EBP Edge: Exploring Cognitive Interventions for the Inpatient TBI Population

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Introduction

According to the Brain Injury Association of America (Reyst, 2016), traumatic brain injury (TBI) is second only to depression as the most disabling disorder in the United States. In addition to causing significant disability, one-third of all injury-related deaths are associated with TBI. As a result, it would appear that these injuries profoundly impact individuals, families, communities, and society in terms of function, burden of care, and cost. To illustrate this impact further, the Centers for Disease Control and Prevention (CDC, 2016) indicate that while traumatic brain injuries are most prevalent among adolescents and young adults, the second-highest incidence of injury occurs in adults over the age of 75. Amid all these factors contributing to disability, cognition is often the most debilitating factor for individuals with TBI and presents a significant and often unfamiliar burden for their caregivers (Barman, Chatterjee, and Bhide, 2016).

Cognition is the functional processing of information by our brains (Diller & Weinberg, 1993). Furthermore, cognitive dysfunction refers to performing below typical cognitive levels and/or losing the ability to perform efficiently in cognitive areas such as problem-solving (AOTA, 2013). The optimal standard of care consists of an interdisciplinary team implementing frequent, open communication and collaboration for setting goals and standards of care, a process especially important and necessary due to the fact that not one traumatic brain injury presents alike (Vanderploeg et al, 2008). This team, including speech-language pathologists (SLPs) and occupational therapists (OTs), serves to enhance the interdisciplinary treatment techniques of our respective professions through the shared “knowledge of cognition, participation, and context” (AOTA, 2013).

As clinicians, we aim to tailor therapy into an individualized plan of care utilizing our collective expertise in the functional and cognitive rehabilitation of persons with traumatic brain injury (AOTA, 2013). Therefore, the authors seek to explore which tools and strategies SLPs and OTs can implement in a rehabilitation setting to promote more effective and cohesive treatments for the cognitively impaired individual with TBI in order to improve independence, decrease burden of care, and increase participation in the community.

Cognitive Process Review

According to the American Speech-Language-Hearing Association (ASHA, 2019), cognitive processes include attention, memory, thought organization, problem-solving, reasoning, and executive function. Attention may be defined as the basic ability to focus. The ability to recall new and old information can be referred to as memory. Thought organization can be defined as the ability to cohesively convey basic wants/needs/ideas, whereas problem-solving and reasoning encompass actively identifying and correcting issues both functionally and physically. Lastly, executive functioning can be described as the ability to initiate and execute a task or plan.

Furthermore, these processes also can be subcategorized. Attention, often necessary for the functional participation of an occupation or task, can be designated into four different types: focused (i.e., ability to briefly locate or track stimuli), sustained (i.e., focusing on one task for a period of time), selective (i.e., filtering external stimuli to focus on an individual task), and divided (i.e., multitasking, such as driving). Similarly, memory can be divided into a myriad of classifications including, but not limited to, long-term, short-term, and procedural (Barman, Chatterjee, & Bhide, 2016). For the purpose of this review, the authors will be further investigating the most prominent cognitive disruptions and how those impact function and therapeutic interventions related to TBI.

Common Cognitive Deficits of Persons with Traumatic Brain Injury

The hallmark cognitive deficits associated with persons with TBI include “poor attention, memory deficits, and disturbances in executive functioning” (Barman, Chatterjee, & Bhide, 2016, p. 173). These commonly observed deficits are supported further by McDonald, Flashman, & Saykin (2002, p. 333), who corroborated that the most constant and prominent deficits following a TBI include cognitive and behavioral impairments as a product of executive dysfunction. The combination of impairments often can result in diminished independence for persons with TBI, increased burden of care for family and caregivers, and decreased quality of life for both.

Decreased attention, for example, may manifest itself in a variety of presentations and severity levels, ranging from difficulty multitasking and/or filtering stimuli to inability to recognize safety hazards as a result of visual neglect. Additionally, poor attention may have a cascade effect on the ability to recall old or new information.

In fact, “memory is one of the most common [and is] frequently the first to be noted as impaired and one of the last functions to be regained in the recovery process” (McDonald, Flashman, & Saykin, 2002). Per Hart and Sander (2017), long-term and procedural memories (memories related to the past) may be more preserved. These types of memory may include events such as education (e.g., basic math, reading/writing) or personal milestones and habits (e.g., brushing teeth, birthdays). However, while the memories may technically be preserved, retrieval of that information may become problematic. For example, persons with TBI may recognize a family member but have issues recalling the family member’s name or how they are related. Comparatively, short-term memory is a typical and frequent area of difficulty for persons with TBI. Short-term memory deficit examples may include difficulty recalling recent discussions or where personal items are located. Prospective memory, or “remembering to remember” (Hart & Sander, 2017, p. 407), also may be impacted. In these instances, persons with TBI may exhibit difficulty encoding information long enough in the brain to act on the task. For example, persons with TBI may state they are going to the store for groceries but then once at the store or while driving forget where they are and/or what they were doing.

Executive function deficits may present in diverse manifestations. The process of executive function itself can be broken down into four components: (1) the ability to conceptualize and facilitate goals; (2) the organization and arrangement of information to perform a task; (3) the ability to initiate and engage in a task with modifications as needed; and (4) the ability to self-monitor and self-correct (Lezak, 1995). A breakdown in one or more of these areas can result in the inaccurate overall execution or performance of a task. For example, those who have experienced a TBI may successfully plan the steps or sequence of a particular activity; however, they may experience difficulty executing those specific motor and/or cognitive tasks. On the other end of the spectrum, those who can perform the task may not be able to initiate transition or termination of an activity, resulting in a breakdown of cognitive flexibility or problem-solving (McDonald, Flashman, & Saykin, 2002). To further complicate this matter, impaired executive functioning impacts self-awareness of purposeful or volitional behaviors. Generally, this may cause inappropriate interpersonal communication, poor hygiene, and diminished interpretation of social cues (McDonald, Flashman, & Saykin, 2002). Impairment in executive functioning also limits a variety of responses and abilities to adapt to new situations or modify thinking habits, despite environmental changes, resulting in risk-taking and rule-breaking behaviors (McDonald, Flashman, & Saykin, 2002). Consequently, this can increase the chances of additional injuries and complications. For example, a person with a TBI is three times more likely to sustain another TBI, and after a second sustained TBI, the likelihood increases to eight times more likely to sustain a third TBI (Reyst, 2016). It is important to consider, however, additional factors that contribute to this increased likelihood, such as substance abuse, psychological comorbidities, and lack of psychosocial support.

Another important consideration when discussing deficits includes cognitive fatigue. Cognitive fatigue may display itself through a variety of behaviors including restlessness, decreased arousal, and/or agitation. Per Hicks, Larkins, & Purdy (2011, p.147), persons with TBI “reported that fatigue

had a greater impact on their lifestyle" compared to a control group of neurotypical individuals. Hicks, Larkins, & Purdy (2011) further discussed that cognitive fatigue needs a "multidimensional approach" in order to aid in overall success.

The Treatment Team

In his article, occupational therapist Gordon Giles (2010, p. 184) cites substantial support advocating for a multidisciplinary treatment team involved in the rehabilitation of persons with TBI, adding how programs that implement intense, function-based interventions accelerate functional return. This multidisciplinary team may include physicians, neuropsychologists, neuro-optometrists, case management, physical therapists, occupational therapists, speech-language pathologists, recreational therapists, and music therapists. Family members also should be included as part of the interdisciplinary team as they are also crucial to the success and progress of the individual with TBI (Togher, 2012). Typically, caregivers spend more time with the survivor as compared to medical personnel, and their support plays an integral role in the growth and progress of individuals with TBI. The education and training in cognition that occupational therapists and speech-language pathologists can offer is integral in the development of individualizing a plan of care and serves as an educational and training resource to the family.

Cognitive Treatment Interventions

While some strategies may have evolved from specific treatment models born of our respective professions, many can and do share common tenets and procedures in our collective effort to maximize function of persons with a TBI and to decrease burden of care on the family. Frequently, these interventions can be utilized conjointly in order to enhance efficacy and optimize progress within the time constraints typically allotted in an inpatient rehabilitation setting.

Interventions Targeting Attention

Attention Processing Training (APT), as defined by Tsaousides and Gordon (2009, p. 176), is a highly structured restorative program that include a procession of tasks progressing in demand intensity and distraction with the primary focus of targeting improvement of both visual and auditory attention. An application example of APT in an inpatient rehabilitation setting may include having a patient listen to a list of random items and to only "click the pen" on items that are found in the hospital. Initially, this can be done in a quiet environment at a slow pace. The clinician may gradually increase complexity by changing location to a noisy gym, providing the words at a faster rate, or having the patient click the pen for items belonging to a specific semantic category (e.g., items in the hospital) while raising their hand for another category (e.g., items in a school). Similarly, Direct Attention Training (DAT) is an automated program that targets similar attention components using computerized cognitive remediation techniques to improve attention alongside metacognitive strategies (Barman, Chatterjee, and Bhide, 2016).

International Cognitive, or INCOG, is an organization of brain injury experts tasked with establishing guidelines for cognitive rehabilitation. INCOG guidelines for attention, per Ponsford et al. (2014), detail recommendations for best practice resulting from various grading levels of evidence and systematic reviews. The authors determined that computerized tasks and/or repeated exposure may improve performance with a particular skill but do not generalize into restoring the impaired "attentional mechanism" (Ponsford et al., 2014). INCOG guidelines further advocate for use of compensatory strategies during attentional metacognitive tasks, such as chunking information (e.g., a phone number) into manageable pieces of data. These strategies may aid in increased independence and accurate performance of daily tasks and may be specifically useful for persons with mild to moderate TBI.

For persons with severe to profound TBI, INCOG guidelines suggest the method of Time Pressure Management (TPM) training. TPM is a structured three-step method that facilitates heightened awareness of (1) how slow processing can impact attention and performance of daily life tasks, (2) how this deficit may persist, specifically with fatigue, and (3) the need to self-monitor and adjust accordingly. TPM utilizes written materials and overt self-monitoring prompts (e.g., asking to move to

a quieter environment, asking for stimuli to be repeated, and/or utilizing external aids to review later such as video/audio recordings). An example of applying TPM in a rehabilitation setting, which both SLPs and OTs can facilitate, may include a dynamic cooking task, in which the patient is provided written instructions of the task to review and implement. The instructions may state, “You have 10 minutes to decide on a snack to make. You need to check the kitchen for ingredients that you already have and make a list of only the ingredients you need. Once completed, notify your SLP/OT. Remember, you can always ask for ‘repetition’ and/or state if you need ‘help,’ ‘supplies such as a pen/paper,’ or a change of rooms during the activity.” This task can become a routine, and as the patient makes progress, the SLPs/OTs can then decrease the level of visual support (i.e., written instructions) and/or implement greater cognitive challenges (e.g., increase the level of background noise) to facilitate improved functioning and generalization of learned skills.

Another factor to consider with traumatic brain injuries and the impact on attention are visual spatial deficits. Persons with visual spatial deficits may benefit from the use of specialized prism lenses that attempt to enhance or draw visual attention to a particular portion of the visual field that may be neglected. Barman, Chatterjee, and Bhide (2016) cite the use of Vision Restoration Therapy (VRT) and prism lenses to assist with improved neural plasticity, visual perception, and abnormal gaze patterns. Prism lenses may be incorporated in a rehabilitation setting through functional tasks such as reading a recipe while locating the ingredients and items on the table/shelf strategically placed on the neglected side.

As mentioned above, INCOG guidelines provide a thorough outlook on ways to address the complex process of attention and should be considered as a reference for the inpatient rehabilitation setting. These guidelines include a variety of non-pharmacological tools and techniques for improved attention and information processing based on the severity of TBI. These guidelines endorse the application of functional tasks for metacognitive strategy training, dual task performance, cognitive behavioral therapy (CBT), assessing for and treating sleep disorders, and task and environment modifications in order to facilitate optimum outcomes in the TBI population (Ponsford et al., 2014).

Interventions Targeting Memory

Memory deficits are pervasive in persons with TBI, and both restorative and compensatory approaches may be useful for navigating the temporal, biographical, and topographical domains. Restorative approaches focus on returning function whereas compensatory strategies focus on adaptation. For example, restorative approaches may include word lists, paragraph recall, visual imagery, and mnemonics, each of which target improving general recall skills during functional tasks and activities (Arciniegas, Held, & Wagner, 2002). Alternatively, compensatory approaches may enlist both high-tech and low-tech assistive technology, such as memory books, phone alarms, and calendars to aide in recall and overall independence. Per INCOG guidelines for memory, Velikonja et al. (2014) indicated that the use of compensatory strategies is best practice for the TBI population versus the restorative approach. Additionally, these compensatory strategies can be further classified into internal and external strategies. Internal strategies rely on recall/processing within the brain whereas external strategies rely on compensatory strategies in the patients’ environmental surroundings.Evidence suggests the use of internal strategies (e.g., self-talk, spaced retrieval, repetition) are more efficacious for persons with mild to moderate TBI. External aids (e.g., smartphones, whiteboards/lists, memory books, etc.) are more beneficial for persons with severe TBI.

These compensatory approaches are sometimes utilized in conjunction with errorless learning techniques focusing on learning specific information and procedures (Arciniegas, Held, & Wagner, 2002). An example of the errorless learning technique in an inpatient rehabilitation setting may include priming the patient with basic orientation information. For example, an SLP could implement visual and auditory cues to orient a patient to time and location: “We are in the month of…, the month is…”, “Mr./Ms., what is the month?” This strategy is repeated several times during the session, fading out the supports and having the patient state it independently. This errorless learning approach has proven effective in “route-finding tasks,” resulting in intuitive learning and

generalization. As with attention, INCOG recommends utilizing compensatory and remediation approaches for memory including metacognitive strategies (i.e., self-cueing), environmental supports and modifications (e.g., smartphones or notebooks), goal-setting, and interventions emphasizing group-based learning and support (Velikonja et al., 2014).

Interventions Targeting Executive Functioning

Though complex, there are several strategies for engaging and improving executive functioning. Metacognitive training targets improvement of self-monitoring and self-regulation using consistent cueing or encouraging the individual with a TBI to "self-monitor" during a task (Barman, Chatterjee, & Bhide, 2016). An application example of metacognitive training may include having a patient complete a series of structured written directions and cueing the patient to re-read or check responses during the task in order to aid in increased attention to detail and facilitate better self-monitoring as the task progresses. Expanding on the use of complex executive function skills, McDonald, Flashman, & Saykin (2002) describe Goal Management Training (GMT) as specifically targeting disorganized, irregular behavior through structured stages of meeting and reassessing goals in an effort to summarize, prioritize, and categorize subsequent actions associated with the successful completion of a desired outcome. An application of GMT may include having a patient verbalize the goal of getting out of bed. After the goal is set, SLPs/OTs can implement a cueing hierarchy to prompt the patient to state what is needed to accomplish the goal (e.g., the wheelchair and/or walker, gait belt for safety, proper footwear) and recognize precautions or safety considerations (e.g., weight-bearing status, wheelchair safety). Additionally, reasoning tasks can be incorporated (e.g., rationale for safety precautions), and the patient may verbally recall or physically complete a sequence of steps to take in order to safely achieve their goal.

Along with this compensatory technique, Domain-Specific Strategy Training (DSST) promotes compensatory techniques for specific perceptual or cognitive deficits as opposed to managing the overall activity or task. Individuals with a TBI might learn and apply tools to navigate through the specific cognitive or physical demand of a task rather than learning how to perform the task itself (e.g., incorporating a mnemonic to sequence through a morning routine; AOTA, 2013). Furthermore, the Cognitive-Didactic Approach (CAD), a strategy within DSST, promotes explicit learning by utilizing trial and error techniques to expand self-awareness and introspection as a remedial technique (Vanderploeg et al., 2008). An illustration of this type of learning would include introducing and educating an individual or family member on compensatory strategies, such as using an assistive device for ambulation or adaptive equipment for dressing.

Alternatively, the Functional-Experiential Approach (FEA) encourages implicit-learning. FEA endorses errorless-learning techniques to maximize structured procedural skills and environmental aids as compensatory strategies (Vanderploeg et al., 2008). This approach may include the facilitation of a particular task (e.g., sequencing the donning of a shirt) with cueing or prompting to minimize any errors. As the individual practices the task, cueing is gradually reduced or faded to support task completion without assistance.

Interventions Targeting Behavior and Family

There are tools and strategies to educate and assist the survivor and family with common behaviors, expectations, and lifestyle changes associated with TBI. These interventions may include family education and training with activities of daily living (e.g., taking a shower, following a morning routine, creating a 'low-stim' room), safe patient handling (e.g., use of a gait belt, rolling walker safety), de-escalation maneuvers (e.g., body language, tone of voice, limiting the amount of people/noise/lights), and/or appropriate communication techniques (e.g., not correcting the patient or arguing, providing choices, visual schedules).

A study by Sinnakaruppan, Downey, & Morrison (2005) illustrates how patient and family education can facilitate improved morale and reduce stress following a TBI event, specifically through the utilization of positive coping skills. For example, setting up a collaborative meeting with family members, the patient, and members of the treatment team (i.e., case management, SLP, OT) can

often help address anticipated questions and concerns regarding plan of care, goals, expectations, and discharge setting. The researchers highlighted how anxiety is the most common feeling among both family members and persons with TBI. Therefore, initiating family training will promote direct, hands-on coaching for caregivers and will foster an environment of safety and confidence between the patient and caregiver(s) by discharge.

Lifestyle changes and choices also have proven effective in reducing qualms about returning home and to the community. Lifestyle choices may include changes to diet/exercise, promoting adequate sleep/wake cycles (e.g., set bedtime, turning off electronics/lights when going to sleep), establishing a daily routine, and engaging in community involvement. Encouraging patients and caregivers to participate in support groups also can ameliorate anxiety and empower families navigating new challenges (e.g., role changes or increased burden of care).

Interventions Targeting Cognitive Fatigue

One of the most prominent techniques for decreasing cognitive fatigue encompasses environmental modifications as well as education and/or coping strategies to facilitate success (Hicks, Larkins, & Purdy, 2011). Environmental modifications may include scheduling the patient with ample breaks between sessions, modifying the room (e.g., lighting, temperature), task modification, and utilization of adaptive equipment (e.g., prisms to decrease eye strain and support focus). Persons with TBI can be supported through increased awareness on the signs and symptoms of fatigue. Direct instruction on potential coping strategies such as rest, relaxation strategies, and breathing techniques may be beneficial to reduce or alleviate the individual's fatigue.

Evidence-Based Research

Although there is a continued need for research to identify the best interventions and their long-term success rates among persons with TBI and their families, there is growing evidence to support the benefits of cognitive and neuro-functional rehabilitation approaches using an interdisciplinary framework. Per Barman, Chatterjee, and Bhide (2016), "The complexity and heterogeneous nature of brain injuries make it difficult to standardize treatment." As a result, there are a myriad of variables to consider when selecting and applying an intervention for a patient or client. For example, pre-morbidity education level, socioeconomic status, prior level of function and activity level, and severity of TBI can adversely impact the performance and overall effectiveness of a cognitive and/or functional treatment approach.

In one of the largest randomized controlled trials assessing rehabilitation strategies following TBI, Vanderploeg et al. (2008) determined that factors such as education level and age of injury both play an important and dynamic role in the response and efficacy of treatment. This claim was further illustrated by breaking down individuals with TBI responses to the Functional-Experiential Approach (i.e., implicit learning) versus the Cognitive-Didactic Approach (i.e., explicit learning) corresponding to the stage of life and level of education. Their research concluded that the Functional-Experiential Approach is more beneficial for older survivors or those with higher education levels who have goals of functional independence as opposed to returning to work. Conversely, younger survivors and survivors of any age with a lower education level who valued goals of returning to work benefited more from the Cognitive-Didactic Approach. This study demonstrates the complexity and uniqueness of a traumatic brain injury. Therefore, prior level of function should be considered in the development of the plan of care and intervention approach for individuals with TBI in order to facilitate optimum results. Reflecting upon this study, the selection and modification of each approach would be best constructed through an interdisciplinary effort utilizing the combined knowledge and skills of both the occupational therapist and speech-language pathologist in an effort to maximize function and community integration.

In a randomized group trial, Levine et al. (2000) performed a study utilizing Goal Management Training (GMT) compared to a TBI group that received only motor skills training. Results validated that GMT significantly improved performance on paper and pencil tasks that corresponded to everyday problem situations compared to the group who only received motor skills training.

Therefore, a more tailored interdisciplinary approach incorporating cognitive elements was more efficacious to the success and independence of the persons with TBI.

There is a high incidence of frontal lobe damage with persons with TBI. Per McDonald, Flashman, & Saykin (2002, p. 355), “Frontal lobes were the last of the cerebral structures to form evolutionarily…[and] demonstrate rich connections with many other brain regions.” Per Togher (2012), frontal lobe damage can impact the ability to learn and retain novel information. Togher (2012), via a three-arm non-randomized control trial, analyzed the success of training “everyday communication partners to the TBI survivor.” The groups trained in communication strategies were as follows: 1) the person with TBI (i.e., TBI SOLO); 2) training the family member and person with TBI (i.e., TBI JOINT); and 3) delayed treatment control condition. Results indicated that the TBI JOINT group, in which both the family and person with TBI were trained, made the most functional gains characterized by the completion of “homework tasks.” The TBI JOINT group completed homework tasks at 100 percent versus the TBI SOLO group, which completed none. Logically, this is more than likely attributed to the assumption that communication partners have an intact executive functioning system and are able to recall novel information and incorporate these trainings and strategies into everyday communication and routines with the person with TBI, resulting in increased generalization. Overwhelmingly, family education provided by both SLPs and OTs regarding cognitive and communicative strategies can further aid in recovery and overall independence.

Limitations and Conclusion

Although several cognitive interventions for the TBI population were found in both SLP and OT literature, the authors discovered several limitations, such as lack of contemporary data and decreased collaborative studies. Furthermore, even the studies utilized endorsed the difficult nature of researching the TBI population due to their complexity and diffuse range of presentations.

Traumatic brain injuries are as unique as the individual who survived them and, as a result, should be treated as such during the rehabilitation phase of their recovery. The assessment and intervention selection should reflect the prior level of function, occupational roles, available support network, anticipated discharge setting, and current physical and cognitive limitations of the person with TBI. As our Baby Boomer population continues to age, persons with TBI and their families are likely to represent a much larger population in the coming years, further driving the need for continued research, education, and intervention to ameliorate the financial, physical, and emotional demands on their families, communities, and society at large.

The first step of the rehabilitation process begins with recognizing and understanding the prevalent signs and symptoms following a TBI. Secondly, a collaborative approach of neuro-rehabilitative, evidence-based practice from an interdisciplinary team to include speech-language pathologists, occupational therapists, potential caregivers, and support networks needs to be established. With our broad but specialized skill sets, SLPs and OTs have a significant advantage of working together to provide and promote meaningful, effective, and function-based intervention strategies in an effort to reduce the burden of care and maximize the number of individuals with TBI reintegrating as contributing members of society. While there is some evidence to suggest that using a collaborative approach when considering the specific needs and desires of the survivor of a traumatic brain injury is critical in producing successful outcomes and return of function, there continues to be a need for more research and interest in TBI rehabilitation between our two professions. As our respective fields grow, we should find ourselves on the exciting frontier of research and discovery to further promote the value of our colleagues and efficacy on the rehabilitation outcome of persons with TBI. After all, as Aristotle once said, “The whole is greater than the sum of its parts.”

Cognitive Process	**Strategies/Tools**	**Patient may present with..**
Attention	• Attention processing (APT)	The patient demonstrates difficulty with attending to objects on the left side or

	• Direct attention training • Time pressure management (TPM) • Vision-prisms • Environmental modifications	difficulty maintaining task performance with multiple environmental stimuli (i.e., TV on and nurse administering medications)
Memory	• Word list • Paragraph recall • Visual imagery • Mnemonic • Memory books • AT tools (phones, alarms, reminders) • Notebooks/logs • Calendar • Errorless learning	The patient often has difficulty remembering basic orientation elements, spinal precautions, or difficulty with immediate and/or biographical recall
Executive Functions	• Metacognitive training • Goal management training (GMT) • Domain-specific strategy training	The patient frequently exhibits decreased insight into deficits and/or safety awareness
Behavior and Family	• Education program • Expectations • Signs and/or symptoms of behavior changes • Lifestyle	The patient may become easily agitated or frustrated or develops inappropriately psychosocial communication
Cognitive Fatigue	• Education/counseling • Recognizing signs and symptoms • Scheduling • Shorter sessions • Modifications of task/exercise • Changing level of stimuli/cues • Environmental modifications	Patient expresses difficulty with completing tasks, becomes restless, or is difficult to arouse following mild to moderate mental and/or physical stimulation

	• Prism lenses	

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