sample (Heilmann et al., 2010), which can be used to guide treatment.

Story Grammar Analysis is one approach to assessing narratives that focuses on content, organization, and overall quality. Existing research on story grammar analysis in adults with TBI uses retellings of short stories that follow a simple narrative structure (Cannizzaro & Coelho, 2002; Coelho, 2002; Jorgensen & Togher, 2009; Lindsey et al., 2019; Mozeiko et al., 2011). These simple narrative retellings may create an inaccurate image of the specific discourse deficits in an individual with TBI, as they involve less internal planning and organization and therefore may place lower demands on sequencing and memory (Cannizzaro & Coelho, 2012; Chapman et al., 1992). Additionally, a longer or more complex narrative may "stress the system" and reveal more subtle deficits that are not demonstrated in shorter narratives (Schneider et al., 2006). One complex narrative that has been used in discourse research on individuals with TBI is the story of Cinderella (Elbourn et al., 2019). However, no studies have analyzed the story

grammar of Cinderella narratives in adults with TBI as compared to non-brain injured (NBI) adults.The current study aims to elucidate the impact of TBI on complex narrative production by identifying differences in story grammar production between individuals with TBI and NBI individuals, using the story of Cinderella.

Discourse deficits in TBI

A primary language deficit observed following TBI is difficulty constructing discourse, including conversations, narratives, and procedural discourse. In contrast, structural language, including vocabulary and grammar, are often relatively intact. Thus, standardized language tests administered clinically to individuals with TBI that measure structural language, but do not assess language organization or coherence, may not identify the primary deficits in this population (Schneider et al., 2006; Gillam et al., 2017). Macrostructural analysis of discourse, examines language skills beyond the utterance level, and therefore can capture deficits that may not be apparent in these standardized language tests.

Like discourse more broadly, narratives rely on complex language production, social communication, and cognitive organizational processes (Cannizzaro & Coelho, 2002). They also require the storyteller to have an understanding of and an ability to communicate the motivations, social roles, and interactions of the characters (Hughes et al.,1997; Roth & Spekman, 1986). Individuals with TBI often have deficits in social cognition, including understanding others' motivations (Jorgensen & Togher, 2009), as well as executive functions, such as cognitive flexibility, planning, and organization (Lindsey et al., 2019). These deficits, particularly those related to executive functions, contribute to narrative production deficits in TBI, including the production of stories that are tangential, confusing, or incomplete (Lindsay et al., 2019). Although narratives can be analyzed at both the macrostructural level (content,

organization, and quality of the overall story) and the microstructural level (within-narrative units that create the underlying network for the story, such as vocabulary, sentence complexity, and cohesive ties) (Paul et al., 2018), deficits in organization and coherence are best captured through macrostructural analysis.

Macrostructural story grammar analyses of narratives

Story grammar is one way to describe the macrostructural organization of a narrative (Stein & Glenn, 1979). Story grammar guides narrative structure through creation of relationships between people and events in a logical way that is comprehensible to both storyteller and listener. Knowledge of typical story structure guides a storyteller's ability to create logical relationships between events within a narrative (Roth & Spekman, 1989). Story grammar analyses focus on the organization of narrative themes and demonstration of logical and/or sequential relationships between story events (Hughes et al., 1997).

Rumelhart (1975) created an early schema describing an internal representation of narrative structure, based on his observations of oral retellings of folktales. While the syntactic and semantic structures of fairy tales varied across storytellers, the main concepts and organization remained stable. Such is the case with Cinderella, a classic fairytale that has been adapted, restructured, and modified hundreds of times in books, movies, and television shows. Despite changes in setting and details (e.g., modern adaptations changing the glass slipper to something else), they are easily recognizable as the story of Cinderella because the story's key elements remain the same across all retellings. There is a kind-hearted girl who loses both parents and lives with her stepmother and two stepsisters. Her stepfamily are always cruel, forcing Cinderella to be their servant. There is always a ball or party that Cinderella is not allowed to attend, and a fairy godmother always helps her attend. Cinderella always meets the

prince and dances with him, and she always must leave by midnight. She always leaves something identifiable behind that eventually allows the prince to find her, and she always lives happily ever after with him.

Rumelhart's (1975) story grammar schema included higher order categories that could be divided into lower order categories that still held a relationship or underlying common feature with the higher order. However, this concept of narratives was too simplistic to explain more complex narratives and did not explain how concepts in a narrative were causally linked. Arguing against this model of a hierarchical categorization in narratives, Schank (1975) proposed that all categories were causally linked by a single chain (as cited by Stein & Glenn, 1979). This model assumes that all story elements were linked by linear, causal relationships, which might not be the case in more complex narratives.

Stein and Glenn's (1979) story grammar model addressed the clear problems present in prior frameworks, adopting Rumelhart's concept of higher categories as well as Schank's concept of relations that connect story events. Higher order categories were retained to help explain how stories could be cognitively stored and retrieved as "chunks" of information, rather than as individual sentences or words. Stein and Glenn (1979) referred to these higher categories as "episodes," which were composed of related lower level categories, known as "elements". Further, expanding upon Schank, three relations were identified that could connect story elements within episodes and create links between episodes, allowing for variation in the complexity of narrative structures. These relations were "and", "then", and "cause". The "and" relationship, often used to connect habitual actions or behaviors, labeled components or episodes as being related, without attributing cause and effect or establishing a linear temporal relationship. The "then" relationship labeled components as being temporally related. Rather

than elements or episodes being connected by a cause, there was a clear order that the elements or episodes followed. The "cause" relationship created a cause-effect relationship between elements within an episodic structure or between two episodes.

Stein and Glenn's (1979) story grammar framework describes the basic structure of a narrative. They proposed that narratives consist of one or more complete episodes, which include three basic elements: an initiating event, attempt, and direct consequence. An *initiating event* is defined as something that occurs to make the main character formulate a plan of action, e.g., "Cinderella and her stepfamily received an invitation to the ball." An *attempt* is defined as the behavior or event that occurs in response to the initiating event, e.g., "Cinderella created a beautiful gown with the help of her mice friends." A *direct consequence* is the successful or unsuccessful result of the attempt, e.g., "Upon seeing Cinderella's dress, the wicked stepsisters tore it apart." Story grammar also includes elements that occur solely outside the episode structure, such as the conclusion or coda, which refers to statements that wrap up the story and serve as a direct consequence for the story as a whole. Setting statements refer to the time and place in which the story occurs, or to establish habitual states of characters or settings; these elements may exist within and/or outside of episodes.

Story grammar is frequently measured through the number of complete episodes produced, defined as including at least one initiating event, attempt, and direct consequence. This measure demonstrates a storyteller's understanding of the logical connections between episode components and organization within each episode (Mozeiko et al., 2011). Storytellers can generate more elaborate episodes through the use of other elements, including setting statements and statements that provide insight into characters' thoughts, feelings, and motivations. For example, *internal responses* convey a character's reaction to the initiating event; *internal plans*

describe what the character wants to do about the problem presented in the initiating event; and *reactions* communicate how a character reacts to the success or failure of their attempt (Hughes et al., 1997). These elements are not necessary for an episode to be considered complete; however, their addition to episodes makes narratives more elaborate, detailed, and compelling.

Story grammar in TBI

Deficits in innate story grammar knowledge and use of episodic structure are common following a TBI (Brookshire et al., 2000; Chapman et al.,1992; Coelho et al., 1991). Many people with TBI have deficits in organization and sequencing, and therefore may struggle to create complete, logical episodes (Ylvisaker et al., 2005). Further, individuals with TBI may produce episodes that are shorter in content or are missing one or more elements required to be considered complete, which affects the story's overall comprehensibility (Brookshire et al., 2000; Hartley & Jensen, 1991).

Several studies have addressed the impact of TBI on story grammar. Coelho (2002), Lindsey et al. (2019), and Mozeiko et al. (2011) examined the proportion of T-units (a main clause and its dependent clauses) within story grammar episodes to all T-units produced in a participant's story as a measure of episode length and narrative organization. Across these three studies, participants with TBI had significantly lower performance on this story grammar measure than the non-brain injured (NBI) group, indicating that NBI participants produced fewer unnecessary T-units (i.e., those occurring outside of episodes). Coelho (2002) and Mozeiko et al. (2011) also examined the total number of story grammar episodes, which included both complete and incomplete episodes. In Mozeiko et al. (2011), TBI participants produced significantly fewer episodes on average than the NBI group, whereas in Coelho (2002), no significant differences in number of episodes produced were found between TBI and NBI groups. The latter finding was

noted not to align with previous research (Coehlo, 2002). Each study demonstrated a significant difference between TBI and NBI participants in at least one measure of story grammar. TBI participants produced fewer T-units within episode structures, more unnecessary T-units, and fewer episodes overall.

Taking a different approach, Jorgensen and Togher (2009) looked at the percentage of story grammar elements produced – that is, the number of story grammar elements that were produced by the participant out of the number that were expected to be produced. They found that participants with TBI included significantly fewer story grammar elements than the control group when producing narratives monologically (that is, independently) than jointly (paired TBI and control subjects). No significant difference existed in the control group between monologic and jointly-told narratives (Jorgensen & Togher, 2009). Thus, co-construction of stories can facilitate the use of story grammar organization in those with TBI.

Only one study explored the specific differences in story grammar elements. Cannizzaro and Coelho (2002) examined the percentage of story grammar episodes and story grammar elements (e.g., initiating events) that were accurately identified by one participant during treatment as well as the number of complete and incomplete episodes produced by the participant pre- and post-treatment. Results showed the participant with TBI often excluded direct consequences from his episodes. Visual analysis of treatment outcomes for this participant showed a distinct increase in number of complete episodes and a decrease in number of incomplete episodes produced as a result of treatment. However, no control data on episode completeness was presented for comparison, making this change difficult to interpret (Cannizaro & Coelho, 2002).

Across studies, investigators reported poor story quality in participants with TBI both within and outside the constraints of story grammar. Participants with TBI often included extraneous or unnecessary information in their stories and often described stimulus images rather than exploring a narrative (Cannizzaro & Coelho, 2002). Across studies, story grammar was consistently a measure of narrative ability that showed differences between TBI and NBI individuals even when other measures did not. Thus, because narratives are common in everyday conversation (Jorgensen & Togher, 2009) and require individuals to inhibit unnecessary details, provide necessary background information, and tie information together in a cohesive way, narrative analyses can offer a window into the functional communication skills of individuals with TBI. Yet, despite their clear clinical utility for identifying areas of deficit in individuals with TBI, few standardized evaluations of narrative discourse exist for adults with TBI (Lindsay et al., 2019). Because narrative analyses are often time-consuming, they have been used primarily for research and are rarely implemented in clinical settings. This results in incomplete assessments of cognitive communication disorders (Lindsay et al., 2019).

Furthermore, it is important to note that prior studies on story grammar in TBI have utilized short, macrostructurally simple stories for narrative retell rather than narrative generation from picture stimuli or a retell requiring a more complex structure (Chapman et al., 1992). While some studies looked at partial and complete episodes, these variables were not used to compare performance of individuals with TBI and NBI controls. Yet, the completeness of episodes (i.e., inclusion of all three basic elements: initiating event, attempt, consequence) is critical to insuring that listeners can easily follow the story's content and organization. Furthermore, despite acknowledging that inclusion of non-basic story grammar elements (e.g., internal plan, internal response, setting, etc.) is indicative of higher-level narrative organization, none of the studies

examined how episode elaboration differed between individuals with TBI and controls (Cannizzaro & Coelho, 2002; Coelho, 2002; Jorgensen & Togher, 2009; Lindsey et al., 2019; Mozeiko et al., 2011). The lack of episodic complexity measures in story grammar analyses in adults with communication disorders is particularly noteworthy given that similar analyses do address such robustness in child narratives (e.g., Gillam et al., 2017; Heilmann et al., 2010). Examination of narrative robustness acknowledges the importance of going beyond completing episodes to elaborate upon the basic elements. Such elaborated episodes provide additional information about characters' mental states (e.g., *Cinderella was sad* that she could not go to the ball), offer descriptive "setting" information about characters, events, or other story-related entities (e.g., the fairy godmother created a pair of slippers *that were made of glass*), or contribute more than one basic element (e.g., multiple attempts in response to a single initiating event). By elaborating on simple episodic structure, storytellers can show more mature linguistic organization. Thus, measuring episodic complexity in adults with TBI, as has been done in children with language disorders, could capture this population's challenges with complex discourse organization.

Measures of episodic complexity for children

The *Monitoring Indicators of Scholarly Language* (MISL; Gillam et al., 2017) is a narrative analysis tool developed to assess self-generated child and adolescent narratives elicited from single pictures. It measures both macro- and microstructural elements in a narrative, and uses four-point rating scales (0-3) to assess the complexity of each story grammar element (e.g., setting, initiating events, plans, attempts). A score of 0 indicates that the element is absent, a score of 2 indicates "mastery" (i.e., inclusion of one basic or elaborated element, such as a mental state), and a score of 3 indicates "elaborated knowledge" (i.e., inclusion of multiple basic

or elaborated elements). For example, “mastery” for direct consequences involves including one result from an attempt, whereas “elaborated knowledge” involves including at least two results. This concept of differentiating between “mastery”, or an episode that is considered complete but lacks complexity, and “elaborated knowledge”, or an episode that is both complete and complex, is not represented in traditional story grammar analysis, including those used to assess adult narratives. However, it offers vital information regarding the quality of an individual’s narrative that cannot be captured through simple story grammar analysis. Therefore, the current study’s analyses mimicked the MISL’s measure of episodic elaboration to differentiate between simple (“mastery level”) complete episodes and elaborate (“elaborated knowledge level” complex/ complete) episodes.

The Narrative Scoring Scheme (NSS; Heilmann et al., 2010) also assesses both macro- and microstructural elements of narrative storytelling. In terms of story grammar-related macrostructure, the NSS utilizes a Likert-style rating scale to score story elements including setting, character introduction and development, mental states, conflict resolution, and conclusion. This scoring scheme has associated normative databases on SALT (Systematic Analysis of Language Transcripts), which allows clinicians to compare self-generated and retold stories from wordless picture books for children with and without language disorders. However, this scoring schema is overwhelmingly used with children and adolescents; no normative reference exists for adults. This measure utilizes some components of story grammar analysis in conjunction with microstructural measures of narrative quality. However, this measure separates the concepts of “setting” and “character introduction”, whereas in the Stein & Glenn (1979) framework, these concepts are grouped together under “setting”. In addition, this scheme differs from traditional story grammar in that it considers “conflict resolution”, which is a measure of

story completeness as a whole, rather than individual episode completeness. Unlike traditional story grammar analysis, the NSS also combines all internal plans, thoughts, and emotions into one overarching category called "mental states". The current study's analyses mimicked this method of grouping these related story grammar categories into one "mental state" code. This approach was used to create a more inclusive and broader definition of mental states, which had the potential to increase inter-rater reliability in analyzing this form of narrative elaboration.

The current study

This study expands on prior story grammar research in TBI by comparing the proportion of within-episode utterances and total number of episodes to NBI individuals (Coelho, 2002; Lindsey et al., 2019; Mozeiko et al., 2011), while also using more specific analysis units (clause and sub-clause units, referred to as "meaningful units," rather than T-units) and a more complex narrative. Cinderella is a longer story, with greater potential for embedded episodes and complex storytelling. In addition, drawing on narrative analyses for children, the current study evaluates the robustness of speakers' story grammar use by examining their episode completeness and elaboration. The questions this study aims to address are as follows:

1. Will individuals with TBI produce significantly shorter narratives?
2. Will individuals with TBI produce significantly less complete and/or elaborate stories than their NBI counterparts?
3. Will individuals with TBI produce significantly higher proportion of utterances that cannot be assigned any specific story grammar function (non-story grammar elements) than NBI participants?

It is hypothesized that individuals with TBI will produce significantly 1) fewer total episodes and total story grammar elements, 2) fewer complete and/or elaborate episodes and more incomplete

and/or simple episodes, and 3) more non-story grammar elements than NBI counterparts. These findings will yield a more complete understanding of discourse deficits in TBI, which should allow for better treatment planning to address the communicative needs of these clients.

METHODS

This study used a between-groups design to compare a group of participants with TBI to a group of NBI participants. Fifty-eight participants (29 TBI, 29 NBI) were selected from TalkBank, a secure online database used by laboratories to store and share participant videos and transcripts of discourse tasks. Control participants for this study were selected from the Richardson, Wright, Capilouto, Boyle/MSUC, and UNH labs. TBI participants were selected from the Togher lab at the 12-month data point, as recovery of cognitive and linguistic skills often becomes more stable and consistent by this time. Consent from participants was required to add videos/transcripts to AphasiaBank and TBIBank. The consenting process was conducted with participants at the lab where they participated according to that university's IRB approved protocol. Participants with TBI were included based on the criteria that they spoke English as their primary language, did not have aphasia, and did not have a motor speech disorder. NBI participants were included based on the criteria that they spoke English as their primary language, did not have any history of brain injury or illness, and had no known speech or language disorders. TBI and control participants were matched pairwise for age (n = 26 within 1 year, n = 4 within 3 years) and sex. While highest level of education was not a variable used to match participants, between-group differences for this variable were not statistically significant (p = .217). See Table 1.

Table 1. Demographic information for included TBI and NBI participants from TalkBank.

	TBI	**NBI**
N	29	29
Age (years)	Mean = 37.58 Range = 18-67	Mean = 38.11 Range = 18-66
Gender (F:M)	5:24	6:23
Race	Not reported	27 white 2 African American
Education (years)	Mean = 14.172 Range: 10-20	Mean = 14.77* Range: 12-20
Language Status (monolingual: bilingual: multilingual: NR)	26:3:0:0	16:0:3:10
Post-Traumatic Amnesia (days)	Mean = 57.552	N/A

Note: NR: not reported. *3 NBI not reported.

Procedure

Cinderella stories were elicited using the standard TalkBank protocol (MacWhinney, Fromm, Forbes, and Holland, 2011). First, participants were asked if they knew the story of Cinderella; all participants reported familiarity with the story. The participant was given a copy of Disney's Cinderella picture book (Grimes, 2005) with the words concealed, and encouraged to look through the pictures to help remind them of how the story goes. After adequate time was given, and the participant indicated they were finished looking at the book, the examiner removed the book from sight and prompted them to tell as much of the story as s/he could. While prompts could be given (e.g., "what happened next?") if it seemed that the participant was

faltering, none of the participants included in this study required such prompting. The participant continued until indicating that the story had concluded. Each participant's narrative was then transcribed verbatim, separated into C-units, and uploaded to TalkBank along with the video recording of the session. To reduce coder bias, no videos were viewed for the present analyses.

Measures

Transcription and identification of "meaningful units." Most assessments of story grammar separate participant utterances into C-units, defined as an independent clause along with any of its attached dependent clauses. Because Cinderella is a more complex story than those often assessed with story grammar, participants often used complex sentences with multiple clauses (or parts of clauses) that each served separate story grammar functions. For example, a sentence such as "When Cinderella arrived at the ball, the prince saw her, fell instantly in love, and danced with her all evening," is a single c-unit, and yet it contains an initiating event, attempt, and direct consequence. As a result, the current study's coding schema broke utterances into "meaningful units," to create a more consistent and concrete way to assign story grammar codes. In general, the term "meaningful unit" meant separating utterances into clauses which had a subject or noun phrase and a verb or verb phrase. Infinitives, or uninflected verbs, were not considered to be separate meaningful units and remained attached to the clause upon which they were dependent. Additional verb phrases (i.e., compound predicates and compound infinitives) were separated from the clause to which they are attached to form their own meaningful units. Compound predicates, defined as a subject performing more than one action, and compound infinitives, defined as two infinitives linked to the same subject and main verb (e.g., "I want to run and jump", with "want" as the verb), often were found to meet criteria for more than one story grammar element, justifying their separation from the clause to which

they were attached. For example, "[1]the prince saw her, [2]fell instantly in love, [3]and danced with her all evening" includes a compound predicate, which would be broken up into three meaningful units ([1]the prince saw her, [2]fell instantly in love, [3]and danced with her all evening). On rare occasions, a clause was split if it was deemed to meet criteria for two distinct story grammar elements (e.g., "At the strike of midnight, Cinderella ran away." = [1]At the strike of midnight, [2]Cinderella ran away).

Each meaningful unit articulated by a participant was assigned one of seven story grammar codes, described below. All story grammar codes were mutually exclusive (i.e., only a single code could be assigned to each meaningful unit), with the exception of *mental states* [MS] which could be assigned alone or in conjunction with any other code. The story grammar codes used in this schema were based on the traditional story grammar elements described by Stein and Glenn (1975). Specifically, *setting statements* were used to create a reference for the story's location and time, or to introduce characters, relationships, or habitual states. *Initiating events* were changes to the status quo that caused the narrative to progress. These could be natural occurrences (such as a change in environment), actions (taken by any character, as long as it provoked a response by the main character), or internal events (knowledge or perception of the occurrence of an external event). Causally linked to an initiating event or presented problem, *attempts* were steps a character took toward achieving a goal. In the present schema, plans were coded as attempts, as plans often took the place of an attempt, rather than both elements being included (e.g., "The prince decided to search door to door for the woman who would fit the glass slipper"). The result of one or more character attempts was a *direct consequence*—whether the character was successful or unsuccessful in their attempt (Stein & Glenn, 1979). A *conclusion*

statement signaled that the story was coming to a close through "wrapping up" statements. The conclusion often served as a direct consequence for the overarching story.

Based on Stein and Glenn's (1979) story grammar elements, two elements (rnternal responses and reactions) were combined, and one (non-story grammar [NSG]) was added in an attempt to achieve more reliable coding and to target anticipated challenges in the narratives of participants with TBI. The code *mental state* [MS] subsumed the categories of internal responses and reactions, as well as any other statement of a character's internal thoughts, feelings, or motivations. Mental state was the only code that was combined with another story grammar code, under the condition that the clause in question served a story grammar function (such as a plan) and also included a mental state term. Meaningful units that included a mental state term – or were dependent on a mental state term (e.g., she thought [MS] *she would never be able to go to the ball* [MS]) were coded as mental states. An additional code, NSG, was created for use with utterances unrelated to the narrative, which did not meet criteria for any story grammar elements.

After codes were assigned to each meaningful unit, coders assigned episode numbers to sets of episodic components (some combination of an intiating event, attempt, and direct consequence). Once all meaningful units had been assigned a story grammar or NSG code, the number of episodes, number of story grammar elements (i.e., total of setting, initiating event, attempt, direct consequence, conclusion, and mental states), and number of NSG codes were totaled. From here, the proportion of NSG elements to total elements (i.e., story grammar elements + NSG) was calculated. The total number of episodes and total number of story grammar elements were dependent variables, used to compare story length. The proportion of NSG elements was a dependent variable to compare how often speakers in each group contributed utterances that did not serve a story grammar function.

Typically, for a story grammar episode to be considered "complete", it must have at least one initiating event, one attempt, and one direct consequence. Because one of the aims of this study was to reveal specific language differences between groups, episodes were evaluated based on both completeness (having the necessary elements), and complexity (inclusion of other non-crucial elements to tell a more complex or elaborate story). In this schema, an episode was considered "incomplete" if it had two or fewer of the three basic elements and "complete" if it had all three basic elements. An episode was considered "simple" if it included at most one of each basic episodic element and "elaborate" if it included additional episodic elements (e.g., more than one of a given basic element, one or more mental states, one or more setting statements). Based on these two dichotomous categories, all episodes in each transcript were coded as simple-complete, simple-incomplete, elaborate-complete, or elaborate-incomplete. The number of episodes of each type was totaled. These four totals were used as dependent variables for comparing episode completeness and elaboration between groups.

Reliability

One graduate student in communication sciences and disorders was trained first to separate utterances into meaningful units based on the rules devised by the author and thesis adviser, and then to apply story grammar codes and episodic completeness/complexity codes. This secondary coder was required to reach a kappa of .8 with the primary coder (author) in training across at least four out of five participants before coding the study sample's transcripts.

The thesis adviser created coding numbers for each participant, allowing primary and secondary coders to be naïve to participants' diagnostic status. Reliability coding, conducted for 20% of the sample (n=12), was completed at regular intervals, to prevent coder drift. Interrater reliability had a kappa of .83 for episodic story grammar coding (basic elements and mental

states) and a kappa of .90 for full story grammar coding (all elements). Point-to-point reliability for overall episode coding was .87.

Data Analysis

To examine group differences in narrative organization, in terms of narrative length, completeness and elaboration of episodes, and the inclusion of NSG elements, the normality of each dependent variable was assessed via Shapiro-Wilk's test. Data across all variables was non-normally distributed (all p's<.05); therefore, Mann-Whitney U-tests were used to analyze group differences for all variables.

RESULTS

Narrative length

A Mann-Whitney U test was run to determine if there were differences in total number of episodes between TBI and NBI groups. Distributions of the number of episodes for TBI and NBI groups were similar, as assessed by visual inspection. The total number episodes for the TBI group (mean rank = 24.67) was statistically significantly lower than the total number of episodes for the NBI group (mean rank = 34.33), U = 280.5, z = -2.198, p = .028.

A Mann-Whitney U test was run to determine if there were differences in total number of story grammar elements between TBI and NBI groups. Distributions of the number of episodes for TBI and NBI groups were similar, as assessed by visual inspection. The total number of story grammar elements for the TBI group (mean rank = 24.34) was statistically significantly lower than the total number of story grammar elements for the NBI group (mean rank = 34.66), U = 271.00, z = -2.325, p = .020.

Narrative completeness and elaboration

A Mann-Whitney U test was run to determine if there were differences in number of simple-complete episodes between TBI and NBI groups. Distributions of simple-complete episode scores for TBI and NBI groups were similar, as assessed by visual inspection. The total number of simple-complete episodes for the TBI group (mean rank = 27.40) were not statistically significantly different than the number of simple-complete episodes for the NBI group (mean rank = 31.60), $U = 359.5$, $z = -1.119$, $p = .263$.

A Mann-Whitney U test was run to determine if there were differences in number of simple-incomplete episodes between TBI and NBI groups. Distributions of simple-incomplete episode scores for TBI and NBI groups were similar, as assessed by visual inspection. The total number of simple-incomplete episodes for the TBI group (mean rank = 32.40) were not statistically significantly different than the number of simple-incomplete episodes for the NBI group (mean rank = 26.60), $U = 504.5$, $z = 1.754$, $p = .079$.

A Mann-Whitney U test was run to determine if there were differences in number of elaborate-complete episodes between TBI and NBI groups. Distributions of the elaborate-complete episode scores for TBI and NBI groups were not similar, as assessed by visual inspection. The total number of elaborate-complete episodes for the TBI group (mean rank = 24.33) were statistically significantly lower than the number of elaborate-complete episodes for the NBI group (mean rank = 34.67), $U = 270.5$, $z = -2.350$, $p = .019$.

A Mann-Whitney U test was run to determine if there were differences in number of elaborate-incomplete episodes between TBI and NBI groups. Distributions of the elaborate-incomplete episode scores for TBI and NBI groups were similar, as assessed by visual inspection. The total number of elaborate-incomplete episodes for the TBI group (mean rank =

32.93) were not statistically significantly different than the number of elaborate-incomplete episodes for the NBI group (mean rank = 26.07), $U = 520.0$, $z = 1.632$, $p = .103$.

Non-story grammar elements

A Mann-Whitney U test was run to determine if there were differences in the proportion of NSG elements between TBI and NBI groups. Distributions of NSG proportions for the TBI and NBI groups were similar, as assessed by visual inspection. The proportion of NSG elements for the TBI group (mean rank = 35.72) was statistically significantly higher than the proportion of NSG elements for the NBI group (mean rank = 23.28), $U = 601.0$, $z = 2.823$, $p = .005$.

DISCUSSION

The present study used a sample of TBI and NBI transcripts from TalkBank participants (N=58) to analyze Cinderella narratives using a modified story grammar analysis. The study aimed to examine whether individuals with TBI would demonstrate significant variations in narrative length, completeness, elaboration, and organization from non-brain injured (NBI) individuals, as measured by the total number of episodes and story grammar elements, number of each episode completeness and elaboration type (simple-complete, elaborate-complete, simple-incomplete, and elaborate-incomplete), and proportion of non-story grammar (NSG) elements. Results found that individuals with TBI overall produced fewer episodes and story grammar elements overall, fewer elaborate-complete episodes, and a higher proportion of NSG elements. The results did not demonstrate a statistically significant difference between groups for simple-complete, simple-incomplete, or elaborate-incomplete episodes. Thus, groups were only differentiated based on production the most advanced type of episode structure: elaborate-complete episodes.

The results showed that as compared to the NBI group, individuals with TBI included fewer total episodes (whether complete or incomplete), fewer story grammar elements (initiating event, attempt, direct consequence, mental state, setting, conclusion), and fewer elaborate-complete episodes (consisting of at least one initiating event, attempt, and direct consequence, as well as a mental state, setting statement, and/or multiple basic elements). These findings were consistent with previous studies, which found participants with TBI were likely to have fewer total story grammar episodes than their NBI counterparts (Mozeiko et al., 2011).

In the current study, participants in the TBI group on average created shorter, simpler stories with less detail contained within episodes than the NBI group. Individuals in the NBI group were more likely to elaborate their stories with multiple different elements, creating more complex and appealing narratives through use of mental states and setting statements. Inclusion of these elements often create a subjectively richer or more compelling story. These individuals created stories that "painted a picture" due to the amount of detail provided. Individuals with TBI who did elaborate their episodes were more likely to do so with multiple basic elements (initiating event, attempt, direct consequence), creating more complex episodes but ones that lacked compelling detail. Multiple participants with TBI focused disproportionately on the introductory portion of the story, when Cinderella first meets her stepfamily and is forced to become the family's servant. This information is considered to be "setting statement" information in this schema that sets the ground for the rest of the story prior to the first initiating event, and is not considered to be episodic in nature. Thus, if the total number of story grammar elements were held constant, fewer elements would have been part of episodes, and fewer total episodes would have been produced by such participants.

The results of the NSG measure showed that individuals with TBI were more likely to include elements outside the story grammar structure, namely "meaningful units" that were tangential, off-topic, or otherwise unrelated to the story. This result, likewise, confirmed the findings of multiple other studies (Coelho, 2002; Lindsey et al., 2019; Mozeiko et al., 2011), while extending our knowledge by analyzing a more complex narrative with multiple episodes. In our study, many participants with TBI were judged to have excessive "non story grammar elements" through their use of asides (e.g., "They hadn't exchanged phone numbers. I don't think they even had phones in those days"), vague language (e.g., "yeah who was it? The guy, it was something of him. He did something"), filler phrases (e.g., "or whatever you call it"), abandoned utterances (e.g., " I want a +//.") or units that otherwise interrupted the flow of the story and did not add meaningful information to the story. NSG elements were identified as such based on how disruptive they were to the story being told. In an extreme manifestation of such disruptions, some adults with TBI produced stories that were unrecognizable as the story of Cinderella or too vague to be considered a retelling of the fairytale. In fact, one such participant (Togher 18) produced a narrative that was almost entirely composed of units rated as NSG, as the units were either too vague to be considered a part of the Cinderella narrative, too tangential, or abandoned altogether. This participant also had the lengthiest stretch of post-traumatic amnesia at 215 days. The second-longest stretch of post-traumatic amnesia was 122 days; this participant's narrative consisted of four elaborate-complete episodes, with 19% of their meaningful units coded as NSG. This suggests that post-traumatic amnesia may be one factor that impacts the overall organization and quality of an individual's narrative.

While study results documented poorer narrative quality on average in the TBI group, it is important to note that some participants with TBI demonstrated narrative abilities

commensurate with the NBI group on one or more measures. For example, one adult with TBI (Togher 26) produced a single non-story grammar element, six elaborate-complete episodes, and no other episode types. Thus, the current story grammar analyses were able to capture the nuances of narrative production abilities across adults with TBI, from those who demonstrated significant discourse-level difficulties to those whose narratives were within the average range by 12-months post-injury.

Limitations

Results of this study must be interpreted cautiously due to a limited sample size. Sample size was limited due to a number of factors; namely, time constraints of coding, exclusion criteria (closed head injuries only, primary English speakers only), and matching criteria (age, sex). In addition, TalkBank videos that lacked accompanying transcripts or had incomplete transcripts were excluded from the current sample. This limited sample size prevented moderation analyses to determine the potential influence of post-traumatic amnesia on the relationship between TBI and story grammar outcomes.

Additionally, while age, sex, and education level were controlled across groups, nationality was not. The TBI group consisted entirely of participation from the Togher lab in Australia, whereas the NBI group consisted of participants from labs within the United States. Differences in narrative organization could reflect cultural or dialectal differences between groups. Future studies should confirm results by comparing samples from the same country or region.

This current method of narrative analysis was time-consuming and required transcription of narratives prior to coding, which limits its clinical utility. Researchers in this study coded transcripts within an average of 10-20 minutes, depending on the length of the sample and

complexity of the episodic structure; this was with pre-generated transcripts provided by TalkBank. Transcribing these narratives would add a considerable amount of time to the total time spent performing the analysis, limiting its practicality for assessing narrative capabilities in a clinical setting.

Finally, it should be noted that Cinderella is a familiar story to the majority of participants. This may have impacted narrative production; that is, participants may have produced fewer details in a story that is considered shared knowledge. This may have impacted their narratives in a way that an unfamiliar story (such as those used in other narrative studies) would not.

Despite these limitations, the implications of the present study cannot be discounted. This study utilized a story grammar measure not commonly employed in other analyses for adults, namely how elaborate or simple an episode is. This measure, akin to ratings of episodic elements on the MISL, pinpointed the specific nature of story grammar deficits in participants with TBI. In particular, the results of this study offer preliminary findings that individuals with TBI create less complex episodes by utilizing fewer mental states, setting statements, and/or multiple basic elements. Based on a measure similar to the story grammar measure from Coelho (2002), Lindsey et al. (2019), and Mozeiko et al. (2011), this study also confirmed that individuals with TBI use more NSG utterances during narrative production.

Future Directions

The current study's approach to story grammar analysis was performed on transcripts collected twelve months post-injury. Participants from the Togher lab also contributed videos and transcripts from 3-months, 6-months, 9-months, and 24-months post-TBI, all of which are available through TalkBank. Similar analyses could be performed at these other time points to

monitor participants' spontaneous recovery from their injuries. Earlier time points in the recovery process may show more obvious differences between TBI and control groups, as observed in main concept analysis results of Cinderella narratives (Elbourn et al., 2019).

The current story grammar analysis approach also could be utilized in the future to analyze other narrative discourse measures from the TalkBank protocol, such as the picture description tasks (Broken Window, Refused Umbrella, Cat Rescue). However, as those stories tend to be shorter and less complex than Cinderella (consisting of only one or two episodes), between-group differences may be most likely on the NSG measure, while differences in the total number of episodes/elements or episode elaboration may not be detectable.

This method of story grammar analysis may not be the most efficient method of capturing deficits in narrative organization. Future research should focus on more efficient methods of analysis for comparison, to determine if representative results can be achieved from a more clinically practical method of analysis. For example, it may be possible to compare retellings of Cinderella to a standard set of concepts and what story grammar elements those concepts serve. Story grammar analysis is further limited in its ability to detect macrostructural deficits in terms of sequencing; that is, a participant may produce complete episodes with all basic elements but present these episodes or elements out of order, making the story confusing to the listener. In such cases, story grammar analysis may inaccurately suggest proficiency in their narrative retell. Future research should explore a method of narrative analysis that accounts for sequencing in addition to story grammar, such as the Main Concept, Sequencing, and Story Grammar (MSSG) analyses of Greenslade et al. (in submission).

CONCLUSION

This study utilized story grammar analysis in a novel way by assessing a more complex story with more scrutiny and precision than previous story grammar analyses in adults with TBI. Resulting comparisons of narrative length, completeness, elaboration, and topic maintenance (as represented by NSG elements) revealed shorter narratives with fewer episodes and story grammar elements, as well as fewer elaborate-complete episodes in adults with TBI as compared to NBI counterparts. Further, adults with TBI included a higher proportion of utterances that did not serve a story grammar function as compared to NBI adults. Overall, study results suggest that episode elaboration as well as the proportion of non-story grammar elements may be key variables to quantify the qualitatively poorer narrative production abilities of individuals with TBI. Overall, current analyses offer new insights into the narrative organizational abilities of individuals with TBI, and provide researchers and clinicians with a tool that effectively captured nuances in narrative production across TBI and NBI participants. Results of such analyses have the potential to improve our ability to individualize interventions and maximize communication outcomes following TBI.

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