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To cite this article: Sarah Tran, Belinda Kenny, Emma Power, Robyn Tate, Skye McDonald, Rob Heard & Leanne Togher (2018) Cognitive-communication and psychosocial functioning 12 months after severe traumatic brain injury, *Brain Injury*, 32:13-14, 1700-1711, DOI: [10.1080/02699052.2018.1537006](https://doi.org/10.1080/02699052.2018.1537006)

To link to this article: <https://doi.org/10.1080/02699052.2018.1537006>



Published online: 22 Oct 2018.



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Cognitive-communication and psychosocial functioning 12 months after severe traumatic brain injury

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ABSTRACT

Objective: Cognitive-communication deficits after severe Traumatic Brain Injury (TBI) may contribute to poor psychosocial functioning, however, the possible nature of this relationship remains unclear and warrants investigation. The current study explored the variance and correlations of a measure of cognitive-communication with a measure of psychosocial outcome in adults 12 months following TBI.

Method: 36 adults with severe TBI evaluated at 12 months post-injury. Cognitive-communication skills were evaluated with the Functional Assessment of Verbal Reasoning and Executive Strategies (FAVRES), Sydney Psychosocial Reintegration Scale-2 (SPRS-2) Form A – Informant version assessed psychosocial functioning. Multiple regression analyses were used to investigate association between cognitive-communication and psychosocial outcomes.

Results: Two measures of cognitive-communication assessment (Accuracy and Rationale of the FAVRES) contributed significantly to total psychosocial outcome (SPRS-2). Multiple regression analyses revealed these variables accounted for 29.1% of the variance. Cognitive-communication variables accounted for 24.0% and 28.6% of the Work/Leisure and Relationship domains of the SPRS-2.

Conclusion: Cognitive-communication ability was significantly related to psychosocial functioning at 12 months post-TBI. Findings suggested continued speech pathology involvement in the post-acute stages of recovery may improve social, vocational and overall psychosocial functioning. The FAVRES is a promising cognitive-communication assessment for identification of treatable factors impacting psychosocial outcomes.

ARTICLE HISTORY

Received 5 January 2018
Revised 6 June 2018
Accepted 13 October 2018

KEYWORDS

Traumatic brain injury;
cognitive-communication;
psychosocial functioning;
speech pathology assessment;
community rehabilitation

Introduction

Traumatic Brain Injury (TBI) refers to an alteration in brain function or other evidence of brain pathology, as a consequence of an external force (1). TBI has been termed a “silent global epidemic”, carrying major health and socioeconomic problems (2). While medical and technological advancements have improved survival rates following TBI, long-term consequences for the person sustaining TBI, their families and social networks remain problematic. As such, ongoing therapy to address physical, communicative and psychological impairments and to aid re-integration into vocational and social activities continue to incur costs over the years, particularly for those with more severe injuries (3).

At the core of these long-term social and vocational difficulties faced by people with severe TBI are neuropsychological variables such as impaired attention, memory and executive functioning (4). Neuropsychological assessments consistently indicate that the most impaired domains at both 6 months and 12 months post severe injury are verbal memory, complex attention and executive functioning (5,6). In addition to these impairments, people with severe TBI also frequently present

with cognitive-communication difficulties which impact upon their day-to-day communication situations.

Cognitive-communication impairments are characterised by tangential and irrelevant utterances in conversation, egocentrism and problems with quality and quantity of language produced. This can range from excessive verbosity through to an impoverished discourse profile (7,8). Other cognitive-communication difficulties for this population include impaired comprehension as a result of increased length and complexity, difficulty understanding implied and abstract content, and an inability to facilitate new learning through language and communication (9–11). Cognitive-communication disorders also encompass a broad spectrum of social communication difficulties, including problems with topic initiation, conversational repair, and accurately reading verbal and non-verbal social cues in conversation (9,12,13).

Impaired communication can have a negative impact on social re-integration, familial relationships and friendships, and employment ability and success (14–17). Douglas, Bracy and Snow (18) found that social communication difficulties were the discriminating factors between return to work outcomes following severe TBI. Return to work is a

challenge for this population, with one Australian review reporting an overall rate of only 44% of those with acquired brain injury returning to work, consistent with a 45% rate found in international studies (19). These figures are particularly concerning given the 15–24 age group carry the highest risk of sustaining a TBI, and these are the individuals about to enter the workforce or beginning their careers (20,21). Outside of this age group, a significant number of individuals who sustain a TBI are in the prime of their employment years. Those that return to work are often unsuccessful at maintaining employment, with one study reporting only 44% of participants with moderate to severe TBI employed 3 years post-injury (22). A recent study (23) reported higher rates of employment in a sample of 46 participants who were followed up in the longer term (6–15 years following injury), with 67% of participants either partially or fully employed at the time of the study. However, a significant proportion of these individuals (43%) had sustained a mild TBI, with those of a higher severity less successful at returning to work.

Cognitive-communication impairments after TBI have a long-term impact upon not only those with TBI, but also their families and friends. Cognitive-communication impairments can result in interactions with individuals with cognitive-communication difficulties being considered more taxing and less fulfilling (14,24). As a consequence, relationships with the family and friends that play a major role in assisting recovery and are often the primary communication partners become significantly affected (25,26). In addition, the difficulty in maintaining successful communication exchanges with these individuals affect their reintegration back into the wider community and negatively impact their ability to build new interpersonal relationships. Longitudinal studies on social outcomes post-TBI suggest a decline in the number and quality of interpersonal relationships, leading to depression, loneliness, anxiety, and continued impacts on psychosocial functioning (26–28).

Rehabilitation post-TBI is therefore crucial to enable the highest degree of return to pre-injury level of functioning in the social, emotional and vocational domains (21). Effective clinical assessment is the first step in achieving this outcome, by utilising tools which identify the impact of the impairment on the individual, and support the development of individualised therapy. Traditional language assessment tools are generally inadequate as the primary method of assessment, as they focus on identifying impairment-level difficulties with little consideration of other aspects of the WHO-ICF framework (29). These measures can fail to identify the communication difficulties experienced in everyday communication situations by people with TBI. Inappropriate selection of assessment tools may result in misidentification or inability to identify deficits, leading to the risk of exclusion from much needed intervention or services (30). Cognitive-communication deficits can be easily overlooked if the inappropriate assessment tool is used, due to the ‘subtle’ nature of these deficits. That is, they are only apparent when the cognitive, linguistic, emotional and social aspects of the situation are suitably demanding. However, it is these multifaceted situations that are most representative of the circumstances individuals with TBI experience in their home, social and vocational contexts.

In the recent decade, there has been a push internationally to move towards functional assessments as guided by the WHO-ICF framework (29,31,32). The framework recommends that assessments consider disability not only in terms of the impairment itself, but also its impact on activities and participation in life situations (30). The recently published International Cognitive Rehabilitation (INCOG) guidelines recommend that assessments focus on communicative abilities in the context of the individuals’ everyday activities (33). It remains to be investigated as to whether these recommendations have had an impact on clinical assessment practices for individuals with TBI. Mueller and Dollaghan (34) found that existing assessment measures of cognitive-communication ability are sparse, and strong evidence concerning diagnostic accuracy and concurrent validity of cognitive-linguistic functioning measures for adults with acquired brain injury is limited. Currently, the most frequently used tools are language assessments such as traditional aphasia batteries designed for other clinical populations, or neuropsychological tests administered by speech-language pathologists (SLPs) and neuropsychologists. The Functional Assessment of Verbal Reasoning and Executive Strategies (FAVRES) (35) may fill the role of an assessment that specifically evaluates communication among individuals with cognitive-communication disorders (32).

The FAVRES (35) is a psychometrically robust assessment specifically designed for individuals with acquired brain injury to measure high level cognitive-communication skills. It integrates the examination of social communication and discourse skills with contextually rich and real world activity and participation level tasks (36). By doing so, the measure is sensitive to the identification of subtle deficits following TBI that may not be apparent on standardised impairment-based assessments.

To date, no studies have investigated performance on the FAVRES in relation to overall psychosocial outcome, and few studies have utilised the FAVRES as an outcome measure. Three studies (15,37,38) suggest that subtests of the FAVRES may predict return to work outcomes following TBI. However as mentioned by Meulenbroek and Turkstra (37), all three studies utilise employment status and stability as the measure of vocational outcome rather than investigating occupational ability or competence. There is the potential that other factors distinct from performance ability such as personal factors, lifestyle changes, and physical and mental health issues may be the cause of inability to maintain consistent employment. Investigation of performance on FAVRES and its association with other facets of vocational outcome such as work skill is needed to clarify the existing literature suggesting performance on the FAVRES as a predictor of vocational outcome following TBI.

In regards to other domains of psychosocial functioning, no research has investigated the relationship between performance on the FAVRES and family reports of other psychosocial domains such as maintaining relationships or engaging in activities of daily living. These psychosocial domains in addition to return to work and leisure form the basis of investigation within the Sydney Psychosocial Reintegration Scale Version 2 (SPRS-2) (39).

The Sydney Psychosocial Reintegration Scale Version 2 (39) (SPRS-2 Form A) is a 12-item questionnaire measuring change in psychosocial functioning from pre-injury in individuals with

brain injury over three domains: (1) work and leisure, (2) interpersonal relationships and (3) independent living skills. An overall psychosocial functioning score is calculated from the sum of the three domains. The SPRS-2 has been psychometrically evaluated and found to have high internal consistency and high inter-rater reliability among individuals with TBI (39). Good concurrent validity and construct validity have also been established (40). In light of recommendations that SLPs consider multiple facets of health outcome during assessment, the SPRS-2 measures outcome at the participation level of the WHO-ICF framework. By gathering multifactorial information during assessment, this will allow for holistic and relevant intervention decisions.

Effective rehabilitation enables the individual to make gains beyond the context of their intervention setting by improving community integration outcomes. This is particularly important once individuals reach the post-acute stage of their recovery, and a large proportion of these individuals begin to seriously look at maximising return to their pre-injury lives. Interventions specifically addressing functional communication impairments have been recommended as a practice standard for professionals working with individuals following TBI (41). In addition, the existing body of evidence suggests communication interventions for this population are more likely to be effective when they are individualised, contextualised and involving practice in real world communication situations (33,42). An assessment such as the FAVRES is ideal for identification of potential goals, given that its tasks aim to replicate suitably complex communication situations that are typical in day-to-day lives.

An identified relationship between the FAVRES and the SPRS-2 would have significant implications for SLPs and other health professionals working with individuals with TBI. For example, if poor performance on the FAVRES is found to be correlated with a significant change in work skills on the SPRS-2, this could highlight a potential need for speech pathology intervention for an individual aiming at work re-entry following injury. There is a need for evidence demonstrating a role for SLPs among rehabilitation teams in the post-acute stages of recovery as individuals look towards community reintegration and maximising their return to their pre-injury levels of functioning.

This study aims to investigate the relationship between cognitive-communication ability and psychosocial outcome. The research questions were:

- (1) Does poorer cognitive-communication ability as measured by the Functional Assessment of Verbal Reasoning and Executive Strategies (FAVRES) indicate poorer overall psychosocial outcome as measured by the Sydney Psychosocial Reintegration Question-2 (SPRS-2) at 12 months post-TBI?
- (2) Is there a relationship between cognitive-communication ability and specific psychosocial domains – Work and Leisure, Relationships, Living Skills on the SPRS-2?

Methods

Research design

An observational cross-sectional research design was employed.

Participants

Participants in this study were part of a larger longitudinal project funded by the Australian National Health and Medical Research Council, which investigated communication recovery following severe TBI. From the larger longitudinal study sample of 58 participants, a total of 36 participants with severe TBI who met the following inclusion criteria were recruited from 3 Brain Injury Rehabilitation Units in Sydney, Australia. Inclusion criteria comprised: (1) consent obtained from participant or next-of-kin; (2) 10–14 months post TBI at the time of data collection; (3) severe TBI as indicated by a Glasgow Coma Scale score of 8 or less and/or a period of PTA greater than 24 hours (43,44); (4) aged 16–65 years at the time of injury and (5) resided in the Sydney Metropolitan area or within a 3 hour travelling distance.

Exclusion criteria included: (1) inability to obtain consent from person with TBI or their significant other; (2) patients were less than 10 months or more than 14 months post-injury; and (3) a positive history of previous neurological illness, injury or significant medical history.

The sample of 36 participants consisted of 30 males, 6 females with a mean age of 36.8 years, standard deviation of 13.1 years. Additional participant demographic information appears in Table 1.

Measures

Cognitive-communication

Cognitive-communication ability was measured using the FAVRES (35). The FAVRES is comprised of four ecologically valid and contextually rich verbal reasoning tasks (see Table 2) based on familiar and functional activities in home or work contexts.

Three measures were calculated from the individual's performance on each task; Accuracy (measuring whether the individual can make a correct decision), Rationale (whether the individual can provide appropriate and logical reasons for their decisions) and Time (indicating whether the individual can perform these tasks efficiently). All scores were then

Table 1. Demographic and injury-related characteristics of study sample.

Characteristic	Sample (n = 36)	
Sex (n, %)		
Male	30	83.3
Female	6	16.7
Age, y (mean, SD)	36.8	13.1
Primary Language (n, %)		
English	34	94.4
Other	2	5.6
Vocational status (n, %)		
Unemployed	15	41.7
Casual	3	8.3
Part time	7	19.4
Full time	11	30.6
Years of education (mean, SD)	14.1	3.0
PTA duration* (days) (mean, SD)	54.2	33.8
GCS score** (mean, SD)	6.5	3.4
Cause of injury (n, %)		
Motor vehicle accident	25	69.4
Fall	8	22.2
Assault	1	2.8
Other vehicle accident	2	5.6

*PTA = Post-Traumatic Amnesia; **GCS = Glasgow Coma Scale

Table 2. Description of the four FAVRES tasks.

Task	Design	Skills
Planning an event – Selecting an event for child’s birthday from newspaper listings	<ul style="list-style-type: none"> ● Multiple Choice – visual and written (newspaper format) 	<ul style="list-style-type: none"> ● Selecting most appropriate option according to parameters (date, time, money, appropriateness) ● Ability to shift between sources of information ● Eliminating inappropriate options ● Comprehending written information ● Theory of mind
Scheduling – Filling in written schedule according to priorities and time constraints from ‘things to do’ list and telephone messages	<ul style="list-style-type: none"> ● Filling in a diary ● Written list 	<ul style="list-style-type: none"> ● Ability to sequence, organise and prioritise tasks with time constraints ● Integrating different sources of information (Things to Do List, Estimated Time Frames, Messages) ● Reasoning skills to explain why tasks were prioritised
Making a Decision – Choosing a gift for a couple from transcript of their conversation	<ul style="list-style-type: none"> ● Written dialogue ● Multiple Choice 	<ul style="list-style-type: none"> ● Reading comprehension of a transcript ● Interpretation of a conversation (inferential ability) ● Draw conclusions from written transcript of a dialogue ● Selecting most appropriate option according to parameters (date, time, money, appropriateness) ● Eliminating inappropriate options ● Theory of mind
Building a case – Producing a written complaint	<ul style="list-style-type: none"> ● Written monologue ● Persuasive Argument 	<ul style="list-style-type: none"> ● Analysing sequence of events in a monologue ● Paragraph and text level reading comprehension ● Paragraph level written expression ● Ability to come up with solutions

converted to standard scores based on the normative data (36) reported in the FAVRES manual. Standard scores for Accuracy and Rationale were calculated for each of the four individual tasks in addition to standard scores for Total Accuracy and Rationale. While a Total Time score and individual Time scores for each subtest were also calculated at the time of assessment of each participant, these were found to be an unreliable measure of performance, as a faster time and thus a higher Time score could indicate efficiency, but could also indicate lack of perseverance during assessment. Therefore, Time was not included in the set of study variables.

A Total Reasoning score and individual Reasoning scores for each task were calculated based on spoken responses to a standard set of questions asked by the examiner that investigated the individual’s reasoning subskills in relation to getting all the facts and eliminating the irrelevant facts, prioritising the relevant options, producing alternative choices and predicting the potential consequences of particular choices. The FAVRES also has a cut-off score to answer the clinical question “Is the individual’s performance within normal limits?” The cut-off was determined through a logistic regression analysis of the results of those with brain injuries and without in the sample. The cut-off score indicates that those scoring lower than the cut-off have a probability greater than 45% of being in the brain injured group of the normative sample (36).

Psychosocial functioning

Psychosocial functioning was measured using the SPRS-2 (39). The 12-item questionnaire examined perceived change since injury across three domains (work and leisure, interpersonal relationships, independent living skills). All items are answered on a 5-point scale from “no change” to “an extreme

amount of change”, with higher scores indicating higher participation and less change to pre-injury functioning. There are two formats for the SPRS-2 which examine the same domains but differ by question phrasing: Form A measures change since injury whereas Form B measures current level of functioning. Each form can be completed by the individual who has sustained the injury, a clinician or by a significant other (informant). Impaired self-awareness has been noted among individuals following TBI (45). As a result, this study utilised the informant-rated Form A of the SPRS-2 (for example, “Have your relative’s communication skills (that is, talk with other people and understand what others say) changed because of the injury?”). This accounted for concerns regarding participants’ possible impaired sense of self-awareness.

A score for each of the three domains was calculated from the informant responses (SPRS-2 Work and Leisure, SPRS-2 Interpersonal Relationships and SPRS-2 Independent Living Skills). A total score (SPRS-2 Other) was also calculated from the sum of the three domain scores as rated by the informant.

Procedure

Ethical approval for this study was obtained from the relevant Area Health Service Human Research Ethics Committees. Participants provided written informed consent. Next-of-kin in the form of a spouse, partner, adult family member or legal guardian provided consent for those participants who were unable to do so. The participants were seen by a speech pathologist in a 1.5–3-hour session within 2 months of their 12-month anniversary of injury. All assessments were administered according to standardised manual instructions. Participants were offered a choice of setting of either

outpatient hospital ward or their own home, and were offered frequent rest breaks to minimise fatigue. Collected participant data were de-identified and stored on a password-protected database.

Data analysis

Data analysis was undertaken using IBM SPSS Statistics V22.0 (46). Descriptive statistics were generated (Table 3). The data were inspected for normality using the Kolmogorov-Smirnov test. Several scores were not normally distributed and as a result, non-parametric analyses were conducted on the data.

Spearman's rank correlation coefficients were computed among the Total FAVRES measures (Accuracy, Reasoning and Rationale) and the SPRS-2 Total score to answer research question one (the association between overall FAVRES performance and overall SPRS-2 score/psychosocial functioning). Participants could not be discriminated using the Total Reasoning Sub-skills standard score due to a floor effect, as a result of participants' performance clustering at the low end of the scale, where participants who scored 70 or below on Total Reasoning Sub-skills were assigned a standard score of 76 as per manual instructions. Instead, the Total Reasoning Sub-skills raw score was shown to have a more varied and accurate distribution than the standard score, and therefore was the more appropriate measure to be used. A partial Bonferroni correction was applied to control for Type I and II errors due to the exploratory nature of the research (47).

To further examine the relationship between cognitive-communication and psychosocial functioning, multiple linear regression analysis was also conducted to examine the variance (R^2 and adjusted R^2) in psychosocial functioning (Total SPRS-2 Other score) accounted for by two cognitive-communication variables (Total FAVRES Accuracy and Reasoning measures). Although one of the cognitive-communication variables was found to be non-normally distributed, screening procedures indicated that when combined, the two demonstrated multivariate normality, and therefore were suitable for multiple regression analysis. The SPRS-2 Other logit score was used as the dependent variable and the Total Accuracy standard score and Total Reasoning raw score Sub-skills were used as independent variables. Due to Accuracy and Reasoning Sub-skills being highly correlated, it was decided that they would be more appropriate as alternative variables. Between the two variables, the Accuracy score was found to be more significantly associated with the SPRS-2 scores, and therefore, it was the variable used in the multiple regression

equation. It was decided that the multiple regression equation would be limited to two variables in consideration of the smaller sample size, as per Harrell's suggestion of a minimum of 10 subjects per variable (48). All variables were evaluated and all assumptions were met.

To answer research question two (association between overall FAVRES performance and individual SPRS-2 domain scores) Spearman's rank correlations were performed. A series of multiple linear regression analyses were conducted to examine the effects of the FAVRES measures on each psychosocial outcome variable (Work and Leisure, Relationships and Living Skills). As with research question one, all assumptions were checked and met.

The strength of correlations in each question were analysed as follows: $\rho < 0.3$ (weak to no correlation), $\rho = 0.3-0.7$ (substantial), $\rho > 0.7$ (strong correlation) (49).

Results

Descriptive information

Of the total sample, 72% of participants scored below the cut-off on Total Accuracy and 75% of participants below cut-off Total Reasoning on the FAVRES. See Table 3 for additional information.

Research question 1: Relationship of cognitive-communication measures to concurrently measured overall psychosocial functioning

Table 4 reports the bivariate correlations between the cognitive-communication variables (the Total FAVRES scores: Accuracy, Rationale and Reasoning scores) and psychosocial functioning (SPRS-2 Other logit scores). There was a substantial positive association between participants' Total Accuracy score on the FAVRES and their SPRS-2 other overall score ($\rho_s = .537$, $n = 36$, $p < .01$). The participants' Total Reasoning score on the FAVRES and their SPRS-2 other overall score ($\rho_s = .446$, $n = 36$, $p < .01$) were also positively correlated with substantial levels of association.

Results of the multiple regression are found in Table 5. The R^2 resulting from the multiple regression analysis was statistically significant ($F(2,33) = 6.782$, $p < 0.01$), and accounted for approximately 29% of the variance of the SPRS-2 Other score. While both predictors (Total Accuracy and Total Reasoning) are significantly correlated with the SPRS-2 Other score, the SPRS-2 Other was primarily predicted by the Total Accuracy Standard Score ($\beta = 0.54$, $p < 0.05$), while the Total Reasoning score did not add any predictive

Table 3. Mean performances on cognitive-communication and psychosocial measures.

	Mean	SD	Min-max	Below cut-off (n, %)
FAVRES				
Total Accuracy SS	41.31	35.40	1-101	16 (72%)
Total Rationale SS	51.33	34.53	1-111	17 (75%)
Total Reasoning Raw	60.19	19.04	15-94	n/a
SPRS-2				
Other Total	60.26	10.69	42.08-88.80	n/a
Work and Leisure	9.28	3.58	2-15	n/a
Relationships	12.31	3.34	5-16	n/a
Living Skills	13.19	2.94	5-16	n/a

Table 4. Correlations between the cognitive-communication and psychosocial functioning measures.

	SPRS Total	SPRS Work and Leisure	SPRS Relationships	SPRS Living Skills
FAVRES Total	0.537**	0.484**	0.544**	0.372
Accuracy SS				
FAVRES Total	0.363*	0.302	0.395	0.210
Rationale SS				
FAVRES Total	0.446**	0.427**	0.398*	0.200
Reasoning Raw				

* $P < 0.05$ (2 tailed); ** $P < 0.01$ (2 tailed).

Table 5. Multiple regression of total accuracy and reasoning variables on total SPRS-2 scores.

Variables Entered	R ²	Adjusted R ²	F	P
FAVRES Total Accuracy SS	0.291	0.248	6.782	0.003**
FAVRES Total Reasoning Raw				

*P < 0.05 (2 tailed); **P < 0.01 (2 tailed).

value ($\beta = 0.003$, n.s.) beyond what the Total Accuracy Standard Score was able to predict.

Research question 2: Relationship between cognitive-communication measures to specific psychosocial domains

Moderate positive correlations were found between the Total Accuracy score and both the SPRS Work and Leisure Total score ($\rho_s = .484$, $n = 36$, $p < .01$) and the SPRS Relationships Total score ($\rho_s = .544$, $n = 36$, $p < .01$) (Table 4). Increased performance on the FAVRES was associated with better Work and Leisure, and Relationship outcomes. The Total Reasoning score was also significantly correlated with the SPRS Work and Leisure Total score ($\rho_s = .446$, $n = 36$, $p < .01$).

Table 6 contains the results of the multiple regression analyses between the FAVRES measures and the SPRS-2 Work and Leisure domain. The grouped FAVRES measures resulting from the multiple regression analysis was statistically significant ($F(2,33) = 5.216$, $p < 0.05$), and accounted for approximately 24% of the variance of the SPRS-2 Work and Leisure score. However, neither the Total Accuracy Standard Score ($\beta = 0.414$, $p = 0.058$), nor the Total Reasoning Score ($\beta = 0.485$, n.s.) were significant predictors.

Results of the multiple regression analyses between the FAVRES measures and the SPRS-2 Relationships domain are

Table 6. Multiple regression of total accuracy and reasoning variables on level of work and leisure.

Variables Entered	R ²	Adjusted R ²	F	P
FAVRES Total Accuracy SS	0.240	0.194	5.216	0.011*
FAVRES Total Reasoning Raw				

*P < 0.05 (2 tailed).

Table 7. Multiple regression of total accuracy and reasoning variables on level of relationships.

Variables Entered	R ²	Adjusted R ²	F	P
FAVRES Total Accuracy SS	0.286	0.243	6.621	0.004**
FAVRES Total Reasoning Raw				

*P < 0.05 (2 tailed); **P < 0.01 (2 tailed).

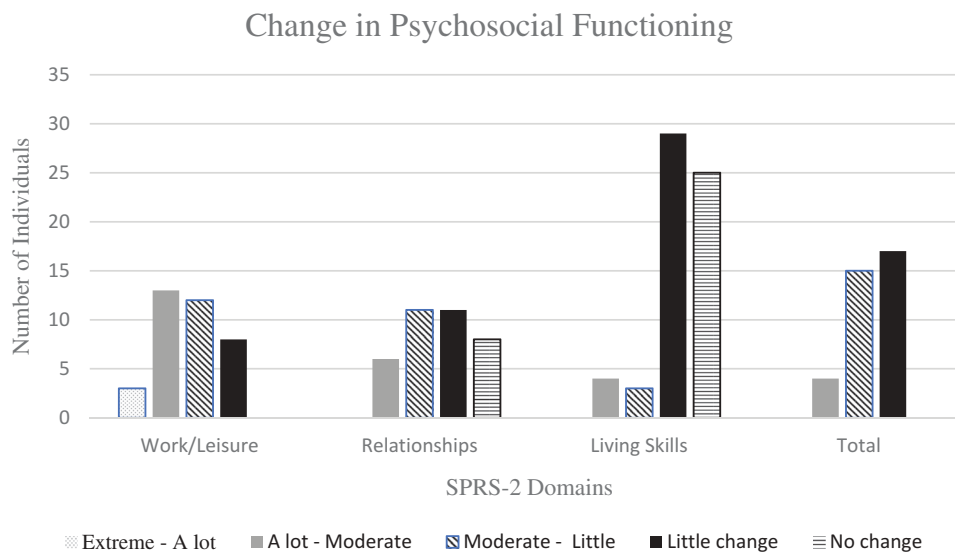
reported in Table 7. The R² resulting from the multiple regression analysis is statistically significant ($F(2,33) = 6.621$, $p < 0.01$), and accounted for approximately 29% of the variance of the SPRS-2 Other score. The Total Accuracy Standard Score was shown to be a significant predictor to the Relationships score ($\beta = 0.521$, $p < 0.05$).

No significant correlations between the FAVRES measures and the SPRS-2 Living Skills domain was found (Table 4).

Discussion

This study explored the relationship between cognitive-communication ability and psychosocial outcome at 12 months post-severe TBI. A significant majority (72%) of participants had difficulty with the FAVRES at 12 months post injury (Table 3), while all participants were rated to have some degree of psychosocial change (Figure 1) 12 months post-injury. The study reinforces that individuals with cognitive-communication impairments following TBI are also the individuals experiencing poor psychosocial outcomes (14–16,29). The key finding from this study was that individuals who achieve higher Accuracy and Reasoning scores on the FAVRES are more likely to have better psychosocial outcomes, or more specifically, less change to pre-injury psychosocial functioning.

Previously, predictive relationships between standardised measures and everyday functioning have been low to moderate among individuals with acquired brain injury (50,51). In contrast to specific test items in decontextualised formats, the FAVRES Accuracy and Reasoning scores examine the individual's simultaneous use of processes while comprehending and

**Figure 1.** Amount of change in psychosocial functioning.

discriminating between multiple modalities and sources of information in realistic situations (35). On the FAVRES, individuals are assessed at the activity and participation level of the WHO-ICF framework, rather than solely on impairment-based tasks in previous standardised measures. In order to score highly on Accuracy on the FAVRES, an individual is required to employ complex comprehension, consider a number of factors to draw a conclusion, tap into multiple stimuli, and distinguish between important and irrelevant information, while the Reasoning score is based on a specific set of questions examining the individual's problem-solving process (35).

It is arguably the integration of the specific cognitive-communication skills examined by the FAVRES that reflect the complex demands that vocational and social contexts place on an individual's communication. That is, the same combination of cognitive and communicative skills that individuals require on a day-to-day basis in their work and social environments are critically evaluated during the administration of the FAVRES. Thus, the FAVRES demonstrates both ecological and predictive validity, in that it is able to predict performance in generalised contexts relevant to daily life situations.

Areas of psychosocial functioning that are most frequently reported to be impaired following TBI include employment and relationship status (14–16). This study represents a novel investigation of the relationship between cognitive-communication measures and individual domains of psychosocial functioning - employment, relationships with friends and family, and daily living skills. Participants who performed poorly on the FAVRES were more likely to be rated as having more change to their employment and leisure activities. These findings are in accord with three previous studies (15,37,38) and confirm that functional communication abilities as assessed by the FAVRES are significantly associated with these individuals' capability to

return to work following TBI. The current study is unique in that the psychosocial outcome measure investigates aspects of return to work outcome other than employment status and stability. The SPRS-2 contains questions examining work and organization skills, in addition to change in work type and workload. That these aspects have also been found to be related to cognitive-communication performance, strengthens existing findings that suggest performance on the FAVRES is associated with vocational outcomes.

In this study, 39% of the participants were unemployed 12 months post injury, and these participants were not predominantly from any one occupation type, but from across a range of sectors (Figure 2). It is understandable that individuals in a managerial role pre-injury who scored lower on the FAVRES would not have returned to employment, as success in these roles are likely dependent on complex communication skills. However, participants previously employed as labourers or jobs of a more physical nature with lower FAVRES performance were also unemployed at 12 months following injury, highlighting the impact of communication deficits on employment regardless of occupation type. The FAVRES examines executive functioning skills required in communication such as attention to detail, self-monitoring and self-evaluation which are expected in high performing employees in any workforce. The individuals who had difficulty with the scheduling task of the FAVRES will also be challenged by similar activities in the real world. In addition, the increasing emphasis placed on spoken communication skills in the workplace further iterates the need to address these cognitive-communication deficits in order for individuals to maximise work re-entry capacity (37).

Participants with poorer performance on the Total Accuracy measure of the FAVRES were more likely to be perceived as having increased changes in their interpersonal

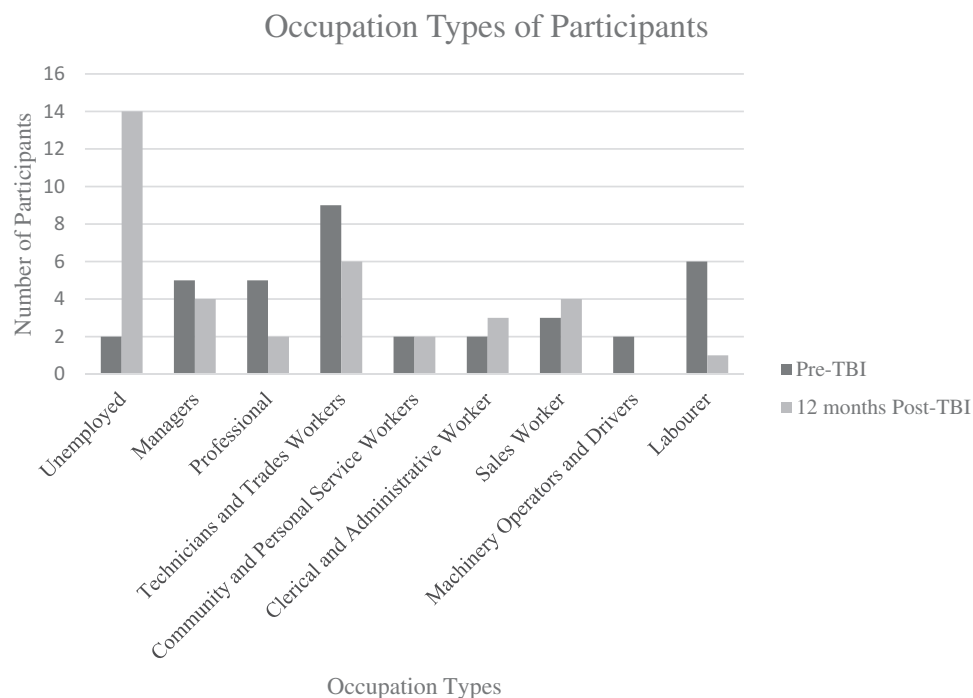


Figure 2. Occupation types of participants.

relationships on the SPRS-2. This study is the first to investigate performance on the FAVRES and its association with social outcomes has implications for clinical practice. The findings suggest that individuals who struggled with tasks requiring prediction of consequences or consideration of other perspectives on the FAVRES would also have difficulties with sustaining healthy relationships.

Conversely, the living skills domain on the SPRS-2 contains questions investigating the participant's personal habits, use of transport and accommodation, which did not have significant relationships with any of the cognitive-communication measures. These are the aspects of psychosocial functioning that may be less reliant on complex social communication, with greater focus on independence at day to day tasks. It is also possible that these tasks have a lesser cognitive load and are more physical in nature. At 12 months post injury, individuals generally report good physical recovery, with up to 91% of participants in a self-report study being independently mobile (52). However, it should be noted that the living skills domain also contains a question about social skills ("Have your relative's social skills and behaviour in public changed because of the injury?"). While social skills can be a predictive factor for poor social integration outcomes (14,24), it may be that the other 3 questions of the living skills domain decreased the statistical impact of this test item. As a result, the association between cognitive-communication and change in social skills following injury has remained undetected in this study. Further research is required to clarify if performance on the FAVRES has a statistically significant association with social skills.

In addition, it could be argued that there are a number of tasks that fall under the umbrella of everyday living skills which require cognitive-communication competence to successfully accomplish. Examples of such tasks could include planning a journey to the local supermarket using public transport, or recalling a sequence of household cleaning tasks. Therefore, the lack of relationship between the living skills domain and the FAVRES outcomes may be a limitation of the assessment tools, and further research is required to investigate whether this may be the case.

Clinical implications for rehabilitation

The findings from this current study provide a strong argument that cognitive-communication should remain a focus of rehabilitation even at 12 months post-injury. FAVRES scores indicated that cognitive-communication difficulties continued to persist at 12 months for a number of participants with 72% of participants failing to above the cut-off on the Accuracy measure. Despite these marked difficulties with high-level communication skills, 20 participants (56%) were no longer receiving speech pathology intervention at the time of this study. The results of this study demonstrate the importance of continued SLP involvement in the post-acute and later stages of recovery.

The FAVRES has the potential to be used for various purposes in the rehabilitation of individuals following TBI. Firstly, given the sensitivity of the FAVRES in detecting deficits in complex situations, it can be used as a benchmark to determine the need for intervention or discharge from speech

pathology intervention, and a continuous baseline outcome measure. An assessment such as the FAVRES is fitting as a standard measure as it enables discovery of functional deficits that are only apparent in similar real-world situations. This is in line with the recommended assessment practices for cognitive-communication disorders, in that they should be relevant to everyday life situations (33). In comparison, a traditional impairment-based language assessment may fail to detect these deficits leading to inappropriate discharge from speech pathology intervention. With the ongoing shift towards incorporating all aspects of the WHO-ICF framework into speech pathology assessment practices, a tool such as the FAVRES, which captures multiple aspects of health outcome is more appropriate for the purposes of determining the need for intervention and support services.

This study also supports the suggestion from Rietdijk et al (38) that the FAVRES should be used as a critical tool to assist in the identification of individualised rehabilitation goals. Turkstra, Coelho and Ylvisaker (32) state that for an assessment to be used to make intervention decisions, evidence must show that those specific assessment scores are able to predict performance in the relevant contexts. The results of this study demonstrate a significant relationship between performance on the FAVRES and vocational and social functioning in the community. SLPs may be able to use the FAVRES to tailor rehabilitation dependent on individual strengths and weaknesses, goals and priorities. Each of the four FAVRES tasks vary in genre, context and specific cognitive-communication skills, making it suitable for this purpose. An individual looking to return to work may benefit from goals based on their performance on the scheduling task (see Table 2), as the combination of language skills, problem-solving, organisation and working memory closely resembles similar tasks in the workplace (15). Similarly, an individual who is experiencing difficulty maintaining relationships may find Task 1 or Task 3 based goals useful, as they require the individual to consider other points of view before making choices.

While the Everyday Living Skills domain was not found to be significantly correlated to FAVRES performance, there are many activities of daily living or everyday routines that require cognitive-communication skills not unlike those required in the workplace. For example, scheduling household chores and day to day errands involves a combination of organisation, time management and problem-solving that require a similar set of cognitive-communication skills examined in the scheduling task of the FAVRES. Thus, tasks in the FAVRES may be an appropriate tool in the identification of intervention targets beyond the vocational and social domains. This will assist clinicians in recognising individuals who may require assistance with developing or re-learning everyday routines, through interventions involving environmental modifications and supports, repeated contextualised practice of habitual routines and explicit teaching and discussion of routine sequences (53,54).

The FAVRES may also potentially be utilised in flagging social communication deficits affecting the social and vocational domains. Social pragmatic impairments such as egocentrism in conversation, inaccurately reading social cues, and tangential utterances are often characteristic of cognitive-

communication disorders, and contribute to making interactions more effortful and less enjoyable, therefore affecting an individual's interpersonal relationships. Several studies have identified interpersonal difficulties as a common reason for post-injury loss of employment (42,55). Social pragmatic difficulties such as responding inappropriately to social cues and improper comments can lead to difficulty forming effective relationships with colleagues, uncomfortable workplace atmosphere, and ultimately termination of employment.

The Rationale subscale of the FAVRES requires individuals to justify their answers and provide appropriate and logical reasons for their decisions. This measure may be particularly useful for clinicians to flag social pragmatic deficits, as extended responses are required from the individual, yet they must remain relevant, logical and appropriate to the task. For example, in Task 2, individuals must justify their decisions behind their scheduling such as why they must have lunch with an important work client rather than a friend.

Given the predictive value of the FAVRES found in this study, it also has the potential to inform the timing of clinical decisions and allocation of resources over the course of recovery. For instance, the findings from this particular study suggest that for a large number of these participants, return to work goals set prior to the 12 month point may be inappropriate, considering their poor performance on the FAVRES and associated Work and Leisure score on the SPRS-2. Healthcare and rehabilitation services impose immense costs (3,56) for the individual with the TBI, but also for the professionals and organizations working with these individuals, in regards to financial expenses, human resources and time spent. This study indicates that an individual's performance on the FAVRES has the potential to inform clinicians and organizations in their distribution of resources (e.g. training of carers and communication partners versus return-to-work programmes).

Findings from this study confirm that the SPRS-2 is a valuable tool in the rehabilitation process. The Moving Ahead Centre of Research Excellence in Brain Recovery identified the SPRS-2 as a tool that should be a core outcome measure in the rehabilitation of patients with TBI (57). This is due to its sensitivity to change and treatment effects, strong psychometric properties, versatility in measuring both change since injury and current competency, and having clinician, informant and self-report versions. Being an assessment that examines an individual's participation, SLPs should consider more frequent use of the SPRS-2 during post-acute recovery in their clinical practice to gain a representative view of an individual's changing level of functioning. The broad scope of the SPRS-2 lends itself to helping facilitate interdisciplinary practice. It may be able to help professionals from other health disciplines identify when speech pathology intervention is needed over the course of recovery. This study identified cognitive-communication measures as predictors for the Work and Leisure, and Relationships domains of the SPRS-2. Other members of the rehabilitation team may use the SPRS-2 to flag individuals who are having difficulty in these particular domains, and thus may benefit from speech pathology intervention.

Several large-scale reviews of rehabilitation practices and trends for adults with TBI highlight a focus on physical rehabilitation, cognitive and behavioural therapy, vocational

and recreational therapy, psychosocial and counselling input (20,41,58,59). In these studies, there were either no or minimal mention of specific speech pathology or cognitive-communication intervention. There is undoubtedly a gap in community rehabilitation for speech pathology intervention. This study indicates that an explicit focus on cognitive-communication assessment and intervention within the context of return to work and community reintegration programs is prudent. This focus is well within the scope of practice for speech pathologists, who possess crucial knowledge of how underlying neuropsychological deficits can affect the presentation of cognitive-communication difficulties in social and vocational contexts, and should play an integral role in managing cognitive-communication disorders following TBI.

Furthermore, the complex relationship between cognitive-communication and psychosocial outcomes suggest speech pathology intervention should be incorporated in a multidisciplinary team-based approach with the inclusion of all relevant professions. Given that cognitive-communication disorders result from underlying neuropsychological and cognitive impairments, collaboration with neuropsychologists to simultaneously address communication, cognition, carer support, and intervention focused on meaningful activities and tackling barriers in context seems to be particularly crucial. This is one of the basic assumptions of managing cognitive-communication disorders in a report submitted to the Academy of Neurological Communication Disorders and Sciences (60).

Research implications, limitations and future directions

This study was limited by the small sample size. Studies with larger sample sizes would allow further investigation into the individual tasks of the FAVRES to discriminate which of the tasks are the most clinically useful. More importantly, the predictive value of each individual FAVRES task for the specific psychosocial domains could be examined with a larger sample size. Currently, the only findings at this level have examined employment within preliminary or exploratory studies. For example, Isaki and Turkstra (15) found that the scheduling task (refer to Table 2) of the FAVRES was highly successful at discriminating between employed and unemployed individuals one to four years post-injury, while Rietdijk et al (38) reported that Tasks 2, 3 and 4 are all useful individually due to the strong correlations between the individual scores and employment status in their study. A finding such as Task 3 being a significant predictor of relationship maintenance following injury would have useful implications for rehabilitation.

A larger sample size would also allow for exploration of a larger number of factors, such as years of education and pre-injury occupation in the multiple regression equation. In addition, inclusion of factors such as non-linguistic measures of cognition in the multiple regression equation would allow researchers to determine with further certainty that the association of the higher scores on the FAVRES measures with higher psychosocial functioning is specific to cognitive-communication and not due to an overall severity effect.

The effect of a mild aphasia or comorbid language impairment must also be considered among the sample, and this may have had an effect on their performance on the FAVRES.

This study adds to the existing body of research into predictors of psychosocial outcome following a TBI. Follow up of this sample in 12 months (at 2 years post-TBI) and then at various time points (3 years, 5 years, and so forth) as a longitudinal study is another direction to determine whether the relationships identified in this study are consistent in the long-term or whether any other patterns emerge. Any follow up will also provide much needed data to the paucity of current research regarding the nature and trajectory of cognitive-communication recovery.

This study also provided information about the FAVRES that may be useful to clinicians and other researchers. While the Total Accuracy and Total Reasoning scores were correlated to psychosocial functioning individually, it can be deduced from the β weights of the combined cognitive-communication measures (Total Accuracy and Reasoning scores) that Total Accuracy alone may provide sufficient predictive information about performance on the SPRS-2 at 12 months following TBI. This finding is echoed in the multiple regression analyses of the individual domains of Work and Leisure, and Relationships.

Finally, individual interviews or focus groups with this population would shed valuable insight into the perspectives of the individuals with TBI and their close relatives on how their cognitive-communication abilities have impacted reintegration into their communities.

Conclusion

Cognitive-communication impairments after severe TBI are well documented in the literature. Less researched is the relationship between cognitive-communication ability and overall psychosocial outcome. The findings of the current study suggest that cognitive-communication is a significant predictor of change in overall psychosocial functioning following injury, change in employment and leisure activity, and an individual's ability to form and maintain relationships following TBI. Given the challenges faced by individuals following TBI in returning to their pre-injury lives and reintegrating into the community, it is hoped that this study will provide further evidence for practicing clinicians to support intervention in the post-acute stage of recovery. The findings of this study should also serve as the basis for further exploration of the role of cognitive-communication assessment and for practicing clinicians to advocate for holistic rehabilitation for individuals with TBI.

Disclosure Statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this paper. Leanne Togher is in receipt of a NHMRC Grant (#632681) and is the recipient of a NHMRC Senior Research Fellowship.

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