Procedural discourse performance in severe traumatic brain injury at 3 and 6 months post injury

Abstract. There is limited research about communicative recovery during the early stages after a severe traumatic brain injury (TBI) in adults. 43 severely brain injured people described a simple procedure at 3 and 6 months post injury and were compared to 37 healthy speakers. Linguistic productivity and the presence of macrostructural discourse elements were analysed. No change occurred in productivity in the TBI group between the two time points. There was increased inclusion of relevant information (macrostructure) over time for the TBI group, reflecting improvement. People with TBI differed from controls in speech rate and two of three macrostructural categories at both time points, indicating difficulties even after 12 weeks of recovery. Overall, TBI participants demonstrated disordered quality of discourse rather than disordered quantity in discourse. Findings indicate that procedural discourse is sensitive to discourse deficits of people with TBI and can be used to map recovery during the sub-acute phase.

Keywords: Traumatic brain injury, communication, recovery, follow-up, procedural discourse.
Traumatic brain injury (TBI) occurs when an external object hits the skull with such force that it causes damages to the brain. Injuries following a head trauma are broadly classified as closed head injuries (non-penetrating/intracranial) and open head injuries (penetrating) (World Health Organization, 2010). Open head injuries occur when an external object ruptures the skull and the inner membranes covering the brain. In closed head injuries the membranes covering the brain are still intact, but can still cause serious brain damage (Blumbergs, 1997). Closed head injuries are generally referred to as TBI.

Open head injuries arise from a penetrating wound, which may be caused by bullets or missiles penetrating the head, and are therefore commonly reported in soldiers returning from war (Lehman, 2008). Closed head injuries are more frequent in peacetime. Common causes of TBI are involvement in motor vehicle accidents and falls (Naugle, 1990; Rutland-Brown, Langlois, Thomas, Xi, 2006; Tagliaferri et al., 2006), as well as assaults and injuries resulting from sports (Naugle, 1990). Three different age groups have been identified to more often acquire TBI; very young children (0-4 years), young adults (15-25 years) and older adults (65 + years). Children and older adults to greater extent acquire TBI from falls (Naugle, 1990; Rutland-Brown et al., 2006). Young adults more often acquire TBI following motor vehicle accidents (Naugle, 1990; McKinlay et al., 2008). Motor vehicle accidents have also proven to lead to more severe TBI than falls (Naugle, 1990; McKinlay et al., 2008; Kraus et al., 1984). Males are more likely to suffer a head trauma compared to women, and also a more severe form of TBI. The ratio varies from 2:1–4:1 and the difference in ratio peaks between mid-adolescence to early adulthood (Naugle, 1990).

TBI is a large health problem in the developed world, costing the society enormous amounts of money in medical care and rehabilitation (Corrigan, Selassie, Orman, 2010; Tagliaferri et al., 2006). Between 100-200 people per 100,000 annually suffer a head trauma in the Western countries (Naugle, 1990; Tagliaferri et al., 2006) and it has been estimated that a little more than 6 million people experience impairments following TBI in Europe (Tagliaferri et al., 2006). Yearly in the United States, roughly 1.2 million people are in contact with emergency care, almost 300,000 are hospitalized and 50,000 die following TBI (Rutland-Brown et al., 2006). Furthermore, approximately 3.2 million people experience disabilities following TBI in the United States (Corrigan et al., 2010). The majority of all traumatic head injuries, between 70-90%, are classified as mild (Cassidy et al., 2004). 12-15 people per 100,000 are estimated to yearly suffer moderate TBI, and 14-20 people per 100,000 are estimated to yearly suffer severe TBI (Kraus et al., 1984; Tate, McDonald, Lulham, 1998).

When grading the severity (mild, moderate, severe) of the injury, the initial level of consciousness and the length of altered consciousness are used as indicators (Jennett, 1976). The initial level of consciousness can be assessed with the Glasgow Coma Score (GCS) (Teasdale & Jennet, 1976). By assessing the patient’s eye opening responses, motor responses and verbal responses, the clinician can give an overall score between 3-15 (15 being most conscious and 3 not giving any response). The overall score indicates the depth of the altered consciousness. The length of altered consciousness is indicated by the length of post-traumatic amnesia (PTA) (Russell & Smith, 1961) and by the duration of coma (Jennet, 1976). Se-
vere TBI is associated with a GCS of 3-8, PTA longer than 7 days and duration of coma longer than 24 hours. Moderate TBI is associated with a GCS of 9-12, PTA between 1-7 days and duration of coma from 30 minutes to 24 hours. Mild TBI is associated with a GCS of 13-15, PTA of less than one day and duration of coma for less than 30 minutes (McDonald, Togher, Code, 2013). For those that suffer a mild TBI there are usually no long-term impairments (Cassidy et al., 2004; Tate et al., 1998). For people suffering moderate to severe TBI, most recovery is seen in the first months post injury (Jennett, Snoek, Bond, Brooks, 1981). However, for many severely injured people, impairments and difficulties following the trauma are lifelong (Tate, Broe, Lulham, 1989).

The neuropathology following TBI can be diffuse and/or focal (Adams, et al., 2011). Contusions are local bruises or lacerations in the area of the actual impact of the trauma and at the point of counter-coup (Blumbergs, 1997). Diffuse axonal injury (DAI) occurs when the brain moves inside the skull, caused by high velocity acceleration, deceleration or rotation. The axonal fibres and glia cell structures are stretched, compressed and/or torn and cause temporary or irreversible disruption of action potential transfer (Bigler, 1990). Other common complications are intracranial bleeding (Adams et al., 2011) and oedemas (Muehlschlegel et al., 2013), which both can cause increased intracranial pressure (Bigler, 1990).

Symptoms and impairments following TBI will vary depending on the nature of the trauma. Focal lesions will generally generate specific symptoms reflecting the injured area, while diffuse lesions will present symptoms reflecting a more generalized brain damage. Diffuse pathology, such as DAI, has been reported to result in more severe impairment, whereas focal lesions such as contusions are associated with better outcomes (Adams et al., 2011). Impairments following severe TBI can be seen in cognitive (Dikmen et al., 2009), behavioural (Kinsella, Packer, Olver, 1991) and physical functions (Jennet et al., 1981). Common cognitive symptoms are difficulties with memory (Shum, Levin, Chan, 2011; Wright & Schmitter-Edgecombe, 2011), information processing (Dikmen, Machamer, Winn, Temkin, 1995), attention (Mathias & Wheaton, 2007) and executive functions (Chiu, Carlson, Arnett, Consentino, Hillary, 2011). Many of the cognitive symptoms are persistent over time. People with severe TBI have been reported to perform significantly worse compared to healthy people in tasks involving information processing, learning and memory, as late as 6 years post injury (Tate, Fenelon, Manning, Hunter, 1991). Behavioural symptoms in severe TBI may be manifested as disordered emotional regulation (Brooks, Campsie, Symington, Beattie, MacKinley, 1986) or lack of behavioural control (Kinsella et al., 1991). Disabilities such as hemi paresis (Jennet et al., 1981), dysphagia (Safaz, Alaca, Yasar, Tok, Yilmaz, 2008), balance difficulties and ataxia (Thomsen, 1984) are common physical symptoms following severe TBI.

Communication disorders arising from severe TBI may include dysarthria, aphasia and cognitive communication disorders. Dysarthria has been reported for about 30% of the TBI population (Safaz et al., 2008) and appears to persist over time (Safaz et al., 2008; Thomsen, 1984). Aphasia has been reported for about 19% of the people with TBI (Safaz et al., 2008). Aphasic symptoms are generally present in the early stages of recovery and a greater improvement is seen in aphasia compared to dysarthria (Safaz et al., 2008; Thomsen, 1984). Although a majority of
people with severe TBI score normally on aphasia tests (Sarno, 1980, 1984), research has shown that they perform worse on subtests assessing word finding abilities, verbal fluency and complex comprehension tasks compared to controls (Coppens, 1995; Levin, Grossman, Kelly, 1976). However, impairments in such specific language functions do not reflect the deviant communication behaviour seen in severely brain-injured people (Levin, Grossman, Sarwar, Meyers, 1981). People with severe TBI present a disordered usage of language (pragmatic level), rather than difficulties with language as a skill (word and sentence level) (Hagen, 1984).

It has been established that the deficits in severe TBI are not of the aphasic type (Sarno, 1980, 1984) and that conventional aphasia batteries cannot target the communication difficulties in this population (Coelho, 2007). The term “cognitive communication deficit” (World Health Organization, 2010) is often used today to define the communicative deficits that are present in people with TBI. The term demonstrates the relationship between the communicative impairments and the underlying mechanisms causing them. A cognitive communication disorder in severe TBI may be manifested as lack of information provided for a topic (Douglas, Bracy, Snow, 2007a), making irrelevant comments (Hagen, 1984) and drifting in topic (Mentis & Prutting, 1991). Lack of self-monitoring and planning, caused by dysfunctions in the executive system, has been reported to correlate with an inability to provide the accurate amount of information and putting ideas together logically. Furthermore, attention has been reported as a factor reflecting reduced ability to stay attentive when having a conversation and therefore getting sidetracked (Douglas et al., 2007a). Communicative behaviour in people with severe TBI has also been reported to be more self-centred and communication partners have rated conversations with people with TBI to be more effortful (Bond & Godfrey, 1997).

Communication ability has been reported to break down at the discourse level and therefore discourse assessment has been recommended (Coelho, Liles, Duffy, 1991; Coelho, Ylvisaker, Turskstra, 2005). Discourses can be either conversational or monologic. They can also be described as belonging to different genres e.g. narrative, procedural or conversational genres. Texts within the same genre have similar structures and linguistic organization (Eggins, 1994). To successfully manage any type of discourse task requires a complex interaction between linguistic, cognitive and behavioural skills. This is why severely brain injured people show difficulties in discourse tasks (Coelho et al., 2005). Different discourse tasks vary according to task demands and people with severe TBI vary in performance depending on what task they are given (Hartley & Jensen, 1991; Mentis & Prutting, 1987). In conversational settings, severely injured people fail to maintain the conversational topic, show poor turn-taking skills and present situational inappropriateness (Snow, Douglas, Ponsford, 1997a). Hartley & Jensen (1992) found three different discourse profiles when investigating monologic narrative discourse in severe TBI. It appeared that participants with longer time in coma expressed an “impoverished discourse”. They presented an overall reduction in linguistic productivity (speaking time, total number of words and C-Units (closely corresponding to an utterance), words/C-Unit, speech rate). Frequent silent pauses during the monologue and a reduced ability to express abstract relationships were also
prominent in this subgroup. The other two profiles that the authors identified were “confused discourse” and “inefficient discourse”. Participants belonging to the latter demonstrated a longer speaking time, higher number of words and C-Units, as well as a large proportion of mazes compared to the control participants. The “confused discourse” stood out from the other two profiles by displaying the highest amount of inaccurate content, the least amount of accurate content and the highest amount of problems with clarity. They also presented a very high number of mazes compared to the other participants and scored the lowest on the Western Aphasia Battery (WAB) (Kertész, 1982).

Narratives (story retelling, story generation and personal event retelling), picture description and procedural description are different types of monologic discourses. These tasks have all been used in TBI and communication research, but narrative tasks are the most commonly researched (Coelho et al., 2005). Findings from studies analysing monologic tasks have consistently demonstrated impairments in linguistic productivity, efficiency, content accuracy and organization as well as story grammar and coherence (Coelho et al., 2005). These findings indicate that monologic discourses are sensitive to the communication deficits present in the severely injured TBI population.

A procedural description consists of a goal that is accomplished through a sequence of actions or steps (NSW Department of School Education, 1989). The procedural discourse is also a speech task closely related to real life situations. In research, the given discourse task usually entitles a description of a simple and commonly occurring day-to-day procedure e.g. How to buy groceries (Hartley & Jensen, 1991) or how to withdraw money from a bank account (Snow, Douglas, Ponsford, 1997b). Sometimes it entitles a more unusual description, although still simple, such as explaining a board/dice game (McDonald & Pearce, 1995). Procedural texts have been identified as one of the key texts occurring at a workplace e.g. instructions to machinery or training manuals (Joyce, 1992). It is also a frequently occurring discourse in day-to-day life e.g. describing the way or giving instructions. Furthermore, this genre of discourse is taught as a part of the factual writing curriculum in schools today (NSW Department of School Education, 1989). Thus, procedural discourse is a frequently occurring speech act and an important genre in both educational and employment settings.

The research exploring procedural discourse is sparse. In a study by Hartley & Jensen (1991) the authors compared the performance on narrative tasks and a procedural task between 11 people with severe TBI and 21 healthy speakers. They found that compared to the control group on the procedural task, the TBI patients where significantly less productive (shorter speaking time, fewer meaningful words, fewer C-Units, slower syllabic rate, more syllables in mazes), used significantly fewer cohesive ties (in total and fewer lexical ties) and were significantly impaired in information quality (fewer target content units, problems of reference). Further studies have demonstrated that when explaining a board game, severely brain injured people omit essential steps (essential steps are actions that need to be described for the procedure to be understood) in their description as well as they add irrelevant contents (McDonald & Pearce, 1995). Snow et al., (1997b) studied the performance on a procedural discourse in 26 people with severe TBI compared to a demographically distinct control group (26 people), as well
as a demographically similar control group (26 people). The people with severe TBI produced fewer essential steps compared to the demographically distinct control group. The authors also examined pragmatic features (quantity, quality, relation and manner) in the discourse. Compared to both control groups, the people with TBI made significantly more errors in topic maintenance, information redundancy and information insufficiency.

In most previous research looking at procedural discourse, the number of TBI participants has been limited, ranging from 3 (Mentis & Prutting, 1987) to 26 (Snow et al., 1997b). The time between the actual injuries to when the testing was conducted has also varied widely. It is not uncommon that TBI participants in the same study range from just being a few months post injury to many years after their injury (e.g. Hartley & Jensen, 1991; Marini et al., 2011; McDonald & Pearce, 1995). However, Snow et al., (1997b) examined procedural discourse performance between 3 and 6 months post injury and this is the only study assessing TBI participant within a distinct and narrow timeline. Snow et al., (1997b) is also the only research examining procedural discourse abilities with a larger participant sample at an early stage post injury, whilst most other studies only have included very few participants at such an early stage in recovery (Hartley & Jensen, 1991; McDonald & Pearce, 1995). To date, there have been no follow-up studies examining procedural discourse as a measure of early communication recovery. Some follow-up research has been made in neighbouring discourses, such as narratives (Coelho, Liles, Duffy, 1991; Snow, Douglas, Ponsford, 1999), conversational discourse (Snow, Douglas, Ponsford, 1998), and narrative performance in people with aphasia (Ellis, Rosenbek, Rittman, Boylstein, 2005). However, the two follow-up studies by Snow et al., (1998, 1999) were conducted more than two years post injury. Due to the lack of early follow-up studies, the nature of procedural discourse in early post injury stage in severe TBI is unknown. Consequently, our insight into communication and recovery in the very early phase after severe TBI is limited.

There are a number of ways to study the performance on a monologic task. Common analyses are microlinguistic and macrostructural analyses (Coelho, 2007). At a microlinguistic level, within sentence features are examined, and often involve analysing linguistic productivity. Linguistic productivity is generally measured in terms of total number of words, total number of utterances, words per utterance, total speaking time and words per minute or second (Coelho, 2007). The description of an utterance varies, but is often closely corresponding to a T-Unit (minimal terminable unit; an independent clause plus any dependent clauses associated with it) (Hunt, 1970). Compared to healthy speakers, people with severe TBI have demonstrated reduced productivity in monologic discourses in terms of fewer words, fewer T-Units, fewer words/T-Unit and fewer words/min (e.g. CarloMagnno, Giannotti, Vorano, Marini, 2011; Hartley & Jensen, 1991).

The macrostructure of a discourse refers to aspects across the whole discourse. A discourse can be analysed for macrostructural features by looking at the coherence or the content of the text (Coelho, 2007). In procedural discourse specifically, this may mean examining propositions in the description as to whether they are essential, optional, irrelevant, ambiguous or added (McDonald & Pearce, 1995; Snow et al., 1997b; Ulatowska, 1983). Analysing the macrostructure in a procedural discourse in terms of different propositions is closely related to generic structure po-
tential analysis (GSP). GSP is based on a text belonging to a certain genre, and depending on the genre, the text follows a predicted schematic structure (Eggins, 1994). The schematic structure of procedural monologues is a goal followed by a series of steps oriented to achieving the goal (NSW Department of School Education, 1989). Previous research has shown that people with TBI produce fewer essential elements (McDonald & Pearce, 1995; Snow et al., 1997b) as well as adding more extra elements compared to controls (McDonald & Pearce, 1995).

In the current study, procedural descriptions are analysed in terms of linguistic productivity and macrostructural features. The aim with this study is to explore communication recovery in severe TBI in the early stages post injury and how it relates to the discourse behaviour of healthy speakers. The research questions are the following:

1) Will the people with TBI change in terms of linguistic productivity between 3 and 6 months?
2) Will the discourse in people with TBI change in terms of macrostructural features between 3 and 6 months?
3) Will the discourse behaviour in people with TBI differ from the discourse behaviour of the healthy speakers at 3 and 6 months post injury?

Method

The current study is a part of a longitudinal project examining communication recovery after severe TBI. In the longitudinal project participants with severe TBI were assessed according to a standardised test protocol at 3, 6 and 12 months post injury. The protocol includes non-standardised speech tasks (monologic discourse tasks) and standardised tests or parts of standardised test batteries. In addition to this, the participants were recorded having a conversation with one other person. They were also assessed for the presence of dysarthria and completed a self-evaluation form aimed at measuring their perception of their communicative ability. Furthermore, they also received a neuropsychological test protocol at each interval. At the time of the current study, most participants have reached their twelve-month interval. The data for this paper was collected at three and six months post injury.

Participants

The clinical group included 43 subjects, comprising 8 females and 35 males. Their age ranged from 17 to 67 years (mean= 36.2, SD= 13.7). Mean years of education were 14.1 years (SD= 3.1, range= 8-20). All participants in the cohort group had sustained a severe traumatic brain injury as defined by PTA longer than 24 hours and/or a GCS between 3 and 8. Individuals with a GCS higher than 8 were considered for inclusion in the study if they were diagnosed with severe TBI. Length of PTA ranged from 3 to 122 days (mean= 46, SD= 29.4). The majority of the injuries were caused by involvement in motor vehicle accidents (MVA) (28 people), followed by falls (8 people), assaults (5 people), gunshot (1), and train accident (1). Participants were recruited across Sydney metropolitan area and at locations within 3 hours travelling distance from Sydney. Participants were recruited
when they were medically stable, generally meaning recruitment occurred at 2 months post injury. Participants from diverse cultural and linguistic backgrounds were included after consideration on an individual basis. Exclusion criteria for the longitudinal project were: history of previous neurological illness or injury or significant medical history (i.e. developmental delay), still in PTA, consent unable to be obtained from person with TBI or from significant other, more than 6 months since injury, patients not available for follow up testing (i.e. a minimum of 2 data points). Further exclusion criteria for the current study were: unable to complete the protocol at 3 and 6 months post injury and not giving consent to recording of the assessment. At the time of the first assessment 23 participants had aphasia. One suffered severe Broca’s aphasia and the others mild anomic aphasia. 37 participants had dysarthria at the first assessment. The presence of dysarthria was based on a 9-point scale that accounted for ratings from A to D in the Frenchay Dysarthria Assessment Test (Enderby & Palmer, 2008). A 7 on the 9-point scale equated to a B in the test and was defined as mild dysarthria. A score of 7 along the scale was used as a cut off point to indicate the presence of dysarthria. At the first interval 37 people had or did receive speech therapy at an average of 1.9 hours per week (average range= 0.25-7, SD= 1.3 average hours/week). This information was derived from the participant’s rehabilitation timetable and from reports from rehabilitation staff. Table 1 shows an overview of the participants’ demographic information, the lowest GCS that was reported, type and severity of aphasia at 3 months post injury, presence of dysarthria at 3 months, average hours of speech therapy per week at 3 months post injury, as well as scores on the Latrobe Communication Questionnaire (Douglas, O’Flaherty, Snow, 2000) (LCQ) for the TBI participants and their significant others.

The control group comprised a selected subset of the control participants (Wright and Capilouto) that were available from the shared online database AphasiaBank (URL 1). The total number of control participants on AphasiaBank was 152 with ages ranging from 23 to 89 years (mean= 65, SD= 17.4). For the current study, a sub group of controls were selected based on their age and years of education to match the TBI group. The selected control group included 37 American subjects, 24 females and 13 males. Their age ranged from 23 to 55 years (mean= 40.3, SD= 7.9). Mean years of education were 15.3 years (SD= 1.8, range= 12-18). The control subjects had no history of stroke, head injury, other neurological conditions or cognitively deteriorating conditions. Their vision and hearing was adequate for testing based on clinical judgement or assessment, they had no depression at the time of the testing and were fluent in English.

Material
When the data for the current paper was collected, a standardised communication assessment protocol was used at each interval post injury. This protocol is also available from AphasiaBank (URL 1). In addition to the protocol two other tests were carried out; the Frenchay Dysarthria Assessment Test, second edition (Enderby & Palmer, 2008) that assessed dysarthria and the Latrobe Communication Questionnaire (Douglas, O’Flaherty, Snow, 2000) (LCQ), where people with TBI and a significant other evaluated their communication ability after the injury.
### Table 1.
Background information of participants with severe TBI.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Age</th>
<th>Gender</th>
<th>Education years</th>
<th>Cause of injury</th>
<th>GSC lowest</th>
<th>PTA days</th>
<th>^2^Aphasia severity 3 mths</th>
<th>Aphasia type 3 mths</th>
<th>Dysarthria 3 mths</th>
<th>% Speech therapy 3 mths</th>
<th>% LCQ self 3 mths</th>
<th>% LCQ other 3 mths</th>
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<td>Yes</td>
<td>2occ./w</td>
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<td>2</td>
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</tbody>
</table>

*^N = non-aphasic.*

*^N/A = not available.*

*Occasions of speech therapy services/week.*
Total scores on the LCQ range from 30-120. Higher scores are consistent with the perception of frequent difficulties and lower scores with less frequent difficulties.

The assessment protocol consisted of four different discourse categories and six linguistic tests: Aphasia Bank Repetition Test (2007), Verb Naming Test (from the Northwestern Assessment of Verbs and Sentences) (Thompson), Boston Naming Test, Short Form (Kaplan, Goodglass, Weintraub, 2001), Western Aphasia Battery (part AQ only) (Kertész, 2007) and verbal fluency (F, A, S). The discourse categories included two free monologic speech tasks, three picture descriptions, one story narrative and one procedural description task. The current paper is concerned only with the procedural discourse task. In the original protocol, subjects were asked to describe how they would make a peanut butter and jelly sandwich. Since the protocol was developed for international use, another type of sandwich description that better suits the subject is allowed. Hence, in the current study the procedural discourse task instead entitled a description of how to make a cheese and Vegemite sandwich. However, the data from the control group included the procedural description according to the original protocol.

To enable linguistic productivity analyses through the computerized analysis programme CLAN (Computerized Linguistic Analyses) the transcriptions had to be coded first. The transcriptions from the people with TBI were coded using basic CHAT codes (Appendix A). CHAT is a transcription coding system developed to work with CLAN. Transcriptions for the control group were already coded with CHAT.

Procedure

When the data was collected from the people with TBI, all the discourse tasks in the protocol were audio and video recorded. Participants still receiving inpatient care were assessed at the rehabilitation unit. Participants receiving outpatient care were assessed either at a rehabilitation centre or at home. To complete the protocol and the additional tasks (conversation, dysarthria assessment and self evaluation form) took approximately 4.5 hours (not including the neuropsychological component). Due to the extensive assessment most 3 and 6 months appointments were completed over several sessions.

The instructions for the procedural discourse task were: “Let’s move on to something a little different. Tell me how you would make a cheese and Vegemite Sandwich”. If the participant did not respond within 10 seconds or if the participant gave a very incomplete description the investigator could give a verbal prompt (i.e. “Is there anything else you can tell me?”). If the participant still didn’t respond to the instructions visual prompts could be given (pictures of the ingredients). None of the participants with TBI needed picture prompts. 6 participants got verbal prompts after giving very short descriptions of the sandwich procedure. On one occasion the investigator accidently gave the first half of the instruction for a peanut butter and jelly sandwich. The investigator then revised the instruction and gave the correct instruction (cheese and Vegemite). The participant mentions both versions of the sandwich in his description. Since the correct instructions were given before he initiated the description the discourse was analysed normally.
The author transcribed the discourse samples orthographically and coded them according to CHAT (Appendix A). The transcriptions were segmented into utterances, which closely corresponded to a T-Unit (an independent clause plus any dependent clauses associated with it) (Hunt, 1970). To segment the speech samples into utterances the following indicators were considered with primary weight on the first and second indicators: 1. Syntax – a well-formed sentence was considered to be an utterance, 2. Intonation – falling or rising (in the case of a question) intonation indicated the end of an utterance, 3. Pauses – unless they occurred in what appeared to be an otherwise well-formed sentence, 4. Semantics – the speaker changed the topic. The above indicators are the guidelines given in the CHAT manual (Appendix A). Transcriptions were blinded as to whether the sample was recorded at three or six months post injury and to any participant background information.

18 (20%) transcriptions (9 from each post injury interval) were randomly selected and checked for transcription and CHAT coding accuracy. The transcriptions were retranscribed by the author (intra-rater reliability) and inspected by an experienced speech and language pathologist (inter-rater reliability). Due to technical problems the number of transcriptions checked for inter-rater reliability ended up to be 17 (19.77%). The same 18 transcriptions as well as 8 samples from the control group (a total of 26 transcriptions, 21% of the whole group of participants) were reanalysed for macrostructural elements by the author, and analysed by the experienced speech and language pathologist mentioned above. The author aimed to reach 80% for the reliability measures. Reliability check was conducted at least two weeks after the transcriptions and macrostructural analyses were conducted.

The control group had completed the same protocol, the only difference being the instruction for the procedural task (“Tell me how you would make a peanut butter and jelly sandwich”). The control group’s audio/video recordings and transcriptions were available from AphasiaBank (URL 1). The transcriptions were already coded according to CHAT and segmented into utterances following the guidelines provided in the CHAT manual. Their transcriptions were checked for accuracy at the time that they were downloaded from AphasiaBank.

Productivity

Productivity measures was the total number of meaningful words (repeated and revised words as well as fillers were not included), total number of utterances, speaking time, speech rate and words per utterance. Speaking time was measured in seconds. It was measured from the second that the participant first started to speak after being given instructions, to the second they uttered their final word. Hence, introductory comments such as “A cheese and Vegemite sandwich” or questions such as “Should I tell you how to make a cheese and Vegemite sandwich?” were included, as well as final comments such as “that’s it”. Speech rate was derived by dividing the total number of words in a sample with the length of the utterance (words/second). Values for the total number of words, total number of utterances and words/utterance were analysed by CLAN. All productivity measures were conducted on both the people with TBI and the control group.
Macrostructure

The macrostructure of the procedural discourses was measured in terms of essential steps, optional steps and low content elements. The macrostructural elements were analysed according to a checklist (Appendix B).

Based on what 80% of the control participant included in their procedural description and the essential steps that Ulatowska et al., (1983) had identified, six essential steps were identified. Since the essential steps were derived from the control group that described a different sandwich, the steps were adjusted to fit both the control group and the people with TBI. The six essential steps was 1) Get the bread, 2) Get the peanut butter/Vegemite, 3) Get the jelly/cheese, 4) Put the peanut butter/Vegemite on the bread, 5) Put the jelly/cheese on the bread, 6) Put it together/Fold together/Put on top.

A list of optional steps was developed to simplify the macrostructural analysis. Based on Snow, Douglas & Ponsford (1997b), steps that less than 80% of the controls mentioned were identified as optional. These steps still had to be in accordance of Ulatowska et al., (1983) definition of an optional step. Namely, it had to clarify, add, or give more detail beyond the essential steps. And either being at the same hierarchical level as the essential step and produces new actions beyond the essential one (auxiliary step), or being sub steps that produced finer detail for already existing steps. To the list of optional steps derived from the control group's responses, four steps were added. Three of the steps were options being very likely to appear in the Vegemite sandwich (grate/slice the cheese, get butter, butter the bread). The fourth added step, not actually fitting into the definition of an optional step, was a “Goal/target step” e.g. “and that is a peanut butter and jelly sandwich”. This step was mentioned by a number of controls and people with TBI and appeared to be a natural final element, therefore included as an optional step.

Low content elements could be repeated information (that did not bring a new action to the procedure) e.g. “undo the lid to the Vegemite” and later “take the lid off the Vegemite”, irrelevant information e.g. “if I was making the sandwich for X” or tangential/ambiguous steps e.g. questions in the middle of the description or interrupted steps.

In each transcript, utterances or parts of utterances were marked as to which of the 3 macrostructural categories they belonged to. In the occurrence of low content elements, it was also specified if it was a matter of repeats, irrelevance or tangentially/ambiguousness. The essential steps could be either stated or inferred by the speaker. The utterance “Get the Vegemite” is stating step 2. An utterance such as “I spread the Vegemite on the bread” is stating step 4 but also inferring that step 2 has already been carried out. The same optional step could occur multiple times, as long as it involved a new action and was not a repeated step, e.g. “undo lid/take lid off jar” for the butter and later “undo lid/take lid off jar” for the Vegemite is the same optional step used twice, but referring to different actions. The total number of essential steps, optional steps and low content elements were summarized.

Ethical considerations
The longitudinal project received ethics approval from the University of Sydney and the participating health sites.
All TBI participants or a significant other had given written consent prior to participating in the longitudinal project. Participants and significant others (if available) received oral and written information about the longitudinal research project by the project manager. Before meeting with the project manager the speech pathologist in the rehabilitation team had approached the patients and their families regarding participation in the study. Only patients meeting the inclusion criteria were approached and referred to the project manager e.g. patients who were medically unstable, still in PTA or not willing to partake in the study were excluded. The speech pathologist in the rehabilitation team indicated whether the patient had capacity to provide informed consent. If the person with TBI, was assessed as unable to consent, a significant other or a guardian had to be present when receiving information about the study and providing informed consent. The written information about the study and the consent form was also available in an “aphasia friendly” version. The informed consent comprised 3 options; participation in the longitudinal study, audio/video recording, data being used for educational purposes. Participants provided consent to one or more options.

Audio/video files were coded and stored on a secure, password protected data storage site at the University of Sydney.

**Statistical analyses**

Tests of normal distribution showed skewed distribution in years of education, the total number of essential steps and the total number of low content elements.

For within group measures paired sample t-tests were used to compare the linguistic productivity of the TBI group between 3 months and 6 months post injury. Wilcoxon signed rank tests were used to analyse changes in the number of essential steps and number of low content elements between 3 and 6 months post injury. The total number of optional steps was normally distributed and was analysed with a paired sampled t-test. Finally, a Wilcoxon signed ranks test was used to analyse differences in change over time between optional steps and low content elements. Due to multiple comparisons a partial Bonferroni adjustment was set for each series of within group measures (9 tests in 1 series). The alpha was set to .0056 for all within group measures. A partial adjustment was used to balance the control for type I errors with the increased risk of type II errors (Field, 2013).

For between group measures independent t-tests were used to analyse the differences in productivity between the control group and the TBI group at 3 months and 6 months post injury. Mann-Whitney U-tests were used to analyse the number of essential steps and the number of low content elements. The number of optional steps were analysed with independent t-tests. Due to multiple comparisons a partial Bonferroni adjustment was set for each series of between group measures (8 tests in 2 different series). The alpha was set to .0063 for all between group measures. A partial adjustment was used to balance the control for type I errors with the increased risk of type II errors (Field, 2013).
Results

Transcription, CHAT coding and segmentation accuracy reached 92.96% in intra-rater reliability, and 92.72% in inter-rater reliability. Macrostructural ratings reached 91.21% in intra-rater reliability, and 81.21% in inter-rater reliability. All reliability measures reached the minimum acceptable level (80%).

Descriptive statistics for both productivity and macrostructural variables are presented in Table 2. Mean and SD is presented for normally distributed variables. Median, range and inter quartile range is presented for the variables with skewed distribution. Results from the statistical analyses that were conducted are presented in Table 3. The control group and the TBI group did not differ in age ($t(78) = 1.68, p = .097$) or years of education ($z = -1.78, p = .076$).

Table 2.
Means and SD or medians, range and inter quartile range for raw scores on productivity measures and macrostructural measures.

<table>
<thead>
<tr>
<th>Variables</th>
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<th>TBI 3 months</th>
<th>TBI 6 months</th>
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<td>SD</td>
<td>Mean</td>
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<td>2.4</td>
<td>7.9</td>
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<td></td>
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<td>6</td>
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<tr>
<td></td>
<td>(6-6)</td>
<td></td>
<td>(5-6)</td>
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<td></td>
<td>(0-1.5)</td>
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</table>

*Median, range and (inter quartile range) is presented due to skewed distribution.

The people with TBI produced fewer words, and fewer utterances at 6 months post injury than they did at 3 months post injury. However, these changes were not significant. At 6 months post injury the TBI group spoke for a shorter time than they did at 3 months post injury. This change was not significant either. The people with TBI produced fewer words per utterance at the second interval compared to the first, and had little change in their speech rate (words/second) between the two time points. Neither speech rate nor number of words per utterance reached significant changes between 3 and 6 months post injury. The people with TBI became less varied in the number of words and utterances at 6 months post injury compared to at 3 months post injury. At the second interval the TBI group showed as much variation in the number of words as the controls did, and they varied less than controls in the number of utterances. Furthermore, the speaking time was more varied in the TBI group at both time points compared to the speaking time in the control group.

In terms of macrostructure, the number of essential steps did not change significantly between the two time points. However, the range in the number of essential steps had decreased at the second interval.
The number of low content elements did not change significantly between the two time points. Although, the range in the number of low content elements produced decreased at 6 months post injury compared to 3 months post injury. The number of optional steps increased from 3 months to 6 months post injury, but this increase was not significant.

However, when comparing the change in the number of optional steps from the first to the second interval, to the change in the number of low content elements from the first the second interval, significant differences emerged. Difference scores were derived for both the number of optional steps and low content elements between the two time points (difference scores: number of optional steps 6 months – number of optional steps 3 months, number of low content elements 6 months – number of low content elements 3 months). The difference in the amount of change between the optional steps and the low content elements was significant ($z = 1.398, p < .001$). The change in the number of optional steps between 3 ($M = 3.6, s = 2.5$) and 6 months ($M = 4.4, s = 2.4$) post injury was significantly greater than the number of low content elements between 3 ($M = 2.3, s = 2.6$) and 6 months ($M = 1.7, s = 2$) post injury. Figure 1 illustrates the change in optional steps from the first to the second interval, compared to the change in low content elements from the first to the second interval. 9 people had a smaller change in the number of optional steps compared to how they changed in the number of low content elements between the two time points (change in optional steps between 3 and 6 months < change in low content elements between 3 and 6 months). Meanwhile, 29 people showed a greater change in the number of optional steps between the two intervals compared to how they changed in number of low content elements between the two intervals (change in optional steps between 3 and 6 months > change in low content elements between 3 and 6 months). 5 people changed as much/as little in the number of optional steps as the number of low content elements between the two time points (change in optional steps between 3 and 6 months = change in low content elements between 3 and 6 months). The dis-

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**Table 3.**

*Statistical results for between group comparisons and within group comparisons on productivity measures and macrostructural measures.*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Control vs. TBI 3 months</th>
<th>Control vs. TBI 6 months</th>
<th>TBI 3 months vs. TBI 6 months</th>
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<td>$p$</td>
<td>$t$ ($df = 78$)</td>
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<td></td>
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<td>.331</td>
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<tr>
<td>Uterances</td>
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</tr>
<tr>
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</tr>
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<td>5.71</td>
<td>&lt;.001*</td>
<td>4.63</td>
</tr>
<tr>
<td>Low content elements</td>
<td>-2.93</td>
<td>.003*</td>
<td>-2.1</td>
</tr>
</tbody>
</table>

*Significant result (within group measures $p < .0056$, between group measures $p < .0063$).

*z-value is presented due to the use of non parametric tests.
tribution of the amount of change in optional and low content elements between the two intervals is illustrated in Figure 2.

![Figure 1](image1.png)

*Figure 1. Differences in the amount of change between the two time points in the number of optional steps compared to the number of low content elements.*

![Figure 2](image2.png)

*Figure 2. Rank distribution of the changes in optional steps and low content elements from 3 months to 6 months post injury.*

At 3 months post injury the people with TBI produced fewer words and fewer utterances compared to the controls. However, the differences were not significant. At 6 months after the injury the TBI group produced yet even fewer words and utterances compared to the controls, but these differences did not reach significance. In terms of speaking time, the people with TBI spoke for a shorter time than the controls did at both time points. However, neither at 3 months post injury or 6 months post injury did the speaking time reach significant differences between the groups. The number of words per utterance was lower in the TBI group at both 3 and 6 months post injury compared to the controls, but these differences did not reach significance. At both the first and second interval post injury the TBI group
had a significantly slower speech rate (words/second) compared to the control participants.

There was a significant difference in the number of essential steps between the control group and the people with TBI at both 3 months and 6 months after the injury. As can be seen in Table 2, the median did not differ between the controls and the people with TBI at either time point. However, all the healthy speakers mentioned all essential steps, whereas the people with TBI ranged from mentioning 0-6 essential steps at 3 months post injury, to 3-6 essential steps 6 months post injury. The number of low content elements was significantly higher in the TBI group at 3 months post injury. Although, at 6 months post injury there was no longer a significant difference between the controls and the people with TBI in the number of low content elements produced. Finally, the number of optional steps differed between the control group and the TBI group. The control participants produced a significantly larger amount of optional steps than the people with TBI did at both 3 months post injury and 6 months post injury.

Discussion

This is the first study that has examined linguistic behaviour in procedural discourse at two distinct time points in the very early stages of recovery after a severe traumatic brain injury. No significant changes were seen in the TBI group in terms of linguistic productivity or macrostructural elements from 3 months to 6 months post injury. However, the change in number of optional steps from 3 to 6 months post injury was significantly larger compared to the change in number of low content elements between the two intervals. This indicated a pattern; that the TBI group increased the production of optional steps during the first months of recovery. The control subjects had a significantly faster speech rate and mentioned significantly more essential and optional steps compared to the TBI group at both intervals post injury. Furthermore, only at 3 months post injury did the TBI participants produce a significantly higher number of low content elements than the controls.

Even though no significant changes were seen between the two time points in terms of linguistic productivity, the people with TBI appeared to show less variability in the number of words and utterances at 6 months post injury compared to 3 months post injury. The move towards a reduced variability may be subtle signs of improvement in early recovery.

No change was observed in speech rate in the TBI group from 3 months to 6 months post injury. However, the TBI group demonstrated significantly reduced speech rate compared to the controls at both post injury intervals. A majority of the TBI participants had dysarthria at 3 months post injury and previous research has shown that dysarthria is a persistent communication disorder in the TBI population (Safaz et al., 2008; Thomsen, 1984). Hence, a significant proportion of the TBI group was expected to still experience dysarthria at 6 months post injury. Persistent dysarthria is likely to be the underlying cause as to why there was no significant change in speech rate between the two time points. It is also a likely explanation to why the TBI group differed from the control group in speech rate at both 3 and 6 months post injury. Hartley & Jensen (1991) also examined perform-
dance on a procedural discourse task and reported reduced speech rate among the people with severe TBI compared to control participants. Similar findings have been reported in previous monologic discourse research (Ehrlich, 1988; Carlon-magno et al., 2011; Marini et al., 2011). Hartley & Jensen (1991) reported that the presence of dysarthria was a likely contributing factor for the reduced speech rate in their TBI group. They also hypothesised that reduced psychomotor speed and a general slowness of thinking and movement were other factors that could contribute to the slower speech rate. Marini et al., (2011) suggested that frequent interruptions in the flow of thoughts could be the main cause of reduced speech rate in their severe TBI group. However, no information regarding the presence of dysarthria was reported for the TBI participants in their study. Hence, it is possible that some of the people with severe TBI in Marini et al., (2011) did have dysarthria that may have contributed to the reduced speech rate.

Since the people with TBI demonstrated normal amounts of verbal output at 3 months post injury (except in speech rate) a change over time in the TBI group was not to be expected. The nature of the procedural description task may have affected the amount of verbal output being elicited. A description of how to make a sandwich is a very structured task following quite a distinct sequence (NSW Department of School Education, 1989) and the overall level of constraint is low (Shadden, 1998). The structured nature of this discourse task may contribute to a more definite amount of linguistic productivity and therefore the TBI group and the control group perform similarly in verbal output. This is in contrast to what Hartley & Jensen (1991) found in their analysis of procedural discourse where the people with TBI spoke for a significantly shorter time, produced significantly fewer words and C-Units (closely corresponding to an utterance) compared to the control participants. The procedural discourse task in Hartley & Jensen (1991) comprised a description of how to buy groceries which has a different number of essential macrostructural elements. Hence, it is possible that the difference in the core details between that description task and the current discourse task contributed to the contrasting results.

In this study the number of meaningful words was used as one of the productivity measures, i.e. repetitions, revisions and fillers (mazes) were excluded from the word count in order to generate a more reliable word count. Previous studies have reported mixed results regarding maze behaviour. Some studies have reported significantly more mazes in the TBI group compared to controls (Hartley & Jensen, 1991, 1992). Other studies have reported no significant differences neither between the TBI group and demographically similar controls, nor differences between the TBI group and demographically distinct controls (higher education) (Snow et al., 1997b). Thus, it would be of interest to further analyse discourse productivity in relation to maze behaviour and whether changes occur during recovery. Such studies are planned where longer discourse samples across a number of genres will be analysed.

Between 3 and 6 months post injury the individual scores on optional steps and low content elements did not change enough to be significant. With the number of low content elements, the relatively low mean at 3 months post injury may have left little room for any significant decrease to appear during the 12 weeks of recovery. However, a significant difference was found between the change in optional
steps between the two time points compared to the *change* in low content elements between the two time points. The TBI group changed more in the number of optional steps they produced between 3 and 6 months post injury, than they changed in the number of low content elements they produced between 3 and 6 months post injury. This indicated a subtle pattern – that people with TBI increased the number of optional steps as they recovered. It also implies that after only a few months of recovery the people with TBI appear to spend more time on optional, but still relevant, information in their procedural descriptions. This pattern indicates the onset of an improvement in the TBI group, as the discourse behaviour began to approximate that of the healthy speakers. In relation to the results described above, it is also worth noting that the TBI group no longer differed significantly from the controls in terms of low content elements at 6 months post injury, as well as the fact that the speaking time did not change between the two time points. Taken together, the pattern that the TBI group produced more optional steps, combined with a decrease in the number of low content elements, and no change in speaking time, indicates that they spend more time on relevant information, and replaced irrelevant content with relevant information as they recovered. This change may reflect improvements in mental organization and planning as the people with TBI became better at including more detailed information whilst keeping it relevant. It may also reflect increased inhibition abilities as irrelevant information is omitted to a greater extent.

In spite of this improvement, between group comparisons showed that the healthy speakers generated significantly more optional steps at both time points post injury. Snow et al., (1997b) also examined the use of optional information in a procedural discourse task and the mean percentage of optional steps was higher in both the demographically distinct (higher education) and similar control groups compared to the TBI participants. Rather than comparing the percentage of optional steps between the TBI group and the 2 control groups Snow et al., (1997b) combined the proportions of optional and essential information into an “on-target output”. The TBI group generated significantly less “on-target output” compared to the demographically distinct control group. Since the optional steps are sub steps or more detailed steps in relation to the essential steps, generating an optional step is highly dependent on planning and organizational skills as well as memory. Thus, as difficulties occur already with the essential information (discussed below), it is not surprising that the people with TBI also demonstrate difficulties with inclusion of optional steps.

In the current study the people with TBI produced significantly more low content elements compared to the controls at 3 months post injury. Low content elements included repeated, tangential (questions or ambiguous comments) and irrelevant information. Hence, a higher amount of low content elements reflects impairments within a few cognitive functions. Irrelevant responses may represent difficulty with inhibition. Repetitions and requests for clarification may be related to poor memory and planning difficulties. Tangential information, such as not providing enough information in an utterance for it to be understood, demonstrates pragmatic difficulties and limitations in taking the listener perspective. As the TBI participants no longer mention significantly more low content elements after 12 weeks of recovery, this could indicate improved cognitive functioning. The differ-
ence seen in low content information between the TBI group at 3 months post injury and the controls is consistent with previous findings. McDonald & Pearce (1995) found that people with TBI produced a significantly higher proportion of extra information compared to controls during their procedural dice game task. They also reported that the features of the TBI discourse in their study, i.e., fewer essential steps and more irrelevant content, resembled conversational styles arising from dysfunctions in the executive system. This lends support to the view that impaired planning and organization is contributing to the discourse behaviour in the current study. Snow et al. (1997b) also reported a higher mean percentage of redundant output (repeated or irrelevant information) in TBI discourse compared to controls. However, these differences were not compared statistically.

The TBI group did not change in their production of essential steps from 3 months to 6 months post injury. Although, at 6 months post injury the variability in number of covered essential steps was reduced in the TBI group. This may be an indication of improvement for some of the TBI participants, as none of them omitted more than half of the steps after 12 weeks of recovery. However, this must be considered with caution as most of the TBI participants covered more than half of the essential steps at both time points. Snow et al., (1997b) also analysed the production of essential steps in a procedural discourse in people with severe TBI and the authors concluded that the people with TBI were clearly able to select and provide information in procedural steps. The results from the current study, where a large amount of essential steps were covered at both 3 and 6 months post injury, supports Snow et al.'s (1997b) conclusion.

Snow et al., (1997b) also reported that even if the people with TBI in their study were able to select and provide procedural information in steps, they made a number of pragmatic errors and differed significantly from healthy speakers in discourse performance. The same could be said about the TBI group in the current study. They presented the procedural information in steps and covered a large amount of essential steps, but they also included a significantly higher number of low content elements. Furthermore, the people with TBI covered significantly fewer essential steps at both 3 and 6 months post injury compared to the control participants, who all covered each essential step. This shows the great difficulties that people with TBI experience even in a highly structured and simple communication task. After 12 weeks of recovery the TBI group still omitted basic procedural steps that were essential for the task description. Yet again, impaired memory, planning and organizational abilities could account for the poorer performance in the TBI group. Many of their discourses appeared disorganized as steps were commonly revised and the procedural descriptions were restarted, a behaviour likely caused by poor planning and organisation. The essential bits of information may then have been omitted due to the disorganized verbal output as well as problems with memory. Correlations between narrative discourse performance and working memory in moderate to severe TBI have been reported (Youse & Coelho, 2005). Thus, poor working memory is likely to also affect procedural discourse performance. The findings from this study in terms of differences in essential steps between controls and TBI participants are similar to those in Snow et al., (1997b). However, they found that it was only between the TBI group and a demographically distinct control group that significant differences in essential steps occurred.
Hartley & Jensen (1991) examined the number of target content units in the procedural discourse. A target content unit was defined as a proposition that at least 80% of the controls used, which makes it almost equivalent to an essential step. In their study they found the same difference between the controls and the TBI group as in the current study, i.e. the TBI participants generated significantly fewer target content units/essential steps compared to the controls. McDonald & Pearce’s (1995) also reported people with TBI to produce significantly fewer essential steps. Furthermore, the TBI group in their study showed a larger amount of variability in the number of essential steps that they covered compared to the controls, consistent with the findings in this study.

In the current study, the people with TBI demonstrated impoverished quality of procedural discourse rather than reduced quantity. The combination of macrostructural and linguistic productivity analyses showed that it was not the amount of verbal output that was reduced in the discourse people with TBI, but rather the content of their output. The results also confirm the importance of analysing TBI discourse on more than one linguistic level, e.g. microlinguistically and macrostructurally, which has been emphasized in previous reports (Coelho et al., 1991, 1994).

The findings have provided an indication of how severe the communication difficulties might be for people with severe TBI in the early stages of recovery. It is not hard to imagine the difficulties that this population will have during their conversations when performance in a structured and simple discourse task is significantly impoverished, and how this would have many negative impacts on quality of life and close relationships. The difficulties seen still at 6 months post injury may also indicate a delay in return to employment. In many cases persistent communication difficulties may also reduce future employment completely.

However, indications of improvements in optional steps and low content elements were observed between 3 and 6 months post injury and further research at a later stage in recovery is needed. Discourse analyses at e.g. 12 months post injury would provide an insight to whether the people with TBI improve further in discourse behaviour. Some of the participants received speech and language therapy during these first months of recovery. Treatment may also have contributed to the indicated improvements. A number of other discourse tasks were assessed at the two time points, all more complex than the procedural description. Hence, further research into those genres will provide important knowledge about the communicative recovery in early post TBI.

The great difficulties with the procedural description, still observable at 6 months post injury, offer an explanation to why there was no significant change in the individual scores on macrostructural elements between the two time points. 12 weeks between assessments may be too little time to detect significant changes in macrostructural behaviour, which lends further support to the idea of a follow-up at a later stage.

Aphasia may have contributed to the demonstrated differences in discourse performance between the TBI group and the control group. A little more than half of the TBI group experienced mild anomic aphasia at 3 months post injury which may have affected the discourse production. Further research is needed to investigate
how cognitive and linguistic factors contribute to the communication difficulties in early post injury staged in severe TBI.

The findings in the current study imply the importance of including procedural description tasks in clinical communication assessments. Not only does the performance on the procedural discourse task give some indication of the overall communication deficits. It is also a valuable assessment tool especially for those who are looking to return to work after a TBI. As procedural texts and discourses are key workplace texts and are also commonly occurring in everyday life (Joyce, 1992), it may be appropriate to train procedural description performance as a part of communication intervention.

There are a number of limitations to this study and therefore the findings should be viewed with caution. The number of participants with severe TBI was higher in this study than within any previous research examining communication in severe TBI. However, the sample size can still be considered limited. The procedural description was the very last discourse task in the TBI protocol, as it was considered to be the easiest of the different discourse task. However, fatigue may have had an effect on the results. Finally, the controls and the people with TBI were assigned to describe very similar tasks, the only thing differing between the tasks being the type of sandwich they were describing. Both types of sandwiches are deeply embedded in the participant’s culture and should elicit very similar linguistic output. However, the fact that the two groups essentially described different details of the procedure may have affected the results.

In conclusion, the procedural discourse task was a useful tool for examining recovery of cognitive communication skills following severe traumatic brain injury. While most participants were able to recount the essential elements of how to make a cheese and vegemite sandwich, this very structured controlled task presented challenges to the TBI participants’ executive functioning and cognitive skills which were reflected in production of repeated information, tangential responses, poor planning of responses and reduced communicative efficiency. This task is therefore recommended as one way of measuring communicative recovery during the subacute phase. It is also recommended, however, that this task be completed as part of a battery of discourse tasks, such as those presented in the TBI Bank protocol, in addition to an evaluation of the person’s conversational skills with their everyday communication partners (Togher, Hand, Code, 1997). Further research is needed to evaluate the sensitivity of different discourse genres to detecting recovery longitudinally, and also to examine the relationship between discourse outcomes, neuropsychological functioning and psychosocial recovery over time. This information will assist clinicians to identify evidence based assessments, which are relevant to the person’s everyday life outcomes, and can therefore inform contextually relevant treatment decisions.

References


NSW Department of School Education (1989). *A Brief Introduction to Genre*. Erskineville, New South Wales: Metropolitan East Disadvantaged Schools’ Program.


Appendix A

CHAT coding

? question
! exclamation
@n neologism
Exclamations common ones: ah, aw, haha, ow, oy, sh, ugh, uhoh
Interjections common ones: mhm, uhuh, hm, uhhuh
Fillers common ones: &um, &uh
xxx unintelligible speech, not treated as a word
xxx@a unintelligible speech, treated as a word
&text phonological fragment (&sh &w we came home)
&=text simple local event and gestures (&=laughs, &=sighs, &=ges:fishing)
[] shortenings e.g. runnin(g) for running, (be)cause
[/] the word preceding this code is repeated (the [/] the bread)
<text> [/] the words preceding this code is repeated (<the bread> [/] the bread)
[//] the word preceding this code is revised (I put the butter in [//--] on the bread)
<text> [//--] the words preceding this code is revised (I <put the jelly> [//--] put the butter on the bread)

Utterance segmentation

Consider the following indicators with primary weight on syntax and intonation:

1. Syntax - unless there are strong prosodic counter-indications, a well-formed sentence is considered to be an utterance. However, and utterance may not necessarily be grammatically correct to be considered an utterance.

2. Intonation – falling intonation (or rising intonation in the case of a question) suggests the end of an utterance.

3. Pauses – may not be a reliable guide to utterance boundaries. When pauses occur in what appears to be otherwise well-formed utterances, disregard them.

4. Semantics – the speaker changes the topic.
Appendix B

Macrostructure analyses checklist

**Essential steps**
1. Get bread [Y/N]
2. Get peanut butter/Vegemite [Y/N]
3. Get jelly/cheese [Y/N]
4. Put on the peanut butter/Vegemite [Y/N]
5. Put on the jelly/cheese [Y/N]
6. Put together/put bread on top [Y/N]

Total number of essential steps:___

**Optional steps**
1. Two slices of bread ___
2. Take bread out of bread bag ___
3. Take a knife ___
4. Lay slices out/on a plate/table ___
5. Unscrew lid/open jar ___
6. Take ingredient out of jar ___
7. Cut/slice the bread ___
8. Eat the bread ___
9. Goal step e.g. “that is a Vegemite Sandwich” ___
10. Get butter ___
11. Butter the bread ___
12. Buy bread/ingredients ___
13. Go to fridge/cupboard/bread container ___
14. Put ingredients on counter ___
15. Assemble items ___
16. Open bread bag/untwist bag/undo tag ___
17. Toast the bread/grill sandwich ___
18. Bring out a plate ___
19. Slice/grate the cheese ___
20. Wipe/clean/put down the knife/spoon ___
21. Lick off the knife ___
22. Close jar/put lids back on/close bread bag ___
23. Cut crust off ___
24. Serve the sandwich ___
25. Other optional steps (not classified as irrelevant): ___

Total number of optional steps:___

**Low content elements**
1. Repeated___
2. Irrelevant___
3. Tangential/ambiguous___

Total number of low content elements:___