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## Teen Online Problem Solving for Teens With Traumatic Brain Injury: Rationale, Methods, and Preliminary Feasibility of a Teen Only Intervention

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### Abstract

**Purpose/Objective**—To describe the Teen Online Problem Solving—Teen Only (TOPS-TO) intervention relative to the original Teen Online Problem Solving—Family (TOPS-F) intervention,

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to describe a randomized controlled trial to assess intervention efficacy, and to report feasibility and acceptability of the TOPS-TO intervention.

**Research method and design**—This is a multisite randomized controlled trial, including 152 teens (49 TOPS-F, 51 TOPS-TO, 52 IRC) between the ages of 11–18 who were hospitalized for a moderate to severe traumatic brain injury in the previous 18 months. Assessments were completed at baseline, 6-months post baseline, and 12-months post baseline. Data discussed include adherence and satisfaction data collected at the 6-month assessment (treatment completion) for TOPS-F and TOPS-TO.

**Results**—Adherence measures (sessions completed, dropout rates, duration of treatment engagement, and rates of program completion) were similar across treatment groups. Overall, teen and parent reported satisfaction was high and similar across groups. Teens spent a similar amount of time on the TOPS website across groups, and parents in the TOPS-F spent more time on the TOPS website than those in the TOPS-TO group ( $p = .002$ ). Parents in the TOPS-F group rated the TOPS website as more helpful than those in the TOPS-TO group ( $p = .05$ ).

**Conclusions/Implications**—TOPS-TO intervention is a feasible and acceptable intervention approach. Parents may perceive greater benefit from the family based intervention. Further examination is required to understand the comparative efficacy in improving child and family outcomes, and who is likely to benefit from each approach.

### Keywords

problem solving intervention; traumatic brain injury; telehealth

## Introduction

Traumatic brain injury (TBI) within the pediatric population results in 2,685 deaths, 37,000 hospitalizations, and 435,000 emergency department visits annually in the United States (Faul, Xu, Wald, & Coronado, 2010), making it one of the leading causes of morbidity and mortality in childhood, and the most common source of acquired disability in children (Thurman, 2016). TBI contributes to impairment in cognition, social competence, and behavioral functioning, which may persist for years following the injury (Anderson, Catroppa, Morse, Haritou, & Rosenfeld, 2000; Ganesalingam, Sanson, Anderson, & Yeates, 2006; Max et al., 2005). Specifically, attention, self-regulation, and planning/problem solving-abilities are among the domains most often negatively affected (Janusz, Kirkwood, Yeates, & Taylor, 2002; Max et al., 1998; Turkstra, McDonald, & DePompei, 2001). Frequently considered under the broader umbrella of executive function (EF), these skills continue to develop through adolescence into early adulthood and provide a critical foundation for academic and social success as well as longer-term functional outcomes such as employment, secondary education, and meaningful relationships (Arnett et al., 2013; Fulton, Yeates, Taylor, Walz, & Wade, 2012; Robinson et al., 2014).

Among the age groups at highest risk for TBIs are those 15–19 years (Faul et al., 2010). Adolescence constitutes a critical period for neural, social, and emotional development. In addition to the cognitive and behavioral changes often associated with acquiring a TBI, this population is at increased risk due to the disruption of normative developmental processes

characterized by increased autonomy and decision-making. Adolescents with TBI are at elevated risk for difficulties navigating the complex demands of schoolwork, social relationships, and planning for the future in the context of impaired self-regulation (Jacobs & Anderson, 2002; Janusz et al., 2002; Kennedy & Coelho, 2005).

Despite the high incidence of adolescent TBI and its attendant challenges, existing interventions targeted to adolescents are extremely limited and access to treatment can be restricted by distance and finances. One exception is the work of Wade and colleagues, who have published results from several randomized clinical trials of online family problem solving (Kurowski et al., 2013; Wade, Carey, & Wolfe, 2006a, 2006b; Wade, Michaud, & Brown, 2006; Wade et al., 2014, 2011, 2010). This intervention model provides training in problem solving and communication skills to children with TBI as well as their families and is predicated upon the expectation that improvements in family level skills will result in improvements in the child's behavior. Across three trials, consistent evidence was found for improvements in behavioral outcomes and EF skills among older adolescents receiving the problem-solving intervention (Kurowski et al., 2013; Wade et al., 2014, 2010), suggesting that older youth are particularly likely to benefit.

Problem solving therapy (PST; D'Zurilla & Nezu, 2010; Nezu, 1986; Nezu & Perri, 1989) is a cognitive-behavioral treatment that addresses the individual's attitude and approach toward solving problems, equipping them with skills to systematically resolve problems that are causing distress. Psychological distress or psychopathology is conceptualized as the product of a maladaptive approach to coping with life stresses (Lazarus & Folkman, 1984). By approaching problems positively and systematically, the individual is able to reduce the consequences of various life stresses on their functioning. For individuals with TBI, emerging deficits in EF may lead to broad impairments in problem-solving which further exacerbate psychological distress.

For adults with TBI, PST and goal management training have gained currency as effective approaches for improving executive dysfunction (Rath, Simon, Langenbahn, Sherr, & Diller, 2003; von Cramon, Mattes-von Cramon, & Mai, 1991). In a pilot study completed by Novakovic-Agopian and colleagues (2011) with 16 adults with TBI, participants were assigned to receive either a treatment integrating self-regulation, goal management training, and PST, or an educational control treatment. At Week 5, participants who completed goal management training displayed significant improvements on tests of attention and EF and had fewer functional task failures, while the educational instruction group did not improve. These findings raise the question of whether individual PST/self-regulation training would be equally effective in adolescents with TBI, or as in the Wade studies, whether family involvement is required to support PST in adolescents.

To address this question, we reconfigured the Teen Online Problem Solving (TOPS) program previously described in the literature (Wade et al., 2010; Wade, Walz, Carey, & Williams, 2008) to be delivered as an individual rather than family-centered program. The intervention has not been conducted outside of the family setting, and little is known about how the program will function in the absence of parental involvement. Throughout the intervention, participating parents often provide scaffolding (sometimes a substantial

amount) for their teen, which is thought to allow the child to use the skills outlined in the treatment. A key first step to understanding how this program functions without family involvement (as is seen in the teen-only program) is to examine the feasibility and acceptability. The aims of the larger funded project were to develop this teen-only intervention, examine if teens were able to engage in the intervention without parental involvement (feasibility), explore teen and family perceptions of the programs (satisfaction), and examine improvements in adolescent behavior and parent/family functioning. The findings regarding changes in functional outcomes have not yet been reported. Our goals in the current article are to (a) describe the TOPS-Teen Only (TOPS-TO) program relative to the original TOPS-Family (TOPS-F) program and (b) report initial feasibility and acceptability through adherence and satisfaction data reported by adolescents and parents/caregivers receiving the TOPS-F and TOPS-TO. This is the first article describing any aspect of the randomized controlled trial.

## Intervention Group Details

### TOPS-F

The content of the TOPS-F intervention was designed to address common sequelae of TBI in adolescents, including deficits in social competence and executive functioning, such as inhibition, self-regulation, planning, and problem solving. These deficits may limit teens' ability to navigate common social tasks and developmental transitions. Problem-solving interventions have been shown to reduce depressive symptoms and behavioral difficulties in populations other than TBI (Kazdin, Siegel, & Bass, 1992; Puskar, Sereika, & Tusaie-Mumford, 2003; Spence, Sheffield, & Donovan, 2003) and to provide an avenue for addressing executive functioning difficulties, particularly in planning and self-regulation, following TBI. Finally, the multifaceted, family-centered approach, addressing collaborative problem-solving and effective communication was used to provide the necessary scaffolding and addressing the complex cognitive and behavioral sequelae of adolescence with TBI.

The intervention consisted of online didactic modules as well as concurrent videoconference sessions with a therapist and the family. TOPS-F included 10 core sessions and eight supplemental sessions (families chose to complete up to four supplemental sessions; see Table 1). The 10 core sessions provided training in stress management, problem solving, communication, and social skills. The specific heuristics and accompanying acronyms are listed in Table 2. Topics and content of supplemental sessions were developed based on stakeholder feedback to address issues that were relevant for some, but not all, families. These sessions were more targeted toward the stressors or burdens of individual families, and selection of supplemental sessions occurred after a self-assessment and discussion with their therapist.

For both the core and supplemental sessions, families completed the online self-guided didactic modules prior to meeting with a therapist via videoconference. Each self-guided online web session included real adolescents talking about how TBI affected them, didactic content regarding the skill (e.g., problem-solving), video clips showing adolescents and/or families modeling the skills, and exercises giving the family an opportunity to practice the skill. Exercises were designed to be interactive and enjoyable by incorporating animation

and graphics. After the completion of the self-guided web pages, the family met with the therapist via videoconference. During these videoconference sessions, the therapist reviewed the exercises completed by the family, and beginning in Session 3, helped the family implement the problem-solving process with a problem or goal identified by the family. Thus, these synchronous sessions gave the adolescent and family experience in implementing the EF skills (planning, problem-solving, self-monitoring) taught through the didactic, self-guided web pages. Families were given access to new didactic modules after completion of each videoconferencing session. Families were able to access all completed didactic content (current session and previous sessions) throughout the study period. Finally, in addition to the session materials and therapist interaction, families had access to the TOPS website homepage featuring links to announcements, contact information, and resources from other brain injury websites. These resources included links to local, state, and national brain-injury associations and to sites specific to pediatric brain injury, such as the Center on Brain Injury Research and Training, Brain Injury Partners, and the National Database of Educational Resources on Traumatic Brain Injury. These websites provided didactic information about brain injury as well as modules about working with schools and family advocacy, handling stress, and problem solving around common issues.

### **TOPS-TO**

To develop TOPS-TO, focus groups with adolescents with TBI and their caregivers were conducted to gather qualitative feedback regarding the TOPS-F intervention and drive refinement of intervention materials. Adolescents and their parents provided consistent feedback that the content was valuable, but overly long and verbose. Adolescents indicated that they preferred shorter online modules requiring less than 20 min to complete. Thus, online modules were abbreviated and longer modules were broken into two shorter modules that could be completed at separate times (see Table 1 for a revised list of sessions). In addition, efforts were made to further streamline and abbreviate didactic content while increasing interactivity. Based on feedback surrounding parental involvement, the program was designed for parents to participate with the teen in Sessions 1 (getting started), 2 (staying positive), and 10 (planning for the future), with the remaining sessions conducted with the therapist and adolescent alone. See Table 1 for a complete list of sessions and a brief description of their content. This framework parallels traditional individual therapy models with parent involvement at the beginning and end of treatment, but with a majority of the intervention carried out with the teen individually.

The overall structure and content of the TOPS-TO intervention was the same as the TOPS-F intervention (discussed above), with Web-based self-guided modules and synchronous videoconference sessions with a therapist. Parents were given a separate login to access the TOPS-TO web modules to ensure familiarization and understand the skills that the teen was learning. Similar to the TOPS-F intervention, participants were provided with the study website homepage that presented links to announcements, contact information, and resources from other brain injury websites (details above).

## Internet Resource Comparison

Internet resource comparison (IRC) families were given access to a home page with links to online resources identical to those given on the TOPS-F and TOPS-TO homepage, but were not able to access specific intervention content. Families were encouraged to spend at least 1 hour each week accessing information regarding pediatric brain injury on the web throughout the study period, track the sites that they visited, and provide information about the TBI related websites visited and the time spent at each site at study completion.

## Method

### Study Design

The effectiveness of the interventions was examined using a three-arm (TOPS-F, TOPS-TO, and IRC), multisite, randomized controlled trial ([clinicaltrials.gov](https://clinicaltrials.gov) trial number NCT01042899).

### Study Setting

The current study was completed in the United States, with participants recruited from four children's hospitals and one general medical center, at locations in Ohio and Colorado. All procedures were approved by institutional review boards at each of the participating institutions. Inpatient admissions and trauma registries at participating institutions were screened for eligible children. All baseline and follow-up assessments were completed in the family's home. The first therapy visit was completed in the family's home, and all subsequent therapy sessions took place via videoconference.

**Participants**—Eligible participants were between 11 and 18 years old with moderate-to-severe TBI in the previous 18 months. Consistent with previous studies, severe TBI was defined as a Glasgow Coma Scale (GCS) score of 8 or less, and a moderate TBI was defined as a GCS score of 9–12 or a GCS score greater than 12 accompanied by evidence of neurologic impairment via abnormalities on imaging. Eligibility requirements, in addition to age and injury severity, included residing at home with the parent or primary caregiver and English as the primary language spoken in the home. Children were excluded if there was a history of child abuse documented in the medical records or reported during parent interview, if the child could not communicate sufficiently to participate in the sessions, if the teen had ever been hospitalized for psychiatric reasons, if the primary caregiver had been hospitalized for psychiatric reasons in the previous 5 years, or if the child did not reside with their parent/legal guardian.

**Random assignment**—After obtaining informed consent from parents and assent from adolescents, and baseline measures were administered, families were given an envelope informing them of their group assignment (TOPS-F, TOPS-TO, IRC). Group assignment was stratified by child's gender and race/ethnicity. The envelopes and associated group assignments were generated prior to study initiation using a computer program developed by the Division of Biostatistics at the primary site and were selected in order within each strata. Although we were unable to conceal group assignment from the families or research staff,



given the design of the study, parent and teen report served as the primary outcome measured, therefore minimizing opportunity for research staff bias.

## Procedures

**Baseline visit**—Baseline assessment measures were completed during a home visit. Families in all three treatment groups were given high-speed Internet access, and families who did not have an existing home computer were loaned one to use throughout their participation in the study. During this visit, the research coordinator set up the computer and Internet connection (if necessary), instructed participants how to get online and log onto the study website, and provided written instructions that they could refer to later. The parent completed measures about themselves as well as their child, while the child completed a brief assessment of cognitive functioning.

**Follow-up visits**—Follow up visits were conducted 6 and 12 months after the baseline visit. At each of the follow-up visits, the parent completed measures about themselves and their child, as well as a short interview with the project coordinator.

**Treatment protocol and therapist experience and training**—Both the TOPS-F and TOPS-TO interventions were delivered by licensed psychologists and advanced clinical psychology graduate students. All therapists completed an intensive 2-day training on the consequences of TBI and delivery of the interventions. Session objectives and activities were outlined in a detailed therapist manual. Given the significant overlap in session content and objectives of the two TOPS interventions, with the exception of emphasis on family communication and support in the TOPS-F group, all therapists were trained to deliver both interventions. Therapists were also required to demonstrate appropriate delivery of the intervention with a pilot participant prior to beginning with their first study participant. The intervention developer (clinical psychologist) conducted weekly supervision meetings with the graduate students and biweekly meetings with the licensed psychologists were held to review progress and ensure fidelity to treatment objectives. Fidelity was assessed by reviewing end-of-session checklists documenting the content covered in each session and the aim and resultant plan of the problem-solving process. Ongoing review of the problem-solving process and the resultant plan for each patient ensured that focus of each session was on the problem-solving process. Fidelity on these checklists exceeded 90%.

## Measures

The focus of this article is to document the feasibility and satisfaction with the TOPS-TO intervention in comparison to the traditional TOPS-F intervention. In addition, the measures discussed below (i.e., number of sessions completed, and satisfaction with intervention materials) are only relevant to the TOPS-TO and TOPS-F intervention groups. Therefore, while demographic information for all three treatment groups (including IRC) is reported, discussion of adherence and patient/family satisfaction are limited to the TOPS-TO and TOPS-F groups (excluding IRC group).

**Adherence**—Several metrics were used to evaluate adherence to the intervention. These included the total number of sessions completed, the average length of time between

sessions, and the average length of time between completion of the first session and completion of the final session.

**Patient/family satisfaction**—Both qualitative and quantitative methods were used to assess the teen’s and family’s experience with the treatment that they received. Participating adolescents and their parent/caregiver completed satisfaction surveys, which contained items requesting feedback on specific characteristics of the TOPS-F and TOPS-TO interventions, and perceived helpfulness of the program (i.e., I get along better with my parents, I reached the goals that I had been I began the program, etc.). A Website Rating Scale was also administered to evaluate ease of use and helpfulness of the overall program as well as specific content and components. The satisfaction survey and Website Rating Scale were completed by both parents and teens at the 6-month assessment visit.

## Results

### Participants

A total of 152 teens participated in the study (49 TOPS-F, 51 TOPS-TO, and 52 IRC). See Table 3 for demographic variables. No significant group differences were noted on any of the demographic variables.

### Adherence

Independent samples *t* test revealed that teens in the TOPS-TO group ( $M = 8.40$ ,  $SD = 2.80$ ) completed a similar number of sessions as the TOPS-F group ( $M = 8.00$ ,  $SD = 2.90$ ). In addition, those who completed the 6-month assessment ( $n = 111$ ) were compared to those who dropped out prior to completion of the 6-month assessment visit ( $n = 41$ ). Drop-out rates were similar across treatment groups (TOPS-F = 32.65%, TOPS-TO = 25.49%). Those who completed the 6-month assessment were not demographically different than those who dropped out prior to this assessment (age, gender, race, time since injury, socioeconomic status); however, children who dropped out of the study were more likely to have severe injuries (61%) compared to those who completed the 6-month assessment (38%). For those who completed more than one session (TOPS-F = 77.55%, TOPS-TO = 78.85%), the average time between sessions, as well as the duration from Session 1 to last session completed was calculated. TOPS-F and TOPS-TO groups had similar average duration between sessions—TOPS-F:  $M = 20.14$  days,  $SD = 10.61$ ; TOPS-TO:  $M = 17.32$  days,  $SD = 7.18$ ,  $t(71) = 1.33$ ,  $p = .19$ —and duration of treatment engagement—TOPS-F:  $M = 133.50$  days,  $SD = 66.67$ ; TOPS-TO:  $M = 127.50$  days,  $SD = 49.71$ ,  $t(71) = .43$ ,  $p = .67$ . The TOPS treatment groups displayed similar rates of completing the 10 core sessions (TOPS-F: 36.73%; TOPS-TO: 46.15%,  $\chi^2 = .92$ ,  $p = .34$ ) and supplemental sessions (TOPS-F: 14.29%; TOPS-TO: 13.46%,  $\chi^2 = .01$ ,  $p = .90$ ).

**Patient/family satisfaction**—Data regarding satisfaction were only collected from families in the TOPS-F and TOPS-TO groups. Therefore, the results presented below do not include the IRC group. Teen ratings of satisfaction with the overall program did not differ between the TOPS-F and TOPS-TO groups (see Table 4). Interestingly, teens in the TOPS-F group reported higher agreement with the statement “I get along better with my parents”



than the TOPS-TO group,  $t(64) = 2.49, p = .02$ . No other significant differences were noted on individual items. Similar to teen ratings, parent ratings of satisfaction with the overall program were high, and no significant differences between ratings of those in the TOP-F and TOPS-TO were noted (see Table 4). On individual items, parents in the TOPS-F group reported greater agreement with the statements, “I have reached the goals that I had when I began the program,”  $t(63) = 2.78, p = .01$ ; “I know ways to improve my child’s behavior,”  $t(62) = 2.25, p = .03$ ; “I get along with my child better,”  $t(62) = 2.37, p = .02$ ; and “I get along with my partner better”  $t(53) = 2.32, p = .02$ .

Parents and teens were also asked to identify the most and least helpful aspects of the program, as well as things they would change. Parents most commonly reported learning about TBI, the relationship with their therapist, and specific topics as being most helpful. They noted that topics not related to their child/family and the amount of paperwork were the least helpful part of the program. Similar to parents, teens reported talking with the therapist and specific topics as being the most helpful, and identified topics that did not apply to them and technical issues as the least helpful aspects of the program. Teens also offered some ideas for change, including making the sessions, content, and technology of the online modules more relatable/interesting for teens, and making the treatment more specific to the specific needs of the teen/family.

### Website Rating Scale

See Table 5 for summary of Website Rating Scale findings. Teens reported spending similar amount of time per week on the TOPS website (TOPS-F = 1.71 hours; TOPS-TO = 1.72 hours); however, parents of teens in the TOPS-F group reported spending significantly more time on the TOPS website than those in the TOPS-TO group,  $t(59) = 3.27, p = .002$ . Teens in the TOPS-TO group reported greater overall ease of use of video conference sessions than those in the TOPS-F group,  $t(60) = -2.35, p = .02$ . Further, teens in both the TOPS-F and TOPS-TO reported high levels of ease of use of the videoconference sessions, rating them as slightly easier to use than a telephone call and face-to-face sessions.

Parents of teens in the TOPS-F group rated the TOPS website as significantly more helpful than the TOP-TO group,  $t(46) = 2.01, p = .05$ . Parents in the TOPS-F group rated the information on brain injury as more helpful relative to information provided by other sites than TOPS-TO group,  $t(46) = 2.18, p = .03$ . All parents, regardless of group, reported high levels of agreement with items assessing ease of use of video conference sessions, relative to a telephone call or face-to-face meeting. Similarly, both groups reported similar, high levels of agreement with items assessing helpfulness of video conference sessions, noting that they felt these sessions were more helpful than telephone calls and face-to-face interventions.

### Discussion

The current study provides support for the feasibility and acceptability of conducting online PST with adolescents with TBI with limited participation from their parents. Of note, adherence was comparable between the teen-only and family intervention groups, with both completing eight sessions on average. Although drop-out rates were similar across groups, those who did drop out of the study were more likely to have severe injuries than those who

completed the 6-month assessment. Notably, teens found the web modules and videoconferences easy to use, with those in the teen-only intervention reporting significantly higher ratings of ease of use than those in the TOPS-F group. Ratings of helpfulness were similar for adolescents across groups, with the sole exception that adolescents in the TOPS-F group were more likely to endorse getting along with his or her parent better. As described in greater detail below, the parents' relatively limited involvement in the teen-only intervention did affect their perceptions of helpfulness and benefit. These results are not surprising given that parental engagement with the modules and therapist guided sessions was substantially lower in the teen-only group. Taken together, the findings support the feasibility, acceptability, and perceived utility of the TOPS-TO intervention. Further investigation is needed to determine whether it possesses comparable efficacy to TOPS.

Although clinical stakeholders expressed skepticism about the willingness of adolescents to show up for videoconference calls without their parent's involvement, adherence levels were high in the TOPS-TO group. In fact, therapists noted that scheduling was in some respects easier with the teen than with the family, since only one person needed to be available. Therapists often texted reminders 30–60 min before a meeting and were able to engage the teen for the upcoming session, whereas texted reminders to parents often went unanswered until much later.

Although adolescents' perceptions of ease of use and helpfulness showed few differences, adolescents in the teen-only group actually rated the videoconferences as easier to use than their counterparts in the family intervention. Adolescents are native technology users and have greater comfort than their parents. In addition, as noted above, they benefited from the ability to schedule or reschedule on the fly, which was often prohibitively difficult in the family treatment arm. These findings support the possibility that even adolescents with neurological impairment following TBI may find e-health approaches more appealing than traditional therapies.

Adolescents' perceptions of intervention benefits and content helpfulness were largely comparable across groups, whereas more differences were noted in parental ratings. Not surprisingly, for teens, participating in the program with parents was associated with perceived improvements in the parent-teen relationship. Similarly, parents in the teen-only group were less likely than parents in the TOPS-F group to report getting along with their child better.

Based on responses on the satisfaction survey, TOPS-TO parents also viewed the intervention as less helpful on a number of other dimensions. Specifically, they were less likely to endorse reaching their goals, improvements in their marital relationship, or knowing strategies to improve their child's behavior. They also rated the website less helpful overall. These findings are not surprising but do highlight the limitations of a teen-centered approach in addressing the family challenges following TBI. They also raise the possibility that parents may be less able to support the teen's efforts to improve his or her behaviors because parents have not themselves learned these strategies.

This is a relatively large study focused on the feasibility, acceptability, and perceived helpfulness of an intervention designed to improve self-regulation and executive functioning in adolescents with TBI. Given this focus, data regarding comparative efficacy are not included. Assessment of treatment fidelity would have been strengthened by inclusion of ratings of recordings of Skype sessions. Additional limitations include relatively small numbers of nonwhite participants, precluding exploration of racial/ethnic differences that may influence intervention feasibility and acceptability, as well as the possibility that perceptions of the interventions were not representative of the broader population of adolescents with TBI and their families because of attrition, particularly in the severe TBI group. Finally, patient/family preference in treatment modality was not assessed, and future studies would benefit from examining how patient preferences impact treatment outcomes.

Taken together, the findings suggest that TOPS-TO is a feasible and acceptable intervention approach following TBI in adolescence. Adolescents in both groups had similar levels of adherence, rates of session completion, and time engaged in treatment suggesting that conducting the TOPS intervention without family/parent support does not significantly impact the dose of treatment received. However, differences in perceived usefulness of the program suggest that families perceive greater benefit from the higher level of involvement afforded by the TOPS-F approach. The objective of this article was to describe the new TOPS-TO intervention and examine adherence to and satisfaction with the program; therefore, further research is needed to understand the comparative efficacy in improving both child and family outcomes and who is likely to benefit from each approach.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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### Impact and Implications

This study describes the development of a teen-only online problem-solving intervention, procedures of a multisite randomized controlled trial to assess efficacy of this new treatment group, as well as adherence and satisfaction data for the teen-only and traditional family-based intervention groups. The study confirms the feasibility and acceptability of the teen-only intervention group. Some parents perceive greater benefit following the traditional family based intervention. Further examination is needed to explore the comparative efficacy of the teen-only and family-based interventions on child and family outcomes, and determine who benefits from each of the treatment groups.



**Table 1**  
**Teen Online Problem Solving (TOPS) Teen Only (TOPS-TO) and TOPS Family (TOPS-F)**  
**Sessions**

<b>TOPS-F</b>	<b>TOPS-TO</b>
Session 1—Getting started	Session 1—Getting started
Program overview	Program overview
Goal identification	Goal identification
Session 2—Staying positive	Session 2—Staying positive
Importance of a positive approach	Importance of a positive approach
Cognitive reframing	Cognitive reframing
Session 3—Problem solving	Session 3—Problem solving
Steps of problem solving (Aim, Brainstorm, Choose, Do It, Evaluate)	Problem solving part 1
Implement problem-solving process around a goal identified by the teen or family	Problem solving part 2
	Steps of problem solving (Aim, Brainstorm, Choose, Do it, Evaluate)
	Implement problem-solving process around a goal identified by the teen
Session 4—Getting organized	Session 4—Getting organized
Effects of TBI on attention, memory, and cognition.	Effects of TBI on attention, memory, and cognition.
Strategies for addressing TBI-related cognitive problems the teen may be experiencing.	Strategies for addressing TBI-related cognitive problems the teen may be experiencing.
Working with the school	Implement problem-solving process
Implement problem-solving process	
Session 5—Controlling your behavior I	Session 5—Controlling your behavior I
Behavior changes following TBI	Controlling your behavior I part 1
	Controlling your behavior I part 2
Self-management strategies: SMART (Stop, Monitor, Appraise, Reflect, Try)	Behavior changes following TBI
The importance of positive reinforcement	Self-management strategies: SMART (Stop, Monitor, Appraise, Reflect, Try)
Implement problem-solving approach with a “high stress” problem	The importance of self-praise/reinforcement
	Implement problem-solving approach with a “high stress” problem
Session 6—Controlling your behavior II	Session 6—Controlling your behavior II
TBI and anger	Controlling your behavior II part 1
Avoiding assumptions	Controlling your behavior II part 2
The steps of anger management: STARRS (Stop and Think, Accept, Relax, Reframe, Solve)	TBI and anger
Using “I messages” to improve communication	Avoiding assumptions
Implement problem-solving approach with a “high stress” problem	The steps of Anger management: STARRS (Stop and Think, Accept, Relax, Reframe, Solve)
	Using “I messages” to improve communication
	Implement problem-solving approach with a “high stress” problem
Session 7—Listening, talking and reading non-verbal cues	Session 7—Reading non-verbal cues
Good listening	Reading non-verbal cues part 1

TOPS-F	TOPS-TO
Nonverbal communication-what signals are you sending (5 minutes)	Listening and talking part 2
Problem solving with a TBI-related communication problem	Good listening
	Nonverbal communication-what signals are you sending (5 minutes)
	Problem solving with a TBI-related communication problem
Session 8—Social behavior and relationships	Session 8—Social behavior and relationships
Relationship challenges	Social behavior and relationships part 1
Social information processing strategies	Social behavior and relationships part 2
Tips for group entry	Relationship challenges
Integrating new skills with prior skills (e.g., STARRS, SMART, & ABCDE)	Social information processing strategies
Problem solving with a relationship-related problem	Tips for group entry
	Integrating new skills with prior skills (e.g., STARRS, SMART, & ABCDE)
	Problem Solving with a relationship-related problem
Session 9—Taking care of you	Session 9—Taking care of you
The effects of negative emotions on achieving goals	The effects of negative emotions on achieving goals
Controlling stress/taking care of yourself	Controlling stress/taking care of yourself
Practice with relaxation exercises	Practice with relaxation exercises
Problem-solving with a “stress management” problem	Problem-solving with a “stress management” problem
Session 10—Bringing it all together	Session 10—Bringing it all together
Review of goals that have been addressed	Review of goals that have been addressed
Discussion of unresolved goals/problems	Discussion of unresolved goals/problems
Planning for future transitions	Planning for future transitions
Supplemental—after high school	Supplemental—after high school
Supplemental—just siblings	Supplemental—just siblings
Supplemental—memory session	Supplemental—memory session
Supplemental—pain management	Supplemental—pain management
Supplemental—sleep session	Supplemental—sleep session
Supplemental—guilt, grief and caregiving	
Supplemental—marital communication	
Supplemental—parents and siblings	
Supplemental—talking with your teen	

*Note.* TBI = traumatic brain injury. Gray boxes represent sessions where both parents and adolescents video-conferenced with the therapists, whereas white boxes denote therapist-teen only sessions. Teen-only Sessions 3 and 5 were broken into two online modules that could be completed separately. However, content was reviewed in a single Skype session that paralleled the TOPS-Family session content.

**Table 2**

## Key Intervention Content Areas and Heuristics

<b>Area</b>	<b>Heuristic</b>
Problem solving	ABCDE: Aim, Brainstorm, Choose, Do it, Evaluate
Self-regulation	SMART: Stop and Monitor, Appraise, Reflect, Try Something Different
Anger management	STARRS: Stop and Think, Accept, Relax and Reframe, Solve
Communication	Active listening and I messages
Social problem solving	Applying skills to social situations

*Note.* Content areas are presented on the left followed by their associated strategies or heuristics.

Table 3

## Overall Sample Characteristics and by Treatment Group

Characteristic	Total ( <i>N</i> = 152)	Treatment group		
		TOPS ( <i>n</i> = 49)	TOPS-TO ( <i>n</i> = 51)	IRC ( <i>n</i> = 52)
Patient characteristics				
Age at baseline, <i>M</i> ( <i>SD</i> )	14.9 (2.0)	14.7 (2.1)	14.8 (2.0)	15.1 (2.1)
Gender, <i>n</i> (%) male	107 (70)	35 (71)	35 (69)	37 (71)
Ethnicity, <i>n</i> (%) Hispanic	12 (8)	5 (10)	4 (8)	3 (6)
Race, <i>n</i> (%) White	122 (80)	39 (80)	42 (82)	41 (79)
Time since injury, in months, <i>M</i> ( <i>SD</i> )	5.6 (4.1)	5.3 (3.9)	5.8 (4.4)	6.1 (3.8)
Diagnosed with learning disability before injury, <i>n</i> (%)	11 (7)	1 (2)	4 (8)	6 (12)
Diagnosed with ADHD before injury, <i>n</i> (%)	22 (14)	5 (10)	8 (16)	9 (17)
Diagnosed with MR/DD before injury, <i>n</i> (%)	1 (1)	1 (2)	0 (0)	0 (0)
Diagnosed with emotional/behavioral problems before injury, <i>n</i> (%)	12 (8)	2 (4)	4 (8)	6 (12)
Mechanism of injury, <i>n</i> (%)				
Fall from motorized transport	19 (12)	6 (12)	10 (20)	3 (6)
Motor vehicle accident	33 (22)	13 (27)	8 (16)	12 (23)
Pedestrian hit	26 (17)	10 (20)	8 (16)	8 (16)
Fall from nonmotorized transport	33 (22)	8 (16)	11 (22)	14 (27)
Struck by object	11 (7)	1 (2)	5 (10)	5 (10)
Fall	11 (7)	6 (12)	4 (8)	1 (2)
Sports-related injury	17 (11)	5 (10)	4 (8)	8 (15)
Assault	2 (1)	0 (0)	1 (2)	1 (2)
Injury severity, <i>n</i> (%)				
Severe	67 (44)	27 (55)	19 (37)	21 (40)
Moderate/mild	85 (56)	22 (45)	32 (63)	31 (60)
Admitted to inpatient rehabilitation, <i>n</i> (%)	58 (38)	21 (42)	18 (37)	19 (37)
WASI—IQ, <i>M</i> ( <i>SD</i> )	99.1 (14.1)	98.7 (16.4)	99.1 (14.1)	99.5 (12.0)
Parent characteristics				
Mother is primary caregiver, <i>n</i> (%)	133 (87)	43 (88)	46 (90)	44 (85)
Primary caregiver has some college education, <i>n</i> (%)	90 (59)	31 (63)	34 (67)	25 (48)
Primary caregiver is married, <i>n</i> (%)	89 (58)	25 (51)	31 (61)	33 (63)
Census tract income (in thousands), <i>M</i> ( <i>SD</i> )	67.7 (28.1)	67.8 (28.7)	71.1 (29.4)	64.1 (26.4)
ZSES	.0 (1.0)	.0 (1.0)	.2 (1.0)	-.2 (.9)

Note. TOPS = Teen Online Problem Solving; TOPS-TO = Teen Online Problem Solving Teen Only; IRC = internet resource comparison; ADHD = attention deficit hyperactivity disorder; MR/DD = Mental Retardation/Developmental Disability; WASI—IQ = Wechsler Abbreviated Scale of Intelligence - Intelligence Quotient; ZSES = z-score of socioeconomic status. No significant group differences were noted on any variable reported.

**Table 4**

Mean (Standard Deviation) of Satisfaction Rating Scores

Statement	Teen rating		Parent rating	
	TOPS-F	TOPS-TO	TOPS-F	TOPS-TO
The program was what I expected	7.2 (2.4)	6.5 (2.0)	8.2 (2.1)	7.7 (2.1)
The program was helpful	8.5 (1.7)	7.8 (2.4)	8.5 (1.8)	8.1 (2.1)
The information was helpful to me	8.2 (2.2)	7.8 (2.5)	8.6 (1.8)	7.9 (2.3)
I enjoyed the program	7.3 (2.8)	7.3 (2.5)	8.3 (2.1)	8.2 (2.2)

*Note.* TOPS-F = Teen Online Problem Solving Family; TOPS-TO = Teen Online Problem Solving Teen Only. Statements were rated on a scale from 1 to 10 with greater scores indicative of greater agreement with the statement.

**Table 5**

## Parent and Teen Response on Helpfulness and Ease of Use of Intervention Components

Helpfulness/Ease of use Items	Teen report		Parent report	
	TOPS-F	TOPS-TO	TOPS-F	TOPS-TO
Helpfulness of TOPS website				
Overall	3.93 (1.18)	3.79 (1.13)	4.12 (.88)	3.61 (1.08)
Compared to other websites	4.07 (1.17)	3.85 (1.20)	4.04 (.79)	3.52 (.99)
Information on TBI	4.04 (1.20)	3.89 (1.17)	4.16 (.85)	3.52 (1.16)
Training in problem solving	3.96 (1.32)	3.89 (1.10)	4.28 (.94)	3.78 (1.09)
Training on self management	3.89 (1.29)	3.96 (1.17)	4.24 (.97)	3.74 (1.01)
Training on communication skills	3.89 (1.29)	3.82 (1.16)	4.20 (.96)	3.74 (1.14)
Training on anger management	3.89 (1.31)	3.89 (1.26)	4.16 (1.03)	3.61 (1.20)
Ease of use of video conference sessions				
Overall	3.84 (1.29)	4.48 (.81)	4.19 (1.21)	4.44 (1.09)
Compared to a phone call	3.77 (1.36)	4.26 (.97)	4.19 (1.27)	4.59 (.75)
Compared to a face-to-face visit	3.65 (1.17)	3.90 (1.14)	4.30 (1.14)	4.56 (.80)
Helpfulness of video conference sessions				
Overall	3.87 (1.25)	4.29 (.97)	4.52 (.74)	4.33 (1.00)
Compared to a phone call	3.83 (1.28)	4.29 (1.07)	4.59 (.73)	4.44 (.85)
Compared to a face-to-face visit	3.48 (1.15)	3.90 (1.37)	4.41 (.78)	4.44 (.75)

*Note.* TOPS-F = Teen Online Problem Solving Family; TOPS-TO = Teen Online Problem Solving Teen Only; TOPS = TOPS-F = Teen Online Problem Solving; TBI = traumatic brain injury. Helpfulness ratings are from 1 (*not at all helpful*) to 5 (*extremely helpful*). Ease of use ratings are from 1 (*not at all helpful*) to 5 (*extremely helpful*).