ARTICLE

Predictors of Treatment Response to a Psychoeducational Intervention for Anger in Chronic Moderate-Severe Traumatic Brain Injury

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Objective: The investigators examined predictors of treatment response to anger self-management training (ASMT) among patients with chronic moderate-severe traumatic brain injury (TBI).

Methods: A multicenter randomized clinical trial comprising 90 participants with moderate-severe TBI was conducted. Fifty-four participants who were randomly assigned to receive active treatment and provided complete data were included in the current secondary analysis. Model averaging was used to examine the relative importance and significance of pretreatment variables for predicting change during treatment. Dependent variables were pre- to posttreatment changes in trait anger (TA) and anger expression-out (AX-O) subscale scores of the State-Trait Anger Expression Inventory–Revised. Predictors included demographic, injury-related, and neuropsychological variables, including both objective and self-reported measures of executive function, as well as readiness to change and participation of a significant other in treatment.

Results: Change in both dependent variables was predicted by higher baseline anger. Greater change in TA was additionally predicted by White race, higher education, shorter posttraumatic amnesia, and worse self-reported (but not objectively measured) executive dysfunction; the latter predictor may have indicated better self-awareness. Greater change in AX-O was additionally predicted by better episodic memory and, paradoxically, lower readiness to change.

Conclusions: Further research should focus on adapting psychoeducational anger treatments to better serve the diverse populations affected by moderate-severe TBI. These findings suggest that providing memory aids to support the use of learned strategies after treatment cessation would be beneficial. Further research should also examine the construct of readiness to change and specific aspects of executive function that may affect treatment response in psychoeducational treatments. These findings were derived from only one model of anger intervention, and the relevance to other treatment approaches cannot be assumed.

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Problematic anger is a common and important clinical concern following traumatic brain injury (TBI). New or worsened posttraumatic anger has a negative impact on family and social relationships, as well as the ability to maintain employment (1). Anger after TBI can be both neurologically based and reactive to external circumstances, and causes vary from person to person; premorbid personality factors may also play a role (2). Perhaps due in part to this heterogeneity, there are few evidence-based treatments. Among pharmacologic agents, beta blockers can be effective for aggression (3), and dopamine agonists have shown promise for irritability and aggressive behavior following TBI (4).

Psychoeducational approaches have shown some success with people with acquired brain injury (5–8). In the largest such randomized controlled trial to our knowledge, we tested an eight-session one-on-one program called anger self-management training (ASMT) against a structurally equivalent control treatment emphasizing brain injury education and emotional support. In brief, ASMT focused on increasing awareness and self-monitoring of anger, identifying and labeling the associated emotions, slowing down reactions to provoking situations, and increasing the repertoire of behavioral strategies to respond to provoking situations in a more constructive fashion. Importantly, the emphasis throughout was on normalizing anger as an essential human experience, understanding how anger expression may be affected by TBI, and changing one's self-management of anger rather than trying to suppress it. This program was significantly more effective than the control

program in reducing self-reported anger among persons with chronic moderate-severe TBI, a superiority also reflected in the global ratings of improvement as reported by both participants and their significant others (9).

Questions of treatment efficacy should not end with the overall question about whether a treatment is effective; knowing for whom the treatment has the greatest impact is equally important. Research on patient characteristics that are predictive of treatment response is critical for the ultimate goal of tailoring specific treatments for people with a particular problem. This is especially the case in populations such as the TBI patient population, in which a high degree of variability may obscure important aspects of treatment response in analyses conducted at the group level. Some potentially important characteristics are not modifiable, such as demographic variables and severity of TBI, but their relationship to treatment response is still important to understand for treatment development, as well as for use as covariates in data analyses. If shown to predict treatment response, modifiable variables, such as cognitive and emotional status before treatment, self-reported readiness to address anger problems, and the degree of caregiver involvement, could be addressed to make the treatment more efficacious for future participants.

In the present study, we conducted a secondary analysis of the data from the three-center ASMT trial (9) to determine the patient characteristics associated with a positive response to treatment. Review of the prior literature on anger treatment in acquired brain injury and in the general population, as well as predictors of treatment response in other domains of emotional function following TBI, revealed little information to guide specific hypotheses. In previous work on psychoeducational approaches to anger in TBI, Walker and colleagues (8) found that the inclusion of a caregiver in an information session did not affect participant outcomes. Our own pilot work on the ASMT program (10) suggested that integrity of objectively measured executive function was positively associated with treatment response, albeit in a very small sample. Studies of other psychoeducational treatments (e.g., cognitive-behavioral therapy [CBT]) for persons with depression, anxiety, or both following TBI have produced variable findings regarding predictors of treatment response. For example, severity of injury has been associated with worse response in some studies (11) but not others (12). Among cognitive functions measured prior to treatment, episodic memory was positively associated with treatment response in one trial of CBT for anxiety (13) but negatively associated with response to a coping skills group intervention (11). Executive dysfunction was associated with worse treatment response and higher dropout rate in a trial of trauma-focused treatment for veterans with posttraumatic stress disorder (PTSD) and mild to moderate TBI (14). Neither injury severity nor cognitive variables were contributory in a secondary analysis of a CBT trial for anxiety or depression following TBI, but greater symptom reduction was predicted by older age, more severe symptoms at baseline, longer time postinjury, and greater expectancy of change (15).

Relevant findings from neurotypical populations involved in anger management treatment are equally scant. In a large sample of outpatients treated within a forensic context, neurocognitive characteristics such as response inhibition and sustained attention did not predict the effects of anger management or dropout rate (16). Demographic characteristics such as race were not found to be associated with anger treatment outcomes in a sample of veterans (17). On conceptual grounds, Howells and Day (18) argued that readiness to engage in treatment could be a more salient predictor of treatment response for problematic anger compared with other clinical conditions.

In view of the relative lack of evidence pointing toward clear hypotheses, we elected to adopt an exploratory approach. While including the factors noted to be predictive in previous studies, we also examined a range of demographic and injury-related variables, as well as measures of cognitive and emotional status. Prior to random assignment to the ASMT or control arms in the parent trial, we administered a comprehensive battery of neuropsychological tests, any of which may be related to treatment response, and we documented other variables of potential interest, including demographic and injury-related characteristics, readiness for change, and degree of participation in treatment by a significant other. As described in greater detail below, we used an analytic approach known as model averaging, a type of multimodel inferencing (19, 20), to identify the best set of predictors. The main purpose of this study was to identify the candidate predictors of the efficacy of psychoeducational anger management treatment for TBI. We also aimed to illustrate the use of an analytic method that may be of potential value for other studies of neuropsychological treatments, many of which are insufficiently powered to support exploratory findings.

METHODS

The parent trial was overseen by the institutional review boards at all the participating sites. All procedures for the protection of human subjects complied in full with the Declaration of Helsinki.

Participants

Sixty community-dwelling persons with moderate-severe TBI were randomly assigned to the ASMT arm of the parent clinical trial. Of these, two were lost to follow-up, and another four were excluded from the present analysis due to incomplete data in the set of covariates. Thus, a total of 54 persons who completed the primary outcome assessment approximately 1 week after the final treatment session were included. Inclusion and exclusion criteria for the trial are described in detail elsewhere (9). In brief, participants had to be at least 6 months post-TBI and age 18–65 years at the time of enrollment. They also had to report anger that was

TABLE 1. Baseline demographic and clinical characteristics of community-dwelling participants with moderate-severe TBI randomly assigned to anger self-management training (N=54)[a]

Characteristic	Mean	SD
Age (years)	37.0	10.4
Education (years)	13.2	2.1
WASI (IQ)	97.6	16.2
RAVLT z-score	−1.5	1.4
Brixton Spatial Anticipation Test standard score	6.0	2.1
TMT Part B T-score	41.8	13.0
FrSBe T-scores		
Executive dysfunction	64.9	16.2
Disinhibition	58.3	12.8
Apathy	57.4	15.4
BSI Global Severity Index	69.2	8.1
TAS T-score	54.0	11.4
Readiness to change	5.7	1.6
Trait anger T-score (pretreatment)	64.8	11.1
Anger expression-out T-score (pretreatment)	65.5	12.4
	N	%
Male	44	81.5
Race		
White	40	72.0
Black	13	23.0
Native American	1	2.0
Other (e.g., mixed race)	2	3.0
Hispanic/Latino ethnicity	6	11.0
Significant other participated in treatment	33	61.0
	Median	Range
Time postinjury (months)	66.5	6.4–293.7
Posttraumatic amnesia duration (days)	29.0	2.0–730.0

[a] BSI=Brief Symptom Inventory; FrSBe=Frontal Systems Behavior Scale; RAVLT=Rey Auditory Verbal Learning Test; TAS=Toronto Alexithymia Scale; TMT=Trail-Making Test; WASI=Wechsler Abbreviated Scale of Intelligence.

new or worse since their TBI. Problematic anger was verified by a score ≥1 standard deviation above the mean for age and gender on the trait anger (TA) or anger expression-out (AX-O) subscales of the State-Trait Anger Expression Inventory–Revised (STAXI-2) (21) or a score ≥9 on the Brief Anger–Aggression Questionnaire (22). Persons with major mental illness, involvement in one-on-one psychotherapy, or an inability to speak English were excluded.

Measures

Treatment response was defined with reference to change in two measures of self-reported anger administered before and after treatment. These were two subtest scores from the STAXI-2 used to assess two different aspects of anger: TA and AX-O. TA refers to a temperament associated with the tendency to become angry (e.g., by perceiving situations as hostile or unjust), whereas AX-O involves the outward (behavioral) expressions of anger. Thus, TA is a broader construct and is typically used to measure the efficacy of mainstream anger management protocols; it was also the measure that showed the strongest response to ASMT, compared with the control condition, in the primary analysis (9). Parallel analyses were conducted for TA and AX-O to allow for the possibility that different variables might emerge as predictors of each.

Predictor variables were all measured prior to random assignment to the ASMT arm of the parent trial. Demographic variables included age at enrollment, sex, race (White or non-White), years of education, and whether a significant other was available and willing to participate in portions of the treatment (this was encouraged but not required for trial participation). TBI-related variables included time postinjury (months) at enrollment and severity of injury as measured by duration of posttraumatic amnesia; both these variables were log transformed. Duration of posttraumatic amnesia was ascertained by using a structured interview that has been used in other studies of chronic TBI, with the retrospective estimate found to correlate reasonably well with posttraumatic amnesia measured prospectively (23).

Neurocognitive variables included general intelligence (IQ), as measured with the Wechsler Abbreviated Scale of Intelligence (24); declarative memory, as assessed with the Rey Auditory Verbal Learning Test (25) (z-score for the sum of trials 1–5); and objectively measured executive function, as measured by using the standard score from the Brixton Spatial Anticipation Test (26) and T-score from the Trail-Making Test, Part B (27). For self-reported frontal/executive dysfunction, we included the T-scores from each of the three subscales of the Frontal Systems Behavior Scale (FrSBe) (28): apathy, executive dysfunction, and disinhibition.

Emotional function variables included the Global Severity Index of the Brief Symptom Inventory (29); the total score from the 20-item Toronto Alexithymia Scale–I (30); and the score (0–10) from the Readiness Ruler, originally developed to measure the stage of change from contemplation to action in addiction treatment (31), with wording adapted for "changing the way I deal with my anger/irritability." For each dependent variable, we also included the pretreatment T-score for the relevant STAXI-2 subtest (i.e., TA or AX-O).

Data Analyses

Data analyses were conducted by using the *glmulti* R package (32). Pre- to posttreatment changes in trait anger and AX-O subscale scores were analyzed in separate multiple regression models by using model averaging, a method that provides a mechanism for accounting for model uncertainty by combining parameter estimates across a set of plausible candidate models (20, 33). This approach was selected because with 18 candidate predictors and response information from only 54 participants who provided complete baseline

and outcome data, it was not feasible to use the standard approach of including all covariates of interest in one multivariable model and backward-eliminating nonsignificant predictors.

An alternative approach commonly seen in the clinical research literature is to conduct separate regression analyses on smaller clusters of variables (demographic variables in one model, cognitive variables in another model, etc.) and then combine the best predictors from each cluster into a "final" model. However, variables that fit one model may not be optimal when combined in another model; thus, the final model can be very misleading (33). In contrast, the model-averaging approach identifies a set of candidate models with the best goodness-of-fit measures and averages the estimators from these candidate models. Model averaging provides particularly informative results when several models fit the data equally or similarly well, although they may differ substantially in terms of the variables included (34).

In the first stage of model averaging, all possible candidate models (including all combinations of the predictors) were fitted and ranked according to the Akaike information criterion (AIC). Next, the set of the best fitted models was selected (i.e., those with a cumulative relative evidence weight of 95%). The relative evidence weight of each candidate model is the exponentiated difference in information criteria between the best model (the one with the lowest AIC) and the given candidate model, normalized so that relative evidence weights for all models sum to 1. The importance of each predictor is the sum of the relative evidence weights of all models in which the predictor appears. The resulting set of the best-fitted models was used to determine the importance of each predictor and model-averaged estimates of the coefficients for all predictors based only on the set of the best-fitted models. The optimal parsimonious models were obtained from the models with the lowest AIC by backward elimination of nonsignificant predictors.

TABLE 2. Model-averaging results for pre- to posttreatment changes in trait anger among 54 community-dwelling participants with moderate-severe TBI randomly assigned to anger self-management training[a]

Predictor	Importance[b]	Estimate	95% CI
Race	1.00	−5.14	−9.83 to −0.44
Trait anger baseline T-score	1.00	0.81	0.57 to 1.05
Posttraumatic amnesia duration	0.93	−1.16	−2.56 to 0.24
Education (years)	0.89	0.88	−0.31 to 2.06
Executive dysfunction T-score	0.82	−0.12	−0.31 to 0.07
Readiness to change	0.68	−0.82	−2.48 to 0.83
Time postinjury (months)	0.65	0.83	−0.99 to 2.66
Disinhibition T-score	0.62	−0.11	−0.35 to 0.13
BSI Global Severity Index T-score	0.56	−0.13	−0.47 to 0.20
Brixton Spatial Anticipation Test standard score	0.43	0.32	−0.65 to 1.29
Significant other involved in treatment	0.23	−0.55	−2.72 to 1.61
Age (years)	0.16	0.02	−0.06 to 0.09
Apathy T-score	0.06	0.00	−0.02 to 0.02
WASI (IQ)	0.05	0.00	−0.01 to 0.01
Sex	0.04	0.05	−0.30 to 0.40
RAVLT z-score	0.04	−0.01	−0.12 to 0.09
TMT Part B	0.04	0.00	−0.01 to 0.01
TAS T-score	0.03	0.00	−0.01 to 0.01

[a] BSI=Brief Symptom Inventory; RAVLT=Rey Auditory Verbal Learning Test; TAS=Toronto Alexithymia Scale; TMT=Trail-Making Test; WASI=Wechsler Abbreviated Scale of Intelligence.
[b] The importance value is defined as the sum of the relative evidence weights of all models in which a predictor appears.

RESULTS

Participants' demographic and clinical characteristics are presented in Table 1, and the model-averaging results for treatment changes in TA are summarized in Table 2. The importance values of five covariates (race, baseline TA, posttraumatic amnesia duration, years of education, and self-reported executive dysfunction) fell above the customarily used threshold of 0.8, but only race and baseline trait anger had model-averaged coefficients significantly different from zero (i.e., the 95% confidence interval did not include zero). Thus, larger treatment effects are potentially associated with White race, higher education, worse TA and worse self-reported executive dysfunction at baseline, and shorter posttraumatic amnesia duration. These five covariates are exactly the ones included in the optimal parsimonious model (Table 3) obtained by eliminating nonsignificant predictors from the model with the lowest AIC (380.1). Notably, the AIC of this model (380.6) is very close to the lowest AIC.

The model-averaging results for treatment changes in AX-O are summarized in Table 4. The importance values of three covariates (baseline AX-O, memory, and readiness to change) fell above the customarily used threshold of 0.8 and equaled 1.0. All three covariates had model-averaged

TABLE 3. Optimal parsimonious model results for pre- to posttreatment changes in trait anger among 54 community-dwelling participants with moderate-severe TBI randomly assigned to anger self-management training[a]

Predictor	Estimate	95% CI	p
Trait anger baseline T-score	0.77	0.10 to 7.47	0.000
Race	−5.79	2.26 to −2.56	0.014
Education (years)	1.07	0.53 to 2.04	0.047
Posttraumatic amnesia duration	−1.27	0.62 to −2.06	0.045
Executive dysfunction T-score	−0.17	0.07 to −2.48	0.017

[a] The Akaike information criterion of the model was 380.6, the multiple R^2 was 0.646, and the adjusted R^2 was 0.609.

TABLE 4. Model-averaging results for pre- to posttreatment changes in anger expression-out among 54 community-dwelling participants with moderate-severe TBI randomly assigned to anger self-management training[a]

Predictor	Importance[b]	Estimate	95% CI
Anger expression-out baseline T-score	1.00	0.70	0.45 to 0.94
RAVLT z-score	1.00	3.11	0.61 to 5.62
Readiness to change	1.00	−2.70	−4.81 to −0.58
Apathy T-score	0.58	−0.09	−0.30 to 0.12
Significant other involved in treatment	0.52	−2.29	−8.46 to 3.88
Brixton Spatial Anticipation Test standard score	0.50	0.58	−0.99 to 2.16
WASI (IQ)	0.33	−0.05	−0.23 to 0.13
BSI Global Severity Index T-score	0.21	0.05	−0.15 to 0.25
Race	0.21	−0.66	−3.36 to 2.04
Age (years)	0.11	0.01	−0.05 to 0.08
Posttraumatic amnesia duration	0.11	−0.07	−0.43 to 0.29
Time postinjury (months)	0.10	0.09	−0.35 to 0.53
Executive dysfunction T-score	0.09	−0.01	−0.04 to 0.03
Disinhibition T-score	0.06	0.00	−0.02 to 0.02
TAS T-score	0.05	0.00	−0.02 to 0.02
Education (years)	0.04	0.01	−0.08 to 0.10
Sex	0.04	−0.01	−0.41 to 0.39
TMT Part B	0.04	0.00	−0.01 to 0.01

[a] BSI=Brief Symptom Inventory; RAVLT=Rey Auditory Verbal Learning Test; TAS=Toronto Alexithymia Scale; TMT=Trail Making Test; WASI=Wechsler Abbreviated Scale of Intelligence.
[b] The importance value is defined as the sum of the relative evidence weights of all models in which a predictor appears.

coefficients significantly different from zero (the 95% confidence interval did not include zero). Thus, larger treatment effects are potentially associated with better memory test performance and worse AX-O at baseline. Paradoxically, however, lower readiness to change was associated with larger effects on AX-O. Inspection of the readiness scores revealed an approximately normal distribution, and posthoc correlation confirmed a negative association with the degree of change in AX-O ($r=-0.23$, $p=0.09$); the relation of readiness to change in trait anger was also negative but smaller ($r=-0.14$, $p=0.32$). The three most important covariates for AX-O are exactly the ones included in the optimal parsimonious model (Table 5) obtained by eliminating nonsignificant predictors from the model with the lowest possible AIC (414.9). Here again, the AIC of this model (415.1) was very close to the lowest AIC.

TABLE 5. Optimal parsimonious model results for pre- to posttreatment changes in anger expression-out among 54 community-dwelling participants with moderate-severe TBI randomly assigned to anger self-management training[a]

Predictor	Estimate	95% CI	p
Anger expression-out baseline T-score	0.68	0.44 to 0.92	<0.001
RAVLT z-score	3.00	0.83 to 5.17	0.008
Readiness to change	−2.72	−4.57 to −0.86	0.005

[a] The Akaike information criterion for the model was 415.1, the multiple R^2 was 0.497, and the adjusted R^2 was 0.466. RAVLT=Rey Auditory Verbal Learning Test.

DISCUSSION

In this study, we used model averaging to explore the potential predictors of treatment response in a psychoeducational program designed for people with chronic moderate-severe TBI and self-reported problematic anger. Several findings are noteworthy. First, aside from the baseline scores on the respective scales, changes in the two anger measures (TA and AX-O) were most strongly associated with different sets of predictors. This reinforces the notion that trait anger, roughly defined as the tendency to become angry in response to perceived mistreatment or injustice, and the outward expressions of anger reflect different, albeit related, constructs. Our findings also support the use of multidimensional measures in order to more fully understand the complexity of anger-related behavior among persons with TBI.

The prediction of more robust treatment response by a more extreme baseline level of self-reported problems has been noted in previous research on TBI (15). While some of this effect may be due to artifact (e.g., regression to the mean), or to the fact that there is more room for improvement with worse problems, it is also likely that greater difficulty or better awareness of the problem can serve as a motivator for change. In this vein, it is of interest that worse self-reported executive dysfunction, presumably reflecting greater self-awareness of deficits in problem solving and related cognitive functions, was also associated with greater change in TA. The ASMT program emphasizes developing sensitivity to the internal signals and processes of anger as a first step in managing one's reactions to threatening situations. A self-report measure, such as FrSBe, which requires awareness of internal processes as well as overt behavior, might well serve as a marker for the ability to develop such sensitivity during treatment. A limitation of our study is that we did not collect collateral FrSBe ratings for all participants, because only some of them had a significant other involved in the program. Thus, we cannot rule out unrealistic reporting of symptoms (e.g., hypersensitivity or exaggeration) as a contributor to higher self-ratings.

As opposed to the self-reported findings, objective measures of executive function were less important predictors for both dependent variables (pre- to posttreatment changes in TA and AX-O subscale scores) (Tables 2 and 4). This stands in contrast to our own pilot data (10), as well as in contrast to at least one larger study that showed a negative relationship between executive function and treatment response to a behavioral treatment for PTSD in a TBI sample

(14). Because executive function is a multifaceted construct, further research would be necessary to pinpoint the specific cognitive operations, if any, that help or hinder change in emotional behavior following TBI.

Among the other neurocognitive variables, memory was associated with better treatment response for anger expression but not trait anger. We speculate that episodic memory is more critical for retrieving the specific behavioral alternatives to expressing anger. In follow-up interviews, the participants in the ASMT program cited memory dysfunction as a barrier to using learned strategies in time to respond to stressful situations (35). The present findings reinforce the notion that persons with moderate-severe TBI may particularly benefit from booster sessions (36) or structured ways of refreshing the material covered in treatment sessions. This could be as simple as use of cue cards, to be carried in one's wallet, or higher-tech methods, such as reminders installed in a smartphone app. There is increasing evidence that the latter methods are feasible even for participants with significant cognitive impairment due to TBI (37).

Although they are not modifiable, demographic predictors are important to explore in the event that adjustments to treatment may make interventions more accessible to those of different ages, genders, or racial/ethnic groups. In the present study, non-White status (in this case, mostly Black participants) was associated with less treatment response. In a randomized trial of telephone counseling to facilitate community adjustment after discharge from inpatient TBI rehabilitation, less gain from treatment among Black participants was observed (38). Additionally, there is an extensive body of research showing worse outcomes of TBI in Black and Hispanic communities, for reasons that remain poorly understood (39). In our trial, these effects may have been due in part to patient-therapist mismatch; all three clinicians who delivered the ASMT were White. In debriefing interviews, some of our Black participants remarked that several strategies taught in the ASMT program were misaligned with the prevailing culture of their neighborhoods. For example, expressing one's feelings (other than or instead of anger) could be construed as weakness or loss of power. Future adaptations of the ASMT might therefore include more emphasis on assertive behavior and its advantages over aggressive behavior. The inclusion of more diverse participants in future treatment development, as well as consideration of social determinants of emotional expression, would provide valuable insights into ways of adapting the program to meet the needs of people from different cultural backgrounds.

Perhaps the most surprising finding was the important, but negative, association of readiness to change one's outward expression of anger, which is difficult to explain in light of the postulated importance of this variable to successful anger treatment (18). Further examination of this variable would be essential, perhaps using different measures of readiness and/or qualitative methods to explore participants' perceptions of the meaning of this construct.

The main limitation of this study is the small sample size. In view of the fact that most participants were White, this precluded meaningful conclusions regarding treatment response as affected by racial, ethnic, and cultural factors. In addition, these findings apply to only one model of anger treatment for TBI and may not be relevant for different types of programs. Finally, it should be noted that the program described here was tested in moderate-severe TBI; thus, the findings may not apply to persons with mild TBI or to other populations receiving anger treatment.

With a modest sample size, investigators are typically restricted to a limited number of predictors for the outcomes of interest. To overcome this restriction, we used model averaging, a well-established statistical methodology within the framework of multimodel inference (20). This methodology has been successfully applied in social and behavioral science research (40). Multimodel inference provides a statistically rigorous way of accounting for model uncertainty by combining parameter estimates across different plausible models with optimal goodness of fit. This allows for valid conclusions about important candidate predictors when the possible predictors are numerous and when the sample size is relatively small. In such situations, an a priori method of variable selection is infeasible, while model selection can yield models with different sets of predictors and similar goodness of fit. By considering all predictors in all plausible models with optimal goodness of fit, model averaging provides tools for evaluating the importance of numerous candidate predictors in limited data sets. In this study, the most important predictors in each analysis were exactly the ones that remained significant in the most parsimonious models. This finding lends confidence in the soundness of the models for each of the variables representing treatment effects. However, these candidate variables should be tested in further validation studies.

CONCLUSIONS

Prediction of treatment response is crucial for effective intervention development. The present findings underscore the importance of measuring multiple dimensions of anger and multiple predictors, including demographic characteristics and neurocognitive functions. Race and ethnicity, episodic memory, executive function, and expressed readiness to change warrant attention in the clinical context and should also be explored in further research. The multimodel-inferencing approach used here may be fruitfully applied in neuropsychological treatment trials, which are frequently underpowered for exploratory research.

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