Using the Cognitive Orientation to Occupational Performance (CO-OP) with adults with executive dysfunction following traumatic brain injury

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Key words

■ Executive dysfunction ■ Rehabilitation ■ Brain injury ■ Cognition ■ CO-OP ■ Problem solving

Mots clés

■ Troubles des fonctions exécutives ■ Réadaptation ■ Lésion cérébrale ■ Cognition ■ CO-OP ■ Résolution de problème

Abstract

Background. *Meta-cognitive strategies have a positive effect on the rehabilitation of executive dysfunction. However, achieving generalization to daily life remains a challenge. We believe that providing rehabilitation in the person's own physical environment and using self-identified tasks will enhance the benefits of meta-cognitive training and promote generalization.* **Purpose**. *This pilot study tested the applicability of the Cognitive Orientation to Occupational Performance (CO-OP) approach for use with adults with executive dysfunction arising from traumatic brain injury (TBI).* **Methods**. *A single-case design was used with 3 adults, 5 to 20 years post-TBI and their self-identified significant others. Assessments included neuropsychological tests and the Canadian Occupational Performance Measure. The intervention entailed guiding participants to use a meta-cognitive problem-solving strategy to perform self-identified daily tasks that they needed and wanted to do and with which they were having difficulties. The intervention occurred over 20 one-hour sessions in participants' environments.* **Findings**. *Performance improved to criterion (2-point positive change) on 7 of 9 trained goals and on 4 of 7 untrained goals (self-report). Improvement was maintained at a 3-month follow-up assessment.* **Implications**. *The CO-OP approach has the potential to improve performance in daily functioning for adults with executive dysfunction following TBI.*

Résumé

Description. *Les stratégies métacognitives ont un effet positif sur la réadaptation des personnes ayant des troubles des fonctions exécutives. Toutefois, la généralisation des acquis dans la vie quotidienne demeure difficile. Nous croyons que certains facteurs peuvent rehausser les avantages de la réadaptation métacognitive et favoriser la généralisation des acquis, comme la réadaptation se produisant dans l'environnement physique de la personne, c'est-à-dire à son domicile, le fait que la personne fait ses courses ou non et l'utilisation de tâches significatives, identifiées par la personne.* **But.** *Cette étude pilote avait pour but d'évaluer si l'approche Cognitive Orientation to Occupational Performance (CO-OP) serait efficace auprès d'adultes ayant des troubles des fonctions exécutives à la suite d'un traumatisme craniocérébral.* **Méthodologie**. *Une étude de cas à échantillonnage simple a été utilisée auprès de trois adultes ayant subi un traumatisme craniocérébral dans les 5 à 20 dernières années et des personnes signifiantes identifiées par les participants (c'est-à-dire, une personne qui connaît bien le sujet et qui le voit régulièrement). Les évaluations utilisées étaient des tests neuropsychologiques et la Mesure canadienne du rendement occupationnel. L'intervention consistait à guider les participants afin qu'ils puissent utiliser une stratégie métacognitive pour résoudre des problèmes; cette stratégie consistait à choisir et à réaliser des tâches qu'ils voulaient et devaient faire, mais devant lesquelles ils éprouvaient de la difficulté. L'intervention s'est déroulée pendant 20 séances d'une heure dans l'environnement des participants.* **Résultats.** *Le rendement s'est amélioré selon certains critères (changement positif de 2 points) sur 7 des 9 buts pour lesquels les participants ont reçu une intervention et sur 4 des 7 buts sans intervention (tel que rapporté par les participants). L'amélioration s'est maintenue jusqu'à l'évaluation de suivi trois mois plus tard.* **Conséquences**. *L'approche CO-OP pourrait améliorer le rendement au quotidien des adultes ayant des troubles des fonctions exécutives à la suite d'un traumatisme craniocérébral.*

Executive dysfunction is endemic after serious traumatic brain injury (TBI) due to the vulnerability of the pre-frontal cortex in acceleration-deceleration accidents, such as motor-vehicle crashes and falls (Zasler, 2000). Almost 50% of caregivers of persons with TBI report that the person for whom they are caring has planning problems, and almost 40% report poor decision making and a lack of insight (Burgess & Robertson, 2002). Executive dysfunction is highly associated with psychosocial distress, problems in returning to work or school, and reduced quality of life (Dawson, Levine, Schwartz, & Stuss, 2000; Ownsworth & McKenna, 2004; Steadman-Pare, Colantonio, Ratcliff, Chase, & Vernich, 2001). Executive dysfunction is therefore of great concern to occupational therapists.

Although there is a growing body of evidence supporting rehabilitation interventions for persons with executive

dysfunction, most studies have not investigated or have not reported positive changes in daily functioning (Cicerone et al., 2005; Rees, Marshall, Hartridge, Mackie, & Weiser, 2007; Turner & Levine, 2004). Thus, we were interested in determining an approach for adults with executive dysfunction following TBI that would have positive effects in their daily life. In reviewing the literature, four main principles became clear. The first is that positive effects of meta-cognitive or problem-solving training are reported in the literature and there is preliminary evidence for positive everyday life changes (Cicerone et al; Levine et al., 2000). The second is that verbal self-instruction has been found to be an effective strategy in this population (Cicerone & Giacino, 1992). The third is that contextualized therapy, (i.e., therapy conducted in the person's own environment) has been shown to have a positive benefit for adults with TBI (Powell, Heslin, & Greenwood, 2002). The final principle is that goals need to be individually meaningful. Studies with adults with brain injury (and others) have shown that people are more likely to achieve their goals if they are meaningful to them and if they collaborate on choosing the goals (Trombly, Radomski, & Davis, 1998). Once we had identified these key principles for conducting rehabilitation with adults with executive dysfunction following TBI, we realized that the Cognitive Orientation to Occupational Performance (CO-OP) approach reflected all of these. A fuller discussion of each principle and how it is reflected in the CO-OP approach follows.

As mentioned previously, there is little evidence demonstrating positive effects of cognitive rehabilitation for executive dysfunction on daily life performance. However, the evidence that is available reveals that intervention protocols using global problem-solving training strategies and verbal self-instruction may be effective in remediating executive impairments and that such gains may generalize to untrained goals (Cicerone et al., 2005; Levine et al., 2000; Turner & Levine, 2004). Cicerone and his colleagues have recommended "training in problem-solving strategies and their application to everyday-life" (p. 1688) as a practice guideline. This means that there is sufficient evidence to recommend this type of intervention as a promising practice with "probable efficacy," particularly when training occurs in the context in which the strategy will be used. A number of investigators have utilized global or meta-cognitive strategies with adults with TBI. Examples include:

- WSTC – What should I be doing? Select a strategy. Try the strategy. Check the strategy (Lawson & Rice, 1989);
- PST – problem-solving training that includes problem orientation, problem definition, generative alternatives, decision making, and solution verification (von Cramon, Matthes-von Cramon, & Mai, 1991);
- GMT (goal management training) – Stop. Define main task. List steps. Learn steps. Execute task. Check (Levine et al., 2000).

Justifiably, Levine et al.'s work on GMT has received considerable attention because it showed a significant effect on a treatment group after only one hour of training. There now seems to be a general consensus in the TBI research community that problem-solving training is important (Geusgens, Winkens, van Heugten, Jolles, & van den Heuvel, 2007).

A problem-solving strategy is at the core of the CO-OP approach which uses the Goal- Plan- Do- Check strategy (Polatajko & Mandich, 2004). In the 1970s, Meichenbaum (1977) argued that people could learn to regulate their own behaviour by telling themselves to set a goal, make a plan, do the plan, and then check its success. His work was foundational to some of the people working in adult TBI rehabilitation and to Polatajko and Mandich as they developed the CO-OP approach. In addition, the CO-OP approach emphasizes training using verbal self-instruction to enable clients to internalize the strategies they are using. This principle of internalization through self-instruction evolved from early work by Vyotsky (1978) and Luria (1982) who suggested that children's external speech regulates their behaviour and over time translates to an adult's internal speech. A number of researchers have reported this technique useful in working with adults with TBI (Cicerone & Giacino, 1992; von Cramon & Matthes-von Cramon, 1994). As with training in problem-solving strategies, Cicerone et al. (2005) also recommend "interventions that promote internalization of self-regulation strategies through self-instruction and self-monitoring as a practice option" (p. 1688).

Perhaps one of the strongest pieces of evidence for the generalization of improvements to daily life activities using one of these approaches is described by Levine et al. (2000). They reported a case example: GMT was applied to the task of meal preparation for a woman with acquired brain injury. In this case study, the GMT meta-cognitive approach (Stop. Define main task. List steps. Learn steps. Execute task. Check.) was taught to the woman over two therapy sessions, at which point she was able to apply these steps to everyday tasks. She then received three sessions of meal preparation training in which problematic behaviours were identified (e.g., failure to assemble necessary ingredients) and a checklist was used to help her manage the problem behaviours. The woman's meal preparation improved from having difficulties with 80% of attempted recipes to 10% of attempted recipes. Did she improve because of the GMT training on pencil and paper tasks? Possibly, but in our view, it is more likely that improvements were seen because the participant considered the selected task (i.e., meal preparation) important, and she practiced strategies specific to the problem behaviours associated with that task in context. The CO-OP is unique as an approach to the rehabilitation of executive dysfunction in daily life because one of its key tenets is that clients set their own goals. This client involvement is supported by many studies in the literature (e.g., Trombly,

Radomski, Trexel, & Burnet-Smith, 2002) and is a fundamental cornerstone of occupational therapy practice.

In addition to problem-solving and self-selected tasks, a final core feature of CO-OP that is congruent with successful rehabilitation in the TBI population is that of providing rehabilitation in context. Joan Toglia (1991, 2005) has argued for the use of a contextual approach for some years, but unfortunately her approach has received little attention in the research literature. To the best of our knowledge, the only peer-reviewed papers using this approach are single case and pilot studies (Fleming, Lucas, & Lightbody, 2006; Landa-Gonzalez, 2001). However, although not immediately evident in the TBI literature, there is empirical support for this. In the adult literature, two relevant, randomized control trials have been published (Powell, Heslin, Greenwood, 2002; Salazar et al., 2000). Salazar et al. compared a hospital rehabilitation group and a home support group and showed no difference in return to work rates at one year post-TBI for military personnel. In this study, prior to discharge home, patients and families (where available) received education and counselling, were provided with various home cognitive exercises, and were encouraged to resume physical activity. They were further supported by 30-minute weekly telephone calls from a psychiatric nurse, who provided support and advice regarding specific problems. These findings give rise to the surprising hypothesis that contextualized (home) therapy was as effective as inpatient rehabilitation. Further, Powell et al. showed that adults many years post-TBI showed improved function following community-based rehabilitation compared to adults receiving education alone. What is striking in this study is that when therapy was provided in context (the person's own community), improvement was achieved even many years post-TBI.

The CO-OP approach is a global approach. To date, protocols using global approaches have been developed in two ways. Some use a generic approach with training in a rubric designed to be utilized across a variety of tasks (Levine et al., 2000; von Cramon et al., 1991). Others emphasize a domain or task-specific approach with training embedded in a task with which the participant is having difficulty (Giles & Morgan, 1990). Data from both approaches show that generalization to other tasks is limited, if it occurs at all. There are at least three key reasons why generalization may not have occurred. First, executive dysfunction by its nature limits an individual's ability to generalize, so generalization must be built into the protocol. Second, the individual with TBI may not have been fully invested in the task as awareness difficulties, endemic in this population (Burgess & Robertson, 2002), may limit the individual's engagement. Consequently they may not derive any benefit from the training except that gained through the task's procedural elements. Third, specific to the task-specific approach, executive dysfunction means that persons with TBI are unlikely to be able to cull any abstract principles from one task that may be applied to another without explicit guidance. The CO-OP combines these generic and domain-specific approaches. There is a global strategy embedded in the approach but the therapy is done in the context of specific tasks.

Although CO-OP was developed for the treatment of children with developmental coordination disorder, our understanding of the principles upon which it is based and the principles of successful rehabilitation for adults with executive dysfunction post-TBI led us to decide to conduct a CO-OP trial with this population. The CO-OP approach combines Meichenbaum's (1977) cognitive behavioural approach, Feuerstein's (1980) mediational techniques, and the client-centred framework of occupational therapy. The general approach is one in which the participant is guided to use a meta-cognitive problem-solving strategy and to identify domain-specific strategies across self-identified, functional goals. Though the approach is clearly detailed elsewhere (Polatajko & Mandich, 2004), in brief, it has five key elements:

1. The participant is actively engaged in selecting the treatment goals to maximize the possibility that he or she will stay motivated and engaged in the three phases: (a) acquisition, (b) generalization (using it for the same tasks outside the treatment sessions), and (c) transfer to other goals. Further it establishes the therapist and participant as partners in the therapeutic process.

2. The intervention arises from an observation-based process of identifying performance problems or breakdowns. This "dynamic performance analysis" requires the therapist to pay careful attention to the fit between the client's abilities, the demands of the task, and the environment in which the task is being performed.

3. To bridge the gap between the treatment goal and actual performance, cognitive strategies are used. The CO-OP approach teaches participants to use a global problem-solving approach (Goal- Plan- Do- Check). Other domain-specific strategies are identified in the context of the global strategy in relation to specific goals.

4. Critical and unique to the CO-OP approach is that therapists "guide" clients to discover strategies that will solve their task-performance problems. This "guided discovery" is a learning concept rooted in Meichenbaum and Feuerstein's work as well as in general principles of learning theory. There is evidence that the participant's work of discovering the "solution" or strategies is integral to the success of the intervention (Evans et al., 2000; Young, Zakzaine, Campbell, Freyslinger, & Meichenbaum, 2002). This allows the intervention to be founded on individual strengths and abilities, and it is thought that it results in self-efficacy as participants attribute the success of their plans to themselves.

5. Significant others (e.g., close friends, family members) are involved in the CO-OP approach specifically to reinforce use of the global strategy (Goal- Plan- Do-

Check) and to observe and reinforce use of other domain-specific strategies (e.g., verbal mnemonics). These individuals are encouraged to observe treatment sessions and are considered important for assisting with transfer of the strategy use.

The study described here is based on theory and research supporting the effectiveness of using executive strategies to address disturbances in the multi-step process of solving daily problems (i.e., executive dysfunction). It is unique because the rehabilitation intervention (CO-OP) proceeds from, and is evaluated in terms of, real-world individualized goals. That is, the treatment itself occurs within the context of participant-identified difficulties in day-to-day life. Further, the protocol is designed to be practice oriented in that the time involved is understood to be realistic for standard clinical practice in the community.

Thus, the focus of this pilot study was to investigate the efficacy of the CO-OP as a rehabilitation intervention for remediating daily-life difficulties that arise from executive dysfunction following traumatic brain injury (TBI). We had four specific objectives:

1. To refine and validate the CO-OP protocol for use with adults with executive dysfunction following TBI.
2. To collect pilot data on the efficacy of the approach for trained tasks.
3. To investigate whether this approach is generalized and transferred by participants to nontrained tasks.
4. To investigate whether effects on trained and untrained tasks are maintained at three months' follow-up.

Methods

Design

This pilot study used a case series design (1) to allow refinement of the training materials and protocol, and (2) to enable us to test the hypothesis that the CO-OP protocol is effective with adults with TBI prior to piloting it in a larger study.

Sample

Participants were recruited from a community agency serving individuals with TBI and from a cohort of people with TBI available through a study undertaken by the first author. Eligibility criteria for the participants were they had to (a) have complicated mild (Glasgow Coma Scale score 13 or greater with abnormal findings on brain computed tomography scan and/or persistent post-concussion syndrome), moderate (GCS=9-12), or severe TBI (GCS=3 to 8) (Jennett, Snoek, Bond, & Brooks, 1981); (b) have no other neurological or psychiatric disease that has required hospitalization; (c) have no concurrent depression; (d) be at least one-year post-TBI; (e) be age 18 years or older; (f) have a significant other willing to participate; (g) show evidence of executive dysfunction; and (h) be able to identify specific day-to-day difficulties they wanted to improve. Eligibility criteria for the significant others (SO) were they had to (a) be a close friend, family member, or support worker for the person with TBI and know the person well; (b) be 18 years of age or older and (c) be willing to learn the CO-OP strategies. Participants with TBI selected the persons they wanted to be involved in the study as their significant others. The project received ethics approval from the Baycrest Research Ethics Board and the Community Head Injury Resource Services (CHIRS) Research Ethics Board. The three participants and their SOs provided written, informed consent.

Data sources

Participants and SOs were assessed at three time points: pre- and post-intervention and at a follow-up 3 months later. The Canadian Occupational Performance Measures (COPM) (Law et al., 1994) and the Dysexecutive Questionnaire (DEX) (Burgess, Alderman, Evans, Emslie, & Wilson, 1998) were given at each time point. Neuropsychological assessments were conducted at pre-intervention only.

Canadian Occupational Performance Measure

The COPM was used to establish treatment goals. The COPM is a semi-structured interview that allows the examiner to elicit individualized goals that are important to the participant. Interviews were conducted with the participant with TBI. For this study, four to six goals were identified and three were used as training goals (these were goals that the occupational therapist enabled the participant to address through the CO-OP approach). The participant and therapist selected the "training goals" collaboratively. No set criteria were used during this selection. The occupational therapist and the participant did not discuss the other goals, but pre- and post-ratings of performance and satisfaction were done to determine if the participants were transferring the use of the CO-OP approach to other goals. Thus, once goals were identified, participants rated their current performance on all goals using a 10-point scale with 1 being "not doing at all" and 10 being "performance could not be better." Satisfaction was rated similarly with 1 being "not at all satisfied" and 10 being "completely satisfied." Performance ratings were also completed by significant others. Significant others also rated their own satisfaction with the participant's performance on the identified goals. The COPM has reasonable psychometrics, and a change score of 2 points has previously been validated as indicating clinical significance (Law et al., 1994; Wressle, Samuelsson, & Henriksoon, 1999).

Dysexecutive Questionnaire

The DEX (Burgess et al., 1998) was used as a daily life measure of executive dysfunction. We included this measure as we concur with Burgess and his colleagues (2006) "that traditional tests were not developed to address the concerns

of clinicians—that is, to measure the most clinically significant deficits" (p. 198). Both the participant and the significant other filled out this 20-item questionnaire on which the frequency of executive difficulties is rated on a five-point scale from never (0) to very often (4). Items include statements such as "_____ has difficulty thinking ahead or planning for the future" and "_____ has trouble making decisions or deciding what s/he wants to do." The maximum score is 80. The items are the same on self and significant other versions. The DEX is widely used in TBI studies and has strong psychometrics, although normative data are not available (Bennett, Ong, & Ponsford, 2005). However, scores on the DEX correlate with other measures of executive dysfunction (Bennet et al., 2005). Improvement is noted when DEX scores decrease.

Neuropsychological Assessment

A group of neuropsychological assessments to characterize cognitive impairments and abilities were administered to the participant with the TBI. These were administered only at pre-intervention as we did not hypothesize that the CO-OP would change performance on neuropsychological test performance. The group of assessments comprised tests of (1) attention (Symbol Digit Modalities Test [Smith, 1978], the Trail Making Test, Part A [Army Individual Test Battery, 1944])]; (2) memory (Hopkins Verbal Learning Test [Brandt, 1991]); (3) executive functioning (Wisconsin Card Sorting Test [Heaton, Chelune, Talley, Kay & Curtiss, 1993], Trail Making, Part B [Army Individual Test Battery]); and (4) pre-morbid intelligence (vocabulary subtest from the WAIS-R [Wechsler, 1985]). All neuropsychological assessments have sound psychometrics and have been used previously with the TBI population.

Observational Data

Each session was videotaped, and the occupational therapist took notes regarding the plans, homework, and comments made by the participant regarding generalization. Two investigators (DD, HP) reviewed the videotapes to provide feedback to the occupational therapist during the pilot study.

Intervention

Prior to starting the study, five modifications were made to the CO-OP approach as described in the CO-OP manual (Polatajko & Mandich, 2004) to make it more suitable for adults with TBI. One experienced occupational therapist was trained in the approach and delivered it to all participants in the study.

1. We did not use the puppet described but rather provided people with a cue card with the strategy GOAL-PLAN-DO-CHECK written on it.
2. We rewrote the original script introducing the approach to make it appropriate for adults with TBI.
3. All participants were given binders at the beginning of the intervention with goal sheets for each of the goals being trained and additional blank sheets to be used by the participants at their discretion. The sheet was adapted to suit each individual's needs but contained a space for the large goal (e.g., plan family party), spaces for subplans (e.g., buy invitations), spaces for recording what evidence would indicate success, and spaces to indicate if the plan worked or not (see Appendix I for a prototype). This is not done routinely with children.
4. We conducted as many sessions as possible in participants' own environments rather than in an office situation.
5. We doubled the number of sessions from 10 to 20 as we believed the performance problems identified by adults with executive dysfunction would likely be more complex than those typically identified by children.

Procedure

Following recruitment and consent, pre-testing was carried out at the Kunin-Lunenfeld Applied Research Unit (KLARU) and the intervention was delivered in various community locations, including participants' homes. Participants were seen twice weekly for 10 weeks with each session lasting about one hour. Post- and follow-up testing (3 months later) were also done at KLARU. All tests were administered by a trained research assistant. The research assistant was not an occupational therapist, but a person with an undergraduate degree who was trained to administer the assessments used in the study except for the COPM pre-test, which the occupational therapist administered.

Planned analyses

As this is a pilot study, analyses are descriptive in nature. Participants were characterized using descriptive statistics on the demographic, injury-severity, and neuropsychological assessment data. For the latter, performance was compared to available normative data. Efficacy of treatment was determined as follows:

1. COPM performance and satisfaction scores improved by 2 points or more in self-report and/or significant other report on trained goals at posttesting.

Evidence of generalization and transfer was inferred if:

2. COPM performance and satisfaction scores improved by 2 points or more in self-report and/or significant other report on untrained goals at posttesting;
3. DEX scores improved (i.e., decreased) in self- and/or significant other reporting at post-testing.

Maintenance of training and generalization effects was inferred if:

4. improvement on trained and untrained goals was maintained at 3-month follow-up on self- and/or

significant other report.

To determine this, the participant and the significant other rated scores at baseline. These were subtracted from the follow-up scores. The number of goals for which a 2-point change was found is reported in the findings. Maintenance of generalization effects was also inferred if positive DEX changes were noted.

Use of the 2-point change on COPM scores was made to summarize the data. However, inferential analyses were not undertaken on these change scores because these are pilot data and the sample size did not provide adequate power.

The investigators reviewed observations made during the intervention sessions and from the videotapes to determine if there were substantive and consistent differences in the approach used in this study from that prescribed for use by children with DCD. These observations are described under findings.

Findings

Participant characteristics are reported in Table 1. Some details of marital status have been changed to maintain confidentiality. All three had sustained TBIs secondary to motor vehicle crashes. Participants 1 and 3 had severe TBIs 15 to 25 years prior to this study. Participant 2 had a complicated mild injury (abnormal pathology on her initial brain computed tomography scan and persistent post-concussion syndrome). Participant 1 lived in a transitional living situation consisting of bachelor apartments, a shared kitchen and living space, with staff available 24 hours/day. Participant 2 lived with her husband and in-laws and had no professional support at the time of this study. Participant 3 lived alone in a one-bedroom apartment. He received support from a community brain-injury service organization in that a staff member of this organization was assigned to him as his "worker" and made contact with him every 2 weeks unless he requested more. All three participants worked part-time.

Neuropsychological tests were conducted at baseline. Table 1 includes raw scores along with t-scores relative to age, education, and gender-based normative data (Benedict, Schretlen, Grondinger, & Brandt, 1998; Heaton, 1991; Heaton et al., 1993; Heaton, Grant & Matthews, 1991). Clinical interpretation guidelines for t-scores are included in Table 1. Based on the vocabulary subtest from the WAIS-R, participants 2 and 3 were estimated to have average pre-injury intellectual abilities while participant 1 performed in the low-average range. Participants 1 and 3 were severely slowed on speeded pencil-and-paper tasks as evidenced by their scores on the Trails A and B. Their performance on the Wisconsin Card Sorting Task (Heaton et al., 1993), a complex executive task of card sorting, was also impaired. Participant 2 performed normally in terms of errors made on the card-sorting task but showed evidence of executive dysfunction on the number of categories she used sorting the cards. Participants 1 and 3 also showed difficulties in verbal learning on the Hopkin's Verbal Learning Test. That is, they

TABLE 1
Participant characteristics.

Variable	Participant 1	Participant 2	Participant 3
Age	43	32	40
Gender	Male	Female	Male
Injury severity	Severe	Mild with PPCS*	Severe
Years since injury	20	5	17
Years of education completed	14	17	13
Living situation	Transitional apartment	Living with husband and in-laws	Independent
Marital status	Divorced	Married	Single
Pre-injury productivity status	Full-time worker	Full-time worker	Full-time worker
Current productivity status	Part-time supported worker	Part-time worker	Part-time worker
Neuropsychological status			
• Wais vocabulary	36 (t-score=39)**	42 (t-score=42)	39 (t-score=44)
• Digit Symbol	28 (t-score=24)	78 (t-score=39)	36 (t-score=29)
• Trails A time (sec)	112 (t-score=12)	31 (t-score=39)	75 (t-score=20)
• Trails B time (sec)	159 (t-score=29)	49 (t-score=49)	129 (t-score=33)
• WCST correct	37 (t-score=44)	51 (t-score=50)	16 (t-score=35)
• WCST categories	1 (t-score≤30)	4 (t-score≤36)	0 (t-score≤24)
• HVLT T3 correct	5 (t-score≤25)	11 (t-score=50)	8 (t-score≤34)
• HVLT recognition	9 (t-score≤37)	11 (t-score=40)	12 (t-score=43)
Significant Other	Primary care worker	Husband	Primary care worker

*PPCS=persistent post-concussion syndrome
**t-scores may be interpreted as follows : 1–30=very poor; 31–36=borderline impairment; 37–43=low average; 44 and higher=average and above average (Spreen & Strauss, 1998)

had difficulty with freely recalling the information they were trying to learn. The improvement on tests of recognition indicates that they were storing the information but recall was impaired. Trails B, Digit Span, and WCST test scores in the impairment range indicated executive dysfunction. Executive dysfunction was also identified through scores on the DEX (see Table 4). All participants showed evidence of executive dysfunction on one or more of these tests.

Objective 1 (to refine and validate the CO-OP protocol for use with adults with executive dysfunction following TBI) was addressed through the observational data we collected. Based on notes made by the occupational therapist and independent review of the videotapes by the principal investigator (DD), there were a number of observations that led to important alterations to the process of the intervention from that described by Polatajko and Mandich (2004).

1. The development of goals for the adults with TBI required considerable time. Three to five hours of interviewing (over two to three sessions) were conducted to arrive at the goals.
2. Verbal self-instruction was not used in the same manner by adults with TBI as it was used by children. Indeed, participant 1 appeared to lose track of his goal if he was asked to verbalize what he was doing. Participant 2 found the process laborious and too slow. Participant 3 opted to use a written script in specific situations (e.g., getting directions to a sports centre).
3. Depending on the goal, the intervention was conducted through talking, assigned homework, and "doing." The goal "cook the meal" lent itself to doing this through intervention sessions. The goal "getting involved in a recreational sports program" lent itself to talking about plans and assigning homework rather than completing the task at the session.
4. Transfer of training was intentionally built into intervention sessions by asking participants at the beginning and end of each session how they had used or could use the global strategy in other situations. In addition, explicit discussion with the participants and their significant others about how they might continue to use this approach over time was included in the last five to six intervention sessions.

Table 2 shows the number of goals that improved to criterion (i.e., 2-point improvement) on the COPM for trained and untrained goals. The table shows changes according to self- and significant other as reported on the performance and satisfaction scales of the COPM. The data in this table are elucidated as per the planned analyses. Further details about the goals and the actual COPM scores for each participant can be found in Table 3.

Tables 2 and 3 show that objective 2 (to collect pilot data on the efficacy of the approach for trained tasks) was met. Specifically, the CO-OP approach resulted in positive changes for trained goals both in terms of performance and satisfaction with performance. Performance scores on seven (self-report) to eight (SO report) of the nine trained goals improved to criterion over the 10-week intervention period. Significant others reported greater performance improvement than participants themselves on two of the goals. Improvement in performance was mirrored by improvement in satisfaction with performance on seven of nine goals.

Tables 2 and 3 also provide data that relate to objective 3 (to investigate whether this approach is generalized and transferred by participants to nontrained tasks). Some evidence for participants' ability to transfer the use of this approach to goals other than those trained on is seen in COPM scores for untrained goals and DEX scores. Performance scores improved to criterion on two to four of seven untrained goals over the 10-week intervention period with participants with TBIs reporting improvement on four goals and their significant others on two. For untrained goals, improvements in satisfaction were reported for all goals by the participants with TBI and for three of seven goals by their significant others.

Further evidence of transfer was found by looking at

Table 2
Number of goals* with 2-point changes on COPM Performance and Satisfaction scores

	Self-performance		Significant other's performance	
Trained goals	Pre-Post	Pre-FU**	Pre-Post	Pre-FU**
Participant 1	1 / 3	1 / 3	2 / 3	2 / 3
Participant 2	3 / 3	3 / 3	3 / 3	3 / 3
Participant 3	3 / 3	3 / 3	3 / 3	2 / 3
Total	7 / 9	7 / 9	8 / 9	7 / 9
Untrained goals				
Participant 1	1 / 3	1 / 3	1 / 3	1 / 3
Participant 2	2 / 3	1 / 3	1 / 3	2 / 3
Participant 3	1 / 1	1 / 1	0 / 1	0 / 1
Total	4 / 7	3 / 7	2 / 7	3 / 7
	Self-Satisfaction		Significant other's satisfaction	
Trained goals	Pre-Post	Pre-FU**	Pre-Post	Pre-FU**
Participant 1	1 / 3	1 / 3	2 / 3	2 / 3
Participant 2	3 / 3	3 / 3	3 / 3	3 / 3
Participant 3	3 / 3	3 / 3	2 / 3	1 / 3
Total	7 / 9	7 / 9	7 / 9	6 / 9
Untrained goals				
Participant 1	3 / 3	0 / 3	2 / 3	2 / 3
Participant 2	3 / 3	2 / 3	1 / 3	1 / 3
Participant 3	1 / 1	1 / 1	0 / 1	0 / 1
Total	7 / 7	3 / 7	3 / 7	3 / 7

* The denominator identifies the total number of goals in each section; the numerator is the number of goals for which a 2-point change was reported.
** FU=3-month follow-up scores

TABLE 3
COPM goals and scores for Performance and Satisfaction scales.

	Self-rated performance			Significant other-rated performance		
Trained goals – Performance scores	Pre-	Post-	FU*	Pre-	Post-	FU*
Participant 1						
• Make a menu for dinner for 4 & do corresponding shopping.	7	8	8.5	1	9	7
• Cook the dinner.	7	7	8	10	8	9
• Take the train independently to cousin's home.	7	10	9	1	9	8
Participant 2						
• Develop a system to keep track of banking.	3	8	8	3	8	8
• Schedule activities so they are balanced over week.	5	9	9	5	8	10
• Plan large, formal family celebration.	3	8	9	6	8	10
Participant 3						
• Get involved in a recreational sports program.	1	1	8	3	10	4
• Have own bank account and keep track of transactions.	5	9	9	1	8	7
• Do an exercise program to improve strength in knee.	4	9	8	1	5	4
Untrained goals – Performance scores						
Participant 1						
• Get involved in an outdoor activity.	6	1	1	1	1	7
• Get involved in a creative arts activity.	5	8	9	8	7	8
• Improve quality and efficiency of cleaning.	7	7	8	4	6	5
Participant 2						
• Decrease getting lost while driving.	5	7	6	4	6	7
• Learn how to cook a few more meals.	4	8	9	4	5	7
• Go back to school.	1	1	1	1	1	1
Participant 3						
• Learning more and doing more tasks at work.	1	8	6	4	4	1
	Self-rated satisfaction			Significant other-rated satisfaction		
Trained goals – Satisfaction scores	Pre-	Post-	FU*	Pre-	Post-	FU*
Participant 1						
• Make a menu for dinner for 4 & do corresponding shopping.	8	9	8.5	5	10	10
• Cook the dinner.	7	8	9	10	9	10
• Take the train independently to cousin's home.	8	10	9	1	10	8
Participant 2						
• Develop a system to keep track of banking.	4	9	8	3	8	8
• Schedule activities so they are balanced over week.	6	10	9	5	8	10
• Plan large, formal family celebration.	3	8	9	6	9	10
Participant 3						
• Get involved in a recreational sports program.	2	8	7	5	10	8
• Have own bank account and keep track of transactions.	7	10	10	10	10	10
• Do an exercise program to improve strength in knee.	3	10	8	3	5	4
Untrained goals – Satisfaction scores						
Participant 1						
• Get involved in an outdoor activity.	8	10	7	1	10	4
• Get involved in a creative arts activity.	6	10	7	8	10	4
• Improve quality and efficiency of cleaning.	8	10	9	4	5	8
Participant 2						
• Decrease getting lost while driving.	5	7	5	4	7	6
• Learn how to cook a few more meals.	4	8	9	6	5	7
• Go back to school.	1	5	5	7	8	4
Participant 3						
• Learning more and doing more tasks at work.	7	9	9	10	10	1

*FU=3 month follow-up scores

changes in DEX scores (see Table 4). Participants 2 and 3 reported significant improvement on the DEX at posttesting. For Participant 2, this was corroborated by the significant other.

Our fourth objective was to investigate whether the effects of the intervention were maintained at follow-up. Pre-intervention COPM scores were subtracted from follow-up scores to determine if there was a 2-point change (see Table 2). Actual score changes are shown in Table 3. The changes in COPM performance and satisfaction scores, according to the participants with TBIs and their significant others, all provide evidence of maintenance of training effects for the three months following the intervention. The only exception to this was some diminution of satisfaction scores reported by the people with TBIs. The DEX scores also suggest maintenance of transfer effects, particularly for participant 2. Interestingly, participant 2 and the significant other for participant 3 both reported substantive improvement on DEX scores at follow-up. Participant 2's self-scores at follow-up were congruent with those of her significant other, suggesting that their perception of her performance was similar. In contrast, the positive changes seen on the DEX of participant 3 at posttest were not maintained at follow-up, although his significant other reported positive changes at follow-up not seen at posttest. The discrepancy between his self-report scores and those of his significant other suggest a substantive difference in their perceptions of his performance in daily life.

In summary, improved reports of performance and satisfaction suggest that this approach has positive goal-specific effects that transfer to untrained tasks. The transfer of effects of the training was also reflected in changes on DEX scores. Follow-up scores after three months suggest that changes are maintained over time.

Discussion

This is the first study investigating the use of the CO-OP approach with adults with traumatic brain injury. Results show that this approach produces positive changes for trained and untrained goals, though stronger effects are seen for trained goals. Positive changes were reported by both participants and their significant others, with effects maintained at a three-month follow-up assessment.

We trained three adults with TBI to use a meta-cognitive strategy to solve performance problems in everyday, self-selected tasks. Through the application of this strategy (Goal- Plan- Do- Check), they were able to make positive changes in their performance of and satisfaction levels for self-identified goals. These data provide further support for the recommendation made by Cicerone et al. (2005) that adults with executive dysfunction following TBI should be trained in problem-solving strategies and their application to everyday life.

This study also supports the value of strategy training for transfer to other everyday behaviours. Geusgens et al. (2007) noted that prerequisites for transfer include the person's

TABLE 4
Dysexecutive Questionnaire scores.

	Self-rating			Significant other-rating		
	Pre-	Post-	FU*	Pre-	Post-	FU*
Participant 1	20	19	15	15	14	14
Participant 2	34	17	17	16	11	11
Participant 3	29	19	27	30	29	14

*FU=3-month follow-up scores

acknowledging that a strategy is needed to improve functioning, that a person be able to judge when and where transfer could be applied, and that transfer should be addressed during training. The CO-OP approach, as we have described its use for adults with TBI, addressed all of these as follows: First, the inclusion criteria required that participants be able to identify goals they wanted to work on and be able to be able to acknowledge that they required assistance with them. Second, throughout the intervention, we asked people to think of other situations in which they could use the strategy. Third, transfer was addressed throughout the intervention by asking people how else they were using the strategy, how they might use the strategy, and how they would continue using the strategy once the intervention ended. Although, as in the studies cited by Geusgens et al., we could not provide statistical significance for the transfer effects, participants improved on some untrained goals, suggesting transfer had occurred.

One question that we have not answered regarding transfer of training is the extent to which participants were able to apply this strategy and develop plans independently. The fact that all participants achieved improvements on some untrained tasks suggests some level of ability. Further, it appeared from post-hoc observations of the videotapes that Participant 2 in particular was quite independent in using the strategy. Future research should investigate how to quantify the level of coaching required for the process. However, it is conceivable that for some individuals, their executive impairment may interfere enough with independent goal management that cues to apply the meta-cognitive strategy will be required indefinitely. In this case, the CO-OP approach may serve two very important purposes: to teach the participants a method for approaching planning that can readily be cued by others, and to provide a rubric that can be used to train people in the participant's life to facilitate completion of daily activity as a team.

These results of the study regarding transfer are certainly promising, but the question of why there were not more positive effects reported on untrained goals arises. There are a number of possible explanations for this. The first is that the positive results seen on the untrained goals may have simply occurred by chance. We do not believe this was the

case as, on post-intervention interviewing, participants provided examples of how they were using the global strategy on these untrained goals. For example, Participant 3's untrained goal was "to learn more and do more tasks at work." He told us that he was going to work, planning out his tasks, checking his plan with his supervisor and then doing it. He stated that he was not using this strategy prior to the intervention.

Another explanation for the limited effects on untrained goals may be related to the length of the intervention. The occupational therapist providing the intervention believed that the more complex goals expressed by the TBI participants would have benefited from additional intervention sessions, which was not possible due to the pilot nature of this study. She stated that more time for addressing issues of transfer would also have been beneficial (e.g., working with the individuals and their significant others to plan how to continue to use this global strategy).

A final explanation is related to the difficulty participants had in identifying their goals. Each participant required considerable support in refining their large goals and in some cases in refining the plans they would use to achieve these goals. This was the case particularly for Participants 1 and 3. In fact, Participant 3 was only able to identify four goals. Because Participants 1 and 3 had both been settled into life routines for a considerable length of time post-injury, it is possible that some learned helplessness had occurred. This requires further investigation.

It is interesting that the participants in this study did not use verbal self-guidance as a strategy to assist them in accomplishing their goals. Indeed, when we tried to introduce it, some participants' performance deteriorated. We were surprised by this as previous work in TBI supports the value of this technique (Cicerone & Giacino, 1992; Cicerone et al., 2005; Giles & Morgan, 1990). In reviewing these papers we noted that the self-instruction was used in relation to very specific tasks. We have hypothesized that the complexity of the goals the adults in this study selected did not lend themselves to developing verbal scripts that could then be internalized. However, each participant did appear to internalize the global strategy of Goal- Plan- Do- Check over the course of the intervention. By the end, all three participants, regardless of the extent of disability, was providing examples of how they could or did use this strategy in other daily tasks.

Another point about the data that should be discussed is the discrepancy between self- and significant other ratings. In a population in which self-awareness is often impaired, this discrepancy is not surprising and indeed has been highlighted by many others (Abreu et al., 2001; Ownsworth, Fleming, Desbois, Strong, & Kuipers, 2006). A common solution to this problem in assessment and intervention is to document responses both from the person with the TBI and the significant other. If the significant other's ratings corroborate those by the person with the TBI, this is generally understood to be stronger evidence of a positive effect. However, it is not straightforward to interrupt discrepancies. The literature that has investigated this (Dawson, Markowitz, & Stuss, 2005) shows that discrepancy is especially higher in reports of participants and significant others who are not spouses and for tasks that are not highly concrete.

This issue of discrepancy in the study was handled in two ways. The first was by reporting both self- and significant other ratings and noting that there were improvements in both. The second was by reviewing the context of the ratings provided. For example, Participant 1 scored his pre-performance on "taking the train independently to his family" (see Table 3) as 7/10, suggesting that he could do this quite well. However, he had, in fact, never done it. With further questioning, he told the examiner that this was because he thought he would be able to do it quite well. In subsequent interviews we were careful to ask people to score their actual performance. Participant 3 scored his performance for "getting involved in recreational sports" as not changing at all over the course of the intervention whereas the change scored by the significant other was 7 points. In fact, Participant 3, over the course of the intervention, found a recreational sports program and, using the global strategy, figured out how to get to it. Unfortunately, when he got there, he discovered that all the other players were teenagers, whereas he was a middle-aged man and did not feel comfortable. Thus, he had not achieved his goal. At follow-up, he evaluated this in a different way as he believed that his ability to find a sports program and find his way there was important, even if he did not play in it. Although there were explanations for these and some of the other discrepancies in the COPM ratings, we elected to leave the ratings as provided and suggest that these be explored more thoroughly in future research.

If, as we argue, the CO-OP approach is an effective way of improving participation in daily life for adults with executive dysfunction following TBI, then we must consider what is underlying these positive changes. We deliberately did not do neuropsychological posttests as we did not hypothesize that underlying cognitive processes change throughout this intervention. Rather, we hypothesize, as Geusgens et al. (2007) do, that strategy training teaches people how to use a highly effective compensatory mechanism. Whether cognitive process and corresponding neuroanatomical reorganization may occur over time is a question that will require future research involving functional imaging.

A final point for discussion is the clinical feasibility of this approach. We provided participants with 20 hours of training over a 10-week period. All participants were living in the community and in the chronic phase of recovery. We anticipate that this approach would be feasible for occupa-

tional therapists working in community agencies or in outpatient settings if policies permitted the occupational therapists to travel into the community.

Conclusion

These data should be viewed with cautious optimism. They are pre-, post-, and three-month follow-up data on only three participants. Further research using a control group is necessary to determine whether this is an effective approach for adults with executive dysfunction. However, the fact that positive results were seen on trained and untrained goals and that many of these effects were maintained at follow-up is noteworthy. We suggest that occupational therapists consider this approach in their practice with the community-dwelling adult TBI population.

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Key messages

- Use of the CO-OP approach with adults with executive dysfunction following TBI appears to result in beneficial changes in trained goals and may allow for transfer of training effects.
- Occupational therapists might consider whether this approach is relevant in their practice with community-dwelling adults with TBI while watching for further confirmation of its efficacy.
- Future research is necessary to determine if this approach is effective for enhancing occupational performance in community-dwelling adults with TBI

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Appendix I

Template for goal-planning sheets.

Large goal:

Date	Plan	Evidence: How will I know the plan worked?	Did the plan work? Yes	No
	1		☐	☐
	2		☐	☐
	3		☐	☐
	4		☐	☐