

# CASE STUDIES

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## Long-Term Recovery in Paediatric Head Injury: Overcoming the Hurdles

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Despite recovery in the majority of children with severe traumatic brain injury to premorbid levels of function on traditional tests of intellectual and language functions, recent evidence indicates that deficits may persist or even emerge at later developmental stages. Unfortunately, children with severe brain injury often are not followed long term and consequently do not receive the necessary services at later stages of recovery for a variety of reasons. This article presents a case study to delineate some of the frequent yet remediable obstacles faced by children with brain injury, their families, and school personnel. Possible solutions to improve the situation are offered. This case is also presented to illustrate the promise of discourse methods in assessing and treating the unique cognitive-linguistic sequelae of paediatric brain injured populations.

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Severe traumatic brain injury has a long-term impact on the developing brain (Chapman, Levin, Wanek, Weyrauch, & Kufera, 1998; Dennis & Barnes, 1990; Levin & Eisenberg, 1979). A traumatic brain injury (TBI) is an acquired injury to the brain caused by an external force which may impair cognitive, linguistic, physical, behavioural, and emotional func-

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tioning. TBI applies to open or closed head injuries. The focus of this article is on the neurobehavioural sequelae associated with traumatic closed head injury, which is defined as a nonpenetrating head injury in which the primary traumatic force is a sudden acceleration or deceleration. Emerging evidence from longitudinal studies indicates that children and adolescents who survive a severe brain injury demonstrate short- and long-term disabilities unlike that of many other disability groups (Chapman, Levin, & Harward, 1996; Chapman et al., 1992). Therefore, steps should be taken at various stages of recovery and at

subsequent developmental stages to mitigate the risk and degree of later emerging deficits.

In this article, we present the story of Sarah who vividly illustrates the importance of long-term follow-up for pediatric TBI patients and the hurdles these children and their families face along the way. The information pertaining to management hurdles are organised along three dimensions. First, the individual hurdles that emerged during Sarah's "recovery" process are discussed. Then, relevant literature is reviewed to emphasise that this case is not an isolated occurrence. Finally, possible solutions to diminish the hurdles are offered. We delineate the following five hurdles that had to be overcome in order to provide Sarah the necessary treatment to guard against a spiral of downward failure. The five hurdles are:

- Limited information regarding the initial brain injury
- Uninterpretable professional reports
- Lack of knowledge of brain-behaviour relationships and the potential of latent deficits
- Failure to employ appropriate diagnostic measures
- Unavailability of proven methods to identify and remediate the unique deficits

In the final section, we briefly discuss discourse methods of retell and summarisation as a promising avenue to fill the previous void in assessment and treatment methods available to clinicians who deal with pediatric TBI. Discourse measures can be used to directly address the particular deficits in processing connected information manifested by the majority of children such as Sarah who sustain a severe brain injury (Chapman, 1995, 1997). Moreover, discourse offers a functional approach to manipulating both cognitive and linguistic abilities in the academic and social domains (Ylvisaker, 1998).

## SARAH: A CASE STUDY

### Sarah's History

Our research team first met Sarah approximately 3½ years after her initial brain injury. Sarah was injured at 5 years 10 months of age, in a motor vehicle accident in which she was an unrestrained passenger. The accident involved two cars, both travelling in excess of 104 kilometres per hour (65 miles per hour). Sarah was thrown from the car and was found unconscious at the scene of the accident. She was transported by Care Flight to the county trauma unit. Prior to the injury, she had completed kindergarten in school. Sarah returned to the normal classroom after rehabilitation and passed the first and second grades. When she started the third grade, her

mother became concerned about Sarah's increasing problems with schoolwork. Sarah's mother was desperate for help and in search of answers. It was at this stage of development that we came to know Sarah.

### Hurdle One: Limited Information Regarding Initial Injury

#### Sarah

When Sarah came to our clinic, she was 9 years 5 months old, and little information regarding her initial brain injury was readily available to us or to the school personnel. After Sarah's injury, the information regarding her initial injury was not provided to her parents in a permanent format. Consequently, her parents were unable to convey the requested injury information to professionals who became involved in her case at a chronic stage of recovery, that is, 3½ years postinjury. Fortunately, some information was recoverable from a relatively recent neuropsychological report (3-year follow-up), which few children have. The neuropsychological report summarised the early computerised tomography (CT) scan findings and her lowest Glasgow Coma Scale (GCS) score. CT scan findings revealed that Sarah sustained multiple injuries including bilateral frontal contusions, a right temporal contusion, punctate hemorrhages, and diffuse low density areas in the right frontal, left temporal, and right occipital regions of the brain. Her lowest GCS rating was 4. Additional information regarding the accident, timeline of recovery, and premorbid social and academic functioning was gathered from parental report. Sarah's mother reported that she was in coma for 5½ weeks. With regard to evidence of prior learning or developmental problems, all of Sarah's childhood milestones were reportedly normal. A family history of both dyslexia, in her father and sister, and attention deficit disorder (ADD), in her brother, was reported.

#### Relevance

The most consistent finding from longitudinal studies of recovery after severe TBI is that aspects of the initial injury contribute significantly to both the short- and long-term profile of cognitive, linguistic, and behavioural sequelae after TBI (Chapman et al., 1992; Chapman et al., 1998). Although residual deficits after mild injury are rare, children with a severe brain injury are likely to manifest some degree of disability. A mild TBI is associated with a brief or no loss of consciousness and a GCS rating of >12, whereas a severe TBI is associated with coma longer than 24 hours, a GCS <8, and a period of posttraumatic amnesia. Moreover, there is growing evidence that children who sustain frontal lobe lesions are particularly likely to demonstrate persistent, more

severe, and sometimes latent deficits than children without frontal lobe involvement (Chapman et al., 1992; Chapman, 1995; Levin et al., 1993). Thus, children with severe TBI and concomitant frontal lobe injuries may experience continual or intermittent disability in academic, behavioural, and social domains.

It is imperative that the professionals who are responsible for ensuring that the child obtains the necessary services know the facts concerning the initial injury. These professionals may include teachers, both regular and special education, speech-language pathologists, and counsellors. The severity, site, and cause of the injury will continue to be a factor in understanding the child's learning, language, behaviour, and socialisation potential. The injury information may help explain why a child fails to continue to develop at a normal rate in spite of a seemingly good recovery of premorbid abilities, as well as why deficits may emerge at later stages.

Unfortunately, parents are rarely given written information that characterises their child's initial injury. This initial injury information becomes increasingly difficult to gather as the time since hospitalisation increases.

### **Solution**

Access to information about the child's brain injury is easiest in the acute care hospital where relatively good documentation exists. Whereas this information is typically conveyed to the parents verbally, it is done so at a time when the parents are too traumatised emotionally to process, let alone remember, the information. The injury information from the medical charts is difficult to synthesise in a concise and useable format once several years have passed. The lack of readily available information became a problem for Sarah, her family, and her teachers when deficits emerged at a later developmental stage after she had exhibited a seemingly "full" recovery.

Given the recent empirical evidence that the initial injury can provide valuable cues to the recovery process, or lack thereof, throughout the child's life, it is advantageous to summarise the appropriate information in an easy to interpret format before the child leaves hospital. One possible format for summarising the information regarding the child's injury in a concise manner is presented in the Appendix. This TBI patient profile form can be used to convey the most salient information from medical records and case history. The medical history should include the site, size, and severity of the injury. The case history interview should identify the recovery time line as well as information concerning the pre-injury development of the child. Collecting this information in a timely fashion allows the child's parents to accurately provide the facts at subsequent stages to professionals who were not involved in the early treatment process.

This information should be given to the parents as well as placed in their child's permanent medical file. In many cases, the parents' records become the only available data since the school will often not have time to obtain the necessary medical release of information. Additionally, after several years have elapsed since the injury, school personnel may not even recognise the need for such information. With a completed TBI patient profile, Sarah's parents would have been able to provide the initial injury information to school professionals to help facilitate a more appropriate management. As it was, the regular and resource teachers were not only unaware that the brain injury had been severe, but also lacked knowledge that latent deficits could be attributed to the much earlier injury.

### **Hurdle Two: Uninterpretable Professional Reports**

#### *Sarah*

Although a recent neuropsychological report regarding Sarah's abilities was available, understanding the information conveyed by this report was difficult. The report delineated several deficits using professional jargon, and educators were unable to understand how the deficits applied to classroom learning. For example, a portion of the report read: "Visuospatial and perceptuomotor functions showed significant overall improvement . . . particularly in the areas of graphomotor speed, attention to visual detail and inductive visual conceptualisation and construction skills," although these areas were still impaired. The report also provided recommendations for the school that were reportedly not interpretable and consequently not implemented.

#### *Relevance*

It is often difficult to understand the functional implications of professional reports. They contain language that is easily understood by the writer and his or her colleagues, but difficult for others to decipher. All professionals are guilty of writing reports in this manner. It is imperative that we as rehabilitation professionals take the time to write reports that are easily understood by those who are working with the child beyond our setting in a real-world context (Ylvisaker, 1998).

#### *Solution*

Because considerable effort was required to comprehend the results and recommendations of the neuropsychological reports, our research team translated the information for Sarah's teachers using concrete examples of how her identified deficits were manifested in her real-world settings. We presented teachers with a table that illustrated the deficits and their implications for Sarah's academic and social

success and used this to make specific recommendations. If this information had been presented to Sarah's parents and teachers in a clear manner, they would have been able to use valuable information contained in the neuropsychological report and to understand how the identified deficits affected her everyday functioning. Clearly written reports will not only decrease the frustration of parents and teachers, but will also bridge the gap in services across settings.

### **Hurdle Three: Lack of Knowledge of Brain-Behaviour Relationships and Potential for Later Emerging Deficits**

#### *Sarah*

After Sarah's severe brain injury, her recovery was considered to be "miraculous" not only by her family, but also by her doctors. Upon returning home, she functioned well within her environment, although not at her premorbid level. When she returned to school, she was placed in a regular classroom with some special provisions for help in reading. Her performance was average to above average until she reached the middle of the third grade. At that time, her grades began declining dramatically from her B average in the previous term. Sarah demonstrated difficulty learning new information and consequently failed social studies. Her teachers reported that she exhibited difficulty problem-solving, planning, and organising. Her teachers also reported a discrepancy in what they perceived as Sarah's potential performance and her actual performance. Sarah could verbalise steps that she would take to complete an assignment, which demonstrated her potential, but could not carry them out independently. Sarah had difficulty organising and planning on her own which caused her actual performance to be much lower than her teachers would have expected. Sarah had also begun to show difficulty maintaining her behaviour and would easily become agitated, both at home and at school. Because the information was not conveyed early on, the knowledge of the relationships between the nature of the injury and the behaviours that subsequently resulted were not understood by Sarah's parents or teachers. As indicated above under the hurdle of initial brain injury, Sarah had severe bilateral frontal lobe injuries. Many of her emerging deficits such as poor attention, decreased organisation, poor self-monitoring, agitation, and other behaviour difficulties could be associated with the earlier injury to the frontal regions.

Sarah's teachers had minimal information regarding her brain injury because 3 years had passed since the injury. They were unaware of the severity of the injury and site of lesions and did not recognise the significance of this information to Sarah's

current performance. Her teachers lacked knowledge of the relationship between frontal lobe lesions and the potential for later emerging deficits.

#### *Relevance*

Research has shown that the frontal lobes show a protracted maturation that peaks between the ages of 8 and 12 years. This is a point worth noting because it underlies the importance of a continuous reintegration process. Children who have sustained severe injuries to the frontal lobes at an early age may fail to show deficits until they reach a later stage when the frontal lobes have matured (Levin et al., 1993). While initially these children can successfully return to school, the latent manifestation of deficits disrupts this course, puzzling teachers and parents as to the source of the difficulties. Therefore, it is vital that these children be followed by speech-language pathologists or other professionals so that when deficits do emerge, timely and appropriate intervention can be implemented.

#### *Solution*

Because a relationship exists between the nature of the early injury and the deficits that can later result, it is imperative that professionals working with the child be knowledgeable of this relationship. It is often the speech-language pathologist who is responsible for educating parents and teachers since we tend to be the "experts" on the subject. By educating parents and professionals working with the child, it is likely that later emerging deficits will be detected early and therefore treated in an appropriate and timely manner.

### **Hurdle Four: No System in Place for Long-Term Follow-Up**

#### *Sarah*

When Sarah's parents became concerned with the difficulty she was having at school and the behavioural outbursts that were emerging at home, they contacted the school. Neither the educational diagnostician, Sarah's regular education teacher, nor her resource teacher were able to provide a concrete explanation for the sudden changes. Without an objective reason, they felt there was nothing more they could provide by means of specialised services to Sarah or her family. Her mother did not know where to go, so she returned to the rehabilitation facility where Sarah received therapy 3 years before. The rehabilitation centre conducted a follow-up neuropsychological evaluation, and the results reported Sarah's persisting and newly emerging deficits. Sarah's mother showed this report to school personnel who responded with uncertainty. They did not know how the neuropsychological report translated to the educational setting and therefore could not make the ap-



appropriate modifications needed at that time in order to better handle Sarah's deficits.

### *Relevance*

With the knowledge that early brain injury results in later-emerging deficits, long-term follow-up is becoming increasingly important and necessary. Had a system been in place that followed Sarah, detection of her deficits would have been timely. This would have, in turn, made managing the deficits an easier process, as a reassessment would have been conducted and appropriate treatment would have been implemented rapidly. Her teachers would have been informed of appropriate strategies to deal with Sarah's deficits. All of this would have been done in a more timely fashion, instead of wasting valuable time looking for last resorts.

### *Solution*

A system should provide for long-term follow-up service at least until the child completes high school. With this necessity comes the question: Whose job is it to follow the child: the rehabilitation facility or the school system? Our answer is that a team-based approach should be implemented involving both the rehabilitation facility and school personnel, as well as the parents and child. Each one has an important role. Because the child is only in the rehabilitation facility for several months at most, the school system carries the burden of the long-term rehabilitation. We propose that a system be established that detects children who suffer severe brain injuries at the acute care stage. These children and their families would then be followed and monitored by a designated liaison, preferably familiar with how the school system operates. The liaison person's role would be to educate the professionals working with the child and families on the nature of the early injury and behaviours that could emerge at later developmental stages, as well as ease the transition from rehabilitation to school, later from school to school, and finally school to employment.

### **Hurdle Five: Unavailability of Effective Methods for Assessment and Treatment**

#### *Sarah*

Upon returning to school, Sarah's level of academic functioning was assessed. Poor performance was required for her to qualify for either speech therapy or special classroom placement for children with learning problems. Sarah performed within normal limits on the assessment measures and qualified for neither. However, she did show marked difficulty in the classroom and with socialisation. Had it not been for her mother's insistence, Sarah would not have received any support services.

### *Relevance*

This scenario is far too common with children who have sustained a severe brain injury. They may be showing some difficulties in the social arena or classroom, but when tested they perform within normal limits. The assessment given to Sarah by the school was made up primarily of traditional standardised tests. These standardised tests, commonly used by clinicians in all settings, were designed to identify the language deficits exhibited by children with language impairment. However, the deficits experienced by children with severe head injuries are unique, as they are generally cognitive in nature and different from those seen in children with a traditional language impairment. The Individuals with Disabilities Education Act (IDEA) (1990) distinguishes TBI as a separate disability category because the deficits that are present in TBI are different in terms of assessment and treatment from other disabilities. It is therefore important to use discriminating measures that are sensitive to the identification and remediation of these deficits.

The previously held perspective of minimal long-term deficits in language function is based on a narrow view in which language and communication are treated as synonymous behaviours. Considerable evidence verifies that children with acquired brain injury recover the formal aspect of language function as assessed by lexical and grammatical measures (Chapman, Levin, & Lawyer, in press; Chapman et al., 1997; Klonoff, Low, & Clark, 1977; Ylvisaker, 1993). Therefore, isolated use of measurements such as vocabulary and even length or complexity of sentences will suggest that the long-term linguistic sequelae after brain injury is minimal. However, the relatively preserved lexical and grammatical aspects of language after brain injury do not correspond to the ability to manipulate the language system to organise larger chunks of information at a discourse level (Biddle, McCabe, & Bliss, 1996; Chapman et al., 1997; Dennis & Barnes, 1990).

### *Solution*

Research has shown that discourse measures are more effective than traditional language measures for determining the cognitive-communication deficits that are commonly seen after a severe brain injury (Chapman, 1995). Our research group (Chapman, 1995; Chapman et al., 1992) and others (Biddle et al., 1990) have challenged the view that residual communication deficits are rare or subclinical (Jaffe, Brink, Hays, & Choraze, 1990; Klonoff et al., 1977) through the implementation of discourse measures. These methods have been used in assessment to identify impairments in discourse function in the majority of children who sustain a severe brain injury (Chapman et al., 1992; Chapman, Levin, Matejka, Harward, & Kufera, 1995; Chapman et al., 1998;

Chapman et al., 1997). In the next section, we briefly discuss some of the discourse measures we have found useful in paediatric brain injury.

## DISCOURSE METHODS: ASSESSMENT AND TREATMENT IMPLICATIONS

### Retell and Summarisation Tasks

Our research team has incorporated two discourse methods to use in assessment and treatment. The first method involves retell and story generation tasks, and the second method uses summarisation of narrative information. These methods have aided in elucidating the cognitive and linguistic deficits associated with severe TBI.

#### Retell

In a retell, the child is read (or reads) a text/story and is then asked to tell/write the content, being sure to include as much detail as possible. A retell can be used to evaluate memory, comprehension, facility with the formalised aspects of the language system (e.g., semantics, syntax), and ability to manipulate information. The specific measures that we have used in our discourse research (Chapman, 1997; Chapman et al., 1998) are outlined in Table 1 and were applied to characterising Sarah's retell abilities.

#### Summary

Whereas a retell task provides an effective measure of comprehension and recall, performance on a retell task does not readily measure whether the information is encoded at a more abstract or global level of representation. Encoding information is more complicated than simply understanding the individual words, sentences, and information content that comprise the text (van Dijk, 1995). Discourse studies have shown that individuals must be able to process

and store information at higher levels of semantic representation than conveyed in the explicit text (Frederikson, Bracewell, Breuleux, & Renuas, 1990; Ulatowska & Chapman, 1994; van Dijk, 1995). Because of working memory limitation, individuals typically recall little of the original verbatim content, recalling only 10 to 25% of the original surface content on immediate reproduction (Kintsch & van Dijk, 1978). Instead, they remember a condensed version of the text that reflects a more global representation than the original information (Kay & Black, 1986). This level of processing allows for more efficient encoding and retrieving of information.

In regard to structuring information, a good summary should be a condensed version of the original text which retains the important information and deletes the less important details. It is essential that the summary convey the central meaning of the original text in the reduced version (Hill, 1991; Kinnunen & Vauras, 1995). To produce a coherent and concise summary, inferencing and transformation of information at a more general level than the explicit story content is required (Stein & Kirby, 1992; Thistlethwaite, 1991). In contrast, a retell may involve minimal inferencing and transformation of the original content. The ability to transform information indicates that the summariser is capable of processing the information at a more generalised level rather than being bound to the superficial content (Stein & Kirby, 1992).

The specific measures that we have developed to characterise summarisation ability in children after TBI are outlined in Table 2. We derived a summary coding schema from our own research and the work of Kinnunen and Vauras (1995) and Stein and Kirby (1992). In general, we determine if the child condenses the information. Then, we examine whether the information has been transformed. For example, a child's summary may manifest few instances of rewording or inferencing, suggesting minimal trans-

TABLE 1. Retell

<i>Task</i>
Provide as much information from the original text as possible
<i>Measures</i>
Language used by the child
1. Number of words
2. Number of sentences
3. Complexity of sentences
Information included in the retell
1. Amount of core information included
2. Retention of central information (gist)
3. Organisation of information (episodic structure)

TABLE 2. Summary

<i>Task</i>
Provide a shortened version of the original text that still retains the main idea
<i>Measures</i>
Level of Processing
1. Minimal transformation/Superficial Processing
• ideas are expressed in similar wording as original text
• lacks instances of integration, connectives, and inferencing
• information is reduced through deletion only
2. Transformation/Generalised Processing
• ideas are expressed using summariser's own words
• contains examples of integration, connectives, and inferencing
• conveys synthesised meaning across entire story
Distribution of information between episodes

formation (Stein & Kirby, 1992). If the child's summary contains more global statements than contained in the original text, then it becomes apparent that he or she is able to build the necessary semantic relations across sentences through inferencing to construct a transformed, more generalised representation (Stein & Kirby, 1992).

Ability to summarise connected language may be particularly vulnerable to the effects of a severe TBI. In a recent pilot study, we found that children with severe TBI have more difficulty than normal control children in manipulating discourse information when asked to condense and transform the information at a higher level of interpretation than entailed in the original version. The children with severe TBI used significantly fewer transformed statements, including more untransformed, unimportant details in their summaries. Summarisation plays a key role in learning, aiding in the comprehension of the text, facilitating deeper processing of the text, and increasing recall of the text (Kinnunen & Vauras, 1995; Stein & Kirby, 1992). Since summarisation is crucial to academic and social success, it may provide a salient, functional outcome measure (Kinnunen & Vauras, 1995; Stein & Kirby, 1992; Thistlethwaite, 1991).

### Sarah's Discourse Assessment

We used both a story retell task and a summary task to assess Sarah's discourse ability.

#### *Sarah's Retell*

First, we discuss Sarah's performance on a retell task, using the fable "The Crow and the Peacocks" (see Table 3). Sarah read the fable and was then asked to retell it, as if the examiner had never heard the story. Her retell response appears in Table 3. Sarah had difficulty retelling this story with impairments seen primarily in the information domain. With regard to language, she used complex sentence

structure with multiple embedding of dependent clauses. With regard to information, she showed a reduced ability to recall much of the core information and a failure to use the episodic structure of a story effectively. She omitted key information, such as the turning point (e.g., the crow was pretending to be a peacock) and the resolution (e.g., the peacocks rejected the crow) of the first episode. She collapsed both episodes inappropriately producing the setting and limited action of the first episode, omitting most of the second episode, and ending with the global story interpretation. Sarah clearly had difficulty producing a straightforward retell that conveyed the core information from the original text.

#### *Sarah's Summary*

For the summary task, Sarah was read a story called "The Two Roosters" (see Table 4) and was asked to give a shortened version using her own words, giving the most important information and omitting the unimportant information from the original story.

As illustrated in her response shown in Table 4, Sarah had difficulty with the summary task. Her summary showed minimal transformation of information as she expressed predominantly explicitly stated information. This pattern suggests that she is failing to encode the meaning at a more generalised level than the concrete, explicit content. Perhaps she is unable to make the necessary inferences between story elements. Additionally, her difficulty may be caused by an inability to distinguish between important information to include and unimportant information to delete. This weakness was revealed through her omission of important information that was crucial to understanding the global meaning of the story and inclusion of unimportant details. Similar to the retell task, Sarah showed poor organisation of information, again failing to use episodic structure to guide her story summary. She condensed the

TABLE 3. Retell Task

*The Crow and the Peacocks*

One day a crow happened to go into the garden where the peacocks used to live. He found a number of feathers that had fallen off the peacocks when they were molting. He very carefully tied the feathers on his tail and then strutted towards where the peacocks were now sitting. At first the peacocks thought it was another peacock joining them. But when he came closer they discovered the truth. They flew down and began pecking at him and pulling off the borrowed feathers. The crow ran away from the peacocks. He flew back to the other crows, who had watched his behaviour from a distance for some time. They too were very annoyed with him and told him that it is not just fine feathers that make fine birds.

*Sarah's Retell*

There was a peacock. **(setting)**

And there was a crow that went into the place where the peacocks lived. **(setting)**

And he found a number of feathers that didn't belong to him. **(action)**

But it doesn't say that until in the middle and stuff. **(irrelevant)**

The other crows were mad at him too and said it's not just fine feathers that makes good crow or a good bird. **(global story interpretation)**

And I forgot what I was going to say but didn't tell how many feathers he found. **(irrelevant)**

*Retell From 9-Year-Old Normal Control*

There was a crow who went into a garden. **(setting)**

He saw some peacock feathers. **(setting)**

He put them on his tail as if he were a peacock. **(action)**

Then he flew over to the other peacocks. **(action)**

At first the peacocks thought he was a peacock. **(evaluation)**

But as he neared they knew he was a fraud. **(evaluation)**

They came down and pecked at him. **(resolution)**

The peacocks pulled off every feather. **(resolution)**

Then the crow walked over to the other crows who had watched his behaviour from a distance. **(setting)**

They got mad at him because nice feathers do not make nice birds. **(global story interpretation)**

And they didn't want him around them anymore. **(resolution)**

information to focus almost solely on setting information from the first episode.

In general, the summary assessment revealed that Sarah had difficulty going beyond the explicit content, was unable to distinguish important information from unimportant information, and was ineffective at using episodic structure. Consequently, her summary was difficult to understand and the central idea conveyed by the story was not recoverable from her summary. We propose that Sarah's difficulty with manipulating discourse content may underlie some of her emergent academic problems. In particular, her teachers commented that Sarah exhibited marked deficits in acquiring new information from her textbooks, but she had little difficulty mastering assignments based on old knowledge. In the next section, we discuss one possible plan of action to remediate Sarah's discourse problems.

### Discourse Treatment Plan

The results from our assessment using retell and summary tasks revealed both strengths and weaknesses that could be incorporated in a functional treatment plan. Sarah had difficulty on both the retell and summary tasks which suggests that her deficits could be caused by problems in memory, comprehension, and/or the deficits in manipulating information to extract the central meaning. Therefore, we established a hierarchy to guide treatment to help her encode information at a more abstract level of representation. At an initial stage, explicit probe questions were used to ensure comprehension and the memory of the textual information. Second, she was asked to paraphrase the story content, using her own words in a retell format at this stage. Third, probe questions were asked to facilitate inferential processes that underlie summarisation. The central



TABLE 4. SummaryTask

*The Two Roosters*

Once upon a time, there were two roosters. They were always fighting over who would be ruler of all the hens. One day, they decided to really fight it out. Finally, one rooster was beaten. The poor defeated rooster hid himself in the corner. The other rooster, who won the fight, flew to the very top of the henhouse and began crowing and flapping his wings to brag about his victory over the other rooster. Suddenly, an eagle swooped down, grabbed the boasting rooster and carried him far away. Now, this was good luck for the defeated rooster because now he could rule over the chicken yard and have all the hens that he wanted.

*Sarah's Summary*

There were two roosters in the story. **(unimportant, untransformed information)**

There was hens in a henhouse. **(added, unnecessary information)**

They both wanted to be ruler of the hens. **(important, untransformed information)**

And that they were always fighting over who was gonna be it. **(important, untransformed information)**

*Summary From 9-Year-Old Normal Control*

Two roosters were fighting over who would be the head rooster. **(important, untransformed information)**

While the winner flew to the top of the barn to brag of his victory, the loser hid himself in a corner. **(important, untransformed information)**

The winning rooster shouldn't have been showing off so much. **(transformed information)**

When an eagle heard the noise, he swooped down and carried him away. **(important, untransformed information)**

The losing rooster got to be the winner in the end just by being patient. **(transformed information)**

meaning, or gist, was then elicited to reinforce a more generalised level of processing the content. Finally, we elicited a summary. Summarisation relies on all the earlier stages, combining those skills to facilitate the generation of a coherent, concise summary of the story.

Using this treatment hierarchy, our research team determined that Sarah's comprehension and episodic memory were intact, as she demonstrated success on probes for explicit content. Sarah experienced breakdowns with paraphrasing, inferencing, and producing generalised statements. Therefore, we decided to initiate treatment at the level of a paraphrased retell to facilitate Sarah's summarisation skills. To improve her ability to summarise, she needed to first practice the ability to paraphrase the original content, second the ability to inference, and third the ability to combine those skills to produce a summary. These stages were targeted sequentially in a single session. Content from three areas were used as stimuli to facilitate generalisation of the strategies underlying summarisation. We selected narratives, academic content, and Sarah's personal stories. Some sample goals based on her discourse assessment included: (1) Sarah will improve her ability to distinguish between important and unimportant information on recognition tasks; (2) Sarah's ability to make inferences will be enhanced on probe questions requiring inferences; (3) Sarah will practice paraphrasing the information in her own words so she will be able to move beyond the explicit word-

ing and content; and (4) Sarah will improve her self-monitoring skills in order to become a more effective summariser.

## DISCUSSION

The data from this case inform us about the hurdles that children with severe TBI, their families, and their educators must overcome throughout development to achieve their potential. We offer possible solutions to mitigate the effects of these obstacles. Additionally, this case speaks to the efficacy of recently developed discourse methods in pinpointing some of the unique deficits associated with TBI. This case is consistent with previous research that children who sustain severe brain injuries have difficulty with discourse, which in turn affects their academic and social success (Biddle et al., 1996; Chapman, 1997; Dennis & Barnes, 1990).

Growing evidence indicates that discourse is impaired in the majority of children who sustain a severe TBI (Biddle et al., 1996; Chapman et al., 1992; Chapman et al., 1995; Chapman et al., 1998; Dennis & Barnes, 1990). However, the role of linguistic deficits and/or cognitive deficits remains an open question. Although persistent deficits in the formalised aspects of the language system are rare in TBI, language impairment is associated with more severe discourse deficits in a small percentage of severe TBI cases in children (Chapman et al., 1997). Linguistic

deficits such as inability to understand the original text or poor semantic and syntactic abilities can result in the child having difficulty producing discourse (Chapman et al., 1997). In the majority of cases, however, the discourse deficits are attributed to more underlying cognitive mechanisms, such as memory problems and/or impairment in cognitive abilities of executive function, than to formal language problems (Chapman, 1997; Chapman et al., 1992; Chapman et al., 1997). In regard to memory, retell tasks or probes for explicit information can provide clues as to whether the child is able to comprehend and retrieve the story information. Summary tasks can be used to look at cognitive abilities of executive function since such tasks require the child to problem solve (e.g., determine which information is important), make semantic connections through inferences, and formulate the information at an abstract level.

These data address the promise of discourse methods to improve management of the long-term sequelae in pediatric TBI. This report opens the door to pursuing further studies of the relevance of discourse measures in TBI. For example, one question that warrants investigation is whether children who have sustained a severe brain injury can be trained to become better summarisers. Moreover, it will be valuable to determine whether improving summarisation ability can increase the potential for becoming a more efficient learner after a severe TBI (Hill, 1991; Thistlethwaite, 1991). If summarisation can be used to achieve more successful reintegration in school and social settings, then speech-language pathologists can make a difference in diminishing the obstacles that children with severe TBI may face at various stages of development postinjury by adapting similar discourse methods.

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## APPENDIX

## TBI Patient Profile

Name: \_\_\_\_\_ Sex: \_\_\_\_\_ Date of Birth (DOB): \_\_\_\_\_  
 Date of Injury (DOI): \_\_\_\_\_ Cause of Injury: \_\_\_\_\_

## Overall Severity of Brain Injury

\_\_\_ Mild \_\_\_ Moderate \_\_\_ Severe

## MRI/CT Scan Results

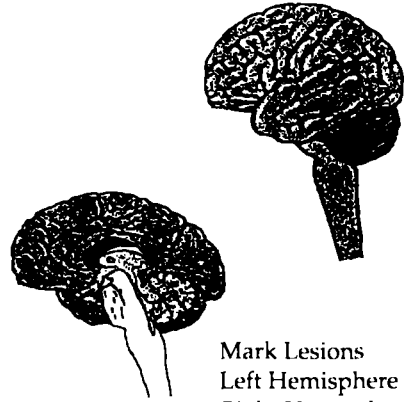
L R C S \_\_\_ Frontal lobe  
 Responsible for behaviour, initiation, self-control,  
 organisation, planning, problem solving,  
 speech & verbal output

L R C S \_\_\_ Temporal lobe  
 Responsible for language comprehension, memory

L R C S \_\_\_ Parietal lobe  
 Responsible for sensory integration, reading, naming

L R C S \_\_\_ Occipital lobe  
 Responsible for vision/visual perception

\_\_\_ Corpus Callosum  
 Connects left and right sides of brain



Mark Lesions  
 Left Hemisphere in Blue  
 Right Hemisphere in Red

L = Left Hemisphere R = Right Hemisphere C = Cortical Lesion S = Subcortical Lesion

## Glasgow Coma Scale (GCS) Rating: \_\_\_\_\_

(used to determine level of consciousness; rates eye opening, motor response, verbal response)

13 – 15 Mild  
 9 – 12 Moderate  
 3 – 8 Severe

Length of Coma: \_\_\_ < 1 hr. \_\_\_ 1–5 hrs. \_\_\_ 1 day \_\_\_ > 1 day \_\_\_ # of days  
 (amount of time until child follows 1-step commands)

## Length of Posttraumatic Amnesia (PTA): \_\_\_\_\_

(child out of coma but without complete orientation to time, place, and person)

## Rancho Los Amigos Scale of Cognitive Functioning

Dismissal from acute care Date: \_\_\_\_\_ Level: \_\_\_\_\_  
 Dismissal from rehab Date: \_\_\_\_\_ Level: \_\_\_\_\_

Level I: No Response  
 Level II: Generalised Response  
 Level III: Localised Response  
 Level IV: Confused-Agitated

Level V: Confused-Inappropriate  
 Level VI: Confused-Appropriate  
 Level VII: Automatic-Appropriate  
 Level VIII: Purposeful-Appropriate

## Complications after Initial Injury

\_\_\_ Seizures \_\_\_ Early \_\_\_ Late  
 \_\_\_ Surgery? \_\_\_\_\_  
 \_\_\_ Other Complications \_\_\_\_\_

## Medications

Name	Dosage	Reason Given
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## Pre-Injury

\_\_\_ Learning Problems? \_\_\_\_\_  
 \_\_\_ Previous Brain Injury? \_\_\_\_\_

## Intervention

Type	# of Sessions
S.T.	
P.T.	
O.T.	