Running head: Social communication difficulties in TBI

Title: A systematic review of behavioural interventions targeting social communication difficulties following traumatic brain injury.

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Abstract

Objective: To determine whether behavioural interventions are beneficial for adults with social communication difficulties following Traumatic Brain Injury (TBI).

Data sources: Electronic databases were searched through 2013 to find behavioural intervention trials. Key words used in our search were: *intervention, therapy, treatment, and program* combined with *pragmatic disorder, pragmatic impairment, social communication disorder/impairment, conversation disorder/impairment, social disorder/impairment, cognitive-linguistic and cognitive-communication deficit; adult; and traumatic brain injury, head injury and brain injury*. Hand searches of the reference lists of relevant papers were also conducted.

Study selection: To be selected for detailed review, papers found in the initial search were assessed by two reviewers and had to meet the following criteria: (1) population (adults with TBI), (2) intervention (behavioural intervention) and (3) outcomes (changes in social communication). Papers needed to describe interventions that were delivered directly to adults with TBI with or without other people (such as significant others) involved. Of the 2181 articles initially identified, 15 were selected for detailed review.

Data synthesis: Of the 15 publications that met the study criteria, seven were single case design studies, three were randomised control trials (RCT), one was a non-randomised control trial (nRCT) and four were cohort studies. The methodological qualities of eligible papers were examined using the PEDro and SCED rating scales. The interventions described in the studies fell into two broad categories: those addressing a specific impairment in social communication, and context-specific interventions with a holistic focus on social communication skills. Studies using context-sensitive approaches had been published more recently and were generally group studies with higher methodological quality.

Conclusions: Overall interventions addressing social communication skills for people with TBI were found to be beneficial irrespective of treatment approach utilised. While the evidence base is small and with varying levels of scientific rigour, there is a body of quality evidence that supports the use of context-sensitive approaches. Further research is still required to determine the role of impairment-specific versus context-specific interventions when treating individuals with social communication skills after TBI to inform clinical decision-making.

Key words: Social communication difficulties; Traumatic brain injury; Behavioural interventions; Review literature; Rehabilitation.

PROSPERO registration number: CRD 42013006484

Abbreviations:

TBI = Traumatic Brain Injury

SCED = Single Case Experimental Design

PEDro = Physiotherapy Evidence Database

RCT = Randomised Control Trial

nRCT = Non Randomised Control Trial

PDA = Personal Digital Assistant

CBT = Cognitive Behaviour Therapy

A systematic review of behavioural interventions targeting social communication difficulties following Traumatic Brain Injury.

Traumatic Brain Injury (TBI) is a leading cause of death and disability, with 1.7 million cases per year occurring in the United States alone.¹ The social and economic implications for individuals who have sustained a TBI can be far-reaching. Young adult males, including late adolescents, are at a higher risk of experiencing a TBI than any other age group. Interestingly there has been a recent trend within the TBI population towards a bimodal distribution, with increasing numbers of individuals over the age of 75 also experiencing TBIs as a result of falls.¹ While TBI has a pervasive impact on all survivors, onset in early adulthood coincides with individuals establishing careers and long-term relationships, and can have enduring negative effects to their future endeavours and life path.

One of the most pervasive and detrimental consequences of TBI is social communication skills impairment. An individual's social communication skills have been described as the amalgamation of verbal and nonverbal skills that enable them to express themselves and understand the meanings intended by others in a diverse array of environments and with varying communication partners.² Effective social communication requires a complex interplay of cognitive skills, self-monitoring of verbal output, and familiarity with social conventions and boundaries, in addition to successful emotional self-regulation.³

Difficulties with social communication skills have been linked to difficulties with participation in social interactions resulting in negative self-concept, depression, loneliness, and ultimately social withdrawal.⁴ Indeed, research has indicated that individuals who have sustained a TBI frequently experience relationship breakdowns, difficulties obtaining and maintaining employment, fewer friendships and social contacts, and reduced participation in leisure activities.^{5,6} These negative psychosocial outcomes have been found to persist 10 to

20 years following TBI,⁵ and unless addressed these deficits are likely to persist throughout the lifetime.

Given the persisting negative psychosocial implications of social communication impairments in TBI, a number of studies have trialled intervention programs to remediate these skills. Broadly, these intervention programs have targeted areas such as general conversation skills including listening, starting and maintaining conversations, assertiveness;^{3,7} communication partner training;⁸ verbosity;⁹ as well as interpretations of emotions and social inferences.¹⁰ The types of interventions trialled have varied in their delivery (i.e., group versus individual), intensity, the type of feedback and reinforcement schedule used, as well as consideration of the need for self-awareness prior to treatment. An international expert panel consisting of researchers and clinicians (INCOG) have recently highlighted the importance of each of these factors when providing treatment to individuals who have sustained a TBI.¹¹ In particular the panel outlined the importance of person-centred treatment which is individualised, as well as encouraged group treatment service delivery for social communication remediation.¹¹

To date, intervention programs trialled to remediate social communication skills have varied in focus from specific impairments impacting social communication to those with a holistic viewpoint or context-sensitive approach. Ylvisaker (2003)³² defined a context-sensitive treatment approach as using one or a combination of impairment-based interventions, functional activities, and context-supported participation to enable the individual to participate in their desired everyday activities. This contrasts with the more traditional impairment-specific approach that focuses solely on restoring a specific damaged cognitive function.¹² Specific targets for an impairment-specific therapy approach include areas such as emotion perception, verbal interaction skills and negative social behaviours.

The complexity of social communication and its component parts is reflected in the literature documenting intervention programs with multiple health profession groups and / or a multidisciplinary approach involved in the research. For instance, intervention studies have been conducted by Speech-Language Pathologists, Occupational Therapists and Neuropsychologists. The degree to which each of these health disciplines are involved in rehabilitation programs may influence the focus of each program. This may partially explain the breadth of social communication remediation programs available and the equally varied number of outcome measures used to evaluate the programs. In order to determine whether behavioural interventions are effective, specific components of these treatments need to be examined. For the purpose of this paper the following treatment components will be explored: treatment design, participant variables, treatment approach and intensity, outcome measures and ongoing maintenance.

Four literature reviews have previously collated the findings of cognitive behavioural interventions for individuals with TBI.^{4,13-15} However the current paper is the only systematic review, that the authors are aware of, that has reviewed the literature with a specific focus on social communication. Three reviews within this field conducted by Cicerone and colleagues,¹³⁻¹⁵ had a broad acquired brain injury (ABI) focus, with participants more likely to have experienced a stroke than TBI. As mentioned above these reviews had a broad focus on cognitive rehabilitation rather than social communication specifically and did not include studies beyond 2008. The final review by Ylvisaker and colleagues⁴ focused on interventions for behavioural self-regulation and social interactive disorders in people with TBI; however, their review did not include studies beyond 2005 and included both children and adults. Although, these reviews have previously recommended that the treatment of social communication skills should be a practice standard and that promoting self-regulation and monitoring may be important,¹⁵ there is a need for an updated review that identifies the

key components necessary for successful social communication interventions to guide clinical practice and future research. The current systematic review aimed to outline the current state of evidence for social communication interventions following TBI. To assist clinicians interpret the evidence presented in the reviewed studies, each of the articles were classified according to whether they investigated context-sensitive or impairment-specific interventions, giving rise to the following overarching clinical questions:

1. What are the effects of context-sensitive communication treatments on social communication skill outcomes for individuals with TBI?
2. What are the effects of impairment-specific communication treatments on social communication skill outcomes for individuals with TBI?

METHOD

Study Identification and Selection

Electronic databases (PubMed, EMBASE, Cochrane library, CINHALL, psycINFO) were searched for papers in English that were published in peer-reviewed journals up until October 2013. The following keywords were used: intervention, therapy, treatment, and program combined with TBI, pragmatic disorder, pragmatic impairment, social communication disorder/impairment, conversation disorder/impairment, social disorder/impairment, cognitive-linguistic and/or cognitive-communication deficit. The filter 'adults' was added to all searches conducted. The reference lists of identified studies and selected review papers were manually searched for additional relevant publications.

The titles and abstracts of papers identified by the initial search strategy were assessed by two reviewers (EF, AC) for the following inclusion criteria: (1) population (adults with TBI), (2) intervention (behavioural intervention) and (3) outcomes (changes in social communication). Papers needed to describe interventions that were directly delivered to

adults with TBI with or without other people (i.e., significant others). When the title or abstract did not clearly indicate whether an article should be included, the article was obtained and read to determine whether it met all three inclusion criteria. Differences of opinion about the suitability of articles were resolved by consensus. The following papers were excluded: (1) review papers and editorials, (2) studies reporting data pertaining to adults with aphasia, and (3) studies reporting social communication outcomes but without a focus on social communication intervention. The reference lists of review articles were hand searched for additional articles.¹³⁻¹⁵ It must be noted that a number of seminal studies listed in the reviews by Cicerone and colleagues¹³⁻¹⁵ were not deemed eligible for inclusion in the review.

In total, 2,181 papers were identified, 27 of which were considered relevant for review after completing the process described above (see Figure 1). Two researchers independently reviewed the full text of the selected papers to determine their suitability for inclusion. After assessing the full text articles 12 articles were rejected based on the above exclusion criteria. Therefore 15 articles were eligible for review.^{3, 7-10, 18-25}

INSERT FIGURE 1 HERE

Quality Assessment

Fifteen papers that met the inclusion criteria were rated for methodological quality with the PEDro or SCED scale where possible. Four papers utilised cohort study designs and therefore did not fit into either a SCED or PEDro format for review, these papers will be reviewed descriptively in the results section of this paper.

The PEDro scale was used to review the methodological quality of randomised and non-randomised control trials (RCT and nRCT). This 11-item scale was used to assess the methodological features of the studies.²⁸ The SCED (single-case experimental design) scale,

also an 11-item scale, was used to assess single-subject design studies.²⁷ For each scale two members of the research team scored methodological features independently as either absent or present. According to the PEDro and SCED guidelines, features 2 through 11 were used for scoring purposes, therefore a score of between 0 and 10 was allocated to PEDro and SCED rated papers. The reliability of total PEDro scores has been shown to be 'fair' to 'good'.²⁸ To improve the reliability of this scale, any disagreement between the two reviewers was resolved by discussion until a consensus was reached.

A summary of the consensus PEDro and SCED ratings for quality of methodology are shown in two modified harvest plots. Harvest plots have been proposed as an ideal method for providing a visual representation of key study characteristics to assist readers to interpret information from systematic reviews, especially when the studies reviewed have varying designs and outcomes.^{29,30} Specifically, harvest plots enable readers to simultaneously view information from multiple studies regarding study design appropriateness, methodological quality and outcome measures.^{29,30} To create the harvest plots, it was necessary to group similar criteria together within each scale (see Table 1). The harvest plot method was initially used by Ogilvie and colleagues²⁹ and more recently by Crowther and colleagues³⁰ and Wall and colleagues.³¹ Modified harvest plots provide a visual display of synthesised evidence, where a lack of comparable studies precludes the traditional use of a harvest plot. Modified harvest plots (as described by Crowther and colleagues³⁰) differ from the original harvest plots proposed by Ogilvie and colleagues²⁹ in areas including the use of stacked bars displaying multiple characteristics (rather than separate bars). Therefore bar height represents methodological quality (rather than the appropriateness of the study design)³⁰. Four of the 15 studies reviewed^{20,21,23,24} were omitted from the modified harvest plots as they could not be rated according to the SCED or PEDro rating scales.

INSERT TABLE 1 HERE

Data Extraction

Heterogeneity in the articles reviewed prohibited a meta-analysis of the data. Therefore, data from the included articles were summarised descriptively in a table and include the 15 reviewed studies' design, treatment (intensity and approach), outcome measures, follow-up and overall results (see Table 2). Articles summarised in table 2 were ordered in terms of research quality. For the purposes of this study the quality of each of the research designs was determined primarily by the NHMRC levels of evidence.²⁶ In this way randomised control trials (RCTs) were considered of highest quality, followed by non-randomised control trials (nRCTs), cohort studies and finally single case designs (SCDs). Where there were multiple studies of the same design type, articles were ranked according to the highest PEDro or SCED scores. Given there was no available tool to rank cohort studies, the level of quality of any cohort studies was determined by considering general aspects of rigour, including each study's description of participants, intervention, outcome measures, and statistical analyses.

RESULTS

Fifteen publications met the study criteria (see Figure 1) and consisted of RCTs (n = 3), a nRCT (n = 1), cohort studies (n = 4), and SCDs (n = 7). The methodological quality of the articles reviewed was examined using PEDro (for RCTs and the nRCT) and SCED (for SCDs). The four cohort studies were unable to be reviewed for methodological quality.

^{20,21,23,24}

INSERT TABLE 2 HERE

PEDro

The PEDro ratings for the three RCTs and one nRCT ranged from 5 to 7 (maximum possible rating = 10) (see Figure 2). Overall, the methodological strengths of the studies lay in the similarity of the intervention groups at baseline, and the reporting of point measures and measures of variability. Additionally, the use of outcome measures and appropriate statistical analysis procedures were relatively strong with two studies achieving 3/3,^{3,8} and one study achieving 2/3.⁷ Overall, areas where study methodological quality could be strengthened were blinding (assessor, therapist, and participant) and participant allocation.

INSERT FIGURE 2 HERE

SCED

The overall SCED ratings for the seven SCDs ranged from 0 to 8 (maximum possible rating = 10) (See Figure 3). The articles with the highest scores were by O'Reilly and colleagues¹⁸ and Brotherton and colleagues.¹⁷ Both studies provided good detail regarding study design and target behaviours. The O'Reilly et al¹⁸ study lacked detail regarding statistical analysis and potential assessor bias, while the study by Brotherton et al¹⁷ lacked detail regarding transferability and statistics. Braunling-McMorrow¹⁶ et al also provided good information about design along with transferability and target behaviours, but provided no evidence of statistical analysis and minimal information about controlling for potential assessor bias. Three studies^{9,21,22} provided detailed descriptions of their study design, however there was minimal evidence of controlling for bias or transferability of findings. Gajar et al²¹ and Giles²² provided information on targeted behaviours and statistical analysis respectively. One study achieved a rating of 0 in all categories.¹⁹

INSERT FIGURE 3 HERE

Data Extraction and Synthesis

Each of the 15 studies reviewed were appraised for their methodological quality and rigour in order to determine their validity within the social communication treatment post TBI body of research. The majority of the studies used group treatment as the primary service delivery model to provide both context-sensitive and impairment-specific therapy.^{3,10,16,18-25} Three of the studies used a combination of group and individual treatment,⁷⁻⁹ and only two studies utilised solely individual treatment for social communication remediation.^{17,22} The intensity of the programs also varied from half an hour per week to four and a half hours of combined therapy, with some studies not reporting treatment session lengths.^{19,21,22} The average length of time the programs were run was 11 weeks (for studies that reported this variable) with one significant outlier being the Goldblum et al²⁵ cohort study which was active over a six year time frame, however the length of time each individual participated varied.

Across the studies, one methodological feature that was lacking was blinding with none of the studies including subject, therapist and assessor blinding. One RCT study had both subject and therapist blinding³ and two RCT studies had participant only blinding.^{7,10} Whilst a lack of blinding in studies which use behavioural intervention programs is often an inherent limitation, it is important to consider the potential implications of this such as assessment and performance bias which may impact research findings. Across the 15 studies there was also limited evidence of maintenance of improvements made with only seven studies completing follow up assessment.^{3,8,17,18,20,24} In addition to this there was also limited detail provided of evidence of participant transfer effect of treatment and generalisation of skills learned. An exception was the study completed by Braunling-McMorrow and colleagues¹⁶ which conducted generalisation tests over 5 mealtimes where participants' interactions were videotaped, transcribed and scored according to the target behaviours.

Participants

The participant characteristics for each of the 15 articles reviewed are outlined in Table 3. The number of participants in the reviewed studies ranged from 1 to 52. The average age of participants ranged from 18-48 years with the majority of participants in all studies being male. Most of the studies included individuals who had sustained a TBI only, however McDonald et al⁷ included participants with other diagnoses (e.g., anoxia) who displayed similar presenting behaviours. The majority of studies (n = 11) primarily included individuals with moderate-severe TBI, however, only 8 studies provided PTA or length of coma data to support injury severity (see table 3). The chronicity of TBI in participants completing social communication interventions varied across studies, with the majority of studies (n=10) having recruited individuals at least 12 months post-TBI.^{3,7,8,10,16-18,20-24} Two studies did not provide information about time post TBI.^{9,25}

Participant exclusion criteria also differed between the studies with some specifically including participants with a history of psychiatric or psychological disorder or substance abuse or additional neurological complications (e.g., stroke, hypoxia) alongside their TBI.²⁰ In contrast, two studies^{3,8} specifically excluded individuals with these co-morbidities, with one study excluding individuals with a recent history of psychosis or severe depression.¹⁰ In addition McDonald et al⁷ excluded individuals diagnosed with a significant aphasia. Brotherton et al¹⁷ excluded individuals with any form of aphasia along with individuals in acute psychologic distress, those exhibiting extreme physical violence, and any individuals unable to follow three stage commands. Four studies did not specify whether co-morbidities resulted in exclusion from the study.^{16,18,19,25} While Kirsch et al⁹ did not state specific exclusion criteria, the authors did report that the single case studied had an extensive history of alcohol abuse.

INSERT TABLE 3 HERE

Interventions and outcomes

Two broad approaches were used to treat social communication skills with individuals post TBI in the reviewed studies. Nine intervention programs utilised a context-sensitive treatment approach^{3,7,8,16,17,20,23-25} whilst the other six studies involved impairment-specific treatment models.^{9,10,18,19,21,22} Table 2 summarises the intervention characteristics of each of the reviewed studies, as well as the outcome variables identified, with a summary of the answers to the clinical questions detailed below.

Clinical question 1: What are the effects of context-sensitive communication treatments on social communication skill outcomes for individuals with TBI?

The nine studies that utilised a context-sensitive approach incorporated a broad array of skills and concepts related to effective social communication delivered predominately in a group setting. The content of the programmes used as well as the constructs and timeframes established varied amongst each of the studies. The overall methodological strength of those context-sensitive studies that were able to be rated was moderate-to-high (PEDro scores 6-8, and SCED scores of 7 and 8) (See Figures 2 and 3). According to PEDro, the relative areas of strength were in the use of outcome measures, similarity of the intervention groups at baseline on key prognostic indicators, and variability, while the primary area of weakness was in patient and assessor blinding. For studies rated according to SCED, key areas of strength lay in descriptions of the study design and target behaviours, with weaknesses noted in the use of statistics to evaluate outcomes. In total of 205 individuals received in interventions using a context-sensitive approach, with participant numbers in individual studies ranging from 3 to 52. Overall, the studies suggested that context-sensitive treatments were beneficial in improving the social communication skills, especially when clinicians presented a manualised program (See Table 2).

Dahlberg et al³ investigated the effects of a broad social skills remediation program within an RCT study design with a treatment and waitlist control group. The intervention adhered to the treatment workbook ‘Social Skills and Traumatic Brain Injury: A Workbook for Group Treatment’, now referred to as ‘Group Interactive Structured Treatment for Social Competence (GIST)’. The key components of the program included self-awareness and self-assessment leading to individual goal setting, groups, social support system, and skill generalisation. Treatment effects were evaluated using a variety of outcome measures with significant improvements in social communication behaviours and satisfaction with life for those who received treatment, with gains maintained at both the three and six month follow up. Changes in social participation levels were not observed as a result of the intervention. Braden et al²⁰ extended their earlier work³ by investigating the treatment effects of the program in a cohort of individuals with TBI plus other diagnoses (e.g., psychiatric disorder, concomitant neurological injuries). As per the original TBI group, the TBI plus participants displayed improved social communication skills on post-treatment measures as well as at 3- and 6-month follow-up.

Two further studies which examined a context-sensitive approach were the RCT completed by McDonald et al⁷ and the nRCT by Togher et al⁸. Both studies incorporated individual and group sessions in their programs. McDonald et al⁷ examined the effects of a three pronged social skills treatment approach compared to placebo and waitlist control groups. The intervention group received manualised group treatment programs for social behaviour and social perception deficits, as well as individual sessions based on cognitive behavioural therapy (CBT) techniques. The placebo group attended group social activities. Outcome measures indicated that participants who received treatment improved significantly in comparison to control groups on specific measures of social behaviour. As with Dahlberg’s³ work, limited generalisation of treatment effects to everyday social functioning

and participation was observed. Togher et al's⁸ study compared the outcomes of training individuals with TBI to communicate more effectively (TBI SOLO) with providing communication partner training involving both the participant post TBI and a frequent communication partner (TBI JOINT). A uniform manualised treatment, 'TBI Express' was used for the group program and individual sessions were tailored specifically for each participant based on personal goals and strategies introduced in group sessions. The treatment was based on the underlying theory that communication involves a set of learned behaviours that are transferrable to different settings, and are influenced by the purpose and participants in an interaction.⁸ The authors reported that the intervention targeting communication partners in conjunction with the individual with TBI was superior to treating individuals with TBI as demonstrated by improved conversational performance, with results maintained at six months post-training.

Three context-sensitive treatment studies used a cohort study design to review their group programmes. Ownsworth et al²⁴ evaluated a group support program designed to improve self-awareness and psychosocial functioning in people with acquired brain injury. A combination of treatment approaches including cognitive-behavioural therapy, cognitive rehabilitation and social skills training were used in the program. Assessment tools indicated that participants displayed significantly improved self-regulation skills and psychosocial functioning post-treatment. Ehrlich and Sipes²³ completed a pragmatic intervention program with four modules designed to target the specific needs of the treatment population (e.g., nonverbal communication, message repair). Treatment effects were measured using a behavioural rating scale adapted from the Pragmatic Protocol assessment tool. All participants showed significant improvements in the areas of pragmatics and linguistic performance on the scale post-treatment. However it was noted by the authors that the scale

was not standardised or evaluated for reliability or validity, and the results were therefore considered exploratory.

Goldblum et al²⁵ was the final cohort study to evaluate a broad spectrum approach to social skills remediation. The researchers reported on a series of conversational groups which were run over a six year period. There was no consistent treatment protocol implemented however the group intervention had a pragmatic skills emphasis. Treatment effects were measured with participant's pragmatic competence noted to plateau over time, however increased self-confidence, assertiveness, acceptance and overall life participation were reported.

Two early context-sensitive treatment studies used a single case design in the 1980s.^{15,17} Braunling-McMorrow and colleagues¹⁶ used a modified version of the social skills program 'Stacking the deck' combined with the board game 'Sorry' to target six social skills areas (complements, social interaction, politeness, criticism, social confrontation, and questions/answers). The researchers observed improved social skills during training and in a natural setting (mealtimes). Brotherton et al's¹⁷ study involved two one hour individual sessions per week which led to improved social skills in 3 out of the 4 participants with generalisation across situations and evidence of maintenance of treatment gains one year later. The structured, clinician presented sessions involved free interaction with two trainers, followed by enactment of 8-10 scenarios, followed by training using verbal instruction, modelling, behaviour rehearsal, videotaped feedback, and social reinforcement.¹⁷

The repeatability of the context-sensitive studies reviewed was considered in the context of replicating programs for both research and clinical purposes. Seven of the studies^{3,8,16,17,20,24} included details to facilitate replicating the treatment. Four of the studies^{3,8,16,20} used published treatment manuals while the others reported specific therapy

and assessment tools used, time frames, and objectives of the study. Two of the context-sensitive cohort studies lacked sufficient detail to be replicable.

Further synthesis of the study outcomes was restricted by the inconsistency amongst the outcome measures used. In part this may have reflected the differences in the theoretical underpinnings of each of the intervention programs. While there was not one specific outcome measure implemented, there were some similarities amongst some of the context-sensitive programs including use of the Social Communication Skills Questionnaire – Adapted (SCSQ-A), Goal Attainment Scaling (GAS), Satisfaction With Life Scale (SWLS), and the LaTrobe Communication Questionnaire (LCQ) (See Table 3). Only the SCSQ-A, GAS and Profile of Functional Impairment in Communication (PFIC) were used as primary outcome measures in more than one study^{3,20}, with statistically significant changes post-intervention were only noted on the SCSQ-A and GAS^{3,20}. Improvements were noted on at least one primary outcome measure for all studies, however, improvements were not always observed on the secondary outcome measures.

Clinical question 2: What are the effects of impairment-specific communication treatments on social communication skill outcomes for individuals with TBI?

The overall methodological strength of the impairment-specific interventions was variable, ranging from very low (SCED score of 0²¹), to medium (PEDro score of 5¹⁰), to high (SCED score of 8¹⁹). Relative strengths were observed in the area of design, with methodological weaknesses tending to occur in the use of statistical analyses of outcomes, and transferability (i.e., replication and generalisation) (See Figures 2 and 3). Participant numbers in the six individual studies ranged from 1-12, with a total number of 19 participants receiving interventions. Overall, the studies suggested that beneficial effects were observed in the

specific skill areas targeted in the majority of participants with generalisation to social communication skills at a broader level usually not examined.

The six impairment-specific interventions reported in the studies reviewed addressed a different aspect of social communication and all but one used a single case design. Bornhofen and McDonald¹⁰ was the only RCT reviewed that investigated the effect of a specific social communication skill intervention; basic emotion perception. A cognitive rehabilitation approach underpinned the intervention incorporating graduated practice of increasingly complex guided tasks relevant to the perception of static and emotional cues. Post-treatment participants demonstrated significant improvements in their ability to judge basic emotional stimuli and social inferences in video-vignettes however without carryover into social functioning.

The remainder of the studies which focused on an impairment-specific communication treatment used a single case design. O'Reilly et al¹⁸ used problem solving interventions to teach specific social skills to two workers with TBIs. The researchers focused on targeting two specific social skills per participant. To evaluate treatment effects, follow-up probes were conducted by the therapist as well as generalisation probes conducted in participants' workplace by observers. All targeted social skills improved and gains were maintained at follow-up. An earlier study by Gajar et al²¹ investigated the effects of feedback on self-monitoring of the conversational behaviours of two individuals with TBI. The outcomes of the intervention were evaluated by recording the percentage of appropriate conversation behaviours displayed by the participants. The researchers reported the participant's conversation skills improved post-treatment. It must be noted however that Gajar et al²¹ examined generalisation of treatment effects in the form of less structured conversations in the same group setting. It is unknown whether similar positive treatment effects were carried over into real life contexts outside of the therapy setting.

The final three reviewed articles were all single participant SCDs. Giles et al²² sought to improve the verbal interaction skills of a person post TBI who used an inappropriate and circumlocutory conversation style. Treatment involved the completion of a variety of tasks from answering closed questions to unstructured conversation. Treatment effects were evaluated using mean number of words per minute during the participant's responses to structured, semi-structured and unstructured questions. There was a significant reduction in the number of words produced per minute across all three question types following treatment. A more recent study by Kirsch et al⁹ examined the use of an assistive-technology intervention to reduce verbosity in a single participant. The web-based intervention consisted of the presentation of a recorded verbal cue to the participant to 'be brief' at 15 minute fixed intervals by a personal digital assistant. Treatment effects were measured using total length of utterance with post-treatment measures indicating utterance frequency remained consistent while utterance length reduced. In neither instance was generalisation beyond the treatment session evaluated.

Lastly, Sladyk¹⁹ reported a unique program whereby remediation of cognitive and behavioural issues were addressed using an interdisciplinary neuro-behavioural approach which was delivered by staff and peers at an inpatient rehabilitation centre. Therapy activities involved small structured groups addressing social skills. There was no formal evaluation of social skills, however the author commented that the participant displayed appropriate social skills with staff, other patients, and visitors following the program.

Similarly to the context-sensitive studies, the impairment-specific articles were appraised in the context of replicating programs for both research and clinical purposes. The RCT study¹⁰ provided adequate information in regards to treatment content and environmental factors to consider repeating the study. However, the remaining impairment-specific cohort and SCD omitted detail in regards to the intervention provided and details of

the environment in which the study took place.^{9,18,19,22} In addition, a theme amongst the majority of the impairment-specific studies was the lack of formal or standardised outcome measures. Instead, the researchers reported use of specific measures such as percentage of conversation behaviours observed and total length of utterance.^{9,18,19,21,22} Additionally, only one study¹⁸ formally evaluated transference into real life environments beyond the treatment setting.

DISCUSSION

The social communication difficulties associated with TBI have the potential for enduring psychosocial effects,⁴⁻⁶ necessitating the identification of effective interventions. This systematic review collated the current evidence to inform best practice in treating social communication skills after TBI, identify the current evidence gaps, and provide direction for future research in this complex area of rehabilitation. Despite the diversity in intervention programs reviewed, common to all studies was that treatment had a beneficial effect on at least one outcome measure. In those studies^{3,7,24} that examined the impact of interventions on broader social participation and function, the findings were equivocal at best. Two RCTs^{3,7} and one cohort study²⁰ evaluating context-specific interventions did not demonstrate superior social functioning immediately post-treatment or at follow-up for people with TBI who received the experimental treatment. However Ownsworth and colleagues' cohort study²⁴ reported positive results in terms of psychosocial function. Although, previous reviews have recommended that the treatment of social communication skills should be a practice standard and that promoting self-regulation and monitoring may be important¹⁵, there was a need to identify the key components necessary for successful social communication interventions. While the current review highlights that either impairment- or context-specific interventions

can positively impact on social communication behaviours in people with TBI, the optimal length of intervention period, delivery mode (group, individual or both), program approach, and methods to achieve generalisation to social functioning and participation requires further investigation.

Clinical Question 1: Context-sensitive communication treatments

Implementation of a context-sensitive treatment approach, whereby multiple communication skills were targeted demonstrated benefits in terms of social behaviours and in some cases the potential to promote generalisation of social communication skills. Togher et al¹¹ (n = 44) highlighted the importance of embedding activities which encourage participation in everyday life, and facilitate practise of a range of skills in a naturalistic setting as part of a rehabilitation program. Positive changes to participants' overall quality of life measures post-treatment were observed in four studies,^{3,19,23,24} (n = 80) with maintenance of improvements evident at follow-up. Whilst long-term effectiveness of each of these intervention was promising it should be noted that only one of the studies used an RCT design. Consistent with the INCOG Recommendations for Management of Cognition Following TBI, the strongest evidence for service delivery models when treating social communication skills was group therapy;¹¹ many of the context-sensitive interventions used group treatment approaches with or without supplementary individual sessions.

Key components of many of the context-sensitive interventions were goal identification and setting, group-based activities with or without individual sessions, homework, and feedback^{3,7,8,20} (n = 165). However it is important to consider the specifics of the various programs and outcome measurement tools used varied significantly across studies. Interestingly studies which used manualised workbooks or programs to guide the content of the treatment were those that reported overall gains in social communication skills

maintained at follow-up^{3, 8, 20} (n = 126). Other studies used a combination of therapeutic approaches both in group and individual sessions.^{7,23,24} For example, McDonald et al⁷ used a combination of manuals which the researchers had previously developed, with tasks tailored specifically for the study's participants in addition to individual Cognitive Behaviour Therapy (CBT) (n = 39). The studies which used a combination of approaches as part of their context-sensitive communication treatment, only reported improvements in specific areas of communication and due to the absence of longitudinal follow-up it was unclear whether the gains made were maintained^{7,23} (n = 45). Goldblum et al²⁵ was of low methodological quality, failing to follow a specific treatment program and the gains reported were based on qualitative observations and reports of improved social communication skills quality of life.

Clinical Question 2: Impairment-specific communication treatments

Studies that targeted impairment-specific treatments all reported improvements for the particular skills addressed. Many of the reported impairment-specific intervention studies were SCDs of varying rigour and included small participant numbers treated either individually or in small groups of two. The RCT conducted undertaken by Bornhofen and McDonald¹⁰ (n = 12) used group therapy to target emotion perception as a component skill of pragmatic abilities commonly impaired in individuals post TBI. The methodological rigour used in this study while only mid-range for an RCT was superior to the other impairment-specific studies and was the only one to use a range of outcome measures and evaluate maintenance. Interestingly the other studies within this subgroup were generally completed much earlier than many of the context-sensitive treatment studies with half of them published in the 1980s and early 1990s. This may reflect a more general trend in cognitive rehabilitation practice after TBI, inclusive of the social communication field, to move away from more traditional impairment based treatment to context-sensitive approaches. Factors which may

have influenced this trend including the widespread use of the World Health Organisation's International Classification of Functioning, Disability and Health (ICF) framework³². This framework acknowledges that 'health' is multifactorial and contextualised by the individual's environment and personal characteristics. Additionally, within the field of rehabilitation the ultimate aim is to increase an individual's participation in life by reducing the impact of impairment and activity restrictions. Whilst the end-point of impairment-specific treatments may be to improve participation, in the field of cognitive rehabilitation after TBI the need to contextualise treatment is well acknowledged and facilitated through context-sensitive treatment approaches.¹¹

The methodological quality of many of the articles reviewed suggested there is room for improvement in designing investigations of impairment-specific treatments, however each study highlighted the potential to improve specific impairments related to social communication functioning in people with TBI. The INCOG Recommendations for Management of Cognition following TBI highlighted the importance of using individualised treatment which incorporates patient-identified goals for social communication deficits.¹¹ Therefore it is important to consider that some individuals post TBI may require impairment-specific treatment prior to or in addition to context-sensitive therapy.

Limitations

Whilst this study aimed to provide a summary of current evidence, both in terms of methodological rigour and treatment content and outcomes in the area of social communication treatment post TBI, there were some limitations to the review. Every effort was made to conduct a comprehensive search of available evidence, however, it is possible that studies may have been missed and hence not included in this systematic review. In addition, the lack of a uniform rating scale for evaluating methodological quality across all

study designs reviewed limited the ability to fully synthesise the studies in terms of methodological rigour. In particular studies reporting on cohort study designs were not able to be rated as thoroughly for methodological quality.

Clinical implications

Overall each of the studies reviewed reported improvements to participants' social communication skills post-treatment, and in some instances these improvements were documented to be maintained up to 6-months post-treatment. Importantly in many cases the participants could be considered as individuals with chronic severe TBI, therefore the potential to improve social communication skills exists well beyond the first few years post-injury. Irrespective of the approach to treatment (impairment-specific or context-sensitive) many of the programs used groups to deliver treatment, even if the group was as small as two people which has implications for clinical TBI service models. While the highest levels of evidence to support practice were found in studies using a context-sensitive approach that were a minimum of 10-weeks long, impairment-specific treatments were also found to improve targeted behaviours. Clinically it should be noted that maintenance of the treatment effect up to 6-months post-treatment was only reported for context-sensitive programs, but the generalisation of improvements to everyday life to improve social participation remains unclear. Individualisation of treatment to meet the goals of the client may require a combination of the two treatment approaches to maximise outcomes, allowing treatment to target an individual's specific impairments whilst giving them opportunities to contextualise communications skills within more naturalistic settings.

Future research

The research to date in the area of social communication remediation has explored a range of different therapy programmes and methods to implement when providing management to

individuals who have sustained a TBI. However these findings have only started to scratch the surface in determining best practice in treating social communication skills in people with TBI. Many of the recent studies in this field^{3,7,8} have applied strong methodological designs, considering the clinical constraints of this population, which should be maintained in future research. The context-sensitive studies in particular reported good social communication outcomes for participants, however further studies with larger population sizes are needed, in addition to identifying the most effective treatment content and delivery format. Particular considerations for research may include comparison of impairment-specific and context-sensitive approaches, or use in combination; and how to ensure transference of improved social communication behaviours to increased social participation.

Conclusions

Remediation of social communication skills in people with TBI, even in the long-term chronic phase can lead to improvements. The review highlights that both context-sensitive and impairment-specific treatment frameworks can be beneficial, but the evidence is greatest to support context-sensitive approaches delivered predominantly in group-based service models. The outcomes obtained from these approaches were maintained in the months after treatment and in some cases evidence was found for enhanced quality of life measures, psychosocial improvements and generalised improvements to communication interactions. Whilst the available evidence suggests social communication skills treatment is beneficial for people with TBI, the need for further high quality studies in this area was also evident.

References

1. Faul M, Corrado V. Epidemiology of traumatic brain injury. P 3-14. Handbook of clinical neurology. Ed Jordan Grafman and Andres M Salazar. 127 3rd series. 2015. Elsevier. Amsterdam: Netherlands.
2. Struchen MA, Davis LC, Bogaards JA, Hudler-Hull T, Clark AN, Mazzei DM et al. Making Connections After Brain Injury: Development and Evaluation of a Social Peer-Mentoring Program for Persons With Traumatic Brain Injury. *Journal of Head Trauma Rehabilitation* 2011;26(1):4-19.
3. Dahlberg CA, Cusick CP, Hawley LA, Newman JK, Morey CE, Harrison-Felix CL, Whiteneck GG. Treatment efficacy of social communication skills training after traumatic brain injury: A randomized treatment and deferred treatment controlled trial. *Archives of Physical Medicine and Rehabilitation* 2007;88(12):1561-73.
4. Ylvisaker M, Adelson PD, Braga LW, Burnett SM, Glang A, Feeney T, Moore W, Rumney P, Todis B. Rehabilitation and ongoing support after pediatric TBI - Twenty years of progress. *Journal of Head Trauma Rehabilitation* 2005;20(1):95-109.
5. Hoofien D, Gilboa A, Vakil E, Donovan PJ. Traumatic brain injury (TBI) 10-20 years later: a comprehensive outcome study of psychiatric symptomatology, cognitive abilities and psychosocial functioning. *Brain Injury* 2001;15(3):189-209.
6. Kersel DA, Marsh NV, Havill JH, Sleigh JW. Psychosocial functioning during the year following severe traumatic brain injury. *Brain Injury* 2001;15(8):683-96.
7. McDonald S, Tate R, Togher L, Bornhofen C, Long E, Gertler P, Bowen R. Social skills treatment for people with severe, chronic acquired brain injuries: A multicenter trial. *Archives of Physical Medicine and Rehabilitation* 2008;89(9):1648-59.
8. Togher L, McDonald S, Tate R, Power E, Rietdijk R. Training communication partners of people with severe traumatic brain injury improves everyday conversations: A multicenter single blind clinical trial. *Journal of Rehabilitation Medicine* 2013;45(7):637-45.
9. Kirsch NL, Shenton M, Spirl E, Simpson R, LoPresti E, Schreckenghost D. An assistive technology intervention for verbose speech after traumatic brain injury - A single case study. *Journal of Head Trauma Rehabilitation* 2004;19(5):366-77.
10. Bornhofen C, McDonald S. Comparing strategies for treating emotion perception deficits in traumatic brain injury. *Journal of Head Trauma Rehabilitation* 2008;23(2):103-15.
11. Togher L, Wiseman-Hakes C, Douglas J, Stergiou-Kita M, Ponsford J, Teasell R, Bayley M, Turkstra LS. INCOG Recommendations for management of cognition following Traumatic Brain Injury, Part IV: Cognitive Communication. *Journal of Head Trauma Rehabilitation* 2014;29(4):353-368.
12. Ylvisaker M. Context-sensitive cognitive rehabilitation after brain injury: Theory and practice. *Brain Impairment* 2003. 4(1):1-16.

13. Cicerone KD, Dahlberg C, Kalmar K, Langenbahn DM, Malec JF, Berquist TF, Felicetti T, Giacino JT, Preston Harley J, Harrington DE, Herzog J, Kneipp S, Laatsch L, Morse PA. Evidence-Based Cognitive Rehabilitation: Recommendations for Clinical Practice. *Archives of Physical Medicine and Rehabilitation* 2000; 81: 1596 - 1614.
14. Cicerone KD, Dahlberg C, Malec JF, Langenbahn DM, Felicetti T, Kneipp S, Ellmo W, Kalmar K, Giacino JT, Preston Harley J, Laatsch L, Morse PA, Catanese J. Evidence-Based Cognitive Rehabilitation: Updated Review of the Literature From 1998 Through 2002 *Archives of Physical Medicine and Rehabilitation* 2005; 86: 1681 -1692.
15. Cicerone KD, Langenbahn DM, Braden C, Malec JF, Kalmar K, Fraas M, Felicetti T, Laatsch L, Preston Harley J, Berquist TF, Azulay J, Cantor J, Ashman T. Evidence-Based Cognitive Rehabilitation: Updated Review of the Literature From 2003 Through 2008. *Archives of Physical Medicine and Rehabilitation* 2011; 92: 519 -530.
16. Braunling-McMorrow. Braunling-McMorrow D, Lloyd K, Fralish K. Teaching social skills to head injured adults. *Journal of Rehabilitation* 1986;.52(1): 39-44.
17. Brotherton FA, Thomas LL, Wisotzek IE, Milan MA. Social skills training in the rehabilitation of patients with traumatic closed head injury. *Archives of physical medicine and rehabilitation* 1988. 69(10): 827-832.
18. O'Reilly MF, Lancioni GE, O'Kane N. Using a problem-solving approach to teach social skills to workers with brain injuries in supported employment settings. *Journal of Vocational Rehabilitation* 2000;14:187-94.
19. Sladyk K. Traumatic brain injury, behavioral-disorder, and group treatment. *American Journal of Occupational Therapy* 1992;46(3):267-70.
20. Braden C, Hawley L, Newman J, Morey C, Gerber D, Harrison-Felix C. Social communication skills group treatment: A feasibility study for persons with traumatic brain injury and comorbid conditions. *Brain Injury* 2010;24(11):1298-310.
21. Gajar A, Schloss PJ, Schloss CN, Thompson CK. Effects of feedback and self monitoring on head trauma youths' conversation skills. *Journal of Applied Behavior Analysis* 1984;17(3):353-358.
22. Giles GM, Fussey I, Burgess P. The behavioural treatment of verbal interaction skills following severe head injury: a single case study. *Brain Injury* 1988;2(1): 75-79.
23. Ehrlich JS, Sipes AL. Group treatment of communication skills for head trauma patients. *Cognitive Rehabilitation* 1985; 3(1): 32-37.
24. Ownsworth TL, McFarland K, Mc Young RD. Self awareness and psychosocial functioning following acquired brain injury: An evaluation of a group support programme. *Neuropsychological Rehabilitation* 2000; 10(5): 465-484. doi:10.1080/09602010050143559

25. Goldblum, G., Mulder, M., & von Gruenewaldt, A. An examination of the impact of participation in a conversation group for individuals with a closed head injury. *South Africa Journal of Communication Disorders* 2001;48, 3-20.
26. National Health and Medical Research Council (NHMRC). NHMRC additional levels of evidence and grades for recommendations for developers of guidelines. 2009. Canberra: National Health and Medical Research Council. Accessed 20 May 2015 from https://www.nhmrc.gov.au/files_nhmrc/file/guidelines/developers/nhmrc_levels_grades_evidence_120423.pdf.
27. Tate RL, McDonald S, Perdices M, Togher L, Schultz R, Savage S. Rating the methodological quality of single subject designs and n-of-1 trials: Introducing the Single-Case Experimental Design (SCED) Scale. *Neuropsychological Rehabilitation: An International Journal* 2008;18(4):385 - 401.
28. Maher CG, Sherrington C, Herbert RD, Moseley AM, Elkins M. Reliability of the PEDro scale for rating quality of randomized controlled trials. *Physical Therapy* 2003;83(8):713-21.
29. Ogilvie D, Fayter D, Petticrew M, Sowden A, Thomas S, Whitehead M, Worthy G. The harvest plot: A method for synthesising evidence about the differential effects of interventions. *Bmc Medical Research Methodology* 2008;8.
30. Crowther M, Avenell A, MacLennan G, Mowatt G. A further use of the harvest plot: A novel method for the presentation of data synthesis. *Research Synthesis Methods* 2011;2:79-83.
31. Wall LR, Ward EC, Cartmill B, Hill AJ. Physiological Changes to the Swallowing Mechanism Following (Chemo) radiotherapy for Head and Neck Cancer: A Systematic Review. *Dysphagia* 2013;28(4):481-93.
32. World Health Organisation (WHO). International Classification of Functioning, Disability and Health (ICF). 2014. Page updated 17 October 2014. Accessed 20 May 2015 from <http://www.who.int/classifications/icf/en/>

734 **FIGURE HEADINGS**

735 **Figure 1: PRISMA flow diagram detailing search strategy and selection criteria**

736 **Figure 2. PEDro data harvest plot**

737 **Figure 3. SCED data harvest plot**

Table 1. PEDro and SCED ratings

Condensed category	PEDro item	Condensed category	SCED item
Participant	2 Random allocation	Target behavior	2 Target behaviours defined
	3 Concealed allocation		
Intervention	4 Prognostic similarity between intervention groups at baseline	Design	3 A-B-A or multiple baseline design used
			4 Sufficient baseline sampling was conducted
			5 Sufficient sampling was conducted in the treatment phase
			6 Raw data points were reported
Blinding	5 Subject blinding	Bias	7 Inter-rater reliability was established for one target behaviour
	6 Therapist blinding		8 Independent assessors
	7 Assessor blinding		9 Statistical analysis
Outcomes	8 Greater than 85% of subjects were followed-up for at least one outcome	Statistics	
	9 Intention-to-treat analysis		
	10 Between-group statistical analysis for at least one key outcome		
Variability	11 Point estimates of variability provided for at least one key outcome	Transferability	10 Replication
			11 Generalisation

Authors	Design	Intensity	Treatment Approach	Outcome measures	Follow-up	Results
Dahlberg et al ³	RCT	1 x 1.5 hour group sessions per week for 12 weeks	Context-sensitive, clinician presented, manualised = Group Interactive Structured Treatment for Social Skills (GIST)	PFIC, SCSQ-A, GAS, CHART - SF, CIQ, SWLS	3, 6 and 9 months	Significant improvement in PFIC and SCSQ-A post-treatment. At 3 and 6 month follow-up, significant improvements on PFIC, SCSQ-A, GAS and SWLS.
McDonald et al ⁷	RCT	1 x 3 hour group session and 1 x 1 hour individual session per week for 12 weeks	Context-sensitive, clinician presented, manualised = program focused on social behaviour, social perception, emotional adjustment and individual goals.	BRISS-R, TASIT, DASS, Katz Adjustment Scale – R1, SPSS, LCQ, SPRS – relative and self	Nil	Improvement noted post-program only on BRISS-R.
Togher et al ⁸	nRCT	1 x 2.5 hour group sessions and 1 x 1 hour individual session per week for 10 weeks	Context-sensitive, clinician presented, manualised = TBI express.	Adapted measure of participation in conversations and adapted measure of support in conversations	6 months	Communication partner training improved performance on the adapted measures of participation and support compared to the TBI SOLO and control groups. Results were maintained 6 months post-training.
Bornhofen & McDonald ¹⁰	RCT	2 x 1.5 hour group sessions per week for 8 weeks	Impairment-specific, clinician presented, manualised program targeting emotion perception using a variety of tasks with static and dynamic emotion cues and making social inferences.	The facial expression naming test, The facial expression matching task, TASIT (parts I – III), SPRS – self	1 month	Significantly improved ability to judge basic emotional stimuli and make social inferences post-program.
Owensworth et al ²⁴	Cohort	1 x 1.5 hour group sessions per week for 16 weeks	Context-sensitive, clinician presented, unstructured group program involving cognitive rehabilitation, cognitive-behaviour therapy, and social skills training.	SADI, HIBS, SRSI and SIP	6 months	Improved self-regulation skills and psychosocial functioning at post-treatment and follow up.
Braden et al ²⁰	Cohort	1 x 1.5 hour group sessions per week for 13 weeks	Context-sensitive, clinician presented, manualised = GIST	PPIC, SCSQ-A, LCQ, GAS, AQ, SWLS, PART	3 and 6 months	Statistically significant improvement on SCSQ-A, LCQ, GAS and SWLS post-treatment and at follow-up. Non-significant improvement on PPIC. No significant improvement on AQ or PART.
Erlrich & Sipes ²³	Cohort	3 x 1.5 hour group sessions per week for 12 weeks	Context-sensitive, clinician presented unstructured group therapy using modules tailored for the treatment population (e.g. nonverbal communication, message repair).	A behavioural rating scale adapted from the Pragmatic Protocol (not standardised or evaluated for	Nil	All participants demonstrated improvements on the scale post-treatment.

			Intervention included evaluation and feedback, role modelling, videotaping, verbal and gestural cues.	reliability/validity).		
Goldblum et al ²⁵	Cohort	1 x ½ hour conversational group sessions per week over a 6 year time frame.	Context-sensitive, clinician presented, unstructured. Intervention had a pragmatic skills emphasis.	Pragmatic protocol, Quality of life scale	Nil	Pragmatic competence plateaued over time. However, increased self-confidence, assertiveness, acceptance and overall life participation were noted.
O'Reilly et al ¹⁸	SCD	2 x 1 hour sessions per week. Period of intervention not specified.	Impairment-specific, clinician presented, unstructured. Two work-related social skills were targeted for each participant including responding to criticism, negotiation and offering assistance.	Social skills task analysis developed by the authors	6 weeks	All targeted social skills improved, gains were maintained at follow-up.
Brotherton et al ¹⁷	SCD	2 x 1 hour individual sessions per week	Context-sensitive, clinician presented. Structured: including enacting 8-10 scenarios, free interaction, and training (using verbal instruction, modelling, behaviour rehearsal, videotaped feedback, social reinforcement)	Rated social behaviours on a 3 point scale	1 year	3 participants had treatment effects with generalisation across situations that was maintained 1 year later
Braunling-McMorrow et al ¹⁶	SCD	2-3 group sessions per week for 30 – 60 mins	Context-sensitive, clinician presented. Modified version of “Stacking the deck” combined with the board game “Sorry.” Targeted 6 social skills areas (complements, social interaction, politeness, criticism, social confrontation, questions/answers).	Percentage of correct responses to social situations	Generalisation measures 12 days after training ceased	Improved social skills observed during training and in a natural setting
Gajar et al ²¹	SCD	20 sessions (details not reported)	Impairment-specific, clinician presented, structured. Program involved a training session, feedback (including visual cues to assist with interpreting feedback) and self monitoring.	The percentage of appropriate conversation behaviours displayed by the participants	Nil	Positive effect for both feedback and self-monitoring of both participants
Giles et al ²²	SCD	5 x half hour individual sessions per week for 4 weeks	Impairment-specific, clinician presented, unstructured. Individually tailored program- three tasks completed each session including: 1) questions requiring one word answers, 2) closed questions 3)	Mean number of words per minute during the participant's responses to structured, semi-structured and unstructured questions	Nil	There was a significant reduction in the number of words per minute across all three question types following treatment.

			unstructured conversation. Positive and negative reinforcement given.			
Kirsch et al ⁹	SCD	5 weeks of intervention, followed by 7 weeks of withdrawn intervention, then 6 weeks of intervention.	Impairment-specific, computerised, assistive technology was used to target participant's verbosity.	Total length of utterance	Nil	Utterance frequency did not change but utterance length was reduced through the use of assistive technology.
Sladyk ¹⁹	SCD	2 daily team meetings (length not specified) Group sessions 3 times weekly for 58 days.	Impairment-specific, clinician presented, unstructured. Daily meetings with staff and patients to review behaviour expectations, along with a daily feedback review meeting.	No formal evaluation of social skills	Nil formal follow up	The author commented that the participant displayed appropriate social skills with staff, other patients, and visitors following the program.

Table 2. Extracted data

Note. RCT = randomised controlled trial; nRCT = non-randomised controlled trial; SCD = single case design; N = number of participants included in the trial; TASIT = The Awareness of Social Inferences Test; SPRS = Sydney Psychosocial Reintegration Scale; BRISS-R = Behaviourally Referenced Rating System of Intermediary Social Skills – Revised; DASS = Depression Anxiety and Stress Scale; LCQ = La Trobe Communication Questionnaire; PPIC = Profile of Pragmatic Impairment in Communication; PFIC = Profile of Functional Impairment in Communication (please note that this is the same measure as the PPIC); SCSQ-A = Social Communication Skills Questionnaire – Adapted; GAS = Goal Attainment Scaling; CHART – SF = Craig Handicap Assessment and Reporting Technique – Short form social integration and productivity subscales; AQ = Awareness Questionnaire; SWLS = Satisfaction With Life Scales; PART = Participation Assessment with Recombined Tools; GIST = Group Interactive Structured Treatment for Social Competence : orientation meeting, skills of good communicators, self awareness and goal setting, keeping conversations going and using feedback, assertiveness and problem solving practise in the community, social confidence through positive self talk, social boundaries, video taping, video review, conflict resolution, closure and celebration; CIQ = Community Integration Questionnaire; * only 6 participants attended the group over the 2 year period; Primary outcome measures (as stated in the individual manuscripts) are highlighted in bold font.

Table 3. Participant variables

Study	N	Age in years M (SD)	Education in years M (SD)	Gender (% males)	Aetiology	TPO (SD)	SLP diagnosis / clinical presentation	Severity of TBI	Days in PTA M (SD)
Dahlberg et al ³	52	41.17 (11.59)	NR *	84.60	TBI	9.67 years (5.59)	Impaired social communication skills	Majority reported to be moderate-severe	63.84 (73.86)
McDonald et al ⁷	39	35.03 (11.5)	12.10 (2.77)	72	ABI	3.93 years (NR)	Impaired social communication skills	NR	81.3 (NR)
Togher et al ⁸	44	36.03 (13.2)	12.5 (3.07)	86	TBI	8.60 (6.70) years	Impaired social communication skills	Moderate-severe	83.6 (61.2)
Bornhofen & McDonald ¹⁰	12	35.83 (13.0)	11.1 (1.6)	92	TBI	93.60 months (72.2)	Impaired social communication skills	NR	120.7 (51.7)
Owensworth et al ²⁴	21	33.50 (NR)	NR	71	ABI	8.60 years (range 1-36 years)	Chronic	Severe	NR ⁺
Braden et al ²⁰	30	42.11 (11.97)	NR [§]	70	TBI	7.85 (8.19) years	Impaired social communication skills	NR [#]	59 (45.31)
Erlrich & Sipes ²³	6	24.50 (18-42 year range)	NR [¥]	83	TBI	NR [‡]	Impaired social communication skills	NR	NR
Goldblum et al ²⁵	6	30 (NR) age range 26-35	NR	NR	TBI	NR	Impaired social communication skills	NR	M= 55.5 days (in a coma)

		years							
O'Reilly et al ¹⁸	2	25.20 years	NR	100	TBI	7 years	Impaired social communication skills,	NR	M= 5.5 weeks (in a coma)
Brotheron et al ¹⁷	4	23.50 (3.11)	NR	75.00	TBI	5.75 (2.22)	Impaired social skills	Severe	M = days in coma 18.50 (8.35)
Braunling-McMorrow et al ¹⁶	3	21.67 (4.73)	NR	33.33	TBI	2.67 (1.15)	Impaired social skills	Severe	NR
Gajar et al ²¹	2	22	NR	100	TBI	18 months	Impaired social communication skills	NR	NR
Giles et al ²²	1	27	NR	100	TBI	5 years (approx)	Impaired social communication skills, mild dysarthria	Severe	NR
Kirsch et al ⁹	1	Mid 30s	NR	100	TBI	NR	Mod-severe difficulties with executive reasoning, impaired social communication skills	Moderate-severe	2 weeks (in a coma)
Sladyk ¹⁹	1	48	NR	0	TBI	NR	Poor attention span and insight, impaired social communication skills	NR	5 days (in a coma)

Note. NR = Not reported, *Majority of participants completed some college/Bachelor's degree, ⁺ Duration of loss of consciousness reported – majority severe (>1 week), [§] Majority some college/Bachelor's degree, PTA duration was reported for 11/30 participants, [¥] All had completed high school, [£] All participants at least one year post injury, [#] GCS was reported for 7/30 participants

Figure 1. PRISMA flow diagram detailing search strategy and selection criteria

Note. Numbers in brackets represent the study identification number. [1] = Bornhofen & McDonald¹⁰; [2] = Togher et al⁸; [3] = McDonald et al⁷; [4] = Dahlberg et al³

Figure 2. PEDro harvestplot

Note. Numbers in brackets represent the study identification number. [5] = Kirsch et al⁹; [6] = Sladyk¹⁹; [7] = O'Reilly¹⁸; [8] = Gajar et al²¹; [9] = Giles et al²²; [10] = Braunling-McMorrow et al¹⁶; [11] = Brotherton et al¹⁷

Figure 3. SCED harvestplot

Highlights

- Remediation of social communication skills in people with TBI can be beneficial
- Evidence is greatest for context-sensitive approaches delivered predominantly in group settings
- There is a need for further high quality studies in this area

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A systematic review of behavioural interventions targeting social communication difficulties following traumatic brain injury

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