ORIGINAL REPORT

TRAINING COMMUNICATION PARTNERS OF PEOPLE WITH SEVERE TRAUMATIC BRAIN INJURY IMPROVES EVERYDAY CONVERSATIONS: A MULTICENTER SINGLE BLIND CLINICAL TRIAL

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Objective: To determine effectiveness of communication training for partners of people with severe traumatic brain injury.

Design: Three arm non-randomized controlled trial comparing communication partner training (JOINT) with individual treatment (TBI SOLO) and a waitlist control group with 6 month follow-up.

Participants: Forty-four outpatients with severe chronic traumatic brain injuries were recruited.

Intervention: Ten-week conversational skills treatment program encompassing weekly group and individual sessions for both treatment groups. The JOINT condition focused on both the partner and the person with traumatic brain injury while the TBI SOLO condition focused on the individual with TBI only.

Main outcome measures: Primary outcomes were blind ratings of the person with traumatic brain injury's level of participation during conversation on the Measure of Participation in Communication Adapted Kagan scales.

Results: Communication partner training improved conversational performance relative to training the person with traumatic brain injury alone and a waitlist control group on the primary outcome measures. Results were maintained at six months post-training.

Conclusion: Training communication partners of people with chronic severe traumatic brain injury was more efficacious than training the person with traumatic brain injury alone. The Adapted Kagan scales proved to be a robust and sensitive outcome measure for a conversational skills training program.

Key words: communication; communication partner; traumatic brain injury; clinical; rehabilitation.

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INTRODUCTION

Communication difficulties arising from severe traumatic brain injury (TBI) commonly result in long-term deleterious psychosocial sequelae including family breakdown, loss of employment, social isolation and a loss of identity (1). Impaired communication may reflect disorders of language function, but the majority arise from generic cognitive deficits reflecting fronto-temporal pathology. People with TBI and their family members identify persistent significant communication difficulties and avoidance of social situations (2). As the person with TBI may have less rewarding interactions, community re-integration can be difficult (3) leading to problems maintaining pre-injury relationships and shrinking social networks (4). Close relationships can change as family members and friends make adaptations to the way they communicate with the person with TBI (5).

Despite its pivotal role in social re-integration, there is a paucity of research examining the effectiveness of remediating social communication disorders after TBI. However, there is reason for optimism in this area. Two avenues of intervention which have shown promise are: (*i*) training people with TBI with the skills necessary for successful social interaction and; (*ii*) training the communication partners of people with TBI to use strategies for promoting more successful interactions.

Behavioural and cognitive deficits thought to contribute to a loss of communicative competence are amenable to remediation (6). A systematic review of treatment outcomes in TBI indicated that social skills was one of only two areas amenable to treatment (7). There is consensus that people with cognitive deficits following TBI should be offered cognitive rehabilitation (8), including treatment for cognitive-communication difficulties (9). Cognitive rehabilitation should focus on meaningful activities for the patient and relevant stakeholders, include interventions in the affected person's environment and incorporate generalization strategies (1, 9, 10). Social skills can be improved for people with chronic severe TBI. A randomised controlled study of a social skills program for people with TBI suggested that treatment effects were modest and limited to

measures of social behaviour and perception (6). Another RCT (11) supported the effectiveness of social skills training using a group format. Improvements were noted on blinded assessors' perceptions of participants' general participation, quantity of information, clarity of expression, social style and self-report of social communication skills.

Social skills treatments are based on the notion that communication is a set of behaviours which can be learned (e.g., greetings, requests) and then transferred into different settings. Sociolinguists, in contrast, recognise that language varies according to the purpose of the interaction and the relationship between participants in the interaction (12). Communication is viewed as an interactional achievement between two or more people who collaborate to jointly produce conversation (13). This suggests that in addition to training people with TBI, communication partners should also be considered within the training process.

A review of the aphasia literature (14) reported that communication partner training interventions had favourable outcomes. For example, partners who received training in supporting the conversations of people with aphasia were better at acknowledging and revealing the competence of people with aphasia compared to a control group (15, 16). In contrast to the field of aphasia, there is a paucity of research examining the effectiveness of communication partner training for people with TBI. One exception is an RCT which showed that trained police officers improved their interactions with people with TBI during routine telephone inquiries (17). This project aimed to determine which method is the more effective approach: (1) treating communication deficits of the person with TBI directly or (2) training particular people with whom the TBI speaker interacts, specifically care-givers and family members in conjunction with the person with TBI to enable successful interactions. The efficacy of these two approaches was evaluated in comparison to a delayed treatment control group, in terms of improving the degree and quality of participation in conversation of people with TBI as measured by independent raters.

METHODS

A non-randomized controlled trial was used to examine outcomes of treatment for social communication impairment. Based on previously published work we expected a large effect size for the primary outcome variables, which are scales derived from the Measure of Participation in Conversation (MPC) (15, 18). Power analysis indicated that for $n=14$ per group, based on the MPC Transaction scale, the study has power of 94% with alpha=0.05 two-tailed. We made a conservative estimation that $n=46$ would accommodate a 10% attrition rate and used this as a minimum sample size.

Preliminary discussions with clinicians at rehabilitation centers indicated that there would not be an adequate core number of participants with an available communication partner to participate in intensive therapy for a randomized trial. The original design involving a randomized component was therefore modified to use a non-randomized method of allocation. Participants were allocated to groups based on availability to attend treatment. Partners were unable to participate in the study primarily due to work commitments, as the treatment was conducted during working hours. Participants were allocated to either the TBI SOLO or CONTROL group based on their willingness

to attend regular treatment for 10 weeks. Control participants were offered treatment at the completion of the study. Intention to treat analysis was used.

Participants were allocated to 1 of 3 interventions:

(1) Social communication training, involving training the person with TBI only, with no training provided to their communication partner (TBI SOLO)
(2) Social communication training, involving training both a communication partner and the person with TBI (JOINT)
(3) Delayed treatment control condition. This group were offered training following completion of the post-assessment phase (CONTROL).

We used planned contrasts with the primary outcome variables with the following questions in mind:

1. Is treatment (TBI SOLO or JOINT) more efficacious than no treatment (CONTROL)?
2. Is the combined training for both the person with TBI and the everyday communication partner (JOINT) more effective than the individual treatment (TBI SOLO)?

Primary outcome variables

Adapted Measure of Participation in Conversation (15, 19). The primary measure evaluated the person with TBI's level of participation in conversation in terms of his/her ability to interact or socially connect with a partner and to respond to and/or initiate specific content during a casual conversation with their partner (18). This measure consists of two subscales which constituted the primary outcome variables of this study: the Adapted MPC Interaction scale and the Adapted MPC Transaction scale.

The original MPC scales were designed to assess interactions between people with aphasia and their communication partners. Togher et al. (19) adapted these scales to evaluate interactions of people with TBI and their partners. Adaptations increased the focus on pragmatic aspects of communication and the anchors were reworded to improve reliability of the scales (19).

Each participant completed two conversations with their communication partner at each timepoint in the study. During the casual conversation participants were instructed to have a chat for a few minutes. In the purposeful conversation participants were instructed to make a list of the important communication situations during the next month and how they planned to deal with these. This latter conversation was used for the secondary outcome measures.

Two trained raters who were blind to group allocation scored 5-min videos of these interactions on two 9-point Likert scales, presented as a range of 0 to 4 with 0.5 levels for ease of scoring. The scales range from 0 (no participation) through 2 (adequate participation) to 4 (full participation in conversation). Psychometric data have been reported (18) attesting to the robust nature of this measure. Inter-rater reliability was estimated using intraclass correlation coefficients (ICCs). This is a conservative statistical procedure that takes into account both agreement and association (18). Inter-rater agreement was established on the adapted MPC scales (ICC=0.84–0.89). Intra-rater agreement was also strong (ICC=0.81–0.92). Over 90% of all ratings scored within 0.5 on a 9 point scale (19).

Secondary outcome variables

Adapted Measure of Support in Conversation (15, 19). The same trained, blind raters made global ratings of the contributions made by the communication partners using the Adapted MSC scales based on the videoed interactions of casual and purposeful conversations. The raters evaluated the degree of support provided by the communication partner on 9 point scales from 0 to 4 pre and post training. There are two Adapted MSC scales, one that evaluates the way a communication partner acknowledges the competence of the person with TBI, and another which evaluates how well communication partners reveal the competence of the person with TBI. These scales have strong inter-rater agreement (ICC=0.85–0.97) and intra-rater agreement (ICC=0.80–0.90). Over 90% of all ratings scored within 0.5 on a 9 point scale (19).

Data analysis

This study employed a non randomized controlled trial design comparing pre-test assessment of key outcome variables to the same measures administered at post-test assessment and at 6 month follow-up. The treatment effects were operationalised as group × time interactions arising from repeated measures ANOVAs examining performance on the primary and secondary outcome variables between the 3 groups at (1) pre-test v. post-test and (2) post-test vs. 6 month follow-up.

Participants

We recruited 44 outpatients from three brain injury rehabilitation centers in Sydney, Australia. Inclusion criteria were: (*i*) a moderate-severe TBI at least 9 months previously defined as a score on the Glasgow Coma Scale (GCS) of 9–12 (moderate), 8 or less (severe) and/or a period of Post Traumatic Amnesia (PTA) of 1–24 h (moderate) or more than 24 h (severe), (*ii*) the presence of significant and chronic social skills deficits including any of the following criteria: awkwardness in social interactions, apparent disregard or lack of awareness of social cues and inappropriate responding, and which were judged to be interfering with the person's everyday communication by the person who was referring the participant or by themselves or their family member, (*iii*) be of at least average premorbid intelligence which was confirmed from the person's most recent neuropsychological assessment, and (*iv*) have a regular communication partner with whom they interact on a daily basis. Exclusion criteria included: (*i*) drug and alcohol addiction or active psychosis, (*ii*) aphasia, (*iii*) a non-English speaking background (*iv*) severe amnesia, (*v*) previous brain injury, (*vi*) presence of previous psychiatric history and (*vii*) severe dysarthria. All participants were not receiving rehabilitation at the time of the study. Caregivers interacted with the person with TBI on a regular basis, had not sustained a brain injury or had a known psychiatric history.

Procedure

Recruitment of participants, allocation to groups and provision of training occurred in 3 waves. Each wave involved a different brain injury rehabilitation center. Human subjects research approval was obtained from all sites and all participants and their communication partners consented to their involvement in the research. After recruitment, participants completed assessments of their communication and cognitive skills. Participants and their communication partners also completed the baseline assessments for the primary and secondary outcome measures, including filming of conversations. Each training group consisted of 4 to 5 TBI participants, leading to a total number of 8 to 10 participants including communication partners in the JOINT groups, and 4 to 5 people with TBI in the TBI SOLO groups. Participants in the JOINT and TBI SOLO groups attended a ten week program including group and individual sessions. Participants in the JOINT group attended all sessions together with their communication partner while TBI SOLO participants attended sessions without their communication partner. The CONTROL group did not attend any social communication skills training during this period. After the training program, all participants and their communication partners completed repeat assessments for the primary and secondary outcome measures. Six months after the end of the training program, the outcome measures were completed again. The assessors for the initial, post and 6 month follow-up assessments were blind to the group allocation of participants.

Social communication skills training program: traumatic brain injury express

The social communication skills training program for the JOINT and TBI SOLO groups involved attending a group session of 2.5 h (with a 15 min break) conducted by two therapists and an individual session of 45–60 min conducted by one therapist weekly for the 10 week program. Both clinicians conducted all group treatment sessions throughout the 3 waves of the study. The individual sessions most commonly occurred on the same day as the group treatment session, although this depended on scheduling availability.

Program format. A uniform manualised approach entitled "TBI Express" was used to structure the group program. Sections of the program are freely available on the internet (http://sydney.edu.au/health_sciences/ disability_community/tbi_express/). Group sessions included review of home-based tasks using tape-recorded samples of interactions taken throughout the previous week, introduction of new information and strategies, role playing, practice of conversational strategies and feedback on use of techniques. During the first session, participants were provided with tape recorders which they kept for the duration of the study. They were trained to record their conversations, and during each week of the treatment program they were given conversational tasks to complete at home with their conversational partner. Completion of these tasks was recorded each week by the therapists. Individual sessions involved personalised goal setting, feedback on home-based tasks, problem-solving of issues raised by the participants, and practice and troubleshooting relating to any new strategies introduced in the group session. We used a combination of individual and group sessions for communication skills training because this approach has particular therapeutic as well as economic benefits. Group members benefit from observing the performance of others on remediation tasks (i.e., vicarious learning), particularly when targeted problems are similar or address the same underlying principle. Group participation is often more enjoyable for participants than one-on-one work with a therapist, and peer feedback may be viewed by the recipient as more 'valid' than similar input from a therapist. Individual sessions allowed therapists to address the more specific needs and problem behaviours of each participant. Participants with any serious psychological issues were referred to clinical psychology for further assistance, and continued to attend the social communication skills training program.

Program content. Participants in both the TBI SOLO and JOINT groups received training based upon behavioural techniques adapted for TBI (20), sociolinguistic theories of communication (21), principles of Vygotskian learning theory (22) and previously validated communication training resources (17, 23). Existing training materials were modified for the present study to include formal, structured role-plays and informal social conversation situations with the purpose of teaching the person with TBI to communicate according to the expected discourse type (e.g. shopping encounter talk vs casual conversation)(21). In order to maximise relevance and generalisability (22, 24) the focus was on everyday discourse, such as chatting during daily activities. The target behaviours for the JOINT program were based on previous work (25–27) in which we identified common problems in interactions between people with TBI and their communication partners. These include: (*i*) over-compensating by speaking too slowly or in other ways infantilising the individual, (*ii*) not giving injured individuals an opportunity to communicate, (*iii*) failing to provide natural consequences for communication successes, such as showing interest in topics introduced by the person with TBI, or alternatively not responding to communication failures, such as giving non-verbal feedback that the person has been talking for too long (*iv*) asking injured individuals questions that the communication partner already knew the answer to (such as "what did we do last weekend?"), (*v*) repeatedly checking on accuracy of information provided during the conversation, and (*vi*) failing to follow up information given by the person with TBI. The JOINT training program therefore focused on developing more positive interactions between people with TBI and their communication partners through using the elaborative and collaborative strategies suggested by Ylvisaker et al. (25) (Appendix SI (available from http://www.medicaljournals.se/jrm/content/?doi=10.2340/16501977-1173)). These scaffolding procedures are specifically designed to facilitate communication, cognitive and social recovery in people with TBI.

The TBI SOLO group was designed to parallel the key concepts of the JOINT group, but without a communication partner present, in order that the key contrasting feature between the groups was the presence or absence of the support of the communication partner. Whereas the JOINT group focused on training communication partners to support people with TBI to participate effectively in everyday interactions, the TBI SOLO group

focused on training people with TBI directly to participate effectively. For example, communication partners in the JOINT group received training in elaboration techniques designed to assist their partner with TBI to extend the amount of information provided in conversations. The TBI SOLO group had a parallel session involving training in behaviours that assisted the person with TBI in extending conversational topics by talking about various aspects of a topic such as who it was about, what happened, when, where and why an event might have occurred. For both groups, initial sessions introduced concepts related to communication, and the impact of brain injury on communication. Strategies that promote more successful communication were then introduced in the middle sessions. In the final sessions, group participants further refined their use of communication strategies and planned for ongoing practice (Appendix 1). Some examples of goals of individual participants were: 'For (person with TBI) to increase the number of questions used in conversations', and 'For (person with TBI) to reduce the length of turn in conversations'. In the JOINT group, participants with TBI and their communication partners had parallel goals. For example, where the goal of the participant with TBI was, 'For (person with TBI) to initiate new topics in conversations', the parallel goal of the communication partner was, 'For (communication partner) to allow (person with TBI) to take more turns in the conversation'. See Appendix 1 for a summary of the topics covered in each group session for the TBI SOLO and the JOINT group.

RESULTS

Allocation and retention of participants

Fig. 1 shows the allocation process. Data collection was undertaken over a period of two years. One hundred and six participants were referred to the research study. Of these, 62 participants were excluded. Nineteen participants were ineligible for inclusion as they were participants in concurrent research, 16 did not meet inclusion criteria and 27 refused to participate or could not be contacted. The remaining 44 participants completed the pre-training screening and assessment and were allocated to groups based on communication partner availability (JOINT: $n=14$, TBI SOLO: $n=15$, CONTROL: $n=15$). All participants received

Fig. 1. Allocation and flow diagram for the 3 groups.

treatment or control conditions as allocated and intention to treat analysis was used.

Of the 44 participants allocated to groups, 93% (41/44) completed the post-training assessment. Three participants withdrew during treatment/before the post assessment (CONTROL: $n=1$, TBI SOLO: $n=1$, JOINT: $n=1$). The control participant dropped out due to ill health, and the two treatment participants did not wish to continue in the program. 87.50% (38/44) of the participants completed the six month follow-up assessment. Three participants declined to participate or could not be contacted at the follow up assessment (CONTROL: $n=2$, TBI SOLO: $n=1$). Additionally, one participant in the control group had missing data for the videotaped conversations measure for 6 month follow-up.

Treatment attendance

Criteria for inclusion of participant data in the study was that each participant must have attended 80% of the group and individual sessions (i.e., 8/10 group sessions and 8/10 individual sessions). One participant and his partner withdrew from the JOINT group in week 5 and attended 3 sessions, and one TBI SOLO participant dropped out at week 6 and attended 4 sessions. All remaining participants in both TBI SOLO and JOINT groups completed the required number of 8 or more sessions. There was no significant difference between JOINT and TBI SOLO groups for the number of group ($U=88.00$, $z=-0.81$, $p=0.41$) or individual sessions attended ($U=100.00$, $z=-0.24$, $p=0.66$). Overall, participants received a median of 32 h of treatment.

Home practice completion

Home practice was rated as "Completed as directed", where home practise was completed according to instructions and for the length of time requested for each task, "Partially complete" where some tasks were completed but the time spent on these was substantially less than the time set for the conversation and/or the participants held a general conversation without targeting the practise to specific goals/target behaviours or "Not completed" where no tape recorded conversations or set tasks were completed. The ranked home practice data for JOINT and TBI SOLO groups was analysed using the Mann-Whitney U-test. The JOINT group was significantly more compliant with completing homework compared to the TBI SOLO group ($U=55.00$, $z=-2.32$, $p=0.02$).

Prognostic indicators

The mean demographic variables and neuropsychological variables are presented in Table I and baseline outcome measures for all participants initially allocated to groups are presented in Table II. To ensure that groups were comparable at baseline, between-group differences on all variables were examined via a series of one-way ANOVAs. Where the data violated Chi-square assumptions, the Fisher exact test was applied.

There were no significant differences between groups for the demographic variables. Additional comparisons were made between the baseline scores of participants who dropped out of
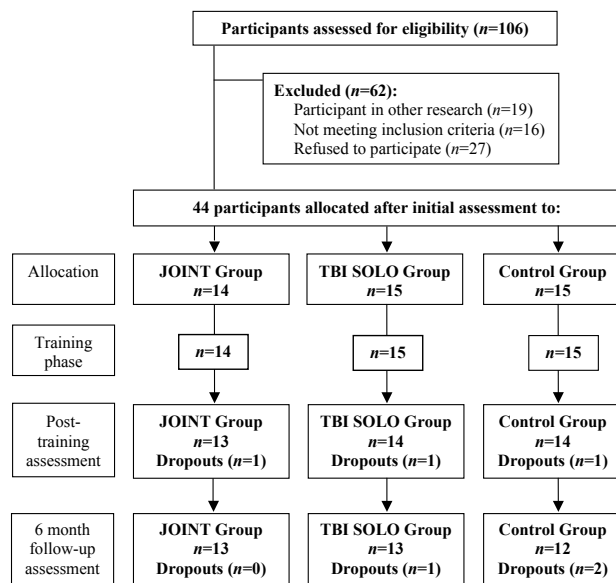
Table I. *Basic demongraphic and neuropsychological baseline data for treatment and control groups*

Demographic and neuropsychological variables	JOINT $n=14$ Mean (SD)	TBI SOLO $n=15$ Mean (SD)	CONTROL $n=15$ Mean (SD)	F	df	*p*-value
Age, years	30.3 (14.0)	39.7 (10.7)	38.1 (15.1)	2.02	2,41	0.15
Education, years	12.0 (2.3)	12.8 (3.7)	12.7 (3.2)	0.29	2,41	0.75
TPO, years	8.0 (5.1)	8.1 (8.3)	9.7 (6.7)	0.82	2,41	0.45
PTA, days	87.8 (56.9)	96.4 (61.2)	66.6 (65.5)	0.87	2,38	0.43
ECP age, years	50.3 (11.3)	49.0 (15.7)	49.7 (19.4)	0.02	2,41	0.78
ECP gender, male/female, *n*	4/10	2/13	3/12	1.08[a]	2	0.59
Gender, male/female, *n*	11/3	14/1	13/2	1.35[a]	2	0.49
Working memory, SS						
WAIS-III Digit Span	7.00 (1.87)	8.64 (3.59)	8.93 (2.06)	0.14	2,38	0.14
WAIS-III Letter Number Sequence	6.62 (3.28)	8.29 (4.10)	7.07 (3.27)	0.79	2,38	0.46
Processing speed, SS						
WAIS-III Symbol Search	4.15 (2.30)	5.89 (2.74)	6.43 (3.61)	2.15	2,38	0.13
WAIS-III Digit Symbol	4.69 (2.32)	5.62 (2.33)	5.57 (2.38)	0.64	2,37	0.53
New learning, SS						
WMS-III Logical Memory I	6.00 (2.83)	7.71 (2.92)	7.14 (3.01)	1.19	2,38	0.31
WMS-III Logical Memory II (SS)	5.08 (3.35)	8.43 (2.24)	7.29 (2.95)	4.72	2,38	0.02[a]
WMS-III Verbal Paired Associates I, SS)	5.50 (2.75)	6.00 (3.23)	5.17 (2.55)	0.10	2,37	0.91
WMS-III Verbal Paired Associates II, SS)	5.17 (2.95)	7.14 (2.82)	6.43 (2.44)	1.71	2,37	0.20
WMS-III Faces I, SS)	8.00 (3.33)	8.00 (3.34)	8.29 (2.64)	0.34	2,36	0.96
WMS-III Faces II, SS)	8.33 (3.71)	7.77 (2.92)	8.50 (3.63)	0.16	2,36	0.85
Executive function						
WAIS-III Similarities, SS)	7.15 (2.34)	6.86 (2.39)	7.93 (3.05)	0.62	2,38	0.54
COWAT, total words	18.08 (10.02)	30.14 (8.87)	28.79 (12.95)	4.97	2,38	0.01[a]
WCST, no. categories	4.67 (1.30)	4.92 (2.02)	4.57 (2.03)	0.13	2,36	0.89
Trails Test, A/B, s	45 (0.17)	42 (0.11)	45 (0.10)	0.22	2,37	0.81
Cognitive-linguistic function						
SCATBI, SS	97.00 (14.21)	103.20 (13.21)	102.67 (14.36)	0.87	2,41	0.43

[a]Chi square statistic reported.
JOINT: communication partner training group; TBI SOLO: individual treatment training group; CONTROL: control group; df: degrees of freedom; TPO: time post onset; PTA: post-traumatic amnesia; ECP: everyday communication partner; WAIS-III: Wechsler Adult Intelligence Scale, 3rd Edition; WMS-III: Wechsler Memory Scale, 3rd Edition; COWAT: Controlled Oral Word Association Test; SCATBI: Scales of Cognitive Ability for Traumatic Brain Injury; SS: standard score; SD: standard deviation.

the study and those of participants who completed the study, and no significant differences were found. No significant differences were found between the groups on measures of working memory, processing speed and cognitive linguistic functioning. However, the JOINT group scored poorly on one measure of new learning (WMS Logical Memory II) and on one measure of executive functioning (COWAT), although they were similar to the other groups on all other measures of new learning and executive functioning (Table II).

Analysis of treatment effects
Mean scores for the 3 groups at pre-test, post-test and follow-up on primary and secondary outcome variables and inferential statistics for the planned contrasts are summarized in Table III.

Table II. *Outcome measures at baseline for all participants*

Outcome measures	JOINT ($n=14$) Mean (SD)	TBI SOLO ($n=15$) Mean (SD)	CTRL ($n=15$) Mean (SD)	F	df	*p*-value
Primary outcome measures						
MPC Interaction CC	2.18 (0.61)	2.27 (0.65)	2.37 (0.79)	0.27	2,41	0.76
MPC Transaction CC	2.07 (0.62)	2.30 (0.70)	2.27 (0.59)	0.53	2,41	0.59
Secondary outcome measures						
MSC Acknowledge CC	1.89 (0.53)	2.27 (0.65)	2.17 (0.77)	1.24	2,41	0.30
MSC Reveal CC	1.88 (0.42)	1.98 (0.55)	1.96 (0.57)	0.14	2,41	0.87
MPC Interaction PC	1.89 (0.53)	2.13 (0.58)	2.17 (0.62)	0.96	2,41	0.39
MPC Transaction PC	1.96 (0.63)	2.10 (0.63)	2.30 (0.62)	1.05	2,41	0.36
MSC Acknowledge PC	1.89 (0.53)	2.27 (0.65)	2.17 (0.77)	0.28	2,41	0.76
MSC Reveal PC	2.14 (0.63)	2.33 (0.70)	2.20 (0.77)	0.05	2,41	0.95

JOINT: communication partner training group; TBI SOLO: individual treatment training group; CONTROL: control group; df: degrees of freedom; MPC: Adapted Measure of Participation in Conversation; MSC: Adapted Measure of Support in Conversation; CC: Casual Conversation; PC: Purposeful Conversation; SD: standard deviation.

Table III. Mean scores (and standard deviations; SDs) at pre-treatment, post treatment and six month follow-up on primary and secondary outcome measures

	Pre treatment			Post treatment			Treatment effect (group × time)				6 month follow-up			Treatment effect (group × time)			
	JOINT Mean (SD)	TBI SOLO Mean (SD)	CONTROL Mean (SD)	JOINT Mean (SD)	TBI SOLO Mean (SD)	CONTROL Mean (SD)	F	df	p	es	JOINT Mean (SD)	TBI SOLO Mean (SD)	CONTROL Mean (SD)	F	df	p	es
Primary outcome measures																	
MPC Interaction CC	2.18 (0.61)	2.27 (0.65)	2.37 (0.79)	2.77 (0.56)	2.50 (0.48)	2.39 (0.66)	3.78	2,38	0.03	0.17	2.58 (0.67)	2.31 (0.69)	2.59 (0.49)	0.76	2,34	0.48	0.04
MPC Transaction CC	2.07 (0.62)	2.30 (0.70)	2.27 (0.59)	2.65 (0.38)	2.32 (0.54)	2.25 (0.67)	5.64	2,38	0.007	0.23	2.50 (0.58)	2.31 (0.56)	2.55 (0.47)	1.36	2,34	0.27	0.07
Secondary outcome measures																	
MSC Acknowledge CC	1.89 (0.53)	2.27 (0.65)	2.17 (0.77)	2.69 (0.52)	2.21 (0.64)	2.11 (0.63)	8.61	2,38	0.001	0.31	2.54 (0.59)	2.19 (0.66)	2.41 (0.44)	1.50	2,34	1.56	0.22
MSC Reveal CC	1.88 (0.42)	1.98 (0.55)	1.96 (0.57)	2.45 (0.49)	1.99 (0.53)	1.94 (0.46)	6.5	2,38	0.004	0.26	2.30 (0.53)	2.01 (0.52)	2.18 (0.44)	0.87	2,34	0.43	0.05
MPC Interaction PC	1.89 (0.53)	2.13 (0.58)	2.17 (0.62)	2.58 (0.34)	2.29 (0.80)	2.29 (0.51)	4.01	2,38	0.03	0.17	2.35 (0.38)	2.42 (0.57)	2.18 (0.46)	0.98	2,34	0.39	0.05
MPC Transaction PC	1.96 (0.63)	2.10 (0.63)	2.30 (0.62)	2.58 (0.28)	2.11 (0.74)	2.21 (0.47)	5.44	2,38	0.008	0.22	2.35 (0.52)	2.39 (0.51)	2.05 (0.47)	2.48	2,34	0.10	0.13
MSC Acknowledge PC	1.89 (0.53)	2.27 (0.65)	2.17 (0.77)	2.65 (0.38)	2.42 (0.70)	2.29 (0.54)	1.86	2,38	0.09	0.12	2.54 (0.52)	2.31 (0.60)	2.27 (0.65)	0.18	2,34	0.84	0.01
MSC Reveal PC	2.14 (0.63)	2.33 (0.70)	2.20 (0.77)	2.42 (0.42)	2.02 (0.69)	2.05 (0.54)	1.86	2,38	0.06	0.14	2.36 (0.53)	2.14 (0.53)	2.08 (0.62)	0.10	2,34	0.84	0.01

Scores in Post-Treatment columns represent Pre-Treatment minus Post-Treatment scores, scores in Follow-up columns represent Post-Treatment minus Follow-up scores. Positive scores indicate improvement over time.

CTRL: Control group; MPC: Adapted Measure of Participation in Conversation; MSC: Adapted Measure of Support in Conversation; CC: Casual Conversation; PC: Purposeful Conversation; df: degrees of freedom; Es: effect size.

There was a significant treatment effect from pre- to post-test for conversational skill as measured by the MPC Interaction and Transaction scales in both casual (CC) and purposeful (PC) conversations. Post hoc testing using the differences between pre-treatment and post-treatment scores showed that the JOINT group had greater gains compared to the CONTROL group for both conversation types for Interaction (CC: $p = 0.01$, PC: 0.03) and Transaction scores (CC: $p = 0.003$, PC: $p = 0.008$). The JOINT group also made increased gains compared to the TBI SOLO group for Transaction scores in both conditions (CC: $p = 0.02$, PC: $p = 0.01$) and the Interaction score in the PC condition ($p = 0.03$). There were no significant differences between the TBI SOLO and CONTROL groups on the MPC scales.

There were also significant treatment effects for the secondary outcome measures from pre- to post-test. For the casual conversations, there was a significant treatment effect for all secondary outcome variables. Post hoc testing on the secondary outcome variables with significant treatment effects for casual conversation indicated that all comparisons between the JOINT and CONTROL groups were significant, and all comparisons between the TBI SOLO and CONTROL groups were not significant. For the purposeful conversations, there were also significant treatment effects for most secondary outcome variables, with the exceptions of the MSC Acknowledge Competence, and MSC Reveal Competence. These results approached but did not reach significance. All post hoc comparisons on the secondary outcome variables with significant treatment effects for purposeful conversations were in favour of the JOINT group.

We were also interested in comparing data between the post-test and 6 month follow-up testing occasions to determine whether gains were maintained over time after the training program had been completed. There were no significant interactions found for most outcome variables, indicating the training groups generally maintained their post-treatment performance and did not revert to pre-intervention levels.

DISCUSSION

Training communication partners was more efficacious in improving the everyday interactions of people with TBI than training the person with TBI alone. The JOINT training mode had a significant effect on the interaction and transaction of information, as demonstrated objectively on the blinded Adapted MPC ratings post-training. In contrast, the TBI SOLO training did not produce a signficant effect in the blinded MPC ratings. Furthermore, results on the secondary outcome measures supported the efficacy of the JOINT training mode over the TBI SOLO training and CONTROL conditions. The JOINT group had significant improvements in terms of the ability of the communication partner to acknowledge and reveal the competence of the person with TBI, and the quality of the interaction as a whole.

The lack of improvement for the TBI SOLO group was disappointing however, these results may be explained by a number of factors. The participants in this study had all sustained a

severe TBI and were in the chronic stages of recovery. Difficulties with new learning, memory and executive functioning may have precluded benefits from the training. The advantage for the JOINT group was that the training was also being given to the communication partners, who were cognitively intact. Thus, one of the pair would remember the content of the training, and put this into practice between sessions. Unfortunately, the TBI SOLO group did not complete homework tasks and therefore did not practice to the same extent as the JOINT group, even though they were offered the same amount of homework. Possibly, the principles of experience dependent neuroplasticity, such as repetition and specificity of practice, were assisting with the acquisition of new skills for JOINT participants (28). Additional strategies to assist with compliance with homework tasks for those without communication partners could include reminders to complete homework using telephone messaging systems, additional Skype booster sessions during the week or the use of volunteers to facilitate practice.

The success of training communication partners may be related to several factors. The principles espoused by Ylvisaker et al. (13) were instrumental in changing interaction styles, including the importance of communication as a collaborative and elaborative process. Training communication partners to reveal competence in the other speaker was also critical to the program's success. Most partners were wives and mothers who had taken on a different communication style following their husband or son's injury, which was often deterimental to the person with TBI's everyday interactions. Sensitively targeting these behaviours such as reducing the partner's use of test questions and reducing the occasions where they spoke on behalf of the person with TBI led to a significant change in everyday interactions. Additionally, the JOINT group completed a substantially increased amount of practice at home compared to the TBI SOLO group due to their partner's involvement. Interviews with participants provided information about other important factors which were they perceived were critical to the program's success (29). The participants identified the course content, individualised goal setting, the combination of group and individual sessions and the focus on developing self-monitoring skills as contributors to the positive outcomes. Furthermore, participants in the JOINT group endorsed the value of the communication partner's involvement in the training. Communication partner training may be considered within the ICF framework to be an environmental facilitator within the participation level of functioning (30). As such, this intervention study created environmental facilitators to enable the expanded performance of communication during one of the most common activities of daily living for people with TBI, which is having a conversation with family members (31).

The communication partners in the JOINT group had a very important role in the success of the program, however, it was not an easy task for them to facilitate improved communication across all types of conversations. Post-treatment the partners were better in acknowledging and revealing the competence of the person with TBI (as measured by the MSC) in casual conversations, but not in the purposeful conversations. Casual conversations were possibly more successful because this genre would be a regular part of participants' daily lives and therefore more frequently practised. In support of this notion, Larkins et al. (31) found that everyday conversation was the most common communication activity for people with TBI. The purposeful conversations required a specific outcome possibly representing a more complex cognitive task. A key barrier to implementing *TBI Express* is that many people with TBI do not have a communication partner available to attend an intensive training program. In this study, randomisation was not possible due to an inadequate number of participants with communication partners who could attend training. With allocation to groups on the basis of communication partner availability, we found that the JOINT group tended to be composed of participants with TBI who had highly committed family members or carers who were willing to attend the training. In the JOINT group, significantly more communication partners lived with the person with TBI than in the TBI SOLO and CONTROL groups, and this may have had some influence on the outcomes of this study. Future research could determine modifications of the approach which could make the training more accessible to communication partners who do not live with the person with TBI or who are unable to attend a course during regular working hours.

It is noteworthy that the JOINT group maintained their improved communication skills 6 months after completion of the program, with no significant interactions observed on the primary and secondary outcome measures analysed using repeated measures. This is similar to Dahlberg et al. (11), who reported their participants maintained gains in communication skills up to 9 months post-intervention, and made further progress on goal attainment scaling measures. The results of this study provide further evidence for the durability of treatment effects after social communication skills training for people with TBI.

This is one of the first studies to use the Adapted Kagan scales as a primary outcome measure for a conversational skills training program for people with TBI. A recent study by our team has also successfully used these scales to evaluate a communication training program for paid carers (32). The advantage of these scales is the opportunity to focus on the contributions of BOTH participants to the interaction. The scales were reliable and sensitive to change as a result of the training. Recently, the Adapted scales were further adapted by Swedish researchers with a minor change to the wording of the rating anchors (33). They reported the Adapted Kagan scales were a useful quantitative measure of the interactional and transactional components of conversation and more time efficient compared to Conversational Analysis.

Study limitations

Limitations included the small sample size, which was partly due to the specific inclusion criteria required for participation in this trial (i.e. having a communication partner available to attend assessments and training). This limited the available pool of participants and made it impossible to run the study as a randomized controlled trial, as initially planned. Non-

randomized allocation to groups limits the validity and generalisability of the findings, as the groups were not equivalent across all measures. Future research using a randomized design would strengthen the positive results of this study.

Conclusions

This study represents an important step forward in investigating interventions for social communication impairment following TBI. To our knowledge this is the first study to examine the effectiveness of everyday communication partner training for people with TBI. The positive findings of this study, alongside other group trials of social communication skills training indicate that social communication impairments after TBI are amenable to intervention. Further support is offered for the efficacy of training the person with TBI alone, but the data suggests that greater gains can be achieved by involving communication partners. Improved communication skills were maintained after training, with ongoing improvements in the period after training being recognised by participants on self-report measures. Although significant and durable improvements in communication skills occurred, the intensive attendance requirements may unfortunately restrict many people with TBI and their communication partners from participating. Future research may investigate adaptations of the training program which are more accessible for communication partners, such as the use of telehealth.

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APPENDIX I. Traumatic brain injury Express training overview

Session	Session title	Description
1	Introduction	Introductory session where the purpose of training, group guidelines and home practice expectations are established and members introduced to each other and clinicians.
2	Brain injury and communication	An educational component on TBI and communication including how cognitive, physical and behavioural symptoms may impact on communication using video case studies
3	Effective communication 1	Explores the forms and purposes of communication, different contexts and communication structures used in each context, different roles in communication and how communication role affects outcomes of interactions.
4	Effective communication 2	Extends Session 3 and examines general communication facilitation strategies, and explores barriers and facilitators to good communication in everyday life.
5	Collaboration (titled 'Starting and Participating in Conversations' for the TBI SOLO group)	Focuses on techniques that help conversations to be a collaborative, more equal and organized process. For the JOINT group, it also helps communication partners provide structure and support to the person with TBI for their conversations.
6	Elaboration (titled 'Extending Conversations' for the TBI SOLO group)	Focuses on the concept of keeping conversations going' by exploring techniques that help to organise and link topics, with use of both questions and comments. For the JOINT group, this session assists communication partners to scaffold conversations for the person with TBI without taking over the conversation.
7	Asking questions	Explores the use of appropriate and helpful questions to start and keep conversations going. For the communication partners in the JOINT group, this session also suggests how to avoid negative, or 'testing' questions and instead focus on a positive questioning style.
8–10	Improving skill and confidence	Revises the information and practises each technique learnt in previous sessions with actual conversations. Session 10 also celebrates group member's achievements and outcomes with a group lunch.

TBI: traumatic brain injury; TBI SOLO: individual treatment training group; JOINT: communication partner training group.