TASK SPECIFIC COGNITIVE CHALLENGES IN BRAIN CANCER SURVIVORS AT WORK

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ABSTRACT

Task specific cognitive challenges in brain cancer survivors at work

Courtney Collins, Master of Science, 2013

Thesis directed by: Michael Feuerstein, PhD, MPH, Professor of Medical and Clinical Psychology and Preventive Medicine and Biometrics

Objective: Past research indicated that generic cognitive limitations related to work occur in both brain tumor and non-cancer comparison groups. However cognitive limitations were greater in occupationally active brain tumor survivors than those without a cancer history. While the link between cognitive limitations and work limitations are similar between groups, it is possible that a specific pattern of work task limitations may be present in the cancer group. The present study aims to identify specific problematic work tasks and their cognitive correlates that are more likely to be reported in brain tumor survivors.

Method: Brain cancer survivors (n = 163) and a non-cancer comparison group (n = 99) completed an online survey that included socio-demographic information, job characteristics, health behaviors, and the Cognitive Symptom Checklist, a self-report measure of task-specific cognitive limitations in the workplace.

Results: Cognitive difficulties in the context of specific work tasks were significantly higher in brain tumor survivors than the comparison group in 54.24% (32 of the 59) of the work tasks. Odds ratios ranged from OR= 0.72 (95% CI=.41-1.24) to OR=14.36 (95% CI=4.23-48.74). Odds ratios for each task were higher for the brain tumor group in tasks related to decision making; identifying mistakes or errors when they occur; completing multi-dimensional or multi-step tasks (e.g. following step-by-step instructions); and remembering things, including following directions, and maintaining train of thought while speaking. Multivariate regression adjusting for age, gender, education, and frequency of aerobic exercise indicated that presence of brain tumor was the strongest predictor of self-reported cognitive limitations at work. The regression models accounted for 5.6% to 27% of the variance in cognitive limitations.

Conclusion: Occupationally active brain tumor survivors following primary tumor treatment report a series of very specific challenges that can impact cognitive functioning at work. The majority of work tasks reported as problematic required working memory and executive function with fewer problematic tasks specifically involving attention.

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INTRODUCTION

The worldwide age-adjusted incidence of primary malignant brain and central nervous system cancers in 2002 was 3.7 per 100,000 person years for males and 2.6 per 100,000 person years for females. This translates into roughly 189,582 cases globally per year, with incidence rates higher in more developed countries (approximately double the incidence rate in developed countries), possibly related to better detection methods (3). Precise tracking of the incidence and prevalence in the US is complicated by the recent inclusion of both non-malignant and malignant brain tumors in epidemiological data (27). The incidence of brain tumors in general also differs by gender (females = 6.1 per 100,000 person years, males= 8.5 per 100,000 person years) (18; 27).

There is little difference in the 10-year survival rate between non-malignant and malignant brain tumors and prevalence rates for these two types of primary tumors, though there has been an increase in the incidence of these cancers in the past decade (27). The incidence of all primary brain tumors in the US was 209 per 100,000 person years in 2004 while it is estimated at 221 per 100,000 person years in 2010. While both numbers include children, more adults are diagnosed with these tumors each year. Higher incidence was noted in those in the age range of 20-64.

Regardless of the type of tumor, completion of primary cancer treatment often marks the commencement of a new set of challenges to include resuming work and/or remaining in the workforce (4). Overcoming fatigue is a struggle frequently experienced post-treatment for many types of cancer including brain tumors (23). Fatigue has been attributed to impaired psychosocial function, a decreased sense of wellbeing, and negative work outcomes (13; 22). In many types of cancer survivors, including those

living following treatment for brain tumors, other post-treatment symptoms include sleep problems, depressive and anxiety symptoms, and cognitive limitations (17; 23).

The treatment of choice for malignant brain tumors includes surgery, radiation, and chemotherapy (28). The literature is consistent regarding the presence of cognitive dysfunction following treatment in brain cancer (33). With earlier diagnosis, efforts to reduce long-term functional outcomes have a greater focus on optimizing quality of life over the remainder of the life span. Despite these improvements in health care, cognitive limitations are experienced by survivors of brain tumors post cancer treatment. Research indicates that impairments of up to 1.5 SD below the norm have been observed on neuropsychological tests of attention, executive function, psychomotor speed, language abilities, and memory (8; 10).

Cognitive dysfunction is one of the most frequently recognized symptoms of long-term brain tumor survivors from six to twelve months post-treatment (8). Despite this, many brain tumor survivors return to the workplace. This may be due to financial necessity, to retain employer-sponsored health insurance in the U.S., and/or to symbolize a return to normalcy (31). Even employed brain tumor survivors who, because of their working status are relatively high functioning, report cognitive limitations to include memory deficits, particularly short term memory, difficulties formulating speech, and emotional changes such as restlessness, irritability, and impulsivity (12; 23). Research has shown that self-reported cognitive limitations at work are associated with work limitations in both brain tumor survivors and non-cancer individuals (12). Higher levels of distress are reported by brain tumor survivors including depression, anxiety, and anger (20) and concomitant cognitive limitations. Brain tumor survivors have indicated that

these negative emotions can affect various aspects of their lives, including work, even at twelve months post-treatment (26).

Most jobs in the global economy require a certain level of cognitive ability (25). Brain tumor survivors who experience some loss of cognitive function who wish to return and/or remain in the workforce must be able to perform these tasks with or without reasonable accommodations (2). Identifying cognitive problems reported in the context of work tasks may inform future occupational rehabilitation efforts including workplace accommodations, improving upon the more generic recommendations that are currently available for work accommodations (1; 21).

Past research indicated that generic cognitive limitations related to work occur in both brain tumor and non-cancer comparison groups (12). However, cognitive limitations were greater in occupationally active brain tumor survivors than those without a cancer history. While the link between cognitive limitations and work limitations are similar between groups, it is possible that a specific pattern of work task limitations may be present in the cancer group. The current study aims to identify specific patterns of problematic work tasks and their cognitive correlates that are more likely to be reported in brain tumor survivors.

METHODS

PARTICIPANTS

Participants for this study were recruited through print and electronic media. Newspaper ads were placed in large newspapers in Washington, D.C., Los Angeles, CA, and New York, NY and fliers were placed in the Baltimore, MD and New York, NY city areas. Cancer survivors were also recruited through brain cancer websites. These included the American Association of Brain Tumors' (AABT) website,

www.braintumor.org, The Brain Tumor Foundation of Canada's website, www.btfc.org, and the website of The Brain Tumor Society, www.tbts.org (active at the time of the study, currently subsumed under AABT's website). All participants were fluent in English with at least a 7th grade reading level and between the ages of 20-70. No consideration was given to ethnicity or gender during recruitment.

CASE DEFINITION

Brain tumor survivors were defined as individuals with a diagnosis of a primary brain tumor who had completed their treatment for the brain tumor and were currently employed. Primary brain tumors include a number of tumor types (6) and treatment modalities including neurosurgical resection, debulking, radiation, and chemotherapy. The tumor and aspects of treatment can influence cognitive function in the short term and over time (28-30). These cognitive changes can influence abilities at work (26). The non-cancer comparison group was defined as individuals with no history of cancer, life threatening illness, or major chronic disease, and who had been employed outside their home for at least one year.

As Table 1 indicates, the most commonly reported brain tumor types were astrocytoma (16.8%) and oligodendroglioma (18.7%), with tumor location being reported most commonly as in the right hemisphere (22.5%). Most of this group (86.6%) reported that they had not received surgical treatment for their tumor. Almost a third of participants (28.2%) had received radiation treatment; but were unsure of how much radiation they had received. Slightly more than a third of survivors (35.1%) reported that they had completed treatment and their tumors were currently stable.

PROCEDURE

This study is a secondary analysis of data collected and analyzed by Feuerstein, et al. (12). Once recruited, participants completed an online questionnaire. It included basic demographic information such as age, ethnicity, gender, marital status, and education level as well as the 59-item CSC. The entire study required 60 minutes. At the conclusion of the survey participants were given the option of entering their personal address into a separate database to receive a Lance Armstrong "LIVESTRONG" wristband and a check for $15 for their participation. Study responses were recorded and stored on a secured USUHS database. Data were subsequently entered into an excel spreadsheet and imported to SPSS (version 20) for data analysis. The sample consisted of 163 brain cancer survivors and 99 adults without a history of any type of cancer who completed the study between February and September of 2005.

MEASURES

Demographic information

General socio-demographic information such as age, gender, marital status, ethnicity, education level, and health insurance status was collected using a set of questions from a survey developed for this study. Significant differences between brain cancer survivors and the non-cancer comparison group (NCG) were observed in several areas. The majority of the sample was between the ages of 30-59 (M=41.41, SD=10.88), which was significantly different between groups (χ^2 (4, N=255) = 11.62, p =.02). Other significant findings between groups include gender, education, and exercise frequency. The brain tumor participants were more likely than the non-cancer comparison group to be female (χ^2 (1, N=260) = 9.07, p =.003), and have a college degree or higher (χ^2 (1, N=260) = 9.07, p =.003). Additionally, the brain tumor group reported they exercised more than the non-cancer group (χ^2 (2, N=262) = 8.90, p =.01), they were more likely to

be single or divorced (χ^2 (1, N=262) = 4.15, p =.042), and they were more likely to report high work stress (χ^2 (3, N=238) = 9.11, p =.03) than their non-cancer counterparts.

There were no significant group differences found for racial characteristics (χ^2 (4, N=262) = 5.04, p =.284), job characteristics (χ^2 (1, N=235) = 2.0, p =.157), and health insurance status (χ^2 (2, N=262) = 0.91, p =.635). All analyses were adjusted to account for any differences between groups. All self-reported demographic, job and health behavior data are presented in Table 2.

Job-related and health-related information

Using the participant survey, individuals were asked six questions related to their type of job, job stress, and frequency of exercise behaviors. These questions assessed job category (e.g. managerial versus production or construction jobs), length of employment, how much physical exertion was required each day at work, how much stress participants felt their job placed them under, and how often they engaged in physical exercise outside of work (e.g. once or twice a week, rarely). Sample questions included items such as, "How often do you feel your present work situation is putting you under too much stress?"

Assessment of task-specific cognitive problems at work

The modified Cognitive Symptom Checklist (CSC) is a 59-item dichotomous self-report questionnaire that asks participants to indicate which cognitive functions are problematic during tasks at work using the domains of working memory, executive function and attention. The scale asks the respondent to provide a yes or no answer to questions that focus on difficulty in the context of their job. Sample items include "I have difficulty focusing on a task when there is a sudden loud noise," designed to assess attention, "I have difficulty remembering to keep appointments once they are scheduled,"

to assess working memory, and "I have difficulty figuring out how a decision was reached," to assess executive function. The measure was originally employed as a patient checklist intended to identify a set of patient-reported generic cognitive problems(24).

Feuerstein, et al. (2007) modified the original 100-item CSC to generate a more succinct list of cognitive problems reported by brain and breast cancer survivors in the context of work (5; 12; 16; 24). This group used factor analysis to reduce the measure to the 59 item version used in the current study. This 59-item version demonstrated substantial inter-item correlations and internal consistency within the three factors of attention (Cronbach $\alpha = 0.86$), working memory (Cronbach $\alpha = 0.93$), and executive function (Cronbach $\alpha = 0.91$) (12).

Identification of brain tumor-specific cognitive limitations in the context of work

In order to identify whether brain tumor survivors report specific work tasks involving cognitive function as problematic more often than non-cancer individuals, logistic regressions were conducted to examine the relationship between brain tumor status (brain tumor survivors vs. non-cancer comparison) and cognitive limitations on each specific occupational task. This resulted in 59 multivariate logistic regressions. Due to the large number of analyses being performed, a Bonferroni correction was applied in order to minimize the risk of Type I error. The original Bonferroni correction called for a p-value of less than .00085, which we rounded to a p-value of less than .001. Admittedly this is a very conservative procedure and results in increased potential for Type II error. However, the purpose of this study is to identify the most specific and robust problem areas rather than serve as a general exploratory study. This is so that in the future these identified problems can be addressed first in rehabilitative efforts.

The regressions were run using group as the independent variable (brain tumor survivor vs. non-cancer) and dichotomous participant response on each CSC item (yes/no) as the dependent variable. Covariates determined by the initial descriptive analyses were included to examine the impact of variables such as gender and education on cognitive impairment outcomes. The model included age, gender, education, and aerobic exercise frequency as covariates. Odds ratios and 95% CI were computed and are listed in Table 3.

RESULTS

Based on the model described above, 32 of the 59 specific work tasks differed significantly between the two groups based on a Bonferroni adjusted alpha level of .001, indicating the brain tumor survivors reported significantly more cognitive limitation-related work task problems. As Table 3 indicates, cancer survivor status was most consistently associated with cognitive limitations in the model, with odds ratios ranging from OR=0.72 (95% CI=0.41-1.24) to OR=14.36 (95% CI=4.23-48.74) depending on the cognitive work task item. The covariates including age, gender, education, and aerobic exercise frequency were not significant at the .001 level in the individual models. The specific cognitive limitation and work task items are listed in Table 3, with significant results highlighted.

Table 1. Brain tumor-related characteristics (n=163)

Brain Tumor Type	**N**	**%**
Glioblastoma	31	11.8
Astrocytoma	44	16.8
Oligodendroglioma	49	18.7
Malignant glioma	5	1.9
Ependymoma	8	3.1
Meningioma	12	4.6
Other	14	5.3

Not sure	1	0.4
Tumor Location		
R Hemisphere	59	22.5
L Hemisphere	35	13.4
Bilateral	2	.8
Frontal	28	10.7
Temporal	23	8.8
Occipital	1	0.4
Radiation Dose		
<40 Gy	5	1.9
46-50 Gy	1	0.4
51-55 Gy	7	2.7
56-60 Gy	10	3.8
>60 Gy	12	4.6
Not Sure	74	28.2
Current Disease Status		
Primary treatment completed, disease stability	92	35.1
Primary treatment, no disease stability, continue treatment	28	10.7
Recurrence, going through treatment again	18	6.9
Recurrence in past, currently under control	19	7.3
No response	105	40.1
Neurosurgery		
None	227	86.6
Partial Resection	35	13.4

Note: Tumor type, location, and radiation dose were determined by self-report. They were not confirmed through medical records for this study.

Table 2. Socio-demographic Variables (n=262)

	Brain Tumor	%	Non-Cancer Comparison	%	Chi Square	p
Gender*						
Male	64	39.5	21	21.4	9.07	0.00
Female	98	60.5	77	78.6		
Missing	1		1			
Marital Status**						
Single/Divorced	100	61.3	48	48.5	4.15	0.04
Married/Cohabitating	63	38.7	51	51.5		
Missing	0		0			
Education*						
Some H.S./H.S./Some college	64	39.5	21	21.4	9.07	0.00
College degree or more	98	60.5	77	78.6		
Missing	1		1			
Health Insurance						
No	9	5.5	4	4	0.91	0.63
Yes	153	93.9	95	96		
Missing	1		0			
Job Category		%		%		
Managerial/administrative	127	87.6	84	93.3	2	0.15
Non-managerial/non-administrative	18	12.4	6	6.7		
Missing	18		9			
Age*				%		
20-29	20	12.7	22	22.4	11.62	0.02
30-39	35	22.3	33	33.7		
40-49	56	35.7	26	26.5		
50-59	40	25.5	14	14.3		
60+	6	3.8	3	3.1		
Missing	6		1			
Race						
White	152	93.3	89	89.9	5.04	0.28
Black	2	1.2	3	3		
Hispanic	3	1.8	0	0		
Asian	3	1.8	5	5.1		
Other	3	1.8	2	2		
Missing	0		0			
Work is too much stress						

Never	10	6.6	3	3.4	9.11	0.03
Seldom	43	28.5	23	26.4		
Sometimes	58	38.4	49	56.3		
Often	40	26.5	12	13.8		
Missing	12		12			
Exercise**						
1-2 times/week	57	35	18	18.2	8.90	0.01
<1 time/week	41	25.2	35	35.4		
Rarely	65	39.9	46	46.5		
Missing	0		0			

*=p<.005 **=p<.05

Table 3. Cognitive Limitations and Work Task Items within Employed Brain Tumor Survivors and Non-Cancer Comparison Group (n=253)

	Subscale	Specific Task	B	S.E.	Exp(B)	CI (95%)
CSC #1	M	"Doing math in my head"	1.42	0.30	4.14**	2.30-7.47
CSC #2	M	"Answering questions quickly"	2.18	0.36	8.87**	4.37-18.01
CSC #3	E	"Seeing/correcting mistakes on my own"	1.59	0.39	4.91**	2.30-10.46
CSC #4	E	"Seeing mistakes pointed out by others"	0.79	0.43	2.20	.954-5.07
CSC #5	M	"Focusing on a task when there is too much detail or clutter"	1.00	0.31	2.71	1.48-4.95
CSC #6	A	"Difficulty making decisions"	1.50	0.31	4.49**	2.46-8.18
CSC #7	M	"Understanding what I read without rereading it"	1.30	0.30	3.65**	2.03-6.57
CSC #8	M	"Understanding what I hear the first time I hear it"	1.33	0.31	3.77**	2.06-6.90
CSC #9	M	"Seeing mistakes as they occur"	1.77	0.36	5.86**	2.87-11.95
CSC #10	M	"Seeing mistakes after task completion"	1.69	0.39	5.39**	2.54-11.47
CSC #11	E	"Trying new ideas or actions"	1.00	0.42	2.72	1.20-6.17
CSC #12	E	"Difficulty planning a speech"	1.26	0.36	3.51**	1.75-7.03
CSC #13	M	"Shifting attention to 2+ things"	1.68	0.30	5.37**	2.98-9.66
CSC #14	A	"Difficulty staying with a task until completion"	0.69	0.28	2.00	1.15-3.48
CSC #15	E	"Planning what to discuss when I meet someone"	1.10	0.34	3.01	1.54-5.88
CSC #16	E	"Following directions to a specific place"	1.70	0.42	5.47**	2.41-12.44
CSC #17	M	"Shifting from one task to another"	2.22	0.47	9.23**	3.71-22.99
CSC #18	M	"Completing steps of a task/activity"	1.86	0.42	6.40**	2.83-14.47
CSC #19	M	"Following step-by-step instructions"	2.11	0.50	8.27**	3.08-22.19

CSC #20	E	“Putting steps in order so that the most important steps are done first”	1.25	0.38	3.48	1.65-7.36
CSC #21	E	"Setting up routine to approach tasks"	1.55	0.42	4.72**	2.07-10.76
CSC #22	E	"Understanding what a problem is"	1.54	0.40	4.68**	2.13-10.31
CSC #23	A	“Starting a task on my own”	0.51	0.31	1.67	.918-3.04
CSC #24	A	“Remembering where my car is parked”	0.87	0.32	2.34	1.28-4.48
CSC #25	A	“Focusing on a task when there is a sudden movement around me”	0.88	0.29	2.40	1.36-4.23
CSC #26	E	"Knowing where to look for information to solve a problem"	1.25	0.46	3.50	1.42-8.58
CSC #27	E	"Using new information to reevaluate what you know”	1.88	0.51	6.56**	2.42-17.82
CSC #28	E	"Choosing a solution from several sources"	1.05	0.40	2.86	1.31-6.20
CSC #29	A	“Focusing on a task when there is a lot of movement happening around me”	0.94	0.29	2.57	1.47-4.50
CSC #30	A	"Focusing when there's a sudden loud noise"	0.51	0.28	1.67	.961-2.91
CSC #31	M	"Following written instructions"	2.41	0.63	11.13**	3.27-37.88
CSC #32	M	“Writing to other people in an organized manner”	1.26	0.43	3.51	1.52-8.12
CSC #33	M	“Organizing information to be remembered”	1.48	0.31	4.37**	2.39-8.00
CSC #34	A	"Focusing when multiple people are speaking at once"	0.62	0.29	1.85	1.05-3.25
CSC #35	A	"Focusing when the radio/TV is on"	0.36	0.28	1.43	.821-2.50
CSC #36	M	"Retracing steps to solve a problem"	2.05	0.42	7.76**	3.41-17.63
CSC #37	M	“Remembering to perform daily routines”	1.44	0.42	4.20	1.84-9.60
CSC #38	M	"Remembering things someone asked you to do"	1.57	0.31	4.79**	2.63-8.73
CSC #39	M	“Remembering the content of phone conversations"	1.97	0.38	7.14**	3.37-15.13
CSC #40	A	"Focusing when you feel hot or cold"	-0.34	0.28	0.72	.413-1.24
CSC #41	M	"Remembering content of conversations/meetings"	2.28	0.37	9.74**	4.68-20.29
CSC #42	M	"Remembering a word you wish to say"	1.43	0.30	4.16**	2.31-7.50
CSC #43	E	"Acting on a decision you made"	0.77	0.35	2.16	1.09-4.30
CSC #44	E	"Putting together materials needed for a task"	2.20	0.55	8.98**	3.05-26.43
CSC #45	E	"Understanding a system"	1.37	0.53	3.92	1.40-10.98
CSC #46	M	"Remembering your train of thought while speaking"	1.92	0.31	6.80**	3.69-12.53
CSC #47	M	"Remembering the name of a familiar object or person"	1.44	0.30	4.21**	2.32-7.62
CSC #48	E	"Understanding graphs or flowcharts"	0.92	0.38	2.51	1.20-5.26
CSC #49	E	“Understanding how a task fits into a plan or system”	1.27	0.46	3.57	1.46-8.70

CSC #50	E	"Understanding politics at work"	0.47	0.33	1.61	.841-3.07
CSC #51	M	"Remembering information that's 'on the tip of your tongue'"	1.92	0.33	6.83**	3.57-13.10
CSC #52	M	"Remembering what I intended to write"	1.94	0.42	6.97**	3.07-15.81
CSC #53	E	"Figuring out how a decision was reached"	0.21	0.36	1.24	.615-2.48
CSC #54	E	"Following the flow of events"	2.67	0.62	14.36**	4.23-48.74
CSC #55	E	"Considering all aspects of what you hear/see"	1.06	0.32	2.90	1.56-5.38
CSC #56	E	"Remembering to schedule appointments"	1.30	0.37	3.65**	1.78-7.49
CSC #57	A	"Staying focused when there are many sights and sounds"	0.62	0.28	1.86	1.07-3.22
CSC #58	E	"Remembering to keep appointments"	1.40	0.39	4.04**	1.88-8.65
CSC #59	A	"Focusing on a task when I am in a large area"	1.10	0.34	2.99	1.53-5.86

**p<.001

M: Memory; A: Attention; E: Executive Function

DISCUSSION

Cognitive demands are known to vary both within and across jobs (25). Previous research has found that cognitive problems in general are a large source of disease burden for brain tumor survivors at work (5; 12). This study expanded upon Feuerstein and colleagues' 2007 and Calvio and colleagues' 2009 papers to identify specific work tasks requiring cognitive demands that were reported as problematic in brain tumor survivors. More brain tumor survivors reported problems in the following areas: decision making; identifying mistakes or errors when they occur; remembering things, to include: following directions (e.g. to a specific place); maintaining train of thought and remembering words while speaking; and activities involving planning and coordination (e.g. planning a speech or setting up a routine). The majority of work tasks reported as problematic dealt with working memory, while several were related to executive function.

These results are important for both employees and employers. Significant problems with working memory and executive function tasks are indicative of the complicated and specific nature of cognitive limitations at work. Employees working in complex jobs often have to perform these mental functions frequently throughout the work day, necessitating that future research, treatment, and accommodations match the complexity of these cognitive problems accordingly and in a targeted way. By identifying the complexity and specificity of problematic cognitive work tasks, underrepresented individuals with brain tumors may soon find more effective ways to manage return to work.

These findings are consistent with recent research that indicates despite resuming employment, brain tumor survivors report cognitive challenges while at work (26; 31). These cognitive challenges can occur one year and beyond post-primary treatment for the individual. While those brain tumor survivors who return to work are likely to be relatively high functioning in contrast to those who cannot return to work (9), the present findings indicate that even these employed brain tumor survivors report cognitive problems during certain tasks. While these results must be replicated, there is a current need to increase recognition and a more in-depth understanding of these challenges and work toward improved approaches to mitigate these specific cognitive work task concerns.

The present findings must be considered in light of certain methodological constraints. The use of a self-report measure of cognitive limitations remains controversial given neuropsychological testing is considered to be the gold standard (30). Given this study's focus on identification of cognitive problems while at work, the self-

report approach was used. Future studies should collect multidimensional measurements (e.g., biological, behavioral, and emotional) of this apparent mismatch between cognitive capacity and task demand directly in the workplace (13). Additionally, type of tumor and treatment should be confirmed based on tumor biology using medical records.

The current findings can help inform workplace accommodations and rehabilitation efforts and provide a step to identifying cognitive challenges in specific areas while at work. It is well known in the area of human factors and ergonomics that task demands vary by worker and within- and across-days making variations in performance inevitable (7). Perhaps specific cognitive accommodations may help stabilize work performance in the specific tasks that were identified as problem areas. At present there are very few effective cognitive rehabilitation modalities for brain tumor survivors (15). A recent randomized controlled trial conducted in malignant brain tumor survivors was targeted at improvement in overall levels of cognitive capacity (14). While this was an important first step at improving cognitive function in brain tumor survivors, perhaps a more context specific intervention (i.e., improving cognitive problems at work) would generate a more promising outcome; such an approach should be investigated. This information might also prove useful in the evaluation of specific drugs that can exert an effect on cognition post chemotherapy exposure and their impact on work function (11).

There are a very limited number of currently available workplace accommodations that address cognitive limitations in brain tumor survivors during specific work tasks. In addition, neuropsychological rehabilitation techniques often center on generic memory and attention retraining, problem solving, and acceptance of one's lower level of functioning and adjustment to a new way of life (19; 34) rather than

active efforts to address specific work-related cognitive problems. Despite these generic rehabilitation efforts, impaired function and cognitive problems persist in brain tumor survivors (32) which can impact work function. The current findings provide preliminary evidence to indicate that occupationally active brain tumor survivors report specific cognitive limitations that influence specific work tasks providing justification for investigation of this process while at work.

Figure 1. Cognitive Symptom Checklist-Modified (CSC)

Cognitive Symptom Checklist – Modified (CSC)

Please read each of the following items below. They describe problems that you may or may not experience at work.

Item:	Yes	No
1. I have difficulty doing math in my head		
2. I have difficult answering questions quickly		
3. I have difficulty seeing and correcting mistakes on my own		
4. I have difficulty seeing and correcting mistakes pointed out to me by others		
5. I have difficulty focusing on a task when there is too much detail or clutter		
6. I have difficulty making decisions		
7. I have difficulty understanding what I read without rereading it		
8. I have difficulty understanding what I hear the first time I hear it		
9. I have difficulty seeing mistakes that I make as they occur		
10. I have difficulty seeing mistakes after I have completed the task		
11. I have difficulty trying new ideas or actions		
12. I have difficulty planning a speech		
13. I have difficulty shifting my attention among two or more things		
14. I have difficulty staying with a task until completion		
15. I have difficulty planning what to discuss when I meet someone		
16. I have difficulty following directions to a specific place		
17. I have difficulty shifting from 1 task or activity to another		
18. I have difficulty completing all steps of a task or activity		
19. I have difficulty following step-by-step instructions		
20. I have difficulty putting steps in order such that the most important steps are done first		
21. I have difficulty setting up a routine or system to approach tasks		
22. I have difficulty understanding what a problem is when it occurs and clearly stating what the problem is		
23. I have difficulty starting a task or activity on my own		
24. I have difficulty remembering where my car is parked		
25. I have difficulty focusing on a task when there is a sudden movement around me		
26. I have difficulty knowing where to look for information to solve a problem		
27. I have difficulty using new information to re-evaluate what I know		
28. I have difficulty choosing a solution to a problem from several possible sources		
29. I have difficulty focusing on a task when there is a lot of movement happening around me		
30. I have difficulty focusing on a task when there is a sudden loud noise		
31. I have difficulty following written instructions		
32. I have difficult writing to other people in an organized manner		
33. I have difficulty organizing information to be remembered		
34. I have difficulty focusing on a task when more than one person is speaking at a time		
35. I have difficulty focusing on a task when a radio or TV is playing in the background		

36. I have difficulty following or retracing steps to solve a problem
37. I have difficulty remembering to perform daily routines
38. I have difficulty remembering things someone has asked me to do
39. I have difficulty remembering the content of telephone conversations
40. I have difficulty focusing on a task when I feel hot or cold
41. I have difficulty remembering the content of conversations and/or meetings
42. I have difficulty remembering a word I wish to say
43. I have difficulty acting on a decision that I made
44. I have difficulty putting together the materials needed for a task
45. I have difficulty understanding a system
46. I have difficulty remembering my train of thought as I am speaking
47. I have difficulty remembering the name of a familiar object or person
48. I have difficulty understanding graphs or flowcharts
49. I have difficulty understanding how a task fits into a plan or system
50. I have difficulty understanding systems and models
51. I have difficulty remembering information that is "on the tip of my tongue"
52. I have difficulty remembering what I intended to write
53. I have difficulty figuring out how a decision was reached
54. I have difficulty following the flow of events
55. I have difficulty considering all aspects of what I hear or see instead of focusing on only one part
56. I have difficulty remembering to schedule appointments
57. I have difficulty staying focused in places where there are many sights and sounds
58. I have difficulty remembering to keep appointments once they are scheduled
59. I have difficulty focusing on a task when I am in a large area

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