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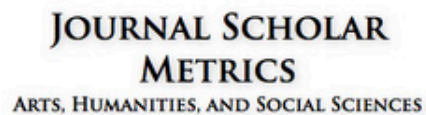
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# Interventions for Social Cognition Following Traumatic Brain Injury: A Single-Case Experimental Design

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## ABSTRACT

People who have experienced traumatic brain injury (TBI) often present with cognitive-communication disorders. Social cognition, the understanding of other people's ideas and beliefs, is one of the most important elements of cognitive-communication and is crucial for building social relationships. Interventions for social cognition should be individualized because the circumstances in which social cognitive impairment surfaces are highly individualized, but not enough research has been reported. In this study we focused self-awareness and self-regulation skills and investigated the effects of interventions for social cognition of a woman who experienced TBI more than 15 years ago. The study objectives were to: 1) examine whether self-awareness and social skills training (SST) interventions could reduce inappropriate behavior during habitual group activities and 2) investigate the change in self-regulation skills through interventions. A single-case experimental ABAC design was implemented in the following phases: A1 (six baseline sessions), B (eight awareness interventions), A2 (eight quiescence sessions), and C (six SST interventions). As a result, during the two intervention phases, the Participant was able to reduce her target behaviors compared to the non-intervention phases ( $\tau = -0.81-0.66, p < .05$ ). The qualitative analysis of changes in the SRSI indicated that the Participant increased her self-awareness of behaviors in the focused group program. In conclusion, the awareness intervention and subsequent SST were effective in reducing the individual's target behaviors in the specific situation. The relationship between self-regulation skills and the generalization of cognitive-communication intervention effects should be further studied.

**Key words:** cognitive-communication, traumatic brain injury, single-case experimental design, self-regulation, social cognition.

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### Novelty and Significance

What is already known about the topic?

- Social cognition is one of the most important factors of cognitive communication.
- Little research has been reported on social cognition interventions.

What this paper adds?

- The article describes the use of self-regulation skills as well as target behaviors to examine the effects of social cognition interventions.
- The awareness and the social skills training interventions were effective in reducing the individual's target behaviors.

People who have experienced traumatic brain injury (TBI) often present with communication deficits, referred to as cognitive-communication disorders (American Speech-Language-Hearing Association, 1988; Togher *et alii*, 2023). Cognitive-communication skills form the basis for building interpersonal relationships, affecting one's psychosocial outcomes in domains including employment, friendship, school, and community re-integration (e.g., Douglas, Bracy, & Snow, 2016; MacDonald & Wiseman-

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Hakes, 2010; Rietdijk, Simpson, Togher, Power, & Gillett, 2013). Unlike the symptoms of aphasia which are caused by damage to specific brain regions, the symptoms of cognitive-communication disorders are more extensive due to the widespread brain network damage implicated (Winson, Wilson, & Bateman, 2017).

MacDonald (2017) presented a model of cognitive-communication competence comprising seven domains and 47 factors. The seven domains are as follows: individual, context, control, cognitive, communication, physical, and emotional. This model illustrates the complexity of cognitive-communication disorders and the importance of contexts. Situations in which cognitive-communication disorders occur are highly individualized, and skills are difficult to generalize across situations; therefore, individualized training is required for specific behaviors in particular situations (Togher *et alii*, 2023).

One of the most important factors of cognitive communication is social cognition (Togher *et alii*, 2023; Winson *et alii* 2017). Social cognition involves understanding the thoughts and beliefs of others -known as the theory of mind (ToM)- and adjusting one's behavior based on this understanding (McDonald, 2013). It is strongly supported by metacognitive function such as self-awareness and self-regulation skills. Metacognitive function refers person's ability to anticipate the possibility of failure prior to a performance, monitor one's behavior during the performance (i.e. self-monitoring), and adjust one's behavior to correct problems (Cicerone *et alii*, 2022; Kennedy & Coelho, 2005; Tate *et alii*, 2014). Metacognitive intervention aims to help individuals self-monitor their behaviors, recognize their failures, self-regulate their behaviors by effective strategies (e.g., Fleming *et alii*, 2017; Ownsworth, Fleming, Desbois, Strong, & Kuipers, 2006).

Research on cognitive communication has increased in recent years which has focused on behavioral (e.g., Douglas, Knox, De Maio, & Bridge, 2014; Gabbatore, Sacco, Angeleri, Zettin, Bara, & Bosco, 2015) and cognitive (e.g., Finch, Cornwell, Copley, Doig, & Fleming, 2017; Rietdijk, Power, Attard, Heard, & Togher, 2020) treatment methods. However, few reports focus on social cognition and its relation with self-regulation skills. In addition, more reports are needed on effective interventions adapted to the individual's social situation (Lê, Coelho, & Fiszdon, 2022; Meulenbroek *et alii*, 2019).

In this study, we implemented interventions for social cognition in a Participant with traumatic brain injury (TBI). We also focused on changes in self-regulation skills through interventions because the depth of self-regulation itself is thought to affect training effectiveness. Clarifying the self-regulation processes was assumed to contribute to an improved understanding of the causes of intervention effects tailored to individuals. Specifically, we examined the effects of two interventions to increase self-awareness of the Participant's behavior, and communication role-play (social skills training [SST]). In addition, changes in the Participant's self-regulation skills throughout the intervention were analyzed through the Self-Regulation Skills Interview (SRSI), a semi-structured interview assessment.

The following were the study objectives: 1) to examine whether self-awareness and SST interventions could reduce inappropriate behavior during group activities in a woman with impaired social cognition; and 2) to investigate changes in self-regulation skills throughout the intervention phases.

## METHOD

### *Participant*

The Participant was a woman in her 40s who attended a community activity support center twice a week. She requested an intervention by family members and the support staff at the center to improve her behavior during group activities. She

experienced a TBI more than 15 years ago, had been hospitalized for approximately eight months immediately after the injury, and had continued rehabilitation as an outpatient for several years. Most recently, over the past year, she had been attending a community activity support center to interact with others. Brain images were not available as the Participant had not attended a medical facility for a long time. Her physical functioning was good, she had retired from work and was engaged in simple household chores at her home. She had been using welfare services and went out almost five times a week. She independently visited familiar places using public transportation

The Participant was able to speak fluently, without any issues related to auditory processing or dysarthria. Social cognition was the main difficulty faced by the Participant, which affected her communication with others. She had often behaved inappropriately in public from the perspective of Japanese sociocultural norms; for example, suddenly talking to a stranger in public institutions in a friendly manner or asking someone she had never met their name or age. At the community activity support center, she had been willing to participate in various group programs. She spoke to others in a positive tone, but she would often excessively praise the other person's appearance, saying things such as "You are so cute! I love you, Mrs..., and you?" Such expressions are generally considered excessive and annoying in Japanese culture; thus, group members often had a hard time coping with such behaviors and had become exhausted. Furthermore, she frequently asked others for their approval of her behaviors, such as "Am I OK? Am I right?" She had difficulty controlling her own behavior, such as interrupting the group facilitator who was explaining group programs, and suddenly talking to others using body gestures. For this reason, several members at the center refused to participate in the group programs with her.

#### *Instrument and Measures*

The following neuropsychological tests were implemented before the interventions by the speech therapist at the center:

*Rivermead Behavioral Memory Test* (RBMT; Kazui *et alii*, 2002). The RBMT has been widely used to assess various aspects of memory function, including disorientation, short-term memory, long-term memory, prospective memory, and delayed recall. The original version was developed by Wilson, Cockburn, Baddeley, & Hiorns (1989), and the Japanese version was developed by Kazui *et alii* (2002). In a study involving 478 Participants with brain injuries and 199 Participants without brain injuries in Japan, the RBMT demonstrated high parallel-form reliability, interrater reliability, and correlations with other memory tests (Kazui *et alii*, 2002). The results are scored using the total screening and standard profile scores. Cut-off scores are set for different age groups, with those in their 40s having a profile score of 16 or less and a screening score of 7 or less considered to display a decline in memory function.

*Behavioral Assessment of the Dysexecutive Syndrome* (BADS; Kashima, 2003). The BADS is used to assess executive function in an ecologically valid way, that is, testing the ability to make judgements and plan actions in an organized and efficient manner (Wilson, Alderman, Burgess, Emslie, & Evans, 1996). The original version was developed by Wilson *et alii* (1996), and a Japanese version was developed by Kashima (2003). Studies showed inter-rater reliability, test-retest reliability, concurrent validity in Japan (Kashima, 2003). The tool consists of 6 items, each of which has a calculated profile score of 0-4. The sum of the resulting profile scores is converted into an age-corrected standardized score (the average score is 100).

*Frontal Assessment Battery* (FAB; Nakaaki *et alii*, 2007). The FAB is a frontal lobe function test comprising six subtests: similarities, lexical fluency, motor series, conflicting instructions, go/no-go, and prehension behavior. The total possible FAB scores range from 0 to 18. The original version was developed by Dubois *et alii* (2000), and the

Japanese version was developed by Nakaaki *et alii* (2007). The Japanese version of FAB was administered with people with mild the frontal variant of frontotemporal dementia and those with Alzheimer's disease, the results showed good internal reliability, test-retest reliability, and significant correlations with other frontal lobe function tests. In the Japanese version of FAB, the cut-off score was set at 10 points (Nakaaki *et alii*, 2007).

The following tools were used to assess the Participant's communication and psychosocial skills:

*Assessment of Communication and Interaction Skills* (ACIS; Yamada, 2000). The ACIS can be used to evaluate an individual's ability to communicate and interact with others while engaging in valued occupations according to three domains: *Physicality*, *Information Exchange*, and *Relations*. The original version was developed by Forsyth, Lai JS, & Kielhofner (1999) and Yamada (2000) translated this tool into Japanese. The assessment comprises 20 observational skill items and an evaluator rates each skill item after observing a Participant's performance in a social situation as 4 ("no problems"), 3 ("questionable problems"), 2 ("interferes with performance"), and 1 (the skill is so deficient as to cause an "unacceptable result").

*Frontal Behavioral Inventory* (FBI; Matsui *et alii*, 2008). The FBI is an observational rating scale to assess frontal behavioral symptoms, with two main types of behavior. The first group consists mainly of items related to negative behaviors or the lack of certain relevant behaviors. The second group includes items related to disinhibition that usually results in excessive or irrelevant behaviors. Each item is scored on the following scale: 0 (none), 1 (mild or occasional), 2 (moderate), or 3 (severe or most of the time). The total score ranges from 26 to 72 points. The original version was developed by Kertesz, Davidson, & Fox (1997), the Japanese version of the FBI was developed by Matsui *et alii* (2008). It was administered with people with brain-injury and people without brain injury. The results showed a significant difference in scores between the two groups, and the validity of the tool was confirmed.

*Self-Regulation Skills Interview* (SRSI; Miyahara *et alii*, 2012). As the secondary outcome, changes in self-regulation skills were assessed with the SRSI before the baseline Phase and after the intervention phases. The SRSI involves a semi-structured interview based on three themes: "emergent awareness," "motivation to change," and "strategy use." It is used to measure a range of metacognitive skills such as self-awareness and self-regulation skills, relating to specific types of everyday difficulties. The original version was developed by Ownsworth, McFarland, & Young (2000) and the Japanese version was developed by Miyahara *et alii* (2012) (see Appendix). The Participant's responses are scored according to the guidelines on a scale of 1-10, with lower scores indicating higher awareness. In this study, the Participant's responses were also analyzed qualitatively. Question 1, on "Emergent Awareness," explored the Participant's awareness of symptoms, and Question 5, on "Strategy Use," inquired into the strategies to manage these symptoms, were analyzed by the same rater who evaluated the target behaviors.

As a dependent variable, the number of the Participant's inappropriate behavior was assessed during the usual group programs at the center. During each group session, a video camera was placed in the corner of the room and the Participant's behavior was recorded. The usual group programs lasted approximately 1 hour, were conducted once a week, and involved approximately 10 participants, all of whom had experienced brain injuries. The occupational therapist who did not know about this study and was not involved in data analysis facilitated the group programs. One staff member participated as an assistant. Each session started after a review of the previous week's program and was facilitated according to the theme of the day. The programs were designed to explore the difficulties that occur in members' lives and their coping strategies. Those included educating members about symptoms; discussing coping strategies for memory, attention, executive, and social functioning; and engaging in various cognitive activities. The formats included lectures, presentations, and experience-sharing sessions.

The main outcome of the target behaviors was evaluated by the rater (i.e. the third author) who did not have information on the phases and date or time of the video recordings. The rater did not participate in the group activities. The recordings data were randomly shared with the rater by the researcher; therefore, it was not clear which Phase the video data were from. Prior to the analysis, the researcher explained the targeted behaviors to the rater in advance to facilitate understanding. Video recordings for 50 min from the start of each group program were used for data analysis.

### *Design and Procedure*

The interventions and data collection took place at the community activity support center attended by the Participant. A single-case experimental ABAC design (withdrawal/reversal design) was employed. Intervention phases were the awareness intervention (Phase B) and the SST Intervention (Phase C). To exceed the recommended number of sessions (Kratochwill *et alii*, 2013), six sessions were scheduled for the Baseline Phase and eight for the other phases, in the following order: A1 (Baseline Phase), B (Awareness Intervention Phase), A2 (Pause Phase), and C (SST Intervention Phase). Meulenbroek *et alii* (2019) stated that communication interventions can be effective when clients understand their symptoms, recognize the significance of the intervention, and actively participate. Therefore, we opted for a sequence in which awareness-focused interventions were implemented, followed by practice of the behaviors using SST.

This study complied with the principles of the World Medical Association's Declaration of Helsinki Ethical Principles for Medical Research involving Human Subjects and it was conducted following institutional approval received from the Ethics Review Committee of X University (2022260).

Before starting the study, the first author set a rehabilitation goal with the Participant, namely, "to be able to review behaviors during group sessions and communicate well with others." She was informed in writing about the interventions, and She provided her consent for video recording.

### *Intervention*

*Phase A1 (Baseline).* The Participant attended the group programs 6 times, as usual, and her behavior patterns were video recorded. After A1 Phase, the videos were played back by the first and third authors, and inappropriate behaviors displayed during the group sessions were extracted and designated as the dependent variable. Targeted behaviors were defined as "utterances and behaviors that have negative impacts on other members of the group." Consequently, the following three behaviors were extracted:

- (1) Out-of-place, sudden body gestures and talking to others, which interrupted the group programs: During the group sessions, the Participant often talked to others, sometimes giving them fist bumps. These gestures were out of place and left others confused; she was often stopped by the staff.
- (2) Frequently seeking approval to ensure her actions are correct: The Participant frequently sought approval when she had completed her task and she spoke up to ensure that her actions were correct; for example, she often asked questions such as "Have I passed? Ok? Am I a good girl?"
- (3) Persistently praising others and seeking validation from others: During the group sessions, the Participant had persistently praised others and sought validation from others; for example, saying things such as "Mrs. (...), you are nice! I love you. Do you love me too?"

*Phase B (Awareness Intervention).* The interview session aimed to increase the Participant's awareness of her own behaviors during the group programs. The video feedback

intervention was conducted for approximately 30 min before each group program began. The researcher (first author) conducted the interview. The previous week's recordings were replayed, and several scenes were selected in order from the start. The Participant watched these recordings and was interviewed about how she felt regarding these behaviors, whether she felt they should be changed, and how she thought they should be dealt with. The researcher did not directly point out the problem behaviors, but when the Participant expressed discomfort, the questions were expanded to guide her thinking. For example, when the Participant said, "I think this statement is not good," the researcher asked, "What do you think is not good?" or when the Participant said, "This behavior should be discouraged," the researcher asked, "Why is that?" The interview responses were recorded using a recording form and the Participant reviewed them at the start of the next interview session. Following each interview, the Participant engaged in the group programs as usual. The interventions were implemented eight times as planned.

*Phase A2 (Pause).* As in the Baseline phase, in this phase, the Participant engaged in the group programs as usual in order to pause the intervention. The number of pauses was eight, as planned.

*Phase C (SST Intervention).* As mentioned above, in Phase B, the Participant realized that her own behavior during the group programs were inappropriate. Based on this acquired awareness, in phase C, the interventions focused on learning how to cope with these target behaviors using SST. The Participant and the researcher (the first author) discussed the communication methods that could be used to improve the target behaviors. Consequently, appropriate conversations and behaviors were determined for each target behavior and used in practice. Individual SST sessions were conducted for approximately 30 min before each group program, carried out through the following procedures: (1) Reconfirming the three target behaviors, (2) reviewing the sample manual of strategy behaviors and conversations for the three situations, and (3) practicing conversations with the researcher as another member of the group. Following the SST sessions, the Participant engaged in the group programs as usual. After six SST sessions, group programs had to be discontinued due to the outbreak of COVID-19. Therefore, the SST phase was terminated after six sessions.

### *Data Analysis*

The frequency of target behaviors was tabulated for each phase, and Tau-U ( $\tau$ ) values (Vannest, Parker, Gonen, & Adiguzel, 2016) were used to examine whether there were changes across the phases. Tau-U combines the non-overlap between phases with a trend from within the baseline phase (Parker, Vannest Davis, & Sauber, 2011).

Four SRSI scores were compared. In addition, verbatim transcripts of the responses were developed, itemized, and compared between phases.

## **RESULTS**

The Participant's RBMT profile score and screening scores were 20 and 10, respectively. The BADS' standardized score was 102. The FAB's standardized score was 16.

The ACIS items for which the Participant in this study had particularly low scores, that is, a score of 1, were "Gestures," "Orients" of Physically, "Asserts," "Asks," "Engages," and "Expresses" of Information exchange, "Relate," and "Respects" of Relations. The scores of the FBI were 39, out of a total of 72; 18 out of the 24 items had a score of "3 (severe or most of the time)." As explained above, the Participant had good neuropsychological test results, but had shown decreased cognitive-communication skills, particularly social cognition.



The frequency of target behaviors in the four phases was compared using Tau-U. The trend within the non-intervention period was not significant: the A1 period ( $\tau = -0.40$ ,  $p = .26$ ) and the A2 period ( $\tau = -0.21$ ,  $p = .46$ ). The results showed no significant changes between phases B and C. However, significant changes were detected between phases A1 and B ( $\tau = -1.00$ ,  $p < .01$ ), A1 and A2 ( $\tau = -0.90$ ,  $p < .01$ ), A1 and C ( $\tau = -1.00$ ,  $p < .01$ ), B and A2 ( $\tau = 0.66$ ,  $p = .03$ ), and A2 and C ( $\tau = -0.81$ ,  $p = .01$ ) (see Figure 1 and Table 1).

As shown in Table 2, the scores for the item “emergent awareness” across the four phases were 8 (phase A1), 6 (phase B), 6 (phase A2), and 6 (phase C). The scores for the item “strategy use” across the four phases were 9 (phase A1), 8 (phase B), 8 (phase A2), and 8 (phase C).

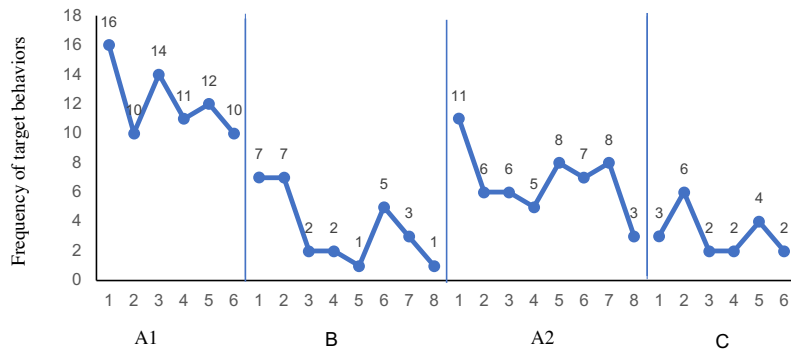


Figure 1. Frequency of target behaviors. A four sections of ABAC line graph show the frequency of target behaviors. These show a decreasing trend with the start of Phase B, an increasing trend in Phase A2 and a decreasing trend again in Phase C. Notes: The target behaviors through the four phases: A1 (baseline), B (awareness intervention), A2 (pause), and C (SST intervention).

Table 1. Changes in data across the four phases (examined using Tau-U).

Phases compared	Tau-U	p	90%CI
A1 vs B	-1.00	<.01	-1.00, -0.47
A1 vs A2	-0.90	<.01	-1.00, -0.37
A1 vs C	-1.00	<.01	1.00, 0.43
B vs A2	0.66	.03	0.17, 1.00
B vs C	0.02	.95	-0.51, 0.55
A2 vs C	-0.81	.01	-1.00, -0.28

The SRSI scores and response content were compared after the four phases. The Participant’s responses were listed and compared by sentence.

As shown in Table 2, results of the qualitative analysis of statements revealed the following points. For the item “emergent awareness” before phase A1: “I can’t concentrate,” and “I am not good at being quiet in quiet places,” the Participant did not mention anything about her communication skills at this point. After phase B, the Participant began to refer to communication behaviors during the group programs, such as “I disturb group members,” and “Asking ‘Do you like me?’ offends the staff.” After phase A2, she stated, “I can’t read between the lines,” and “People point out that I don’t

Table 2. Changes in SRSI scores.

Phase	Item on "emergent awareness"		Item on "strategy use"	
	Score	Statements	Score	Statements
A1 Baseline	8	I can't concentrate. I am not good at being quiet in quiet places. I don't feel like going to lectures. I am quick to talk to strangers.	9	I don't go to quiet places.
B Awareness intervention	6	I'm tempted to make myself appealing to others. I disturb group members. Asking 'Do you like me?' offends the staff.	8	I try not to say the same thing too many times.
A2 Pause	6	I can't read between the lines. People point out that I don't understand the context and say things I shouldn't say.	8	I try not to speak my mind too much.
SST intervention	6	I can't read between the lines. I frequently try to make myself appealing to people. I make extraneous remarks in quiet places.	8	I try to stay quiet in the group.

Notes: SRSI= Self-Regulation Skills Interview; SST= Social Skills Training.

understand the context and say things I shouldn't say." After Phase C, she expressed, "I can't read between the lines," and "I frequently try to make myself appealing to people."

The key statement noted for the item "strategy use" before Phase A1 was "I don't go to quiet places," which is not a direct coping strategy for behaviors but an escape behavior. After Phase B, she described one coping strategy: "I try not to say the same thing too many times." After Phase A2, she expressed, "I try not to speak my mind too much," and after Phase C, "I try to stay quiet in the group."

## DISCUSSION

The frequency of the target behaviors decreased when phase B (Awareness Intervention) began, compared to that noted at Phase A1 (Baseline). Subsequently, it increased again when the intervention was suspended (Phase A2). When Phase C (SST Intervention) began, it again showed a downward trend. This indicates that the awareness intervention and conversational role-play with SST were effective in reducing the target behaviors.

There was no significant difference in the number of target behaviors between phases B and C, indicating that both intervention methods were effective. In this study, the awareness intervention was followed by the SST Intervention. Self-regulation skills are depicted separately at the top of the cognition-communication model as a function for supervising and regulating communication behavior (MacDonald, 2017). Meulenbroek *et alii* (2019) stated that communication interventions are effective when Participants understand their communication skills and are aware of the intervention goals. In this study, as the SRSI responses indicated, the Participant became aware that her own behavior had a negative impact on others in the group through the video feedback (Phase B). Subsequently, based on the acquired self-awareness, the Participant was able to repeat behavioral practice (Phase C). This intervention sequence may have been effective, although this cannot be confirmed because the sequence of interventions was not switched.

In this study, the interventions focused on improving behavior during specific group programs in which Participant s habitually attended. Cognitive-communication disorders are problematic in an individual's unique environment (e.g., Togher *et alii*, 2023; Ylvisaker, Turkstra, Coelho, 2005). These results indicate that individualized interventions are effective. Although the current results cannot be generalized, the findings could be useful when developing rehabilitation interventions aimed at improving individual competence.

Additionally, the Participant in this study had a head injury over 15 years ago. Thus, it is suggested that intervention effects may also be achieved for chronic symptoms related to cognitive-communication disorders.

The targeted behaviors were less frequent in the quiescent phase (Phase A2) than in the Baseline (Phase A1), suggesting that the effects of Phase B (awareness intervention) carried over into the next phase. However, the fact that behaviors increased again during Phase A2 and decreased during Phase C indicates that the behaviors may not had been sufficiently suppressed when the intervention was paused. In prior research, evidence on the persistence of intervention effects and generalization across settings is limited (Lê *et alii*, 2022). One reason for this study's results could be that the number of interventions may not have been sufficient, increasing the number of interventions might have a lasting effect. Another reason could be discussed from the changes in the self-regulation skills. Qualitative analysis of the SRSI results in this study allowed for the consideration of self-regulatory capacity, which cannot be inferred by simply assessing the frequency of target behaviors. SRSI scores improved at the end of the awareness intervention (phase B) compared to Phase A1, but did not change thereafter. Qualitative analysis of the responses revealed that before Phase A, for the item on "emergent awareness," the Participant did not mention any interpersonal communication problems. From Phase B onwards, the Participant described her own behaviors as inappropriate towards group members. This indicated that the Participant 's awareness of communication problems increased as a result of the awareness intervention (Phase B). She continued to be aware of her own symptoms in the same way in the subsequent phases, namely, A2 and C.

On the other hand, the item on "strategy use," the Participant could mention "I try not to say the same thing too many times," after Phase B. This is a strategy to try to control her behavior. However, this statement relates only to the group sessions she habitually attended and do not indicate the extension of her self-regulation skills to other situations. One feature of behavioral learning in people with brain injuries is the difficulty of generalizing across situations (e.g., Meulenbroek *et alii*, 2019; Togher *et alii*, 2023). The awareness intervention and the SST intervention focused only on the group program in the center. As a result, awareness regarding the focal group improved and target behaviors in the group setting reduced, but these outcomes may not have generalized to daily life outside of this group setting. Bornhofen & McDonald (2008) stated that practicing tasks with a particular caregiver is necessary to generalize the effects of communicative competence. In the current study, it may have been useful to examine whether there was a broad improvement in self-regulation skills when daily conversation was practiced with family members.

The qualitative changes in self-regulation skills will help in exploring the causes of intervention effects. The results of this study point to the possibility of predicting improvements in communication skills based on the individual's self-regulation skills. The extent of self-regulation skills and the generalization of cognitive-communication intervention effects should be further studied. In addition, further research should aim to clarify ways to improve self-regulation skills across various communication contexts.

Limitations of this study are that it was not possible to blind the intervention to the Participant in this study. Further, as the present study involved only one Participant, it is difficult to generalize the results. In addition, the duration of the intervention may not have been sufficiently long, and the results may have been different if the intervention had continued for a longer period.

In conclusion, using a single-case experimental method, we investigated the effects of interventions for impaired social cognition in a woman who experienced TBI more than 15 years ago. The main outcome was the frequency of target behaviors, and the secondary outcome was changes in self-regulation skills. A single-case experimental ABAC design (withdrawal/reversal) was implemented in the following phases: A1 (six baseline sessions), B (eight awareness interventions), A2 (eight quiescence sessions), and C (six SST interventions). We also assessed changes in the Participant's self-regulation skills with the SRSI. The results showed that the two interventions improved the Participant's behavior. Accordingly, it is suggested that intervention effects may be achieved for chronic symptoms related to cognitive-communication disorders. The analysis of changes in the SRSI indicated that the Participant increased her self-awareness of behaviors in the focused group program. Although the present findings cannot be generalized because of the single Participant involved in the study, the results showed an association between social cognition and self-regulation skills. Further research should aim to clarify ways to improve self-regulation skills across various communication contexts.

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## APPENDIX

## Interview items of the SRSI.

*Screening question:* "Think about the various ways that you may have changed since your injury. Can you tell me one aspect of yourself that has changed which causes you the most distress and holds you back in everyday living?"

1. *Emergent awareness:* "Can you tell me how you know that you experience (main difficulty); that is, what do you notice about yourself?"  
*Prompt:* "What else might you notice?"; "So far you've told me ..., is there anything else?"
2. *Anticipatory awareness:* "When are you most likely to experience (main difficulty), or, in which situations does it mainly occur?"  
*Prompt:* "In what other situations would you expect more or greater (main difficulty)?"; "So far you've told me..., can you think of anything else?"
3. *Motivation to change:* "How motivated are you to learn some different strategies to help overcome (main difficulty)?"  
 (Encourage self-grading on a scale of 0 to 10)
4. *Strategy awareness:* "Have you thought of any strategies that you could use to help cope with your (main difficulty)?" and "What are they?"  
*Prompt:* "What else could you try that might help?"; "So far you've told me ..., can you think of any other strategies?"
5. *Strategy use:* "What strategies are you currently using to cope with your (main difficulty)?"  
*Prompt:* "Can you think of anything else that you are currently using or have tried recently?"; "So far you have said ....., are there any other strategies you are using?"
6. *Strategy effectiveness:* "How well do the strategies that you are using for (main difficulty) work for you?"  
*Prompt:* "How do you know that they are helpful/unhelpful?"; "Would you notice any difference if you stopped using the strategies?"

*Note:* Derived from Miyahara *et alii*'s (2012) study (the original version was developed by Ownsworth *et alii*, 2000).