Feasibility and initial efficacy of a cognitive-behavioural group programme for managing anger and aggressiveness after traumatic brain injury

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This study assesses the feasibility of a cognitive-behavioural group programme for treating anger and aggressiveness after a traumatic brain injury (TBI). Five feasibility criteria were considered: *demand, implementation, practicality, acceptability* and *initial efficacy*. A self-report questionnaire of aggressiveness (AQ-12) was administered before the intervention (T1), one week following the intervention (T2) and at a four months follow-up (T3). Ten patients with moderate to severe chronic TBI completed the programme through eight once-a-week sessions. The analysis of the feasibility outcomes suggests that:

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(1) The recruitment, the process of grouping participants and the characterisation of anger and aggressiveness at baseline need to be re-evaluated and improved for future designs. (2) The use of specific strategies for bypassing cognitive and other behavioural dysfunctions related to TBI is crucial for the success of this intervention and merits special attention. (3) The high retention rate, the convenient meeting schedule, cost advantages and the good acceptability by participants are positive arguments for the implementation of a larger trial. (4) The significant reduction of AQ-12 scores at T3 and the high effect size constitute a change in the expected direction and support the initial efficacy of the programme.

Keywords: Traumatic brain injury; Cognitive behavioural therapy; Anger; Neurorehabilitation.

INTRODUCTION

Anger and aggressiveness are among the most socially and professionally disturbing neurobehavioural problems following traumatic brain injury (TBI) (Baguley, Cooper, & Felmingham, 2006; Johansson, Jamora, Ruff, & Pack, 2008; Kalechstein, Newton, & van Gorp, 2003). Estimated prevalence ranges between 12% and 76% due to the variability of conceptual definitions, assessment methods and samples (Dikmen, Machamer, Fann, & Temkin, 2010; Kim, Manes, Kosier, Baruah, & Robinson, 1999; O'Connor, Colantonio, & Polatajko, 2005). As with other neurobehavioural problems, anger and aggressiveness are often undervalued and undertreated when compared to impairment in sensory-motor or cognitive functions (Levin, 1995; Olver, Ponsford, & Curran, 1996).

Anger may be an adaptive emotion if manifested appropriately, but can be considered maladapted when it becomes frequent and disproportional to environmental triggers (Denson, 2009; Mayne & Ambrose, 1999). Problems in self-awareness and self-monitoring are among the main psychological underlying mechanisms of emotional dysregulation (Alderman, 2003; Ciurli et al., 2010). Current evidence suggests a multifactorial origin for post-traumatic anger, including brain damage, pre-injury predispositions and coping with the life-changing consequences of TBI (Adair, Williamson, Schwartz, & Heilman, 1996; Salmond & Sahakian, 2005)

Cognitive-behavioural therapy (CBT) may be particularly suited for treating neurobehavioural problems in people with acquired brain injury due to its goal-directed, planned and relatively structured nature, allowing cognitive deficits such as executive dysfunction to be bypassed (Coetzer, 2009; Kangas & McDonald, 2011). However, to date, only a limited number of studies proposing CBT for this population have focused on anger and aggressiveness. In a systematic review on neurobehavioural interventions between

1970 and 2008, 13 out of the 63 included studies adopted a cognitive-behavioural approach, yet only three of them, including case studies, focused on anger and aggressiveness (Cattelani, Zettin, & Zoccolotti, 2010).

Among group studies, Medd and Tate (2000) and Hart, Vaccaro, Hays, and Maiuro (2012) reported a significant reduction in self-reported measures of anger and aggression after an individual CBT programme for chronic TBI patients. Walker et al. (2010) observed similar results in a group intervention held on nine occasions from 1998 to 2006. These anger management programmes for TBI patients included psychoeducation and focused on self-awareness, relaxation techniques, cognitive restructuring and problem solving. Despite the low levels of controllability due to clinical reality and ethical reasons, the studies reported above showed encouraging results.

According to Bowen et al. (2009), assessment of feasibility is crucial to determine if an intervention should be considered for larger trials and may be particularly indicated when there are only a few published studies using a specific intervention technique in a specific population. While the feasibility of a CBT approach for managing anger after a TBI has been discussed for individual treatment (Hart et al., 2012), to our knowledge, no information on feasibility has yet been reported for group programmes.

This paper describes a semi-structured CBT group programme for managing anger and aggressiveness after TBI and analyses specific aspects of its feasibility, including initial efficacy. In particular, we have aimed at assessing: (1) *Demand*: Is it likely to be used? (2) *Implementation:* Can it be successfully delivered as planned? (3) *Practicality:* Can it be administered to the intended participants? (4) *Acceptability:* Is it attractive and satisfying to the intended participants? (5) *Initial efficacy:* Are there any significant changes in the main outcome measure?

METHODS

Ethical approval

The Ethical Committee on Human Experimentation of the Geneva University Hospitals approved this study and written informed consent was obtained for each patient and their proxy (significant other).

Recruitment

Patients invited to participate in the study were selected from the database of the Neuropsychology Unit and Neurosurgery Department of the Geneva University Hospital, where they were hospitalised following their TBI, between 2005 and 2010. These patients could be checked for eligibility criteria as their detailed files included neuropsychological reports and information on their

functional capacities. A first contact was made by phone. Those who showed an interest in the study and confirmed a general change in their behaviour following the TBI received the information and consent letters, as well as the questionnaires described below, by mail. An additional chronic patient (TBI > 10 years) referred by a clinical neurologist from the Neuropsychology Unit was also included. Proxies of all participants were also invited to participate in the assessment by filling in two questionnaires related to general changes in behaviour following the TBI.

Participants

Inclusion criteria. French speakers, aged between 18 and 60 years old, with a history of moderate or severe TBI (GCS between 3 and 12 upon arrival at the emergency department), according to Teasdale and Jennett (1974)'s criteria, at least 12 months after their injury.

Exclusion criteria. Patients were excluded if they had known neurological or psychiatric diseases before the TBI, cognitive or physical handicaps that would impede them in understanding and completing the questionnaires (e.g., severe aphasia or major memory problems), independently attending sessions or participating in group discussions.

Table 1 shows the main demographic and clinical characteristics as well as neuropsychological outcomes at baseline of the 10 participants who completed the emotion management programme.

Neuropsychological tests administered in T1

- Attention and executive systems: Specific subtests of the Test of Attention Performances (TAP; Zimmermann & Fimm, 1995).
- Episodic memory: Word List of the Wechsler Memory Scale-III (Wechsler, 1997).
- Impulsivity: Matching Familiar Figure Test (MFFT; Kagan, 1966) computerised version by Kertzman et al. (2010): Z-scores were calculated based on the healthy sample of Kertzman et al. (2010).
- Social cognition and theory of mind: Mind in the Eyes (MIE; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001): The French translation was used and Z-scores were calculated based on normative data of the original publication.
- Versailles-Situational Intentional Reading (V-SIR; Bazin et al. 2009): Scores were calculated from raw scores using a formula described in Bazin et al. (2009) and transformed afterwards into Z-scores based on results of the healthy subjects' sample.

TABLE 1
Demographic, clinical and neuropsychological characteristics of the sample

Measure	All participants n = 10 median (range)	Participants with impaired performances*
Gender		
Male	8	-
Female	2	-
Age (years)	47 (24–58)	-
Marital status		
Single/divorced	4	-
Married/cohabiting	6	-
Education (years)	14 (12–16)	-
Professional status		
Employed	4	-
Unemployed	6[a]	-
Time since injury (months)	27.5 (16–166)	-
Injury severity (GCS)	5 (3–9)	
TAP		
Tonic Alertness[b]	231 (186–420)	3
Divided Attention AS[b]	519 (428–952)	2
Divided Attention VS[b]	895 (671–1098)	1
Mental Flexibility[b]	993.5 (475–1266)	1
Mental Flexibility errors	4.5 (0–13)	1
Working Memory[b]	681 (497–1228)	1
Matrix reasoning (WAIS-III)	19 (16–24)	1
Word list (WMS-III)		
Total recall	33 (16–41)	1
Delayed recall	6.5 (2–9)	4
MFFT		
First latency[c]	10.8 (7.3–28.9)	0
Mean latency[c]	19.3 (7.3–38.2)	NA
Errors	3.5 (1–14)	3
MIE	21.5 (19–27)	4
V-SIR	14 (9.47–18.53)	1

AS Auditive Stimuli; MFFT Matching Familiar Figure Test; MIE Mind in the Eyes; TAP Test of Attentional Performances; V-SIR Versailles-Situational Intentional Reading; VS Visual stimuli; WMS-III Wechsler Memory Scale 3rd edition; WAIS-R Wechsler Adult Intelligence Scale.

*Impairment was considered for scores under the 10th percentile or Z scores < -1.29;

[a]All participants received full disability pension and two were engaged in informal occupational activities

[b]Median reaction time (ms)

[c]Mean reaction time (ms)

Injury characteristics varied and concerned mostly focal contusions in frontal, temporal and parietal regions. Additional subarachnoid haemorrhages and diffuse axonal lesions were frequent. Regarding medication, one patient was on anti-depressants (venlafaxine), another on anti-epileptic medication

(levetiracetam), a third on anti-histamine treatment (unspecified) and a fourth on acetylcholinesterase inhibitor (donepezil); all had started treatment at least three months before the first assessment session.

Among the proxies who answered the questionnaires, six were spouses, one was a companion and three were parents.

Study design

A pre–post intervention design was carried out followed by an additional four month follow-up. There was no control condition since it was an exploratory study. For practical reasons, as reported by Couillet et al. (2010), the same therapist (TAB) carried out all assessments and intervention.

Pre-intervention assessment (T1). An individual interview was held one to four weeks before the first intervention session for further explanation of the study and confirmation of any behavioural complaints, returning of the questionnaires and neuropsychological assessment.

Post-intervention assessment (T2). An individual session was held, at the latest, one week after the end of the last intervention session for the returning of the questionnaires, further discussion about the programme and the completion of a feedback form.

Follow-up assessment (T3). Four to five months after the end of the programme, participants completed the main outcome measure questionnaire and returned it by mail.

Intervention protocol

The semi-structured outpatient intervention protocol (mainly designed by TAB and CGB), focusing on anger and aggressiveness, was elaborated based on a CBT framework (Greenberger & Padesky, 1995; Gross, 2002; Padesky & Greenberger, 1995) and inspired by previous anger management programmes (Alderman, 2003; Hart et al., 2012; Medd & Tate, 2000; Walker et al., 2010). It consisted of eight 60-minute sessions held once a week, predominantly in small, closed groups (two to four participants) in order to bypass attention and concentration problems. We made use of visual support materials (schemes, written handouts and paperboard) and role-playing for stimulating discussion and interaction between participants. Inter-session homework tasks were encouraged in order to better understand individual emotion regulation skills. Such tasks were mostly characterised by the observation of specific anger-related situations that occurred in the previous week and by the application of various acquired strategies for the

management of emotions. In order to compensate for possible cognitive difficulties, we frequently repeated and reformulated the information, used concrete examples and distributed a personal booklet containing a reminder of the anger management strategies discussed and personal examples given during the sessions at the end of the programme. Logorrhoea and digression during the meetings were minimised by timing speeches and signalling ("red card" notifications).

The intervention was led by TAB and consisted of different modules: (1) Identification of emotions/self-awareness. (2) Managing emotion in emergency situations (relaxation techniques, behaviour interruption). (3) Cognitive restructuring and alternative thinking. (4) Prevention strategies. Additional details can be obtained from: http://www.unifr.ch/neurology/ assets/files/Anger%20maangement%20TBI-link.pdf

Assessment of feasibility

Feasibility was assessed through five selected criteria based on the guideline proposed by Bowen et al. (2009) for which different components of the study were considered.

Demand. (1) The participation rate across recruitment, and the dropout rate after the first session of the intervention. (2) The presence of post-traumatic anger through (i) verbal self-report, (ii) self and proxy-report changes in the second question of the Frontal System Behaviour Scale (FrSBe-Q2): "I easily get angry or irritated; I lose my temper for no reason" (back translation), by comparing ratings before and after the accident (changes were considered when the condition after the accident was at least one point higher than the condition before the accident. (3) Self and proxy reported general behaviour changes after TBI upon T1 assessed through the FrSBe and the UPPS.

Implementation. (1) The process of grouping participants. (2) The possibility of keeping up with the number and duration of sessions.

Practicality. (1) Participants' ability to enrol in the proposed activities. (2) A brief cost analysis based on the state-set tariff for Swiss medically prescribed interventions (TARMED) and neuropsychological rates, by comparing rates of individual and group sessions.

Acceptability. Comments given in a satisfaction questionnaire completed by the participants at T2. This questionnaire integrated general comments, suggestions on what should be kept, modified or included in future interventions and specific forced choice questions related to self-awareness ("Has your perception of anger manifestation changed after the sessions?") and

the ability to manage anger ("Have your abilities to manage your anger changed after the sessions**?**").

Initial efficacy.   Statistical analysis of the preliminary data.

Main outcome behaviour measure (T1, T2 and T3)

Aggression: *Buss and Perry Aggression Questionnaire (AQ-12)* (Bryant & Smith, 2001; Buss & Perry, 1992). The AQ-12 is a shortened version of the original 29-item self-report questionnaire on aggression. It is composed of 12 questions and shows acceptable levels of internal consistency and good test–retest reliability. The French version used in our study also proved very reliable in an initial exploratory and confirmatory factor analysis with a Cronbach's alpha coefficient for the whole questionnaire of .80 (Genoud & Zimmermann, 2009). Each question is scored on a six-point Likert scale, where participants are asked to indicate to what extent the described behaviour feelings correspond to them, between 1 ("Extremely uncharacteristic of me") and 6 ("Extremely characteristic of me"). The total score is calculated by summing up the points given for each of the 12 questions. Higher scores indicate higher levels of self-reported aggressiveness.

Secondary outcomes behaviour measures (T1 and T2)

The following outcomes of interest were selected to assess possible unanticipated or unintended effects of the intervention.

Impulsivity: UPPS Impulsive Behaviour Scale (Rochat et al., 2010*; Whiteside & Lynam*, 2001*).*   This questionnaire contains four impulsivity factors, but we only considered the sum of three of them (urgency, lack of premeditation and lack of perseverance) that have been shown to increase after a TBI (Rochat et al., 2010). At T1 we considered the difference before and after the accident for both self- and proxy-report scales. Furthermore, in order to assess pre- and post-intervention differences on self-assessment, we used only the scores for current ratings ("after the accident") in both T1 and T2. Thus, premorbid condition ratings were not considered for analysis at T2.

General behaviour: Frontal System Behaviour Scale (FrSBe) (Grace & Malloy, 2001*).*   At T1 we considered the difference before and after the accident for both self- and proxy-report scales. As at T2 we were only interested in self-reported changes between pre- and post-intervention. We compared T1 and T2 ratings for the condition "after the accident" for the self-assessment scale.

Empathy: The Cambridge Behaviour Scale (EQ; Baron-Cohen & Wheelwright, 2004)

Mood: Hospital Anxiety Depression Scale (HADS; Zigmond & Snaith, 1983). Quality of Life: SF-36 (Ware & Sherbourne, 1992).

Statistical analysis

Data were treated using SPSS 20.0 software. Due to our small sample size and non-normally distributed data, we used descriptive statistics and non-parametric statistics tests. For longitudinal paired contrasts between the different phases we used a Wilcoxon Signed-Rank test. Effect sizes (Cohen's *d*) of changes for the main outcome measure between T1 and T2, T2 and T3, and T1 and T3 were calculated using G*Power3 (Faul, Erdfelder, Lang, & Buchner, 2007) through the difference between the two means divided by the pooled standard deviation corrected for the amount of correlation between the two measures. (Cohen's *d* is the recommended effect size measure for expressing the difference between two means while effect sizes of the *r* family are more related to the relation between variables. As the Wilcoxon Signed-Rank test is a non-parametric test based on medians, it would probably be more appropriate to use an effect size from the *r* family. However, we adopted Cohen's *d* for the purpose of using a more familiar measure – as recommended by one of the reviewers – which also allowed carrying out post-hoc and a priori power analyses.) Post-hoc achieved power was also calculated using G*Power3 by computing the obtained effect size, the sample size and a two-tailed alpha level of 5%. In addition, an a priori power analysis was carried out for estimating ideal sample sizes for future trials. More specifically, for the same design (pre–post measurements), the effect size *d* of the current study was computed. For a randomised controlled trial, which would include an experimental and a control group (between-subjects factor), with assessments carried out before the intervention and at least twice after the intervention (within-subjects factor), the appropriate statistical test would be a two-factor ANOVA for repeated measures. Therefore, in order to estimate the sample size for this design, we assumed a moderate intensity for both Cohen's f ($f = 0.25$) and Pearson's correlation coefficient among repeated measures ($r = .5$), as well as a non-sphericity correction of one. Results of these a priori power analyses are reported in the discussion section.

RESULTS

Feasibility outcomes

Table 2 summarises the results of all of the five criteria of feasibility assessed. Additional details are discussed below.

TABLE 2
Criteria and outcomes of feasibility

Criteria	Outcomes of interest	Result	Conclusion
Demand	Recruitment rate (T1)	11/20 (55%)	⊙
"To what extent was it used?"	Retention rate (T3)	9/11 (81%)	✓
	Self-reported anger at T1	9/10 (6 verbally and formally[a] and 3 only verbally)	⊙
	Proxy-reported anger at T1	7/10 formally[a]	⊙
Implementation	Grouping participants	Group sizes varied, 3 participants ended up with individual sessions (those in the groups of 2)	⊙
"Was it delivered as planned?"	Number of sessions	As planned, once a week for eight weeks	✓
	Length of sessions	As planned, 60 minute sessions, allowed content to be covered and avoided distractibility	✓
Practicality	Participant's abilities for enrolment in the proposed activities	Good cooperation and interest, but specific strategies were essential to bypass cognitive and other behavioural problems	■
"Could it be administered to the intended participants?"	Cost analysis	Advantageous for participant (cost-sharing) and institution (more availability)	✓
Acceptability	General comments on the satisfaction questionnaire	Mostly positive comments, particularly concerning the possibility of sharing experiences and learning with others	✓
"Was it satisfying for the intended participants?"	Perceived changes in anger awareness	10/10 confirmed a change after the programme (T2)	✓
	Perceived changes in anger management	7/10 confirmed a change after the programme (T2)	✓
Initial efficacy	AQ-12 scores:		
"Is it likely to be successful with the	T1 vs. T2	No significant changes, small effect size and low power	■
intended population?"	T1 vs. T3	Significant decrease, large effect size and moderate power	✓

✓ Feasible; ■ Needs special attention; ⊙ Needs improvement.
[a]In a specific question related to anger at the FrSBe

Demand. Eleven out of the 20 contacted participants started the study (recruitment rate: 55%). Six had refused at the telephone call stage for lack of interest or availability and three at initial individual interview. The final

10

sample at T3 included nine patients out of 11 who started the intervention (retention rate: 81%). Among the two participants who dropped out, one quit after the first session (36 years old, male, married, four years of formal education, one year post-TBI) because he had been showing symptoms of post-traumatic stress disorder with agoraphobia and consequently had difficulties attending sessions, and the second quit after T2 (P7: 58-year-old woman, 16 years of formal education, 13 years post-TBI) citing lack of interest in continuing the study.

At T1, on the FrSBe-Q2, six participants and seven proxies reported an increase in anger and irritability after the accident, but only five of them were congruent. For instance, one patient reported an increase while his proxy did not report any change, and two proxies reported an increase while the respective participants did not. Only one participant did not manifest any form of anger complaint while his proxy stated it on the FrSBe-Q2. (3) At T1, the total FrSBe scores were significantly higher (Wilcoxon Signed-Rank test) after the accident (Mdn = 98, Range = 56–128) than before the accident (Mdn = 76.5, Range = 57–95), $Z = 2.60$, $p < .01$, $n = 10$. Similarly, on the UPPS, scores were significantly higher after the accident (Mdn = 25, Range = 16–34) than before the accident (Mdn = 16.5, Range = 15–24), $Z = 2.14$, $p = .03$, $n = 10$.

Assessment by proxies: The pattern observed corresponded exactly to the one observed in self-assessment, as on the FrSBe, scores were significantly higher after the accident (Mdn = 101.5, Range = 86–49) than before the accident (Mdn = 80, Range = 52–109), $Z = 2.31$, $p = .02$, $n = 9$) and on the UPPS, scores were also significantly higher after the accident (Mdn = 25, Range = 18–35), than before the accident (Mdn = 18, Range = 12–33), $Z = 2.19$, $p = .03$, $n = 10$.

Implementation. Group composition mainly took into account the participants' readiness to start the programme and their availability during the week. This explains in part the variation in the number of participants in the groups. We thus initially had one group of four participants, one group of three and two groups of two. However, participants in the groups of two ended up with individual sessions since one was allocated with a participant who dropped out after the first session, and the other two showed clinical incompatibilities (mostly related to cooperation since one of the participants did not find the programme suitable for her but decided to complete it anyway – she participated at T2 assessment but dropped out at T3) and were separated after the fifth sessions for a better progression of the programme.

For those who were being followed individually, the format of one-hour sessions once a week was adhered to in general, but rescheduling was allowed. All the participants included in T2 assessment ($n = 10$) attended

at least the six sessions required ($M = 6.8$, $SD = 0.9$). Absences were always notified in advance.

Practicality.   Three participants felt the need to be reminded of the session a few hours before. This was accomplished through a telephone call in the first few sessions. In addition, the following neuropsychological strategies had to be used in order to bypass clinically observed difficulties that sometimes interfered with the understanding of the on-going discussion or activity proposed: (1) Clear and concise instructions about the proposed activity were helpful; (2) the use of frequent repetition and reformulation was crucial in the group context; (3) digressive speech and logorrhoea, which are common neuropsychological symptoms after TBI, needed to be adequately managed for a satisfactory progression of the sessions. This was done by timing speeches and politely signalling with cards that it was the partner's turn.

Sessions were free of charge since they were part of a research protocol. According to a state-set tariff in Switzerland, the cost of a group session (the same as an individual one) is shared between the members. For instance, participants in groups of three or four would have paid respectively a third and a quarter less than those going through individual sessions.

Acceptability.   Those in the groups commented in particular about enjoying the possibility of sharing their experiences and learning with their partners. Only one participant reported that the programme was not appropriate for her, mainly because she disliked role-plays (the one with an old TBI who did not collaborate well and who dropped out at T3). This kind of activity was described in the informed consent and was expressly appreciated by others. There was one negative comment on the frequent use of repetition and summaries that were made deliberately to bypass possible cognitive difficulties. Suggestions for future programmes included increasing the number of sessions, creating larger groups, mixing genders, discussing more theoretical aspects of emotions and involving a psychiatrist.

Initial efficacy.   *Buss and Perry Aggression Questionnaire (AQ-12)* (main outcome measure). The Wilcoxon Signed-Rank test showed no significant differences between AQ-12 total scores at T1 (Mdn = 27.5; Range = 17–42) and T2 (Mdn = 31; Range = 13–34), $n = 10$, $Z = -0.20$, $p = .84$, $d = 0.06$, Power = 6%, neither between T2 (Mdn = 32; Range = 13–34) and T3 (Mdn = 27; Range = 15–37), $n = 9$, $Z = -0.56$, $p = .57$, $d = 0.19$, Power = 7.6%. However, significantly lower scores were observed in T3 when compared to initial scores in T1 (Mdn = 29; Range = 17–42), $n = 9$, $Z = -2.39$, $p = .02$, $d = 1.04$ (large effect size), Power = 75% (moderate). (For the contrasts of AQ-12 scores between T1 and T3, r as an

alternative measure of effect size equals −0.80, which is also considered a large effect and therefore does not differ from the intensity of Cohen's *d*. Person's correlation coefficient, *r*, was calculated using the *Z* score and the number of observations.)

For the secondary outcomes behavioural measures, no significant differences were found between T1 and T2 scores in the UPPS, FrSBe, SF-36, HADS or EQ, using the Wilcoxon Signed-Rank test.

DISCUSSION

Our study aimed to examine the feasibility, including the initial efficacy, of an outpatient anger management intervention, based on a CBT approach, for patients with chronic moderate to severe TBI. Based on Bowen et al. (2009), five selected feasibility criteria were considered.

Concerning *demand,* the final sample at T3 represented 45% of the patients who were initially contacted and 81% of those who actually started the programme. Even though recruitment may prove challenging, the retention rate can be relatively high. It is important to point out that, at the time of the initial contact, we had no previous information on the presence or absence of anger issues among the eligible patients. It is therefore possible that those who initially refused did not feel concerned by the problem. Thus, future recruitment through a clinician's referral may help to increase the recruitment rate, as patients will be more likely to display signs of anger management problems.

Nine out of 10 participants who completed the intervention recognised having an anger issue before starting the programme. This could have contributed to the high retention rate. Nonetheless, the participant without any post-traumatic anger complaints (only those reported by his proxy) completed all the phases of the study, including the follow-up. Due to the unavailability of French normative data or an established cut-off for the AQ-12, it is difficult to quantify the severity of self-reported problems at T1. This may limit the discussion on the participants' anger awareness. However, in the baseline assessment, both patients and their proxies reported a significant increase in general disruptive behaviour and impulsivity after the accident, which suggests that, overall, participants were relatively aware of their behavioural problems.

Concerning *implementation,* the number, frequency and duration of sessions were held as planned. The once-a-week frequency allowed time for participants to observe their target emotion/behaviour; and eight sessions of 60 minutes were considered appropriate for covering the intended topic, taking fatigability into account. Thus, the current time schedule should be maintained. Nonetheless, of the 10 participants who completed the intervention,

13

three ended up with individual sessions. Forming closed groups may be a challenge for any group intervention but, in our study, the priority given to small groups (due to possible attention impairment) may have brought additional specific difficulties, due to withdrawal and clinical incompatibilities between participants. Based on our experience, groups of patients with cognitive impairment should ideally include four participants, or at the least three. The group approach may be beneficial on both therapeutic and practical levels, but the possibility of adapting the group protocol to individual sessions may allow for a more rapid implementation and a better tailoring to the participant's needs (Huntley, Araya, & Salisbury, 2012).

Regarding *practicality*, the use of a flexible approach and specific strategies for bypassing clinically observed cognitive difficulties were essential for the progress of the sessions. For this reason, previous clinical and theoretical knowledge of the neuropsychological functioning of the TBI population plus CBT skills would be essential in administering such a protocol. As for the costs in the country where the study was carried out, group sessions may be financially advantageous for both participants and insurance companies since group members share the session tariff. From the position of the therapy provider, group sessions may contribute to an increase in therapist availability and consequently to a decrease in waiting lists.

Participants showed a keen interest and cooperation during the programme and provided mostly positive feedback in a satisfaction questionnaire administered at T2. Furthermore, we observed high rates of self-perceived benefits of the intervention in relation to awareness and capacity to manage anger. Therefore, regarding *acceptability,* the protocol can be considered satisfying and suitable for participants. Acceptability for the therapist was not formally addressed in this study, but the topic seemed clinically relevant given that participants could frequently contribute to recurrent examples of anger outbursts. All of the proposed modules met our expectations, including the one on cognitive restructuring and alternative thinking that was only described in the protocol of Walker et al. (2010) and for which the feasibility has not yet been reported.

With respect to *initial efficacy,* AQ-12 scores decreased significantly between T1 and T3, with a large effect size, but not between T1 and T2 or T2 and T3. Thus, significant lower levels of perceived aggressiveness were observed at four months after the end of the programme, but not at one week after its completion. One possible explanation is that, at T2, participants did not have time to observe their new behaviour patterns or to practise the learnt strategies. Accordingly, long-term positive outcomes of CBT without immediate effects have been reported in the non-neurological population and attributed to the generalisation of acquired strategies (Carroll et al., 1994). However, previous studies using CBT protocols for managing anger in the TBI population have found immediate effects of intervention, with

assessments carried out between zero and three weeks after the completion of the programme (Hart et al., 2012; Walker et al., 2010). These studies required high levels of self-reported anger for inclusion in the protocol, which was not the case in ours. Therefore, it is possible that our T2 outcomes reflect an increase in awareness of their problem, which is also supported by the participants' feedback as discussed previously. Similarly, in their study on coping skills after a TBI, Anson and Ponsford (2006) attributed the absence of significant changes in psychological measures after their intervention to a process of awareness and suggest that awareness should be assessed at different phases in future intervention studies.

Post-hoc power analysis indicated a moderate achieved power (75%). In order to increase the level of power in our future trials, an a priori power analysis suggests that, keeping to the same pre–post design, a sample of at least 10 participants who complete the follow-up phase would be required for an estimated power of 80% and 13 participants for a power of 90%. In order to shift the design into a randomised controlled trial, the analysis suggests that, with an estimated medium effect size (Cohen's $f = 0.25$), assuming a moderate correlation among repeated measures ($r = .5$) and an alpha level of 5%, the ideal sample size for achieving an estimated power of 80% would be 28, with 14 participants in each group – while for an estimated power of 90% this number increases to 36, with 18 participants per group.

We acknowledge that our study has several limiting factors, including the small sample size (which can be justified by its exploratory nature), the lack of formal anger assessment by proxies or external raters and that the same person conducts both assessments and interventions. In addition, participants had high levels of education (> 12 years) and low severity of cognitive impairment, which prevent us from generalising our findings to the larger population with moderate to severe TBI. Another major limitation of this research is the absence of control conditions, a recurrent problem in behavioural intervention studies for the TBI population, for practical and ethical reasons (Hart, Fann, & Novack, 2008). At a statistical level, it is important to point out that, in small samples, effect sizes may be overestimated.

Despite these limitations, the assessment of feasibility of our cognitive-behavioural group protocol for managing anger and aggressiveness after a TBI leads to the following conclusions: (1) The recruitment, the process of grouping participants and the characterisation of anger and aggressiveness at baseline need to be re-evaluated and improved for future designs. (2) The use of specific neuropsychological strategies for bypassing cognitive and other behavioural dysfunctions related to TBI is a crucial component in the success of the intervention and merits special attention. (3) The high retention rate, the convenient meeting schedule, cost advantages and its high rate of acceptability by participants are positive arguments for the implementation

of larger trials. (4) The significant reduction in AQ-12 scores at T3, with a large effect size and moderate power constitutes a change in the expected direction and supports the initial efficacy of our study. Therefore, the implementation of a randomised controlled trial would be justified.

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