12-3-2004

Validation of the Functional Assessment of Cancer Therapy Cognitive Scale with Bone Marrow Transplant Patients

Sheri R. Jacobs
University of South Florida

Validation of the Functional Assessment of Cancer Therapy Cognitive Scale with Bone Marrow Transplant Patients

by

Sheri R. Jacobs

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts
Department of Psychology
College of Arts and Sciences
University of South Florida

Major Professor: Paul B. Jacobsen, Ph.D.
Margaret Booth-Jones, Ph.D.
William P. Sacco, Ph.D.
Douglas Rohrer, Ph.D.

Date of Approval:
December 3, 2004

Keywords: cognitive complaints, quality of life, cognitive functioning, neoplasm, psychometrics

Table of Contents

List of Tables

Validation of the Functional Assessment of Cancer Therapy Cognitive Scale with Bone Marrow Transplant Patients

Sheri R. Jacobs

ABSTRACT

Research has demonstrated that cancer patients report problems with cognitive functioning related to their cancer and their cancer treatments. Cognitive complaints refer to subjective reports of problems such as decreased memory, attention, concentration, and language skills. These problems with cognitive functioning can interfere with a person's quality of life. The current measures of cognitive complaints have poor or unknown psychometric properties. Therefore, the present study sought to examine the psychometric properties of a newly developed measure of cognitive complaints for cancer patients, the Functional Assessment of Cancer Therapy Cognitive Scale (FACT-Cog). Eighty-two patients were administered a comprehensive battery of neuropsychological tests assessing memory, executive functioning, motor, and attention, as well as a battery of psychosocial measures six months or twelve months after receiving a bone marrow transplant. Results indicated that the internal consistency reliability of the FACT-Cog was high. Concurrent validity was evidenced by the significant relationship of the FACT-Cog to another measure of cognitive complaints. Convergent validity is evidenced by the significant relationship of the FACT-Cog to measures of depression, fatigue, anxiety, mental well-being, and physical well-being. Divergent validity was evidenced by the lack of significant relationship of the FACT-Cog to a measure of extroversion. In contrast, there was limited support for the criterion validity of the

FACT-Cog as evidenced by the limited significant relationships with neuropsychological test scores. The FACT-Cog did not demonstrate superior psychometric properties to an existing measure of cognitive complaints (EORTC-CF). Future research should investigate the relationship of cognitive complaints to cognitive performance utilizing longitudinal designs, other clinical populations, and neuropsychological tests that require sustained effort.

Introduction

Cognitive functioning among adult cancer patients has received increasing attention in recent years. Research suggests that problems with cognitive functioning have a large impact on quality life, interfere with the ability to function in daily activities, and affect educational and career choices. Therefore, it is important to correctly identify and assess problems associated with cognitive functioning. Cognitive functioning has been assessed in two ways: by measuring cognitive performance on standardized neuropsychological tests and by obtaining self-reports of cognitive complaints. Although methodology for assessing cognitive performance is fairly well developed, the same cannot be said for the assessment of cognitive complaints. Current methods for measuring cognitive complaints either lack sound psychometric properties or have unknown psychometric properties. Recognizing the need for a reliable and valid measure, Wagner, Sweet, Cella, and Doninger (2002) have developed the Functional Assessment of Cancer Therapy Cognitive Scale (FACT-Cog). This measure of cognitive complaints is composed of behaviorally-based items in an effort to minimize the impact of distress unrelated to cognitive abilities. The aim of the present study was to examine the psychometric properties of this newly developed instrument using bone marrow transplantation (BMT) patients as the validation sample.

The following section will evaluate different methods of measuring cognitive functioning in cancer patients. First, studies assessing cognitive complaints but not cognitive performance in cancer patients will be discussed. Next, studies assessing both cognitive complaints and cognitive performance will be reviewed. Finally, the development and structure of the FACT-Cog will be discussed.

Review of Cognitive Complaints Literature

Although there is no consensus, cognitive complaints typically refers to subjective difficulties with memory, attention, concentration, and language skills (Olin, 2001). Cognitive complaints, such as difficulties with attention and concentration, may overlap with symptoms of depression and fatigue. However, unlike depression and fatigue, cognitive complaints can include problems with mental acuity, verbal and nonverbal memory, verbal fluency, and the impact of decreased cognitive abilities on a person's functioning and quality of life. Although there is overlap among depression, fatigue, and cognitive complaints it is possible to distinguish them, and anecdotally patients report cognitive complaints without experiencing depression or fatigue. This highlights the importance of reliably and validly measuring cognitive complaints.

A variety of methods have been used to assess cognitive functioning in cancer survivors. Some studies have relied on subjective measures to assess cognitive complaints without using objective measures of cognitive performance. Five such studies can be identified. Two studies used the Sickness Impact Profile (SIP) Alertness Behavior Scale (Bergner, Bobbitt, Carter, & Gilson, 1981) and the Profile of Mood State (POMS) Confusion Scale (McNair, Lorr, & Droppleman, 1971) and three studies used the European Organization for Research and Treatment of Cancer – Quality of life Questionaire-C30 Cognitive Functioning Scale (EORTC-CF; Aaronson, Ahmedzai, Bergman, Bullinger, & Cull, 1993) to assess cognitive complaints.

The first study, by Andrykowski, Henslee, and Barnett (1989), used the SIP Alertness Behavior Scale and the POMS Confusion Scale to assess cognitive complaints. The SIP Alertness Behavior Scale consists of ten items assessing the presence of

difficulties in memory, attention, and concentration. Higher scores indicate greater dysfunction. The POMS Confusion Scale consists of seven descriptors, such as, 'confused', 'unable to concentrate', 'muddled', and 'efficient'. Respondents indicate for the last week the degree to which each descriptor is characteristic of them. Higher scores indicate greater dysfunction. In this study, 16 allogeneic BMT patients were assessed two years following transplant and then again at four years post-transplant. Scores on the SIP Alertness Behavior Scale improved significantly from time one to time two. Scores at both assessments reflected more impairment in comparison to scores from a sample of renal implant patients and scores from a sample of chronic peritoneal dialysis patients. Scores on the POMS Confusion Scale remained stable across time and were similar to scores from the comparison samples.

A second study by Andrykowski et al. (1990) also assessed cognitive complaints using the SIP Alertness Behavior Scale and the POMS Confusion Scale. Thirty allogeneic BMT patients were divided into three groups based on the amount of Total Body Irradiation (TBI) they had received: patients who received 900 cGy or less (N=13), patients who received 1200 cGy (N=9), and patients who received 1320 or 1400 cGy (N=8). After controlling for age, time post-BMT, education, and current psychological distress, the SIP Alertness Behavior Scale was found to be significantly positively related to TBI dose. The correlation between the POMS Confusion Scale and TBI dose only approached significance.

Joly et al. (1998) used the EORTC-CF to assess cognitive complaints. The EORTC-CF consists of two items rated on a four-point scale (1=Not at all, 2=A little, 3=Quite a bit, 4=Very much). One item assesses difficulty with concentration and the

other item assesses difficulty with memory. The sample in this study consisted of men with localized prostate cancer (N=71) and healthy controls (N=71). The prostate cancer patients were tested an average of four years post-treatment. No significant difference was found on the EORTC-CF between patients and controls.

Hjermstad, Holte, Evensen, Fayers, and Kaasa (1999) also administered the EORTC-CF to measure cognitive complaints. The samples of cancer patients consisted of leukemia patients treated with high-dose chemotherapy and allogeneic BMT (N=41), lymphoma patients treated with high-dose chemotherapy and autologous BMT (N=51), and lymphoma patients treated with combination chemotherapy (N=85). Lymphoma patients who underwent autologous BMT reported significantly greater cognitive complaints than the other two cancer groups and the healthy controls. No significant differences existed between the leukemia patients treated with allogeneic BMT, the lymphoma patients treated with combination chemotherapy or the healthy controls.

Green, Pakenham, Headley, and Gardiner (2002) used the EORTC-CF to measure cognitive complaints in 65 prostate cancer patients at baseline and 6 months post-treatment and 16 healthy controls over a similar time interval. As part of their cancer treatment, prostate cancer patients were randomized to an observation group or a hormonal therapy group. There was no significant difference in EORTC-CF scores between the observation group and the hormonal therapy group. There was also no significant change in scores from time one to time two in either group. As predicted, higher threat appraisal at baseline was significantly correlated with greater cognitive complaints at baseline and at 6 months. Contrary to the authors' prediction that greater use of emotion or problem-focused coping would be correlated with lower levels of

cognitive complaints, greater use of coping at baseline was significantly correlated with higher levels of cognitive complaints at 6 months.

In summary, evaluation of group differences provides limited support for the validity of the cognitive complaint measures. Findings indicating that, as TBI dose for allogeneic BMT patients increased, scores of the SIP Alertness Behavior Scale also increased (Andrykowski et al., 1990) would be expected and, therefore, support the validity of the SIP Alertness Behavior Scale. However, findings indicating that scores on the SIP Alertness Behavior Scale worsened significantly for allogeneic BMT patients from two years post-transplant to four years post-transplant (Andrykowski et al., 1989) are contrary to what would be expected. Therefore, this finding does not support the validity of the SIP Alertness Behavior Scale.

Findings indicating that the correlation between the POMS Confusion Scale and TBI dose approached significance (Andrykowski et al., 1990) would be expected and provide partial support for the validity of the POMS Confusion Scale. However, findings indicating that scores on the POMS Confusion Scale were stable over time from two years post-transplant to four years post-transplant (Andrykowski et al., 1989) are not what would be expected. Rather, it would be expected that scores would decrease from two years to four years post-transplant. This finding does not support the validity of the POMS Confusion Scale.

Evidence regarding the validity of the EORTC-CF is also mixed. Findings indicating that lymphoma patients treated with autologous BMT scored significantly higher on the EORTC-CF than lymphoma patients treated with combination chemotherapy and a group of healthy controls (Hjermstad et al., 1999) would be expected

and, therefore, support the validity of the EORTC-CF. However in the same study, autologous BMT patients reported greater cognitive complaints on the EORTC-CF than allogeneic BMT patients (Hjermstad et al., 1999). This finding is contrary to what would be expected given the better outcomes usually associated with autologous BMT than allogeneic BMT and, therefore, does not support the validity of the EORTC-CF. Also in the same study, EORTC-CF scores were not significantly different for leukemia patients treated with allogeneic BMT, lymphoma patients treated with combination chemotherapy, and a group of healthy controls (Hjermstad et al., 1999). This finding does not support the validity of the EORTC-CF because group differences would be expected between the different treatment groups and the healthy controls. In another study, EORTC-CF scores were not different for localized prostate cancer patients and healthy controls (Joly et al., 1998). Again, it would be expected that prostate cancer patients would score higher on the EORTC-CF than healthy controls and, therefore, the validity of the EORTC-CF is not supported. No significant differences in EORTC-CF scores were found between prostate cancer patients receiving hormonal therapy and prostate cancer patients not receiving hormonal therapy (Green et al., 2002). Group differences would be expected, with prostate cancer patients receiving hormonal therapy reporting greater cognitive complaints than prostate cancer patients not receiving hormonal therapy. Therefore, this finding does not provide support for the validity of the EORTC-CF.

Other findings reported in these studies also provide mixed evidence regarding the validity of the cognitive complaint measures. Two studies (Andrykowski et al., 1989, 1990) used two measures of cognitive complaints, the SIP Alertness Behavior Scale and

the POMS Confusion scale. The SIP Alertness Behavior Scale was positively correlated with TBI dose and the POMS Confusion Scale approached significance with TBI dose (Andrykowski et al., 1990), providing partial support for the concurrent validity of the two measures. The correlation between the SIP Alertness Behavior Scale and the POMS Confusion Scale was not reported. Concurrent validity was not supported in another study (Andrykowski et al., 1989), in which the SIP Alertness Behavior Scale detected change over time, while the POMS Confusion Scale remained stable over time. Again, the correlation between the SIP Alertness Behavior Scale and the POMS Confusion Scale was not reported. In the three studies which used the EORCT-CF (Green et al., 2002; Hjermstad et al., 1999; Joly et al., 1998), no other measure of cognitive complaints was used, therefore, concurrent validity is unknown.

Convergent validity was not demonstrated in any of the five previously mentioned studies (Andrykowski et al., 1989, 1990; Green et al., 2002; Hjermstad et al., 1999; Joly et al., 1998), as none of the cognitive complaint measures were compared to measures of constructs such as depression, fatigue, anxiety, and health-related quality of life. One study (Green et al., 2002) did look at cognitive complaints, measured by the EORTC-CF, in relation to threat appraisal and coping. As hypothesized by Green et al. (2002), greater threat appraisal was associated with more cognitive complaints. However, contrary to expectations, greater not lesser use, of coping was correlated with higher cognitive complaints.

As none of these studies used neuropsychological tests, criterion validity was not examined. Also, none of the studies reported internal consistency for the scales. As the EORTC-CF consists of only two items, internal consistency may be poor.

Review of Cognitive Complaints and Cognitive Functioning Literature

In contrast to the studies described previously that assessed only subjective complaints, eight studies can be identified that used a measure of cognitive complaints as well as a neuropsychological test battery to assess cognitive functioning. To measure cognitive complaints, one study used the Medical Outcomes Study (MOS) Cognitive Functioning Scale (Stewart & Ware, 1992), one study used the Squire Memory Self-Rating Questionnaire (Squire, Wetzel, & Slater, 1979), one study used the Concentration scale of the Checklist Individual Strength (CIS), the Alertness and Intellectual scales of the SIP, and daily complaints of memory and concentration (Vercoulen et al., 1994), and five studies used the EORTC-CF. Of the five studies that used the EORTC-CF, three also used a checklist of cognitive problems in daily life, and one also used an interview-based rating by a neuropsychologist to assess cognitive complaints.

Klein et al. (2002) used the Cognitive Functioning Scale of the MOS to assess cognitive complaints. The MOS Cognitive Functioning Scale consists of six items adapted from the SIP that assess confusion, concentration and thinking, attention, memory, reasoning, and psychomotor function. Each question is rated on a six-point Likert-type scale (1=All of the time, 2=Most of the time, 3=A good bit of the time, 4=Some of the time, 5=A little of the time, 6=None of the time). The study sample consisted of patients with glioma who had been treated with radiotherapy (N=104), patients with glioma who had not been treated with radiotherapy (N=91), and patients with hematological cancer (N=100). Neuropsychological measures tested the domains of intelligence, perception and psychomotor speed, attention and executive function, and memory. Glioma patients treated with radiotherapy and without radiotherapy reported

significantly lower scores on the MOS Cognitive Functioning Scale than published data on healthy controls, but did not differ from patients with hematological cancer. No difference was found on the MOS Cognitive Functioning Scale between glioma patients treated with or without radiotherapy. Among glioma patients, scores on measures of memory, attention, psychomotor speed, and graphomotor speed were moderately correlated with cognitive complaints (r = .23, .30, 34, and .31, respectively).

Ahles et al. (2002) used the Squire Memory Self-Rating Questionnaire to measure cognitive complaints in cancer patients five years post-treatment. The Squire Memory Self-Rating Questionnaire consists of 18-items rated on a nine-point scale ranging from –4 (worse than ever before) to +4 (better than ever before). Each item inquires about a different aspect of memory functioning and was derived from remarks the scale developers obtained from patients treated with electroconvulsive therapy. The sample in this study consisted of breast cancer patients treated with chemotherapy (N=35), lymphoma patients treated with chemotherapy (N=36), breast cancer patients treated with local therapy (N=35), and lymphoma patients treated with local therapy (N=22). Each patient was administered neuropsychological tests assessing verbal ability, spatial ability, verbal learning, verbal memory, visual memory, psychomotor function, motor functioning, attention, and attention reaction time. Factor analysis of the Squire Memory Self-Rating Questionnaire yielded three factors: new learning, working memory, and remote retrieval. The factor of working memory was found to be significantly lower for patients treated with chemotherapy than local therapy. The correlation between the factors and the neuropsychological domains were described as generally low and nonsignificant (values not reported).

Servaes, Verhagen, and Bleinjenberg (2002) used three instruments to assess cognitive complaints: the Concentration scale of the CIS, the Alertness and Intellectual scales of the SIP, and a daily record of complaints about memory and concentration. The CIS Concentration scale consists of five items scored on a seven-point Likert scale with higher scores indicating a higher level of concentration problems. To determine daily complaints of memory and concentration, patients were asked to keep a self-observation list for a 12-day period. Memory and concentration problems were rated four times daily (0=No, 1=Yes). Total daily scores ranged from 0 to 4, with high scores indicating more problems with memory and concentration. The sample consisted of 150 breast cancer patients who were divided into two groups, severely fatigued patients (n=57) and nonseverely fatigued patients (n=93). Patients were defined as severely fatigued if they scored 35 or higher on the Fatigue Severity Scale of the CIS. Data were also collected for a control group of 78 friends and family of the breast cancer patients with no history of cancer. Patients were tested six months to five years post-treatment. The treatments patients received consisted of radiotherapy and chemotherapy (N=66), no chemotherapy or radiotherapy (N=20), chemotherapy only (N=33), or radiotherapy only (N=31). Neuropsychological tests assessed reaction time and concentration. With one exception, severely fatigued breast cancer patients reported significantly more problems on all three measures of cognitive complaints than the nonseverely fatigued breast cancer patients and controls. The exception was for daily reports of memory problems, in which no difference was seen between severely and nonseverely fatigued patients. Nonseverely fatigued patients did not differ from controls on any measure of cognitive complaints. No significant differences in cognitive complaints existed between the different treatment

groups. Severely fatigued, nonseverely fatigued, and controls did not differ on neuropsychological tests of concentration. However, for reaction time, group differences did exist. Severely fatigued patients were significantly slower compared to controls, but severely fatigued patients were not significantly different than nonseverely fatigued patients. Nonseverely fatigued patients had slower reaction times than the controls for one of the three reaction time subtests. The lack of differences between severely fatigued patients and nonseverely fatigued patients on a concentration task and a reaction time task are not consistent with the subjective reports, where severely fatigued patients had greater complaints than the nonseverely fatigued patients.

Cull, Hay, Love, Mackie, Smets, and Stewart (1996) used the EORTC-CF to measure cognitive complaints in 91 lymphoma patients six months post-treatment. The EORTC-CF was used to divide the sample into complainers (N=25) and non-complainers (N=66), which was defined as rating either question a "3" or a "4". Neuropsychological measures were used to test intelligence, concentration, and memory. Complainers and non-complainers did not differ significantly on the neuropsychological measures of intelligence, memory, and concentration. No significant difference was found between complainers and non-complainers on ratings of their health and global quality of life, however, complainers had significantly higher scores on measures of anxiety, depression, and fatigue than non-complainers.

Van Dam et al. (1998) used the EORTC-CF and a checklist of cognitive complaints in daily life to measure cognitive complaints. The checklist consisted of four questions assessing concentration, memory, thinking, and language. Patients were asked to indicate the extent to which problems in each of these four domains occurred in their

daily life on a five-point Likert scale (0=Not at all, 1=Slightly, 2=Moderately, 3=Quite a bit, 4=Extremely). The sample consisted of 70 patients two years post-treatment who had been randomly assigned to receive high-dose chemotherapy (N=34) or standard-dose chemotherapy (N=36) and a control group of breast cancer patients matched on age and time since treatment who had not received chemotherapy (N=34). Patients were assessed with neuropsychological measures of verbal function, memory, attention/concentration, speed of information processing, motor function, visuoconstructional function, and mental flexibility. An overall score of cognitive impairment (OSCI) was calculated for each patient by counting all tests on which the patient was impaired. Impairment was defined for the chemotherapy groups as scoring two standard deviations below the mean score of the control group on that test. Impairment for the control group was defined as scoring in the fifth percentile of the control patients for that test. On the checklist, the high-dose and standard-dose chemotherapy groups did not significantly differ from each other. Both chemotherapy groups scored significantly higher than the control group for complaints on the checklist items related to concentration, memory, and language. For the EORTC-CF there was no significant difference between the two chemotherapy groups, and only the high-dose chemotherapy group scored significantly higher than the control group. The checklist and the EORTC-CF were significantly correlated with each other. The EORTC-CF and the checklist concentration, memory, and thinking questions were also significantly correlated with measures of anxiety and depression. No relationship existed between either measure of cognitive complaints and the OSCI (range r = -.03 to .08).

Schagen et al. (1999) used the same measures of cognitive complaints as van Dam et al. (1998) to assess breast cancer patients two years post-treatment. The sample in this study consisted of patients who were treated with conventional chemotherapy (N=39) and the control group from the van Dam et al. (1998) study (N=34). These patients received the same neuropsychological measures as in the previously discussed study and impairment was also defined in the same way. On the checklist, the chemotherapy patients reported significantly more complaints in concentration and memory than the control group. No significant group differences existed for the checklist items about thinking and language. Chemotherapy patients scored significantly higher on the EORTC-CF than the healthy controls. Scores on the checklist and on the EORTC-CF were not significantly related to the OSCI or to any of the domain scores of the neuropsychological tests (range r = -.20 to .08). The checklist and the EORTC-CF were significantly correlated with each other and with measures of anxiety and depression.

Schagen et al. (2002) reassessed the samples from the van Dam et al. (1998) study and the Schagen et al. (1999) study two years after the initial testing using the same cognitive complaints measures and neuropsychological measures. The sample consisted of three groups: high-dose and standard-dose chemotherapy patients (N=45) from the van Dam et al. study (1998); conventional chemotherapy patients (N=31) from the Schagen et al. study (1999), and the control group used in both previously mentioned studies (N=27). At four years post-treatment there were no significant differences in scores on the checklist and scores on the EORTC-CF among the high-dose group, the standard-dose group, and the control group. Patients in the conventional chemotherapy group reported significantly more cognitive complaints than the control group on the checklist questions

of concentration and memory and on the EORTC-CF. The correlations between cognitive performance and cognitive complaints for all groups were low and nonsignificant (range r =.19-.22). The relationship between the changes in cognitive performance and the changes in cognitive complaints assessed by the checklist was characterized as negligible.

Harder et al. (2002) used the EORTC-CF and a rating by a neuropsychologist to measure cognitive complaints in 40 patients who had completed allogeneic BMT 22 to 82 months earlier. Based on an interview, the neuropsychologist rated the extent of the patient's cognitive problems on a four-point Likert-type scale (0=no problem, 1=mild problems, 2=moderate problems, 3=severe problems). Patients were assessed on neuropsychological measures of general intelligence and conceptual reasoning, verbal function, memory, attention functions and concentration, executive functions, visual spatial and visuoconstructive ability, psychomotor function, and speed of information processing. The EORTC-CF was significantly positively correlated with fatigue. Total neuropsychological impairment, defined as the number of tests the patient scored two standard deviations below healthy population norms, was significantly negatively correlated with the EORTC-CF (r = -.55). There was no relationship between total neuropsychological impairment and the neuropsychologist's rating (values not reported).

In summary, studies evaluating group differences yield mixed support for the validity of each cognitive complaint measure. For the one study that used the MOS Cognitive Functioning Scale (Klein et al., 2002), glioma patients treated with or without radiotherapy reported significantly greater cognitive complaints in comparison to published data on healthy controls. The finding that glioma patients reported greater

cognitive complaints is consistent with expectations, providing support for the validity of the MOS Cognitive Functioning Scale. However, the MOS Cognitive Functioning Scale did not detect group differences between the glioma patients treated with radiotherapy, the glioma patients treated without radiotherapy, and the patients with hematological cancer. As group differences would be expected, these findings do not support the validity of the MOS Cognitive Functioning Scale.

In the one study that used the Squire Memory Self-Rating Questionnaire (Ahles et al., 2002), one of the three factors of the questionnaire (working memory) was significantly lower for breast cancer patients treated with chemotherapy than breast cancer patients treated with local therapy. This finding would be expected and, therefore, supports the validity of the working memory factor of the Squire Memory Self-Rating Questionnaire. However, no group differences were found for the other two factors of new learning and remote retrieval. Taken together, these findings provide very limited support for the validity of this measure.

Severely fatigued breast cancer patients were found to score significantly higher on the CIS, SIP Alertness Intellectual scales, and ratings of daily complaints of memory or concentration than nonseverely fatigued breast cancer patients and healthy controls (Servaes et al., 2002). These results are consistent with the expectation that severely fatigued patients would have the most cognitive complaints, and provides support for the validity of the CIS, SIP Alertness Intellectual scales, and ratings of daily complaints of memory or concentration. Findings also indicated that scores on the CIS, SIP Alertness Intellectual scales, and ratings of daily complaints of memory or concentration did not differ between nonseverely fatigued breast cancer patients and healthy controls (Servaes

et al., 2002). However, it would be expected that cancer patients would have greater cognitive complaints and the lack of group differences does not provide support for the three measures. The CIS, SIP Alertness Intellectual scales, and ratings of daily complaints of memory or concentration did not detect significant differences between patients treated with radiotherapy and chemotherapy, no chemotherapy or radiotherapy, chemotherapy only, or radiotherapy only (Servaes et al., 2002). This pattern of results does not support the validity of the CIS, SIP Alertness Intellectual scales, or ratings of daily complaints of memory or concentration, as group differences would be expected due to the different treatments.

The checklist of cognitive complaints used in three of the studies (Schagen et al., 1999, 2002; van Dam et al., 1998) yielded mixed results in detecting group differences. In one study, high-dose and standard-dose chemotherapy patients reported more complaints than healthy controls for the three questions assessing concentration, memory and language, but not the fourth question assessing thinking (van Dam et al., 1998). Since it would be expected that cancer patients would have more cognitive complaints than healthy controls, results provide support for the validity of three out of the four questions. Breast cancer patients treated with conventional chemotherapy also reported more complaints about concentration and memory than healthy controls (Schagen et al., 1999), supporting the validity of two out of the four questions. This same sample of breast cancer patients treated with conventional chemotherapy reported greater complaints in concentration and memory than the healthy controls two years later (Schagen et al., 2002), again providing support for the validity of the questions assessing concentration and memory. However, findings indicated that the question assessing

thinking did not yield group differences in all three studies. This is contrary to what would be expected and, therefore, does not support the validity of that question. Findings indicating that the checklist scores did not differ between the high-dose and the standard-dose chemotherapy patients (van Dam et al., 1998) suggest that the checklist was unable to detect group differences based on treatment type. A two year follow-up assessment conducted with this sample (Schagen et al., 2002) found no difference in cognitive complaints assessed by the checklist among high-dose patients, standard-dose patients, and healthy controls. Group differences would be expected, and the lack of findings does not support the validity of the checklist.

Mixed support was also found for the validity of the EORTC-CF based on the detection of group differences. Findings indicating that scores on the EORTC-CF were higher for patients treated with high-dose chemotherapy than healthy controls (van Dam et al., 1998) support the validity of the EORTC-CF. The EORTC-CF also detected group differences between breast cancer patients treated with conventional chemotherapy and healthy controls at an initial assessment (Schagen et al., 1999) and, again, two years later (Schagen et al., 2002). The ability of the EORTC-CF to detect expected group differences between cancer patients and healthy controls supports the validity of the measure. However, the EORTC-CF did not detect a difference between patients treated with high-dose chemotherapy and patients treated with low-dose chemotherapy (van Dam et al., 1998). It would be expected that patients treated with high-dose chemotherapy would have more cognitive complaints than patients treated with low-dose chemotherapy. Assessments conducted two years later with the same samples of high-dose chemotherapy patients, low-dose chemotherapy patients, and healthy controls found no

group differences in EORTC-CF scores (Schagen et al., 2002). The lack of group differences at this assessment does not support the validity of the EORTC-CF.

Mixed support was also obtained for other aspects of validity. Five of the eight studies used multiple measures to assess cognitive complaints. Evidence of concurrent validity was found in three studies (Schagen et al., 1999, 2002; van Dam et al., 1998) in which the EORTC-CF was shown to be significantly correlated with a checklist of cognitive complaints.

Three studies demonstrated convergent validity for the EORTC-CF with anxiety and depression (Cull et al., 1996; Schagen et al., 1999; van Dam et al., 1998) and three studies demonstrated convergent validity for the EORTC-CF with fatigue (Cull et al., 1996; Harder et al., 2002; Servaes et al., 2002). Convergent validity for the EORTC-CF with health related quality of life was not supported in one study (Cull et al., 1996)

All eight of these studies compared cognitive complaints to cognitive performance. Six studies (Ahles et al., 2002; Cull et al., 1996; Schagen et al., 1999, 2002; Servaes et al., 2002; van Dam et al., 1998) found no significant relation between cognitive complaints and cognitive performance. One study (Klein et al., 2002) found scores for the MOS Cognitive Functioning Scale to be moderately correlated with neuropsychological measures assessing memory, attention, psychomotor speed, and graphomotor speed. Another study (Harder et al., 2002) reported a significant correlation between the EORTC-CF and a composite score for neuropsychological measures.

Taken together, these results yield mixed support for the validity of measures currently used to assess cognitive complaints in cancer patients. The general lack of correspondence between measures of cognitive complaints and measures of cognitive

performance is particularly notable. One reason may be that cognitive complaints and neuropsychological functioning have been examined as continuous variables. Their relationship may only be apparent if contrasting groups are used and the relationship of cognitive complaints to impaired versus non-impaired subjects on neuropsychological functioning is examined.

The Functional Assessment of Cancer Therapy Cognitive Scale

The FACT-Cog is a measure of cognitive complaints that was recently developed by Wagner and colleagues (2002). This instrument was created by first obtaining qualitative data from oncology providers and patients on the perceived impact of chemotherapy on cognitive functioning and associated impairments in quality of life. Next, individual interviews were conducted with oncologists, oncology nurses, and cancer patients. Cancer patients also participated in focus groups. The most commonly described deficits were memory loss and forgetfulness, impaired concentration, word-finding difficulties, fatigue, and frustration with these deficits. The oncologists and nurses reported that these deficits impair patients' ability to comprehend medical instructions and adhere to medication regimens. The patients reported that these deficits interfere in social and work functioning (Wagner et al., 2002).

Based on these findings, 51 items were created to assess a cognitive domain, an impact on functioning domain, and an impact on quality of life domain. The cognitive domain consists of subscales assessing mental acuity, concentration, verbal and nonverbal memory, and verbal fluency. The impact on functioning domain consists of subscales assessing functional interference due to deficits, others observation of these deficits, and change from previous functioning. The items in the cognitive domains and

impact on functioning domains are rated on a 5-point scale (0=Never, 1=About once a week, 2=Two to three times a week, 3=Nearly every day, 4=Several times a day) of how often each statement had occurred during the past seven days. The eight items assessing impact on quality of life are administered twice. The first time the respondents are asked to rate the items on the 5-point frequency scale described above and the second time the respondents are asked to rate the items on a 5-point severity scale (0=Not at all, 1=A little bit, 2=Somewhat, 3=Quite a bit, 4=Very much). To minimize the impact of distress unrelated to cognitive abilities on responses, the FACT-Cog is primarily composed of behaviorally based items. The scale was evaluated to be between a fifth and sixth grade reading level.

Aims

The previously discussed literature demonstrates the lack of reliable and valid measures currently available to assess cognitive complaints. The most commonly used measure of cognitive complaints, the EORTC-CF, is of unknown reliability and has yielded mixed evidence of validity. This state of affairs supports the development of a new measure, such as the FACT-Cog. The literature has also demonstrated that a significant portion of BMT patients report cognitive complaints following treatment (Andrykowski et al., 1989, 1990; Harder et al., 2002; Hjermstad et al., 1999; Schagen et al., 2002; van Dam et al., 1998). Patients undergoing a BMT receive high-dose chemotherapy, radiotherapy, or both to deliberately compromise the patient's immune system. The immune system is subsequently restored though induction of blood or marrow products obtained from the same person (autologous transplantation) or from a

donor (allogeneic transplantation). These characteristics suggest that BMT patients are an important and appropriate sample for the current study.

The goal of the current study was to examine the psychometric properties of the FACT-Cog, a newly developed instrument designed to measure perceived cognitive deficits in people with cancer. The first step was to determine internal consistency. To evaluate concurrent validity, scores on the FACT-Cog were compared to scores on an established subjective measure of cognitive deficits, the EORTC-CF. To evaluate convergent validity, scores on the FACT-Cog were compared to scores on established self-report measures of depression (Center for Epidemiological Studies Depression Scale [CES-D]; Radloff, 1977), anxiety (State Version of the State Trait Anxiety Inventory [STAI-S]; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), and fatigue (Fatigue Symptom Inventory [FSI]; Hann et al., 1998). Also to evaluate convergent validity, scores on the FACT-Cog were compared to scores on an established measure of health-related quality of life (Medical Outcome Study Short From [SF-36]; Ware, Snow, Kosinski, & Gandek, 1993). To evaluate divergent validity, scores on the FACT-Cog were compared to scores on an established self-report measure of extroversion/introversion (NEO Five Factor Inventory Extroversion subscale [NEO-FFI]; Costa & McCrae, 1992a). Finally, to evaluate criterion validity, scores on the FACT-Cog were compared to scores derived from standardized neuropsychological measures.

Hypotheses

1. There will be a positive relationship between perceived cognitive deficits as measured by the FACT-Cog and scores on another established subjective measure of cognitive complaints.

- It is predicted that the total score on the FACT-Cog will be positively correlated with the total score on the EORTC-CF.

2. There will be a positive relationship between perceived cognitive deficits as measured by the FACT-Cog and depression.
   - It is predicted that the total score on the FACT-Cog will be positively correlated with the total score on the CES-D.
3. There will be a positive relationship between perceived cognitive deficits as measured by the FACT-Cog and anxiety.
   - It is predicted that the total score on the FACT-Cog will be positively correlated with the total score on the STAI-S.
4. There will be a positive relationship between perceived cognitive deficits as measured by the FACT-Cog and fatigue.
   - It is predicted that the total score on the FACT-Cog will be positively correlated with the total score on the FSI Fatigue Disruptiveness Scale.
5. There will be a positive relationship between perceived cognitive deficits as measured by the FACT-Cog and health-related quality of life.
   - It is predicted that the total score on the FACT-Cog will be negatively correlated with the physical component and mental component summary scales of the SF-36.
6. There will be no relationship between perceived cognitive deficits as measured by the FACT-Cog and extroversion-introversion.
   - It is predicted that the total score on the FACT-Cog will not be correlated with the total score on the NEO-FFI Extroversion scale.

7a. There will be a negative relationship between perceived cognitive deficits as measured by the FACT-Cog and standardized neuropsychological measures.

- It is predicted that the total score on the FACT-Cog will be negatively correlated with the total neuropsychological performance score. If this prediction is supported, exploratory analyses will be conducted to examine relationships between individual subscales of the FACT-Cog and individual cognitive domains from the neuropsychological measures.

7b. Cognitive deficits, as measured by the FACT-Cog, will be greater in patients classified as impaired on neuropsychological performance than in patients classified as non-impaired on neuropsychological performance.

- It is predicted that the total score on the FACT-Cog will be significantly higher for impaired patients than non-impaired patients. If this prediction is supported, exploratory analyses will be conducted to examine group differences for individual subscales of the FACT-Cog.

Method

Participants

Participants were men and women currently enrolled in a study titled "Cognitive Function in Patients Undergoing Blood and Marrow Transplantation" at Moffitt Cancer Center. Eligibility criteria for the aforementioned study were: 1) age between 18 and 75 years; 2) completion of at least 8 years of formal education; 3) the ability to speak and read standard English; and 4) acceptance into the Moffitt BMT program. Additional criteria for the current study were that participants in the aforementioned study were returning to Moffitt to receive neuropsychological testing at either a 6-month or 12-month follow-up assessment.

Procedure

Patients who are identified as BMT candidates are routinely scheduled for a psychosocial evaluation comprised of a clinical interview with a social worker and a brief evaluation with a psychologist to identify psychological problems and assess quality of life. From this standard pre-BMT psychosocial evaluation, patients were recruited for the aforementioned BMT study and randomly assigned to one of three neuropsychological testing groups. All participants completed psychosocial measures pre-BMT, 6-months post-BMT, and 12-months post-BMT. Sixty percent of the participants (Group 1) were assessed with the neuropsychological battery pre-BMT, 6-months post-BMT, and 12-months post-BMT. Of the remaining 40 percent of participants, 20 percent received the neuropsychological battery 6-months post-BMT and 12-months post-BMT (Group 2), and 20 percent received the neuropsychological battery only at 12-months post-BMT (Group 3). For the current study, data on estimated intellectual ability and extroversion

measured for all participants at the pre-BMT assessment were used. The remaining psychosocial measures and neuropsychological tests were assessed once, at either 6-months post-BMT or 12-months post-BMT according to the testing schedule listed above. A trained research assistant administered the neuropsychological battery. The psychosocial questionnaires were given to the participant to complete while at Moffitt or to be taken home and mailed back at the participant's convenience using a postage paid envelope that was provided. For their participation in the aforementioned BMT study, participants were paid 25 dollars upon completion of each of the post-BMT assessments, regardless of the group to which they were assigned.

Measures

Demographic, Disease, and Treatment Measures

Demographic information was obtained through a background interview. Variables assessed include: date of birth, handedness, race, marital status, income, and education. Electronic medical charts were reviewed to obtain information on cancer type, type of transplant, date of diagnosis, date of admittance, date of transplant, and date of discharge.

Psychosocial Measures

Perceived Cognitive Functioning. Two instruments were used to assess perceived cognitive functioning: the Functional Assessment of Cancer Therapy Cognitive Scale and the EORTC QLQ-C30 Cognitive Functioning Scale. The Functional Assessment of Cancer Therapy Cognitive Scale (FACT-Cog; Wagner et al., 2002) is a 51-item measure designed to assess subjective perception of cognitive deficits in cancer patients. Items were written based on the most commonly identified themes obtained from focus groups

or individual interviews with oncologists, oncology nurses, and oncology patients. Item formatting is based on the Functional Assessment of Chronic Illness Therapy (FACIT) measurement system. The FACT-Cog yields four summary scores: 1) a cognitive domain score, consisting of mental acuity, concentration, verbal and nonverbal memory, and verbal fluency subscale scores; 2) an impact on functioning domain score, consisting of functional interferences, other people noticed deficits, and change from previous functioning subscale scores; 3) an impact on quality of life domain score; and 4) a total score. Participants respond on a five-point Likert scale (0=Never to 4=Several times a day) how often each statement had occurred in the past seven days. The eight items assessing impact on quality of life are administered a second time where patients respond on a five-point Likert scale (0=Not at all to 4=Very much) the frequency to which they have experienced each item. The psychometric properties of this scale are currently being established. The EORTC QLQ-C30 Cognitive Functioning Scale (EORTC-CF; Aaronson et al., 1993), consists of two items that measure subjective cognitive functioning. Participants respond on a four-point Likert scale the extent to which they have experienced each cognitive complaint in the past week (1=Not at all to 4=Very much). The EORTC QLQ-C30 Cognitive Functioning Scale has demonstrated validity with a sample of bone marrow transplant patients, with scores being correlated with total neuropsychological impairment ($r = -.55$, $p<.001$; Harder et al., 2002).

Depression. The Center for Epidemiological Studies – Depression (CES-D; Radloff, 1977) is a 20-item measure of depressive symptomotology. The items were selected from a pool of items taken from previously validated depression scales, from the literature, and from factor analytic studies. Respondents indicate on a four-point rating

scale (0= rarely or none of the time, 3= most or all of the time) the extent to which they experienced each depressive symptom during the past week. The CES-D has good internal consistency with alphas of .85 for the general population and .90 for a psychiatric population (Radloff, 1977). The validity of the CES-D has been demonstrated with a wide range of populations, including cancer patients (Beeber, Shea, & McCorkle, 1998; Hann, Winter, & Jacobsen, 1999).

Anxiety. The State form of the State-Trait Anxiety Inventory (STAI-S; Spielberger et al., 1983) is a 20-item inventory that measures the level of current anxiety. Participants respond on a four-point Likert scale (1=Not at all to 4=Very much so) the extent to which they endorse each item. The internal consistency of the instrument ranges from .86 to .95 across male and female samples (Spielberger et al., 1983). The STAI-S has validity correlations of .80 with other established anxiety measures (Spielberger et al., 1983).

Fatigue. The Fatigue Symptom Inventory (FSI; Hann et al., 1998) is a 14-item inventory designed to assess the frequency and severity of fatigue as well as its perceived disruptiveness. Frequency is measured as the number of days in the past week (0-7) respondents felt fatigued as well as on average, the extent they felt fatigued each day (0=None to 10=Entire day). Severity is measured on a separate 11-point scale (0=Not at all fatigued to 10=As fatigued as I could be) that assess most, least, and average fatigue during the past week as well as current fatigue. Perceived disruptiveness is measured on a separate 11-point scale (0=No interference to 10=Extreme interference) that assess the degree to which fatigue in the past week was judged to interfere with general level of activity, ability to bathe and dress, normal work activity, ability to concentrate, relations

with others, enjoyment of life, and mood. The interference ratings can also be summed to obtain a total disruptiveness score. Previous research has demonstrated the reliability and validity of the FSI with individuals diagnosed with cancer (Hann et al., 1998).

Health-Related Quality of Life. The Medical Outcome SF-36 Health Survey (SF-36; Ware et al., 1993) is a 36-item measure of various aspects of perceived health, functioning, and quality of life. It contains eight subscales that measure the extent to which health status impacts each of the following areas; 1) physical functioning; 2) role functioning-physical; 3) bodily pain; 4) general health; 5) vitality; 6) social functioning; 7) role functioning- emotional; and 8) mental health. The SF-36 also yields two summary scores that measure global physical functioning (physical component summary scale) and global mental health functioning (mental component summary scale). The items use Likert-type scales, some with five or six points and others with two or three points. Correlations ranging from .52 to .78 have been reported between the SF-36 subscales and other QOL measures (Ware & Sherbourne, 1992; McHorney, Ware, & Raczek, 1993). Test-retest reliability coefficients range from .68-.93 for the various subscales. The SF-36 has been found to have acceptable reliability and validity when administered to healthy and chronically ill individuals (Ware et al., 1993).

Extroversion and Neuroticism. The Neuroticism, Extroversion, and Openness – Five-Factor Inventory (NEO-FFI; Costa & McCrae, 1992a) is a 60-item personality measure based on the five-factor model of personality. The five factors assessed are Neuroticism, Extroversion, Openness, Agreeableness, and Conscientiousness. Responses are made on a five-point scale ranging from strongly disagree to strongly agree. Factor analyses have provided support for these factors with coefficient alphas for the five

domain scores ranging from .86 to .95 and test-retest coefficients ranging from .63 to .81 (Costa & McCrae, 1992b, c). For the purpose of this study, only the Extroversion and Neuroticism scales were examined.

Neuropsychological Measures

Estimated Intellectual Functioning. The National Adult Reading Test (NART; Nelson, 1982) contains 50 irregular words that cannot be easily phonetically decoded. Inter-rater reliability is high ranging from .96 to .98 and test-retest reliability is high at .98 (Crawford, Parker, Stewart, Besson, & De Lacey, 1989). Previous studies have shown that performance on the NART is highly correlated with the general factor of intelligence 'g' from the Wechsler scales (Crawford et al., 1989).

Attention. The Conners' Continuous Performance Test (CPT-II; Conners, 2000) is a measure of sustained attention administered on the computer. Participants monitor a random series of single numbers or letters, which are presented continuously. They are asked to indicate that they have detected a target event by pressing the space bar while avoiding responding to distracting stimuli. The CPT-II yields three scores: impulsivity, vigilance, and inattention. Test-retest reliability is high at .92 and validity of the CPT-II has been demonstrated with neurological, clinical, and nonclinical populations (Conners, 2000).

Memory. Memory was assessed using three measures: the California Verbal Learning Test; the Logical Memory subtest from the Wechsler Memory Scale-III (WMS-III); and the Visual Reproduction subtest from the WMS-III. The California Verbal Learning Test (CVLT; Delis, Kramer, Kaplan, & Ober, 1987) assesses verbal learning and memory. The test consists of five presentations and recall of a 16-item list of words

belonging to four semantic categories. An interference list of 16-items containing eight words from two shared semantic categories is presented, followed by free recall and a category-cued recall of the original list. Retention is tested 20 minutes after learning by free recall, category-cued recall, and recognition. Split-half reliability and coefficients alpha are in the moderate to high range (Delis et al., 1987). The CVLT correlates well with other measures of memory and learning (Spreen & Strauss, 1998). The Logical Memory subtest from the WMS-III (Wechsler, 1997) assesses memory for prose. Two short stories are read aloud to the participant followed by immediate and delayed recalls and a recognition paradigm. Internal consistency assessed by split-half reliability ranges between .67 and .80 and the inter-scorer reliability coefficient is .99 (Wechsler, 1997). The Visual Reproduction subtest from the WMS-III (Wechsler, 1997) assesses nonverbal memory for designs. Five novel designs are each presented individually for 10 seconds, and the participant is asked to reproduce the design from memory. After a 30 minutes, delayed recall and recognition paradigm are performed. Reliability coefficients for immediate recall and delayed recall are .59 and .46. Inter-scorer reliability is reported at .97 (Wechsler, 1997).

Executive Functioning. Executive functioning was assessed using four instruments: 1) Wechsler Adult Intelligence Scale-Revised (WAIS-R) Digit Symbol, 2) Trail Making Test, 3) Controlled Oral Word Association, and 4) Stroop Neuropsychological Screening Test. The WAIS-R Digit Symbol (Wechsler, 1981) is a test of sustained attention, psychomotor speed, and motor persistence. It requires participants to match numbers with a geometric mark according to a designated code. It is consistently noted to be the most sensitive Wechsler subtest to brain dysfunction

(Lezak, 1995). Test-retest reliability ranges from .82-.86 for adults (Wechsler, 1997). It has been shown to be a sensitive indicator of cognitive changes in BMT candidates (Ahles, Tope, Furstenberg, Hann, & Mills, 1996). The Trail Making Test (TMT; Reitan & Wolfson, 1993) assesses the participant's ability to follow a simple number sequence (Trails A) and their ability to follow a complex sequence of alternating numbers and letters (Trails B). Extensive reliability data are presented in Spreen and Strauss (1998), including reliability coefficients of .69 to .94 for Trail A, and .66 to .86 for Trail B. Strong validity of the TMT as an indicator of mild to severe cognitive dysfunction has been reported with Trails B more sensitive to deficits (Reitan, 1958). The TMT has been shown to be sensitive to BMT treatment effects (Andrykowski et al., 1992). The Controlled Oral Word Association (COWA) from the Multilingual Aphasia Examination (Benton & Hamsher, 1989) assesses the speed and ease of word production and is a measure of executive function (e.g., initiation, perseveration and effortful output). Participants are asked to generate as many words as possible beginning with a target letter provided by the examiner over a one-minute trial. There are three trials and respondents are requested to not use proper nouns or the same words with different suffixes. Inter-scorer reliability is excellent, and test-retest reliability ranges from .70 to .88, as reported in Spreen & Strauss (1998) who also report strong concurrent validity. The COWA has been shown to be a sensitive measure with BMT candidates (Ahles et al., 1996). The Stroop Neuropsychological Screening Test (Stroop; Trenarry, Crosson, DeBoe, & Leber, 1989) is a task of effortful attention and speed and is sensitive to subtle attentional deficits (Lezak, 1995; Spreen & Strauss, 1998). The Stroop consists of two trials: one in which the subject reads the words printed on a page and one in which the

subject names the color of the ink that the word is printed in. Test-retest reliability is high (.90) and validity data indicate that the Stroop can discriminate cognitively impaired groups from normal groups (Trenarry et al., 1989).

Motor. The Grooved Pegboard (Matthews & Klove, 1964) evaluates speeded manual dexterity. It requires the participants to place ridged pegs in a 5 X 5 square array with slots that are at various orientations requiring rotation of the pegs for correct placement. This level of complexity makes this task sensitive to general psychomotor slowing caused by medication and disease effects (Lezak, 1995). Fatigue and treatment with BMT have been shown to negatively impact the time to complete this task (Andrykowski, 1992).

Data Reduction

In order to avoid Type I statistical errors, the 22 test scores generated from these measures were grouped into the following four cognitive domains as suggested by Lezak (1995): Attention (CPT); Memory (CVLT, Logical Memory, Visual Reproduction); Executive Functioning (Digit Symbol, TMT, COWA, Stroop); and Motor (Grooved Pegboard). To accomplish this, raw scores were converted into z-scores according to published normative data (Heaton, 1992; Heaton, Grant, & Matthews, 1991; Spreen and Strauss, 1998; Wechsler, 1997) and then averaged according to domain. A total neuropsychological performance index was computed for each subject by deriving the average z-score from the 22 measures.

Statistical Analyses

Descriptive statistics (mean and standard deviations) were used to characterize the demographic, disease, and treatment characteristics of the sample. Cronbach alpha coefficients were calculated to evaluate internal consistency of the total score and domain scores of the FACT-Cog. Prior to conducting the main analyses, exploratory analyses were conducted to examine the relationship of demographic and clinical variables to the FACT-Cog total score and domain scores.

To test the first hypothesis, a correlational analysis was performed to compare the total score of the FACT-Cog with the total score on the EORTC-CF. A correlational analysis was also performed to compare the FACT-Cog domain scores with the total score on the EORTC-CF. To test the second hypothesis, a correlational analysis was performed to compare the total score of the FACT-Cog with the total score on the CES-D. A correlational analysis was also performed to compare the FACT-Cog domain scores with the total score on the CES-D. To test the third hypothesis, a correlational analysis was performed to compare the total score of the FACT-Cog with the total score on the STAI-S. A correlational analysis was also performed to compare the FACT-Cog domain scores with the total score on the STAI-S. To test the fourth hypothesis, a correlational analysis was performed to compare the total score of the FACT-Cog with the total score on the FSI Fatigue Disruptiveness Scale. A correlational analysis was also performed to compare the FACT-Cog domain scores with the total score on the FSI Fatigue Disruptiveness Scale. To test the fifth hypothesis, a correlational analysis was performed to compare the total score of the FACT-Cog with the physical component and mental component summary scales of the SF-36. A correlational analysis was also

performed to compare the FACT-Cog domain scores with the physical and mental component summary scales of the SF-36. Additional correlational analyses were performed to compare the FACT-Cog total score and domain scores with the total score on the NEO-FFI Neuroticism scale. To test the sixth hypothesis, a correlational analysis was performed to compare the total score of the FACT-Cog with the total score on the NEO-FFI Extroversion scale. A correlational analysis was also performed to compare the FACT-Cog domain scores with the total score on the NEO-FFI Extroversion scale. To test the first part of the seventh hypothesis, a correlational analysis was performed to compare the total score of the FACT-Cog with the total neuropsychological performance score. A correlational analysis was also performed to compare the FACT-Cog domain scores with the total neuropsychological performance score. Correlational analyses were performed to compare the FACT-Cog total score and domain scores to the neuropsychological domain scores and individual test scores. To test the second part of the seventh hypothesis, a correlational analysis was performed to compare the total score of the FACT-Cog for the patients classified as impaired and non-impaired on total neuropsychological performance. A correlational analysis was also performed to compare the FACT-Cog domain scores for patients classified as impaired and non-impaired on total neuropsychological performance. Classification as impaired on total neuropsychological performance was defined as obtaining a z-score at or below –1.5 on three or more neuropsychological tests, similar to the definition used by Schagen et al. (2002). Correlational analyses were performed to compare the FACT-Cog total score and domain scores for patients classified as impaired on neuropsychological domain scores and individual test scores. Performance on individual domains was classified as

impaired if the mean z-score for the domain was at or below –1.5 or at least 50 percent of the z-scores comprising that domain were at or below –1.5 (Lezak, 1995). Performance on individual test scores were classified as impaired if the z-score was at or below –1.5.

In addition, multivariate analyses were conducted. A multiple regression analysis was conducted for the FACT-Cog total score. Demographic variables that were significantly correlated with the FACT-Cog total score were entered into the equation first. Psychosocial variables that were significantly correlated with the FACT-Cog total score were then entered into the equation using a forward selection technique with a $p < .05$ selection criterion. Multiple regression analyses were also conducted for each FACT-Cog domain score using the same procedure. A uniqueness index was calculated for each variable in the regression analyses by subtracting the variance accounted for by all the variables without the target variable from the total variance accounted for by all of the variables.

In order to determine the necessary sample size for correctional analyses, a power analyses was conducted. With 81 participants ($p \leq .05$, two-tailed), there was power of .80 to detect a correlational coefficient of .30 (medium effect size; Cohen, 1988).

Results

A total of eighty-two participants completed the six-month or twelve-month follow-up assessment. Participants ranged in age from 23 to 72 years old (M = 52.91; SD = 12.03) with a similar number of males (N = 42) and females (N = 40). Education ranged from 8 to 23 years (M = 13.76; SD = 2.30) and estimated IQ (NART scores) ranged from 80 to 124 (M = 98.5; SD = 15.3). A majority of these individuals were Caucasian (85%), married (79%), had received autologous stem cell transplantation (85.4%), and had been diagnosed with multiple myeloma (72%). Approximately 49% of participants reported an annual household income of at least $40,000, 28% were working full-time, and 21% reported not working due to disability. See Table 1 for complete demographic information and Table 2 for complete clinical characteristics.

Relationship of FACT-Cog to Demographic Characteristics

Exploratory analyses were conducted to determine the relationship between demographic variables and the FACT-Cog total score (see Table 3). Gender was significantly associated with the total score, indicating that women had greater cognitive complaints ($p < .01$). Age, estimated IQ, years of education, race, marital status, diagnosis, type of transplant, and time since transplant (6 month or 12 month follow-up) were not significantly correlated with the total score (p values > .05). Internal consistency of the FACT-Cog total score was high ($\alpha = .983$), demonstrating the reliability of the measure. Exploratory analyses were also conducted with each of the FACT-Cog domain scores. Gender was significantly associated with the cognitive

domain, interference of functioning domain, and quality of life domain (p values < .05). Estimated IQ was significantly correlated with the quality of life domain (p < .05). Age, years of education, race, marital status, diagnosis, type of transplant, and time since transplant were not significantly correlated with any of the domain scores (p values > .05). Internal consistency was high for the cognitive domain (α = .962), the interference of functioning domain (α = .959), and the quality of life domain (α = .957). The FACT-Cog domain scores were highly correlated with each other. The highest correlation was between the cognitive domain and the interference of functioning domain (r = .92, p < .0001), followed by the interference of functioning domain and quality of life domain (r = .84, p < .0001). The lowest correlation was between the cognitive domain and the quality of life domain (r = .78, p < .0001).

Relationship of FACT-Cog to Psychosocial Variables

As hypothesized, the FACT-Cog total score was significantly correlated with the EORTC-CF supporting the concurrent validity of the measure (r = .66, p <.0001). The FACT-Cog cognitive, interference of functioning, and quality of life domain scores were also significantly correlated with the EORTC-CF. (r = .65, .68, and .57 respectively, p values < .0001).

To test the convergent validity of the FACT-Cog, hypothesized relationships between the total score and psychosocial variables were tested. As expected (see Table 4), the FACT-Cog total score was significantly correlated with measures of depression, fatigue, anxiety, mental well-being, and physical well-being (p values < .01). All three domain scores were also significantly correlated with measures of depression, fatigue, anxiety, mental well-being and physical well-being (p values < .05).

To assess divergent validity, the correlations of the FACT-Cog with extroversion, as measured by the NEO Personality Inventory, were examined. Consistent with expectations, the FACT-Cog total score was not significantly correlated with extroversion ($p > .05$). The cognitive domain score and the quality of life domain score were also not significantly correlated with extroversion ($p > .05$), however, the interference of functioning domain score was significantly correlated with extroversion ($p < .05$).

The relationship of neuroticism with the FACT-Cog was also examined. The FACT-Cog total score, cognitive domain score and interference of functioning domain score were significantly correlated with neuroticism ($p < .05$). The quality of life domain score was not significantly correlated with neuroticism ($p > .05$).

An exploratory regression analysis was conducted to determine the relative contribution of psychosocial variables to the total variance of the FACT-Cog total score (see Table 5). To control for the contribution of gender, which was significantly related to the FACT-Cog total score ($p < .05$), it was entered first. After controlling for gender, the psychosocial variables that were significantly correlated with the total score in univariate analyses were entered into the equation using the forward selection technique with a $p < .05$ selection criterion. Gender accounted for 9% of the variance in the FACT-Cog. Fatigue entered the model on the second step and accounted for 23% of the remaining variance ($p < .0001$). The final variable to enter the model was mental well-being, which accounted for 5% of the remaining variance ($p < .05$). Together, these variables accounted for 37% of the total variance in the FACT-Cog. Physical well-being, anxiety, neuroticism and depression did not account for significant additional variance.

Regression analyses were also conducted for each FACT-Cog domain score using the previously described method. For the cognitive domain (see Table 6), gender was entered into the equation first and accounted for 9% of the variance. Mental well-being entered into the equation next accounting for 18% of the remaining variance ($p < .0001$). Together, these variables accounted for 27% of the total variance in the FACT-Cog cognitive domain. Fatigue, neuroticism, anxiety, depression, and physical well-being did not account for significant additional variance. For the interference of functioning domain (see Table 7), gender was controlled for and accounted for 10% of the variance. Mental well-being entered into the equation next accounting for 22% of the remaining variance ($p < .0001$). Together, these variables account for 32% of the total variance in the FACT-Cog interference of functioning domain. Fatigue, extroversion, anxiety, depression, and physical well-being did not account for significant additional variance. For the quality of life domain (see Table 8), gender and IQ were entered into the equation first and accounted for 10% of the variance. Fatigue entered into the equation next accounting for 26% of the remaining variance ($p < .0001$). Together, these variables account for 36% of the total variance in the FACT-Cog quality of life domain. Mental well-being, anxiety, depression, and physical well-being did not account for significant additional variance.

A uniqueness index was calculated to determine the variance accounted for that is unique to each variable. For the total score (see Table 5), gender contributed the largest amount of unique variance (4%) followed by fatigue (3%) and mental well-being (2%). Neuroticism and anxiety each accounted for 1% of unique variance. Depression and physical well-being each accounted for less than 1% of unique variance in the FACT-Cog

total score. For the cognitive domain score (see Table 6), gender and neuroticism each contributed the largest amount of unique variance (4%) followed by anxiety (2%). Mental well-being, fatigue, and depression each accounted for 1% of unique variance, and physical well-being accounted for less than 1% of unique variance. For the interference of functioning domain (see Table 7), gender contributed the largest amount of unique variance (5%) followed by mental well-being (4%). Fatigue and extroversion each contributed 2% of unique variance and anxiety contributed 1% of unique variance. Physical well-being and depression each contributed less than 1% of unique variance. For the quality of life domain (see Table 8), fatigue contributed the most unique variance (3%). Gender and mental well-being each contributed 1% of unique variance. Estimated IQ, depression, physical well-being, and anxiety each accounted for less than 1% of unique variance.

Relationship of FACT-Cog to Neuropsychological Variables

Contrary to expectations, the FACT-Cog total and domain scores were not significantly related to the total neuropsychological performance score (see Table 9). The lack of significant findings may be a result of a decrease in sensitivity due to the averaging of multiple tests assessing different aspects of cognitive functioning. Therefore, exploratory analyses were conducted to correlate the FACT-Cog with the neuropsychological domain scores and individual test scores (see Tables 9 and 10). The FACT-Cog total and domain scores were not significantly correlated with the four domain scores (memory, executive functioning, motor, and attention). With regards to individual test scores, a significant correlation was found between the quality of life domain score and the vigilance subscale of the CPT-II ($p < .05$), with higher cognitive

complaints being related to lower vigilance. All other correlations between the FACT-Cog total and domain scores and the individual neuropsychological test scores were non-significant.

To determine if patients with greater cognitive complaints had greater impaired performance on neuropsychological tests (see Table 11), neuropsychological test scores were dichotomized into impaired or non-impaired based on the previously described criterion. The FACT-Cog total and domain scores were not significantly correlated with impairment classification based on the total neuropsychological performance score. As previously mentioned, these results may be a related to of loss of sensitivity, therefore exploratory analyses were conducted. The FACT-Cog total and domain scores were not significantly correlated with the four neuropsychological domain scores (see Table 11). When individual neuropsychological test scores were examined, significant correlations did arise with the CPT-II subscales with higher cognitive complaints associated with impaired performance (see Table 12). Impaired performance on the CPT-II impulsivity subscale was significantly correlated with the FACT-Cog total score and the three domain scores ($p < .05$). The FACT-Cog total score and quality of life domain score were also significantly correlated with the CPT-II vigilance subscale ($p < .05$). The direction of these relationships is for impaired performance to be associated with more cognitive complaints. In addition, the FACT-Cog cognitive domain score was significantly correlated with the short delay cued recall score and the long delay free recall score of the CVLT ($p < .05$). The direction of this relationship is for impaired performance to be associated with fewer cognitive complaints.

To better understand the results, the rates of impairment were examined. The Grooved Pegboard (dominant and nondominant hand) had the highest rates of impairment of individual tests (26.8% and 31.7% respectively). The COWA had the next highest rate at 13.4%. For all of the other individual tests, the percentage of scores classified as impaired ranged from 8.5% to 1.2%. Rate of impairment in the domain scores were also low, except for the motor domain which had the highest impairment rate at 37.8%. The memory domain and the executive functioning domain each had an impairment rate of 3.7%. The attention domain had the lowest rate of impairment at 2.4%.

Relationship of EORTC-CF to Demographic Variables

Parallel analyses were performed to study the relationship of the EORTC-CF and the demographic, psychosocial, and neuropsychological variables. The EORTC-CF was significantly related to gender ($p = .04$), with women having greater cognitive complaints, type of transplant ($p = .01$), with patients who received an autologous transplantation having greater cognitive complaints than patients who received an allogeneic transplantation, and race ($p = .05$), with Caucasians having more cognitive complaints than non-Caucasians (see Table 3). Age, estimated IQ, years of education, marital status, diagnosis, and time since transplant were not significantly correlated with the EORTC-CF (p values > .05). The EORTC-CF had strong internal consistency ($\alpha = .77$).

Relationship of the EORTC-CF to Psychosocial Variables

The EORTC-CF was significantly correlated with depression, fatigue, anxiety, mental well-being, and physical well-being (p values < .001; see Table 3). The EORTC-

CF was also significantly correlated with extroversion ($p < .001$), but not with neuroticism ($p > .05$; see Table 3).

A regression analysis was conducted with the EORTC-CF to examine which psychosocial variables accounted for a significant amount of the variance (see Table 13). Type of transplant, gender, and race were significantly correlated with the EORTC-CF in univariate analyses, therefore, these three variables were controlled for by being entered into the equation first. Next, the psychosocial factors were entered using a forward selection technique with a $p < .05$ selection criterion. Type of transplant, gender, and race accounted for 16% of the variance in the EORTC-CF. Mental well-being entered the model in the second step accounting for 20% of the remaining variance ($p < .0001$). Together, these variables account for 37% of the total variance in the EORTC-CF. Physical well-being, extroversion, fatigue, anxiety, and depression did not account for significant additional variance.

A uniqueness index was calculated to determine the amount of unique variance each psychosocial variable contributed (see Table 13). Type of transplant accounted for the most unique variance (6%), followed by extroversion (3%). Gender, race, and mental well-being each accounted for 2% of unique variance in the EORTC-CF. Fatigue accounted for 1% of unique variance and physical well-being, anxiety, and depression each accounted for less than 1% of unique variance.

Relationship of the EORTC-CF to Neuropsychological Variables

The EORTC-CF was not significantly correlated with the total neuropsychological performance score (see Table 9). As previously stated, the lack of significant findings may be a result of a decrease in sensitivity due to the averaging of

multiple tests. Exploratory analyses found that the EORTC-CF was not significantly correlated with the four neuropsychological domain scores (see Table 9). With regards to individual test scores (see Table 10), the EORTC-CF was significantly correlated with the impulsivity subscale of the CPT-II ($p < .05$). The direction of this relationship is for impaired performance to be associated with more cognitive complaints.

The EORTC-CF was correlated with neuropsychological tests scores that were classified as impaired or non-impaired, based on previously described criterion, to determine if patients with greater complaints had greater impaired performance (see Table 11). The correlations between the EORTC-CF and impairment classification of the total score were nonsignificant. This finding may be a result of lack of sensitivity, therefore exploratory analyses were conducted. No significant correlations were found between the EORTC-CF and impairment of any domain scores (see Table 11). When looking at individual test scores (see Table 12), the EORTC-CF was significantly positively correlated with impairment classification for the delayed visual reproduction score ($p < .05$), the inattention subscale of the CPT-II ($p < .05$), and the impulsivity subscale of the CPT-II ($p < .01$). The direction of these relationships is for impaired performance to be associated with more cognitive complaints.

Discussion

The aim of the current study was to examine the psychometric properties of the FACT-Cog, a recently developed instrument designed to measure perceived cognitive deficits in people with cancer. The following section will first evaluate the reliability and validity of the FACT-Cog. Second, additional demographic and multivariate analyses conducted will be reviewed. Next, the FACT-Cog will be compared with the EORTC-CF, an established measure of cognitive complaints. Finally, limitations of this study, clinical implications, and future directions for research will be discussed.

Reliability

The reliability of the FACT-Cog total score was strong, as evidenced by its high internal consistency. The FACT-Cog cognitive, interference of functioning, and quality of life domain scores also demonstrated high internal consistency. Test-retest reliability was not evaluated and thus remains unknown.

Concurrent Validity

As hypothesized, the FACT-Cog total score was significantly correlated with the EORTC-CF. This significant relationship with an established measure of cognitive complaints provides support for the concurrent validity of the FACT-Cog total score. The concurrent validity of the three FACT-Cog domain scores was also supported by their significant relationships with the EORTC-CF.

Convergent Validity

As hypothesized, the FACT-Cog total score was significantly correlated with measures of depression, fatigue, anxiety, mental well-being, and physical well-being. These findings provide evidence for the convergent validity of the FACT-Cog. The same pattern of results was found for the FACT-Cog domain scores. Additional analyses were conducted to examine the relationship of neuroticism to the FACT-Cog total and domain scores. Although no a priori hypothesis about this relationship was made, previous research has found that people with cancer who are high on neuroticism often report worse psychosocial outcomes (Aarstad, Aarstad, Birkhaug, Bru, & Olofsoon, 2003). Therefore, it would be expected that patients high on neuroticism would have greater cognitive complaints. Results for the FACT-Cog total score and cognitive domain and interference of functioning domain scores supported this expectation. The FACT-Cog quality of life domain score, however, was not significantly correlated with neuroticism.

These results are consistent with previous research that has found cognitive complaints to be significantly related to psychosocial factors. More specifically, the significant relationship between depression and cognitive complaints was found in research with cancer patients by Cull et al. (1996), Schagen et al. (1999), and van Dam et al. (1998) using other cognitive complaints measures. The results of this study, regarding the relationship of fatigue and cognitive complaints, were also consistent with previous research with cancer patients (Cull et al., 1996; Harder et al., 2002; Servaes et al., 2002). The significant relationship between anxiety and cognitive complaints in this study is consistent with the previous cancer research as well (Cull et al., 1996; Schagen et al.,

1999; Van Dam et al., 1998). Previous research has not looked specifically at relationship with measures of mental well-being and physical well-being.

Although the FACT-Cog was significantly correlated with measures of depression and fatigue, the FACT-Cog shared only 25% of its variance with depression and 28% of its variance with fatigue. This suggests that cognitive complaints is a distinct construct from depression and fatigue.

Divergent Validity

As hypothesized, the FACT-Cog total score was not correlated with a measure of extroversion. This finding reflects the expected pattern for divergent validity. There was mixed support for the divergent validity of the FACT-Cog domain scores. As expected, the cognitive and quality of life domains were not significantly correlated with extroversion, however, the interference of functioning domain was significantly correlated with extroversion.

Previous research has not examined the divergent validity of cognitive complaints measures. This is the first study to examine the relationship of cognitive complaints to extroversion to assess divergent validity. Previous research has not found a significant relationship between extroversion and depression (Van der Zee, Buunk, Sanderman, Botke, & Van der Bergh, 1999), or between extroversion and quality of life (Aarstad et al., 2003) in cancer patients.

Criterion Validity

Hypotheses regarding the criterion validity of the FACT-Cog were generally not supported. Contrary to predictions, the FACT-Cog total and domain scores were not significantly related to the total and domain scores for the neuropsychological measures.

Likewise, when the neuropsychological total and domain test scores were dichotomized as impaired or nonimpaired, no significant relationships were found with the FACT-Cog scores.

To rule out the possibility that the lack of significant findings may have been related to a loss of sensitivity due to the averaging of multiple tests assessing different aspects of cognitive performance, the relationship of the FACT-Cog total and domain scores to individual neuropsychological test scores was also examined. These analyses did yield a limited number of significant findings. The FACT-Cog quality of life domain was significantly correlated with continuous scores on the vigilance subscale of the CPT-II. When neuropsychological performance was classified as impaired or nonimpaired, the impulsivity subscale of the CPT-II was significantly correlated with the FACT-Cog total score and all three FACT-Cog domain scores. The vigilance subscale was significantly correlated with the FACT-Cog total score and quality of life domain score. In all of these instances, poorer performance on the CPT-II was associated with greater cognitive complaints. The short delay cued recall and the long delay free recall subscales of the CVLT test in the memory domain were also significantly related to the FACT-Cog cognitive domain score. In this instance, better performance on the CVLT was associated with greater cognitive complaints.

Of note, few participants had impaired performance on the neuropsychological tests. However, the increased number of significant relationships when the scores are dichotomized suggests that there are subcategories of cognitive performance. Although no other correlations between the FACT-Cog and neuropsychological test scores were significant, tests in the memory domain and motor domain had small to medium effect

sizes for correlational analyses (r = .15 to .19) as suggested by Cohen (Cohen, 1987). This suggests that there may be a power issue, in that the sample size was too small to detect significant findings of these more subtle effects.

In general, the lack of significant correlations between cognitive complaints and cognitive performance found in this study is consistent with the literature on cancer patients. Ahles et al. (2002) found that correlations between neuropsychological domain scores and cognitive complaints were nonsignificant. Van Dam et al. (1998) and Schagen et al. (1999, 2002) also found no significant relationship between cognitive complaints and neuropsychological total and domain scores. Two studies that examined the relationship between cognitive complaints and individual neuropsychological test scores have also reported nonsignificant relationships (Cull et al., 1996; Servaes et al., 2002). However, Klein et al. (2002) did find significant correlations between cognitive complaints and individual test scores measuring memory, attention, psychomotor speed, and graphomotor speed. Only one study reported results generally inconsistent with the current study's findings. Harder et al. (2002) reported a significant correlation between cognitive complaints as measured by the EORTC-CF and a total neuropsychological impairment performance score. With regards to criterion validity, the FACT-Cog cannot be considered superior to existing measures of cognitive complaints.

Demographic and Multivariate Analyses

When examining the relationship of the FACT-Cog total and domain scores to demographic variables, all FACT-Cog scores were significantly correlated with gender, with women having more cognitive complaints than men. The FACT-Cog quality of life domain score was also significantly related to estimated IQ, with higher estimated IQ

associated with greater complaints. The FACT-Cog total and domain scores were not significantly related to age, years of education, race, marital status, diagnosis, type of transplant, and time since transplant.

The significant relationship between cognitive complaints and gender has not been found in previous research with cancer patients. Few studies have reported testing for gender differences, but ones that did found no significant relationship between cognitive complaints and gender (Andrykowski et al., 1990; Cull et al., 1996; Hjermstad et al., 1999). However, women have been found to report higher levels of neuroticism than men (Goodwin & Gotlib, 2004), and since neuroticism has been associated with more subjective health complaints in cancer patients (Aarastad et al., 2003), women may be expected to have more cognitive complaints than men. One study found that cognitive complaints were related to years of education (Andrykowski et al., 1990), however, another study found no such relationship (Cull et al., 1996). Consistent with this study, cognitive complaints were not significantly related to age in two studies (Andrykowski et al., 1990 & Cull et al., 1996). Cull et al. (1996) also found that cognitive complaints were not significantly related to estimated IQ, which is consistent with the findings for the FACT-Cog total score and cognitive and interference of functioning domain scores. The current study found no significant difference between types of BMT. This finding is inconsistent with one study that found patients who received autologous BMT had more complaints that patients who received allogeneic BMT (Hjermstad et al., 1999), but is consistent with other research that found so significant differences between different types of treatment groups (Cull et al., 1996; Schagen et al., 2002; Van Dam et al., 1998).

Regression analyses were conducted, controlling for significant demographic variables, to determine which psychosocial variables accounted for a significant amount of the variance in the FACT-Cog total score and domain scores. Only fatigue and mental-well being accounted for a significant amount of the remaining variance in the FACT-Cog total score after controlling for gender. For the FACT-Cog cognitive and the interference of functioning domain scores, only mental well-being accounted for a significant amount of the remaining variance after controlling for gender. For the FACT-Cog quality of life domain score, only fatigue accounted for a significant amount of the remaining variance after controlling for gender and estimated IQ.

Fatigue and mental well-being were the only two psychosocial factors that contributed a significant amount of additional variance in the FACT-Cog total score and domain scores. However, the small uniqueness index for all of the variables in the regression analyses indicates that there was significant overlap in the contributions of each variable.

FACT-Cog Total Score in Comparison to the EORTC-CF

The FACT-Cog was designed to be a comprehensive measure of cognitive complaints. Therefore, the psychometric properties of the FACT-Cog total score were compared to an established measure of cognitive complaints, the EORTC-CF. Both measures demonstrated adequate internal consistency reliability, however, the FACT-Cog total score had a slightly higher internal consistency than the EORTC-CF (.98 vs. .77). The FACT-Cog total score and EORTC-CF provided equally strong evidence for convergent validity. Both were significantly correlated with measures of depression, fatigue, anxiety, mental well-being and physical well-being. While the FACT-Cog total

score demonstrated divergent validity with extroversion, the EORTC-CF was significantly correlated with extroversion. Therefore the divergent validity of the EORTC-CF was not supported. An additional analysis to examine the relationship between the EORTC-CF and neuroticism did not find a significant relationship as would be expected, and as found with the FACT-Cog total score.

There was minimal support for criterion validity for both measures. Neither the FACT-Cog total score nor the EORTC-CF was significantly correlated with total neuropsychological performance or with the neuropsychological domain scores (continuous or impairment classifications). When the relationship to the individual test scores as continuous measures was examined, the EORTC-CF yielded similar results to the FACT-Cog total score, with a significant relationship with one of the CPT-II subscales. Relationship of the EORTC-CF to individual test scores classified as impaired or nonimpaired also produced results similar to the FACT-Cog total score, with significant findings mainly within the attention domain. Similar to the FACT-Cog total score, other correlations of individual tests with the EORTC-CF, although nonsignificant, had small to medium effect sizes. Again, this suggests that power may have been an issue for both measures.

When examining the relationship of the cognitive functioning measures to demographic and clinical variable, the FACT-Cog total score was significantly correlated with gender only, while the EORTC-CF was significantly correlated with gender, race, and type of BMT transplant. There is no a priori reason to think that cognitive complaints should be related to race or type of BMT transplant. In the absence of an a

priori reason, the relationship of the EORTC-CF to race and type of transplant is undesirable.

Although these measures demonstrated similar psychometric properties, the content of the measures varies greatly. A strength of the EORTC-CF is the brevity of the measure. However, this brevity also means that the content of the EORTC-CF is very narrow assessing only memory and attention. In comparison, a weakness of the FACT-Cog is the length of the measure, but this allows the FACT-Cog to assess broader aspects of cognitive complaints. Although in this sample the FACT-Cog domain scores had similar results to the FACT-Cog total score showing no clear advantage of domain scores, the utility of the FACT-Cog domain scores may yet be identified.

Limitations

Several limitations of the current study should be noted. First, the cross-sectional design of the study did not allow test-retest reliability to be assessed to demonstrate the temporal stability of the measure. Second, the cross-sectional design also meant that the neuropsychological measures and FACT-Cog were only administered once. Therefore, how changes in cognitive performance may relate to changes in cognitive complaints could not be assessed. Cognitive complaints may not reflect actual cognitive performance, rather they may reflect a change from previous functioning. Looking at discrete cognitive performance in relationship to cognitive complaints may not be an accurate means of evaluating criterion validity. Third, the sample size may have been too small to detect significant differences for small to medium effect sizes. Fourth, the generalizabilty of these results may be limited to patients receiving a BMT. Fifth, the sample was predominantly Caucasian, married, well-educated, and economically stable

potentially limiting the generalizabilty of the results to a more socioeconomically diverse group. A final limitation is that the individual neuropsychological tasks generally did not require sustained effort. Therefore these tasks may not have been demanding enough to simulate the types of cognitive complaints assessed by the FACT-Cog. Anecdotally, patients reported that the CPT-II, a task lasting much longer than any other task, was demanding and required more sustained effort than the other tasks. The significant relationships between the CPT-II subscales and the measures of cognitive complaints may reflect the need for additional tasks that require sustained effort.

Clinical Implications

These results suggest, therefore, that caution should be used when interpreting patients' cognitive complaints. The overlap between cognitive complaints and psychosocial measures raises the possibility that a patient reporting difficulty with cognitive functioning may be experiencing psychological distress rather than impaired cognitive functioning. The limited criterion validity of the FACT-Cog and EORTC-CF also suggest that patients' cognitive complaints are more likely to be related to deficits in attention, than to deficits in memory, executive functioning, and motor coordination.

Future Directions

Future research should seek to refine the FACT-Cog through item reduction as well as to factor analyze the FACT-Cog to provide support for the domain scores. In addition, more research looking at the relationship of cognitive complaints to cognitive performance is needed. Research utilizing a longitudinal design is important to determine the temporal stability of cognitive complaints as well as to examine how changes in cognitive performance relate to cognitive complaints. The small effects sizes

found in this study suggest the need for research with larger sample sizes to have the ability to detect significant difference for small effect sizes. Additionally, research should be conducted with other clinical populations with high rates of impairment where detection of relationships between objective and subjective aspects of cognitive functioning may be more likely. Future research should include more demanding neuropsychological tasks such as the CPT-II since evidence suggests a stronger relationship between cognitive complaints and tasks requiring sustained effort. Finally, neuropsychological tasks that have greater ecological validity, such as memory tasks that requires recall over several days, should be used to assess the relationship between cognitive performance and cognitive complaints.

In conclusion, the present study provides information about the validity and reliability of a new measure to assess cognitive complaint in cancer patients, the FACT-Cog. Results demonstrated the internal consistency reliability of the FACT-Cog. The concurrent validity of the FACT-Cog was supported by significant relationship to the EORTC-CF. The convergent validity of the FACT-Cog was supported by the significant relationships to measures of depression, fatigue, anxiety, mental well-being, physical well-being, and neuroticism demonstrating the convergent validity of the measure. The divergent validity of the FACT-Cog was supported by the lack of significant relationship with a measure of extroversion. The criterion validity of the FACT-Cog was generally not supported based on the limited number of significant correlations with neuropsychological test scores. The FACT-cog did not demonstrate superior psychometric properties than the EORTC-CF, a commonly used measure of cognitive complaints. Future research is needed to reduce the number of items in the FACT-Cog

and to factor analyze the FACT-Cog to provide support for the domain scores. Additional research should also utilize a longitudinal design, be conducted with other clinical populations, and include demanding neuropsychological tasks that require sustained effort.

Table 1

Demographic Characteristics of Sample (N = 82)

Variable		
Mean age (SD)	52.91	(12.03)
Mean education (SD)	13.76	(2.30)
Estimated IQ (SD)	98.5	(15.30)
Gender		
Male	42	(51.2%)
Female	40	(48.8%)
Ethnicity		
White/Caucasian	70	(85.4%)
Black/African American	7	(8.5%)
Latino/Hispanic	4	(4.9%)
Other	1	(1.2%)
Marital Status		
Single, never married	4	(4.9%)
Married	65	(79.3%)
Divorced	9	(11.0%)
Widowed	3	(3.7%)
Separated	1	(1.2%)
Employment status		
Paid full-time employment	23	(28.1%)
Paid part-time employment	5	(6.1%)
On leave with pay	7	(8.5%)
On leave without pay	8	(9.8%)
Not employed – disabled	17	(20.7%)
Not employed – retired	11	(13.4%)
Not employed – Seeking work	2	(2.4%)
Supported by others	9	(11.0%)
Total household income*		
Less than $ 10,000	4	(5.0%)
$10,000 - $19,999	7	(8.8%)
$20,000 - $ 39,999	16	(20.0%)
$40,000 - $59,999	21	(26.3%)
$60,000 - $100,000	18	(22.5%)
Greater than $100,000	12	(15.0%)

* Data missing for 4 participants

Table 2

Clinical Characteristics of Sample (N = 82)

Variable		
Evaluation		
Six month follow-up	56	(68.3%)
Twelve month follow-up	26	(31.7%)
BMT Type		
Autologous	70	(85.4%)
Allogeneic	12	(14.6%)
Diagnosis		
Multiple Myeloma	59	(72.0%)
Non Hodgkins Lymphoma	5	(6.1%)
Acute Lymphocytic Leukemia	2	(2.4%)
Hodgkins Lymphoma	1	(1.2%)
Acute Myelogenous Leukemia	4	(4.9%)
Breast Cancer	4	(4.9%)
Testicular Cancer	1	(1.2%)
Aplastic Anemia	1	(1.2%)
Myelodysplasia	1	(1.2%)
Chronic Myelogenous Leukemia	3	(3.7%)
Amyloidosis	1	(1.2%)

Table 3

Correlational Analyses of FACT-Cog and EORTC-CF with Demographic and Clinical Variables

	FACT-Cog				EORTC-CF
	Total	Cognitive	IOF	QOL	
Gender	.31**	.30**	.32**	.26*	.22*
Age	.03	.07	.04	-.03	.09
Estimated IQ (NART)	.18	.15	.13	.22*	.10
Years of Education	-.02	-.03	-.03	.01	-.14
Race (White/Caucasian or All Others)	-.13	-.17	-.12	-.09	-.22*
Marital Status	.15	.17	.15	.11	.08
Time Since Transplant (6month or 12 month)	.03	.01	.06	.02	.08
Type of Transplant	-.07	-.08	-.07	-.05	-.27**

* $p < .05$
**$p < .01$

IOF = Interference of Functioning
QOL = Quality of Life

Table 4

Correlational Analyses of FACT-Cog and EORTC-CF with Psychosocial Variables

	FACT-Cog				EORTC-CF
	Total	Cognitive	IOF	QOL	
Depression (CES-D)	.50****	.45****	.44****	.52****	.44****
Fatigue (FSI)	.53****	.45****	.49****	.58****	.44****
Anxiety (STAI)	.36***	.33**	.31**	.39***	.35***
Mental Wellbeing (SF-36)	-.51****	-.46****	-.50****	-.50****	-.48****
Physical Wellbeing (SF-36)	-.29**	-.27*	-.25*	-.32**	-.31***
Extroversion (NEO)	-.20	-.18	-.25*	-.14	-.30**
Neuroticism (NEO)	.23*	.29**	.21*	.13	.14

* p < .05
**p < .01
***p < .001
**** p < .0001

IOF = Interference of Functioning
QOL = Quality of Life

Table 5

Regression Analysis of the FACT-Cog Total Score

	β	R^2 change	Cumulative R^2	p value	Uniqueness Index
Demographic variables					
Gender	.201	.094	.094	.005	.037
Psychosocial variables					
Fatigue (FSI)	.265	.257	.357	.0001	.025
Mental Well-being (SF-36)	-.254	.046	.373	.020	.018
Neuroticism (NEO)	.118	.007	.380	.362	.011
Anxiety (STAI)	-.163	.003	.383	.557	.008
Depression (CES-D)	.150	.005	.389	.432	.005
Physical Well-being (SF-36)	-.050	.002	.389	.667	.002

Table 6

Regression Analysis of the FACT-Cog Cognitive Domain

	β	R^2 change	Cumulative R^2	p value	Uniqueness Index
Demographic variables					
Gender	.205	.091	.094	.006	.039
Psychosocial variables					
Mental Well-being (SF-36)	-.225	.183	.274	.0001	.014
Fatigue (FSI)	.169	.023	.298	.111	.010
Neuroticism (NEO)	.219	.027	.325	.082	.036
Anxiety (STAI)	-.229	.006	.331	.425	.016
Depression (CES-D)	.208	.010	.340	.295	.009
Physical Well-being (SF-36)	-.068	.003	.343	.575	.003

Table 7

Regression Analysis of the FACT-Cog Interference of Functioning

	β	R^2 change	Cumulative R^2	p value	Uniqueness Index
Demographic variables					
Gender	.226	.100	.100	.004	.047
Psychosocial variables					
Mental Well-being (SF-36)	-.357	.222	.322	.0001	.037
Fatigue (FSI)	.239	.029	.351	.065	.021
Extroversion (NEO)	-.158	.016	.367	.166	.021
Anxiety (STAI)	-.181	.012	.379	.232	.011
Physical Well-being (SF-36)	-.029	.001	.379	.786	.001
Depression (CES-D)	.047	.000	.380	.819	.001

Table 8

Regression Analysis of the FACT-Cog Quality of Life Domain

	β	R^2 change	Cumulative R^2	p value	Uniqueness Index
Demographic variables					
Gender	.127			.042	.015
IQ (NART)	.072	.099	.099	.087	.004
Psychosocial variables					
Fatigue (FSI)	.317	.257	.356	.0001	.033
Mental Well-being (SF-36)	-.173	.027	.383	.07	.008
Depression (CES-D)	.138	.005	.389	.43	.004
Physical Well-being (SF-36)	-.042	.001	.389	.73	.001
Anxiety (STAI)	-.033	.000	.390	.83	.000

Table 9

Correlational Analyses of FACT-Cog and EORTC-CF with Neuropsychological Test Performance (Continuous Measures)

	FACT-Cog				EORTC-CF
	Total	Cognitive	IOF	QOL	
Total Neuropsychological Performance	.06	.07	.07	.05	.11
Memory Domain	.11	.11	.10	.08	.05
Executive Functioning Domain	-.05	-.12	-.02	.00	-.03
Motor Domain	-.18	-.16	-.17	-.17	-.11
Attention Domain	.08	.11	.07	.04	.18

IOF = Interference of Functioning
QOL = Quality of Life

Table 10

Correlation of FACT-Cog and EORTC-CF with Neuropsychological Test Scores (Continuous Measures)

	FACT-Cog				EORTC-CF
	Total	Cognitive	IOF	QOL	
Memory Domain					
Logical Memory					
Immediate	.07	.08	.08	.05	-.03
Delayed	.09	.10	.09	.06	.04
Visual Reproduction					
Immediate	-.19	-.20	-.18	-.16	-.09
Delayed	-.11	-.12	-.09	-.10	-.08
Recall	.08	.04	.05	.13	-.03
CVLT					
Total	.15	.12	.15	.17	.10
Short Delay Free	.14	.16	.14	.10	.15
Short Delay Cued	.13	.16	.12	.10	.13
Long Delay Free	.15	.16	.14	.11	.13
Long Delay Cued	.15	.18	.16	.10	.09
Recognition	.13	.16	.12	.09	.01
Discrimination	.13	.18	.11	.08	.00
Executive Functioning Domain					
Digit Symbol	-.10	-.06	-.09	-.12	-.06
Trails A	.03	-.01	.06	.05	.02
Trails B	-.01	-.09	.00	.07	.08
COWA	.03	-.05	.05	.10	-.10
Stroop	-.11	-.16	-.06	-.09	-.02
Motor Domain					
Grooved Pegs					
Dominant	-.17	-.16	-.17	-.16	-.16
Non-dominant	-.15	-.13	-.15	-.15	-.04
Attention Domain					
CPT-II Subscales					
Inattention	.01	.04	.02	-.03	.17
Impulsivity	.12	.15	.12	.07	.23*
Vigilance	.18	.17	.14	.21*	.02

*p<.05
IOF = Interference of Functioning; QOL = Quality of Life

Table 11

Correlational Analyses of FACT-Cog and EORTC-CF with Neuropsychological Test Performance (Impairment Classification)

	FACT-Cog				EORTC-CF
	Total	Cognitive	IOF	QOL	
Total Neuropsychological Performance	.01	.04	.03	-.05	.06
Memory Domain	-.15	-.18	-.16	-.08	-.16
Executive Functioning Domain	.03	.06	.00	.02	.12
Motor Domain	.11	.06	.13	.12	.03
Attention Domain	.08	.02	.04	.16	.10

IOF = Interference of Functioning
QOL = Quality of Life

Table 12

Correlation of FACT-Cog and EORTC-CF with Neuropsychological Test Scores (Impairment Classification)

	FACT-Cog				EORTC-CF
	Total	Cognitive	IOF	QOL	
Memory Domain					
Logical Memory					
Immediate	-.10	-.09	-.11	-.10	-.12
Delayed	-.05	-.11	-.07	.03	-.12
Visual Reproduction					
Immediate	.15	.15	.14	.12	.13
Delayed	.16	.14	.13	.19	.26*
Recall	-.10	-.09	-.11	-.10	-.12
CVLT					
Total	-.14	-.18	-.12	-.10	-.15
Short Delay Free	-.14	-.18	-.12	-.10	-.15
Short Delay Cued	-.18	-.22*	-.18	-.12	-.15
Long Delay Free	-.19	-.22*	-.16	-.18	-.15
Long Delay Cued	-.19	-.21	-.16	-.17	-.15
Recognition	-.16	-.16	-.14	-.15	.04
Discrimination	-.14	-.15	-.13	-.11	-.06
Executive Functioning Domain					
Digit Symbol	.07	.07	.03	.09	.07
Trails A	.08	.08	.02	.13	.18
Trails B	-.04	-.04	-.05	-.01	-.10
COWA	-.01	.04	-.01	-.06	.18
Stroop	.01	.03	-.03	.02	-.10
Motor Domain					
Grooved Pegs					
Dominant	.12	.09	.14	.11	.14
Non-dominant	.14	.07	.17	.15	.08
Attention Domain					
CPT-II Subscales					
Inattention	.16	.14	.13	.19	.26*
Impulsivity	.28**	.23*	.24*	.33**	.30**
Vigilance	.22*	.18	.16	.29**	.20

*p<.05, **p<.01
IOF = Interference of Functioning; QOL = Quality of Life

Table 13

Regression Analysis of the EORTC-CF Score

	β	R^2 change	Cumulative R^2	p value	Uniqueness Index
Demographic variables					
Gender	.152			.016	.021
Race (White or other)	-.137			.150	.016
Transplant (auto/allo)	-.260	.160	.160	.028	.057
Psychosocial variables					
Mental Well-being (SF-36)	-.284	.207	.367	.0001	.023
Fatigue (FSI)	.198	.029	.396	.060	.014
Extroversion (NEO)	-.193	.034	.430	.039	.031
Physical Well-being (SF-36)	-.078	.003	.433	.528	.004
Anxiety (STAI)	-.059	.001	.434	.728	.001
Depression (CES-D)	.032	.000	.434	.823	.000

References

Aaronson N.K., Ahmedzai S., Bergman B., Bullinger M., & Cull A. (1993). The European Organization for Research and Treatment of Cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology. *Journal of the National Cancer Institute, 85*, 365-376.

Aarstad, H.J., Aarstad, A.K.H., Birkhaug, E.J., Bru, E., & Olofsoon, J. (2003). The personality and quality of life in HNSCC patients following treatment. *European Journal of Cancer, 39,* 1852-1860.

Ahles, T.A., Saykin, A.J., Furstenberg, C.T., Cole, B., Mott, L.A., Skalla, K., Whedon, M.B., Bivens, S., Mitchell, T., Greenberg, E.R., & Silberfarb, P.M. (2002). Neuropsychologic impact of standard-dose systemic chemotherapy in long-term survivors of breast cancer and lymphoma. *Journal of Clinical Oncology, 20(2)*, 485-493.

Ahles, T.A., Tope, D.M., Furstenberg, C., Hann, D., & Mills, L. (1996). Psychologic and neuropsychologic impact of autologous bone marrow transplantation. *Journal of Clinical Oncology, 14(5)*, 1457-1462.

Andrykowski, M.A., Altmaier, E.M., Barnett, R.L., Burish, T.G., Gingrich, R., & Henslee-Downey, P.J. (1990). Cognitive dysfunction in adult survivors of allogeneic marrow transplantation: relationship to dose of total body irradiation. *Bone Marrow Transplant, 6(4)*, 269-276.

Andrykowski, M.A., Henslee, P.J., & Barnett, R.L. (1989). Longitudinal assessment of psychosocial functioning of adult survivors of allogeneic bone marrow transplantation. *Bone Marrow Transplant, 4(5)*, 505-509.

Andrykowski, M.A., Schmitt, F.A., Gregg, M.E., Brady, M.J., Lamb, D.G., & Henslee-Downey, P.J. (1992). Neuropsychologic impairment in adult bone marrow transplant candidates. *Cancer, 70(9)*, 2288-2297.

Beeber, L.S., Shea, J., & McCorkle, R. (1998). The center for epidemiologic studies depression scale as a measure of depressive symptoms in newly diagnosed patients. *Journal of Psychosocial-Oncology, 16,* 1-20.

Benton, A.L. & Hamsher, K. deS. (1989). *Multilingual Aphasia Examination*. Iowa City, IA: AJA Associates.

Bergner, M., Bobbitt, R.A., Carter, W.B., & Gilson, B.S. (1981). The Sickness Impact Profile: Development and final revision of a health status measure. *Medical Care, 19*, 787-805.

Cohen, J. (1987). *Statisical power analysis for the behavioral sciences (rev.ed.).* Hillsdale, NJ: Lawrence Erlbaum Associates.

Conners, C.K. (2000). *Conners' Continuous Performance Test 3.0*. Toronto, Canada: MHS.

Costa, P. T., & McCrae, R. R. (1992a). *The NEO Personality Inventory-R: professional manual.* Odessa, FL: Psychological Assessment Resources.

Costa, P. T., & McCrae, R. R. (1992b). Normal personality assessment in clinical practice: the NEO Personality Inventory. *Psychological Assessment, 4(1)*, 5-13.

Costa, P. T., & McCrae, R. R. (1992c). Normal personality inventories in clinical assessment: general requirements and the potential for using the NEO Personality Inventory: reply. *Psychological Assessment, 4(1)*, 20-22.

Crawford, J.R., Parker, D.M., Stewart, L.E., Besson, J.A.O., & De Lacey, G. (1989). Prediction of WAIS IQ with the National Adult Reading Test: cross validation and extension. *British Journal of Clinical Psychology, 28*, 267-273.

Cull, A., Hay, C., Love, S.B., Mackie, M., Smets, E., & Stewart, M. (1996). What do cancer patients mean when they complain of concentration and memory problems? *British Journal of Cancer, 74(10)*, 1674-1979.

Delis, D.C., Kramer, J.H., Kaplan, E. & Ober, B.A. (1987). *California Verbal Learning Test: Adult Version Manual.* San Antonio, TX: The Psychological Corporation.

Goodwin R.D. & Gotlib, I.H. (2004). Gender differences in depression: the role of personality factors. *Psychiatry Research, 126,* 135-142.

Green, H.J., Pakenham, K.I., Headley, B.C., & Gardiner, R.A. (2002). Coping and health-related quality of life in men with prostate cancer randomly assigned to hormonal medication or close monitoring. *Psycho-Oncology, 11*, 401-414.

Hann, D. M., Jacobsen, P. B., Azzarello, L. M., Martin, S. C., Curran, S. L., Fields, K. K., Greenberg, H., & Lyman, G. (1998). Measurement of fatigue in cancer patients: Development and validation of the Fatigue Symptom Inventory. *Quality of Life Research, 7,* 301-310.

Hann, D., Winter, K., & Jacobsen, P. B. (1999). Measurement of depressive symptoms in cancer patients: Evaluation of the Center for Epidemiological Studies Depression Scale (CES-D). *Journal of Psychosomatic Research, 46,* 437-443.

Harder, H., Cornelissen, J.J., Van Gool, A.R., Duivenvoorden, H.J., Eijkenboom, W.M.H., & van den Bent, M.J. (2002). Cognitive functioning and quality of life in long-term adult survivors of bone marrow transplantation. *Cancer, 95(1)*, 183-192.

Heaton, R.K. (1992). *Comprehensive Norms for an Expanded Halstead-Reitan Battery: A Supplement for the Wechsler Adult Intelligence Scales – Revised (WAIS-R)*. Odessa, FL: Psychological Assessments Resources.

Heaton, R.K., Grant, I., & Matthews, C.G. (1991). *Comprehensive Norms for an Expanded Halstead-Reitan Battery: Demographic Correction, Research Findings, and Clinical Applications.* Odessa, FL: Psychological Assessment Resources.

Hjermstad, M.J., Holte, H., Evensen, S.A., Fayers, P.M., & Kaasa, S. (1999). Do patients who are treated with stem cell transplantation have a health-related quality of life comparable to the general population after 1 year? *Bone Marrow Transplant, 24(8)*, 911-918.

Joly, F., Brune, D., Couette, D.B., Lesaunier, F., Heron, J.F., Peny, J., & Henry-Amar, M. (1998). Health-related quality of life and sequelae in patients treated with brachytherapy and external beam irradiation for localized prostate cancer. *Annals of Oncology, 9*, 751-757.

Klein, M., Heimans, J.J., Aaronson, N.K., van der Ploeg, H.M., Grit, J., Muller, M., Postma, T.J., Mooij, J.J., Boerman, R.H., Beute, G.N., Ossenkoppele, G.J., van Imhoff, G.W., Dekker, A.W., Jolles, J., Slotman, B.J., Struikmans, H., & Taphoorn, M.J.B. (2002). Effect of radiotherapy and other treatment-related factors on mid-term to long-term cognitive sequelae in low-grade gliomas: a comparative study. *Lancet, 360(9343)*, 1361-1368.

Lezak, MD. (1995). *Neuropsychological assessment, 3rd ed.* New York, NY: Oxford University Press.

Matthews, C.G. & Klove, H. (1964). *Instruction Manual for the Adult Neuropsychology Test Battery*. Madison, WI: University of Wisconsin Medical School.

McHorney, C.A., Ware, J.E., & Raczek, A.E. (1993). The MOS Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring the physical and mental health constructs. *Medical Care, 31*, 247-263.

McNair, D.M., Lorr, M., & Droppleman, L. (1971). *POMS Manual.* San Diego, CA: Educational and Testing Services.

Nelson, H.E. (1982). *The National Adult Reading Test (NART): Test Manual.* Windsoe, Berks, U.K.: NFER-Nelson.

Olin, J.J. (2001). Cognitive function after systemic therapy for breast cancer. *Oncology, 15,* 613-624.

Radloff, L.S. (1977). The CES-D scale: a self-report depression scale for research in the general population. *Applied Psychological Measurement, 1,* 385-401.

Reitan, R.M. (1958). The validity of the Trail Making Test as an indicator of organic brain damage. *Perceptual and Motor Skills, 8*, 271-276.

Reitan, R.M. & Wolfson, D. (1993). *The Halstead-Reitan Neuropsychological Test Battery: Theory and Clinical Interpretation*. Tuscan, AZ: Neuropsychology Press.

Schagen, S.B., Muller, M.J., Boogerd, W., Rosenbrand, R.M., van Rhijn, D., Rodenhuis, S., & van Dam, F.S. (2002). Late effects of adjuvant chemotherapy on cognitive function: a follow-up study in breast cancer patients. *Annals of Oncology, 13(9)*, 1387-1397.

Schagen, S.B., van Dam, F.S., Muller, M.J., Boogerd, W., Lindeboom, J., & Bruning, P.F. (1999). Cognitive deficits after postoperative adjuvant chemotherapy for breast carcinoma. *Cancer, 85(3)*, 640-650.

Servaes, P., Verhagen, C.A., & Bleijenberg, G. (2002). Relations between fatigue, neuropsychological functioning, and physical activity after treatment for breast carcinoma - Daily self-report and objective behavior. *Cancer, 95(9)*, 2017-2026.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State–Trait Anxiety Inventory* (*Form Y*). Palo Alto, CA: Consulting Psychologists Press.

Spreen, O. & Strauss, E. (1998). *A Compendium of Neuropsychological Tests – Second Edition.* New York, NY: The Oxford University Press.

Squire, L.R., Wetzel, C.D., & Slater, P.C. (1979). Memory complaint after electroconvulsive therapy: Assessment with a new self-rating instrument. *Biological Psychiatry, 14(5)*, 791-801.

Stewart, A.L. & Ware, J.E. (1992). *Measuring Functioning and Well-Being: The Medical Outcomes Study Approach*. Durham, NC: Duke University Press.

Trenarry, M.R., Crosson, B., DeBoe, J., & Leber, W.R. (1989). *The Stroop Neuropsychological Screening Test.* Lutz, FL: Psychological Assessment Resources.

Van Dam, F., Schagen, S., Muller, M., Boogerd, W., van dam Wall, E., Droogleever Forttuyn, M., & Rodenhuis, S. (1998). Impairment of cognitive function in women receiving adjuvant treatment for high-risk breast cancer: High dose versus standard-dose chemotherapy. *Journal of the National Cancer Institute, 90(3)*, 210-218.

Van der Zee, K., Buunk, B., Sanderman, R., Botke, G., & Van der Bergh, F. (1999). The Big Five and identification-contrast processes in social comparison in adjustment to cancer treatment. *European Journal of Personality, 13,* 307-326.

Vercoulen, J.H., Swanink, C.M., Fennis, J.F., Galama, J.M., Van-der-Meer, J.W., & Bleijenberg, G. (1994). Dimensional assessment of chronic fatigue syndrome. *Journal of Psychosomatic Research, 38*, 383-392.

Ware, J.E., Snow, K.K., Kosinski, M., & Gandek, B. (1993). *SF-36 Health Survey Manual and Interpretation Guide.* Boston, MA: The Health Institute, The New England Medical Center.

Ware, J.E. & Sherbourne, C.D. (1992). The MOS Short-Form Health Survey (SF-36): I. Conceptual framework and item selection. *Medical Care, 30(6)*, 473-483.

Wagner, L.I., Sweet, J., Cella, D., & Doninger, N. (2003, March). Chemotherapy-related cognitive deficits: A qualitative examination of patients and providers. Presented at the 24th Annual Meeting and Scientific Session of the Society of Behavioral Medicine, Salt Lake City, UT.

Wechsler, D. (1981). *Wechsler Adult Intelligence Scale – Revised Administration and Scoring Manual.* San Antonio, TX: The Psychological Corporation.

Wechsler, D. (1997). *Wechsler Memory Scale-III Manual*. San Antonio, TX: The Psychological Corporation.

Appendices

Appendix A: Functional Assessment of Cancer Therapy Cognitive Scale

Below is a list of statements that other people with your condition have said are important. **By circling one (1) number per line, please indicate how often each of the following has occurred <u>during the past 7 days.</u>**

	Never	About once a week	Two to three times a week	Nearly every day	Several times a day
I have had trouble forming thoughts	0	1	2	3	4
My thinking has been unclear	0	1	2	3	4
My thinking has been slow	0	1	2	3	4
My thinking has been foggy.....	0	1	2	3	4
I have had trouble adding or subtracting numbers in my head.....	0	1	2	3	4
I have made mistakes when writing down phone numbers.....	0	1	2	3	4
I have had trouble concentrating	0	1	2	3	4
I have had trouble remembering the name of a familiar person	0	1	2	3	4
I have had trouble finding my way to a familiar place	0	1	2	3	4
I have had trouble remembering where I put things, like my keys or my wallet.....	0	1	2	3	4
I have had trouble remembering whether I did things I was supposed to do, like taking a medicine or buying something I needed	0	1	2	3	4
I have had trouble remembering new information, like phone numbers or simple instructions	0	1	2	3	4
I have had trouble recalling the name of an object while talking to someone	0	1	2	3	4
Words I wanted to use have seemed to be on the “tip of my tongue”.....	0	1	2	3	4
I have had trouble finding the right word(s) to express myself.....	0	1	2	3	4

By circling one (1) number per line, please indicate how often each statement has occurred during the past 7 days.

	Never	About once a week	Two to three times a week	Nearly every day	Several times a day
I have used the wrong word when I referred to an object	0	1	2	3	4
I have had trouble speaking fluently	0	1	2	3	4
I have had trouble saying what I mean in conversations with others	0	1	2	3	4
I have needed to keep a written list so I would not forget things	0	1	2	3	4
I have walked into a room and forgotten what I meant to get or do there	0	1	2	3	4
I have needed medical instructions repeated because I could not keep them straight	0	1	2	3	4
I have forgotten or accidentally missed medical appointments	0	1	2	3	4
I have had to work really hard to pay attention or else I would forget what I was doing	0	1	2	3	4
I have had to work really hard to pay attention or I would make a mistake	0	1	2	3	4
I have forgotten names of people soon after being introduced	0	1	2	3	4
My reactions in everyday situations have been slow	0	1	2	3	4
Other people have noticed that I had problems remembering information	0	1	2	3	4
Other people have noticed that I had problems speaking clearly	0	1	2	3	4
Other people have noticed that I had problems thinking clearly	0	1	2	3	4

By circling one (1) number per line, please indicate how often each statement has occurred <u>during the past 7 days.</u>

	Never	About once a week	Two to three times a week	Nearly every day	Several times a day
It has seemed like my brain was not working as well as usual	0	1	2	3	4
I have had to work harder than usual to remember things	0	1	2	3	4
I have had to work harder than usual to keep track of what I was doing.....	0	1	2	3	4
My thinking has been slower than usual	0	1	2	3	4
I have had to work harder than usual to express myself clearly.....	0	1	2	3	4
I have had more problems conversing with others	0	1	2	3	4

Please answer the remaining questions with regard to all the above concerns that you have identified.

	Never	About once a week	Two to three times a week	Nearly every day	Several times a day
I have hidden these problems so others would not notice.....	0	1	2	3	4
I have been upset about these problems.....	0	1	2	3	4
I have told others about these problems.....	0	1	2	3	4
These problems have interfered with my ability to work.....	0	1	2	3	4
These problems have interfered with my ability to do things I enjoy.....	0	1	2	3	4
I have tried to do things (like writing lists or keeping a calendar) so these problems would not interfere	0	1	2	3	4
These problems have been frustrating for me	0	1	2	3	4
These problems have interfered with the quality of my life.....	0	1	2	3	4

Please answer the remaining questions with regard to all the above concerns that you have identified.

	Not at all	A little bit	Some-what	Quite a bit	Very much
I have hidden these problems so others would not notice.....	0	1	2	3	4
I have been upset about these problems.....	0	1	2	3	4
I have told others about these problems.....	0	1	2	3	4
These problems have interfered with my ability to work.....	0	1	2	3	4
These problems have interfered with my ability to do things I enjoy..	0	1	2	3	4
I have tried to do things (like writing lists or keeping a calendar) so these problems would not interfere	0	1	2	3	4
These problems have been frustrating for me.....	0	1	2	3	4
These problems have interfered with the quality of my life.....	0	1	2	3	4

Appendix B: EORTC QLQ-C30 Cognitive Functioning Scale

Directions: For each item below, please check the ONE box.

During the past week:

	Not at all	A little	Quite a bit	Very much
1. Have you had difficulty in concentrating on things, like reading a newspaper or watching television?	☐	☐	☐	☐
2. Have you had difficulty remembering things?	☐	☐	☐	☐

Appendix C: Center for Epidemiological Studies – Depression

For each statement below, make an **"X"** in the box which best describes how often you felt or behaved this way-- **DURING THE PAST WEEK, INCLUDING TODAY.**

	Rarely or None of of the time (< 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of the (3-4 days)	Most or all of the time (5-7 days)
DURING THE PAST WEEK:				
1. I was bothered by things that usually don't bother me				
2. I did not feel like eating; my appetite was poor				
3. I felt that I could not shake off the blues even with help from my family or friends				
4. I felt that I was just as good as other people				
5. I had trouble keeping my mind on what I was doing				
6. I felt depressed				
7. I felt that everything I did was an effort				
8. I felt hopeful about the future				
9. I thought my life had been a failure				
10. I felt fearful				
11. My sleep was restless				
12. I was happy				
13. I talked less than usual				
14. I felt lonely				
15. People were unfriendly				
16. I enjoyed life				
17. I had crying spells				
18. I felt sad				
19. I felt that people disliked me				
20. I could not "get going"				

Appendix D: State-Trait Anxiety Inventory

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then check the appropriate box to the right of the statement to indicate how you feel *right now*, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	NOT AT ALL	***SOMEWHAT***	***MODERATELY SO***	***VERY MUCH SO***
1. I feel calm..				
2. I feel secure.....				
3. I am tense.				
4. I feel strained.....				
5. I feel at ease.....				
6. I feel upset.....				
7. I am presently worrying over possible misfortunes.....				
8. I feel satisfied.				
9. I feel frightened..				
10. I feel comfortable.....				
11. I feel self-confident.				
12. I feel nervous.....				
13. I am jittery.....				
14. I feel indecisive.....				

	NOT **AT ALL**	***SOMEWHAT***	***MODERATELY*** **SO**	***VERY*** **MUCH SO**
15. I am relaxed.				
16. I feel content.....				
17. I am worried.				
18. I feel confused.....				
19. I feel steady.....				
20. I feel pleasant.....				

Appendix E: Fatigue Symptom Inventory

PART I. For each of the following, circle the one number that best indicates how that item applies to you.

1. Rate your level of fatigue on the day you felt **most** fatigued during the past week.

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Not at all fatigued										As fatigued as I could be

2. Rate your level of fatigue on the day you felt **least** fatigued during the past week.

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Not at all fatigued										As fatigued as I could be

3. Rate your level of fatigue on the **average** in the last week.

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Not at all fatigued										As fatigued as I could be

4. Rate your level of fatigue **right now**.

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Not at all fatigued										As fatigued as I could be

5. Rate how much, in the past week, fatigue interfered with your **general level of activity**:

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
No interference										Extreme interference

6. Rate how much, in the past week, fatigue interfered with your **ability to bathe and dress yourself**:

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
No interference										Extreme interference

7. Rate how much, in the past week, fatigue interfered with your **normal work activity (includes both work outside the home and housework)**:

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
No interference										Extreme interference

8. Rate how much, in the past week, fatigue interfered with your **ability to concentrate**:

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
No interference										Extreme interference

9. Rate how much, in the past week, fatigue interfered with your **relations with other people**:

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
No interference										Extreme interference

10. Rate how much, in the past week, fatigue interfered with your **enjoyment of life**:

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
No interference										Extreme interference

11. Rate how much, in the past week, fatigue interfered with your **mood**:

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
No interference										Extreme interference

12. Indicate **how many days**, in the past week, you felt fatigued for any part of the day:

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Days							Days

13. Rate **how much of the day**, on average, you felt fatigued in the past week:

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
None of the day										The entire day

14. Indicate which of the following best describes the **daily pattern** of your fatigue in the past week:

0	*1*	*2*	*3*	4
Not at all fatigued	Worse in the morning	Worse in the afternoon	Worse in the evening	No consistent daily pattern of fatigue

Appendix F: Medical Outcome SF-36 Health Survey

INSTRUCTIONS: This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities. Answer every question by marking the answer as indicated. If you are unsure about how to answer a question, please give the best answer you can.

1. In general, would you say your health is (check one):

   Excellent Very good Good Fair Poor

2. *Compared to one year ago*, how would you rate your health in general *now*? (check one)

   Much better now than one year ago

   Somewhat better now than one year ago

   About the same as one year ago

   Somewhat worse now than one year ago

   Much worse than one year ago

3. The following items are about activities you might do during a typical day. Does *your health now limit you* in these activities? If so, how much? (check appropriate answer)

	Yes, Limited a lot	**Yes, Limited a little**	**No, Not limited at all**
a. *Vigorous activities*, such as running, lifting heavy objects, participating in strenuous sports			
b. *Moderate activities*, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf			
c. Lifting or carrying groceries			
d. Climbing *several* flights of stairs			
e. Climbing *one* flight of stairs			
f. Bending, kneeling or stooping			
g. Walking *more than a mile*			
h. Walking *several blocks*			
i. Walking *one block*			

4. During the *past 4 weeks*, have you had any of the following problems with your work or other regular daily activities *as a result of your physical health*? (check yes or no for each)

	Yes	**No**
a. Cut down the *amount of time* you spent on work or other activities		
b. *Accomplished less* than you would like		
c. Were limited in the *kind* of work or other activities		
d. Had *difficulty* performing the work or other activities (for example, it took extra effort)		

5. During the *past 4 weeks*, have you had any of the following problems with your work or other regular daily activities *as a result any emotional problems* (such as feeling depressed or anxious)? (check yes or no for each)

	Yes	**No**
a. Cut down the *amount of time* you spent on work or other activities		
b. *Accomplished less* than you would like		
c. Didn't do work or other activities as *carefully* as usual		

6. During the *past 4 weeks*, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups? (check one)

Not at all

Slightly

Moderately

Quite a bit

Extremely

7. How much *bodily* pain have you had during the *past 4 weeks*? (check one)

None

Very mild

Mild

Moderate

Severe

Very severe

8. During the *past 4 weeks*, how much did *pain* interfere with your normal work (including both work outside the home and housework)? (check one)

Not at all

A little bit

Moderately

Quite a bit

Extremely

9. These questions are about how you feel and how things have been with you *during the past 4 weeks*. For each question, please give the one answer that comes closest to the way you have been feeling. (check appropriate answer).

How much of the time during the *past 4 weeks*:	**All of the time**	**Most of the time**	**A good bit of the time**	**Some of the time**	**A little of the time**	**None of the time**
a. Did you feel full of pep?						
b. Have you been a very nervous person?						
c. Have you felt so down in the dumps that nothing could cheer you up?						
d. Have you felt calm and peaceful?						
e. Did you have a lot of energy?						
f. Have you felt downhearted and blue?						
g. Did you feel worn out?						
h. Have you been a happy person?						
i. Did you feel tired?						

10. During the *past 4 weeks*, how much of the time has your *physical health or emotional problems* interfered with your social activities (like visiting with friends, relatives, etc.)? (check one)

All of the time

Most of the time

Some of the time

A little of the time

None of the time

11. How **TRUE** or **FALSE** is *each* of the following statements for you? (check appropriate answer)

	Defi-nitely true	**Mostly true**	**Don't know**	**Mostly false**	**Defi-nitely false**
a. I seem to get sick a little easier than other people					
b. I am as healthy as anybody I know					
c. I expect my health to get worse					
d. My health is excellent					

Appendix G: NEO – Five-Factor Inventory

Instructions: This questionnaire contains 60 statements. Read each statement carefully. For each statement, check the box that goes with the response that best represents your opinion. Check only one box for each statement.

	Strongly Disagree	*Disagree*	*Neutral*	*Agree*	*Strongly Agree*
1. I am not a worrier					
2. I like to have a lot of people around me					
3. I don't like to waste my time daydreaming					
4. I try to be courteous to everyone I meet					
5. I keep my belongings clean and neat					
6. I often feel inferior to others					
7. I laugh easily					
8. Once I find the right way to do something, I stick to it					
9. I often get into arguments with my family and co-workers					
10. I'm pretty good about pacing myself so as to get things done on time					
11. When I am under a great deal of stress, sometimes I feel like I'm going to pieces					
12. I don't consider myself especially "light-hearted."					
13. I am intrigued by the patterns I find in art and nature					
14. Some people think I'm selfish and egotistical					
15. I am not a very methodical person					
16. I rarely feel lonely or blue					

Appendix G: NEO – Five-Factor Inventory (Continued)

	Strongly Disagree	*Disagree*	*Neutral*	*Agree*	*Strongly Agree*
17. I really enjoy talking to people					
18. I believe letting students hear controversial speakers can only confuse and mislead them					
19. I would rather cooperate with others than ..... compete with them					
20. I try to perform all the tasks assigned to me conscientiously					
21. I often feel tense and jittery					
22. I like to be where the action is					
23. Poetry has little or no effect on me					
24. I tend to be cynical and skeptical of others' intentions					
25. I have a clear set of goals and work toward them in an orderly fashion					
26. Sometimes I feel completely worthless					
27. I usually prefer to do things alone					
28. I often try new and foreign foods					
29. I believe that most people will take advantage of you if you let them.....					
30. I waste a lot of time before settling down to work					
31. I rarely feel fearful or anxious					
32. I often feel as if I'm bursting with energy					
33. I seldom notice the moods or feelings that different environments produce					

Appendix G: NEO – Five-Factor Inventory (Continued)

	Strongly Disagree	*Disagree*	*Neutral*	*Agree*	*Strongly Agree*
34. Most people I know like me					
35. I work hard to accomplish my goals					
36. I often get angry at the way people treat me.....					
37. I am a cheerful, high-spirited person.....					
38. I believe we should look to our religious..... authorities for decisions on moral issues					
39. Some people think of me as cold and calculating					
40. When I make a commitment, I can always be counted on to follow through					
41. Too often, when things go wrong, I get ..... discouraged and feel like giving up.....					
42. I am not a cheerful optimist					
43. Sometimes when I am reading poetry .... or looking at a work of art, I feel a chill or wave of excitement					
44. I'm hard-headed and tough-minded in my attitudes					
45. Sometimes I'm not as dependable or reliable as I should be.....					
46. I am seldom sad or depressed					
47. My life is fast-paced.....					
48. I have little interest in speculating on the nature of the universe or the human condition					
49. I generally try to be thoughtful and considerate.....					

	Strongly Disagree	*Disagree*	*Neutral*	*Agree*	*Strongly Agree*
50. I am a productive person who always get the job done					
51. I often feel helpless and want someone else to solve my problems					
52. I am a very active person.....					
53. I have a lot of intellectual curiosity.....					
54. If I don't like people, I let them know it.....					
55. I never seem to be able to get organized					
56. At times I have been so ashamed I just want to hide					
57. I would rather go my own way then be a leader of others					
58. I often enjoy playing with theories or abstract ideas					
59. If necessary, I am willing to manipulate people to get what I want.....					
60. I strive for excellence in everything I do.....					

Appendix H: Background Interview

BACKGROUND INTERVIEW

Name:

MR#:

Age/DOB:

Handedness:

Race:

Marital Status:

Referring M.D.:

Date of Assessment:

ECOG (neuro only):

Karnofsky (neuro only):

History of Present Illness:
Diagnosis:

Diagnosis date:

BMT type:

Treatment so far?

Psychiatric History:

Have you ever seen a psychiatrist or other mental health professional?	YES	NO
Were you ever hospitalized for mental problems?	YES	NO
Do you see a psychiatrist or other mental health professional now?	YES	NO

Current Medications:

Family Medical and Psychiatric History:
Is there a family history of cancer?

Are there family members with mental problems? Alcohol? Drugs?	YES	NO

Social History:
Who do you live with?

Where do you live?

Do you have any children?

How far did you go in school?

Any learning or attention problems as you were going through school?

Are you currently working? If not, when did you stop? Do you receive SSI or disability?

How have you been sleeping?

How is your appetite?

Do you have a history of smoking? Alcohol consumption? Illicit drug use?

How much caffeine do you typically drink?

Do you have any other medical history of which we should be aware?

Do you have any history of head injury of loss of consciousness? Did this leave any lasting effects?

Mental Status (any comments):

Appendix H: Background Interview (Continued)

MENTAL STATUS EXAM

Appearance: (hygiene, dress, eye contact, posture, gait, level of consciousness, attentiveness)

Does he/she appear his/her chronological age?

Attitude: __ Cooperative __ Uncooperative

Activity: __ Normal __ Psychomotor Retardation (or) __ Agitation
__ Tremor

Mood: __ Euthymic __ Dysphoric __ Angry __ Anxious __ Apathetic

Affect: (parameters: appropriateness, intensity, mobility, range reactivity)
__ Incongruent __ Flat __ Tearful __ Labile
__ Appropriate __ Normal __ Full Range

Speech: (rate, flow, volume, clarity, spontaneity, word finding difficulties)

Thought Process:
__ Organized __ Disorganized __ Tangential __ Loose Association

Level of Consciousness: __ Alert __ Drowsy __ Delirium __ Stupor

Depression: (2 week period)
__ Depressed Mood __ Diminished interest/pleasure __ Weight Loss
__ Insomnia/hyper __ Psychomotor changes __ Fatigue/Loss of energy
__ Worthlessness/guilt __ Poor concentration/decision making
__ Thoughts of death/suicidal ideation

Adjustment: (3 months)
__ Marked Distress __ Impairment (social/occupational)
__Depressed __ Anxiety __ Mixed

Appendix I: National Adult Reading Test

National Adult Reading Test (NART)

SECOND EDITION

Answer/Record Sheet

Name:..... Date of test:.....

	Errors		Errors
CHORD		SUPERFLUOUS	
ACHE		SIMILE	
DEPOT		BANAL	
AISLE		QUADRUPED	
BOUQUET		CELLIST	
PSALM		FACADE	
CAPON		ZEALOT	
DENY		DRACHM	
NAUSEA		AEON	
DEBT		PLACEBO	
COURTEOUS		ABSTEMIOUS	
RAREFY		DETENTE	
EQUIVOCAL		IDYLL	
NAIVE		PUERPERAL	
CATACOMB		AVER	
GAOLED		GAUCHE	
THYME		TOPIARY	
HEIR		LEVIATHAN	
RADIX		BEATIFY	
ASSIGNATE		PRELATE	
HIATUS		SIDEREAL	
SUBTLE		DEMESNE	
PROCREATE		SYNCOPE	
GIST		LABILE	
SOUGE		CAMPANILE	

Maggie M. Rayes

Overall Summary Table

(general population norms used)

MEASURE	VALUE	T-SCORE	PERCENTILE	GUIDELINE
# Omissions	3 (0.9%)	52.21	58.74	within average range
# Commissions	10 (27.8%)	48.94	49.78	within average range
Hit RT	349.20	42.28	22.03	within average range
Hit RT Std. Error	6.62	57.97	81.50	within average range
Variability	13.98	64.38	92.45	MILDLY ATYPICAL
Detectability (d')	2.91	55.40	70.52	within average range
Response Style (B)	0.52	48.43	43.76	within average range
Perseverations	1 (0.3%)	54.98	72.50	within average range
Hit RT Block Change	-0.03	36.16	8.34	within average range
Hit SE Block Change	-0.17	27.67	1.66	good performance
Hit RT ISI Change	0.11	69.84	98.13	MARKEDLY ATYPICAL
Hit SE ISI Change	0.21	67.35	95.85	MARKEDLY ATYPICAL

Conversions were made for d' so that high T-scores (i.e., >= 60) indicate poor performance for ALL measures listed in the table.

Conners' Continuous Performance Test (CPT II) for Windows

Maggie M. Rayes

Inattention Summary

(general population norms used)

	VALUE	T-SCORE	PERCENTILE	GUIDELINE
# Omissions	3 (0.9%)	52.21	58.74	OK
# Commissions	10 (27.8%)	48.94	49.78	OK
Hit RT	349.20	42.28	22.03	OK
Hit RT Std. Error	6.62	57.97	81.50	OK
Variability	13.98	64.38	92.45	Inattention
Detectability (d ')	2.91	55.40	70.52	OK
Hit RT ISI Change	0.11	69.84	98.13	Inattention
Hit SE ISI Change	0.21	67.35	95.85	Inattention

Maggie M. Rayes

Impulsivity Summary

(general population norms used)

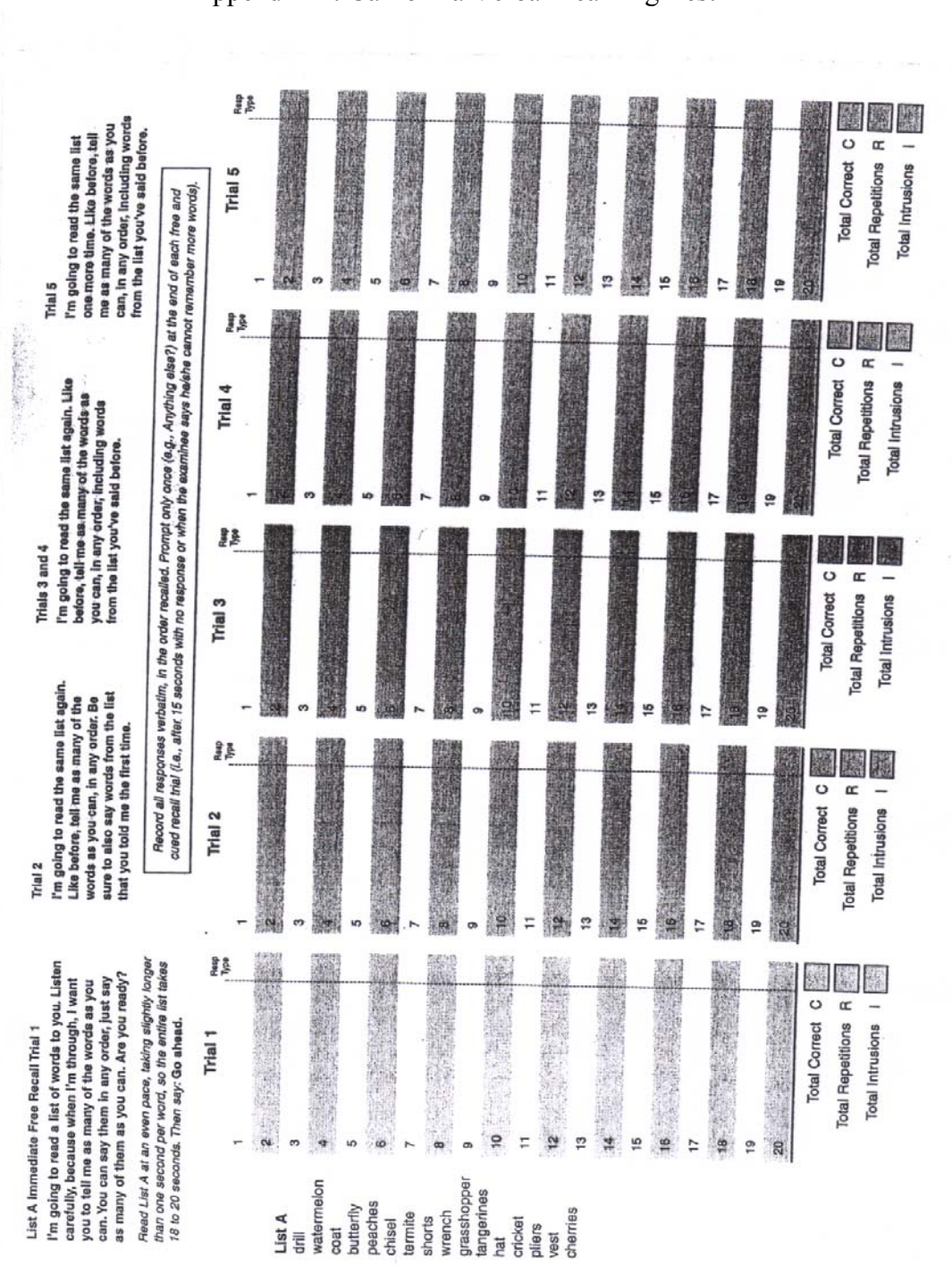
	VALUE	T-SCORE	PERCENTILE	GUIDELINE
# Commissions	10 (27.8%)	48.94	49.78	OK
Hit RT	349.20	42.28	22.03	Impulsive
Perseverations	1 (0.3%)	54.98	72.50	OK

Vigilance Summary

(general population norms used)

	VALUE	T-SCORE	PERCENTILE	GUIDELINE
Hit RT Block Change	-0.03	36.16	8.34	OK
Hit SE Block Change	-0.17	27.67	1.66	OK

Appendix K: California Verbal Learning Test



List B Immediate Free Recall

Now I'm going to read a second list of words to you. When I'm through, I want you to tell me as many words from this second list as you can, in any order. Don't tell me words from the first list, just this second list.

Read List B at an even pace, taking slightly longer than one second per word, so the entire list takes 18 to 20 seconds. Then say: **Go ahead.**

List B
notebook
pineapple
gloves
shampoo
lemon
envelope
perfume
sweater
paper clip
comb
strawberries
jeans
lipstick
typewriter
belt
plums

Trial B	Resp Type
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
Total Correct C	
Total Repetitions R	
Total Intrusions I	

List A Short-Delay Free Recall

Now I want you to tell me all the words you can from the *first* list, the one I read to you several times. Don't tell me words from the second list, just the first list. Go ahead.

Record all responses verbatim, in the order recalled. Prompt only once (e.g., Anything else?) at the end of each free and cued recall trial (i.e., after 15 seconds with no response or when the examinee says he/she cannot remember more words).

List A	Resp Type
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
Total Correct C	
Total Repetitions R	
Total Intrusions I	

List A Short-Delay Cued Recall

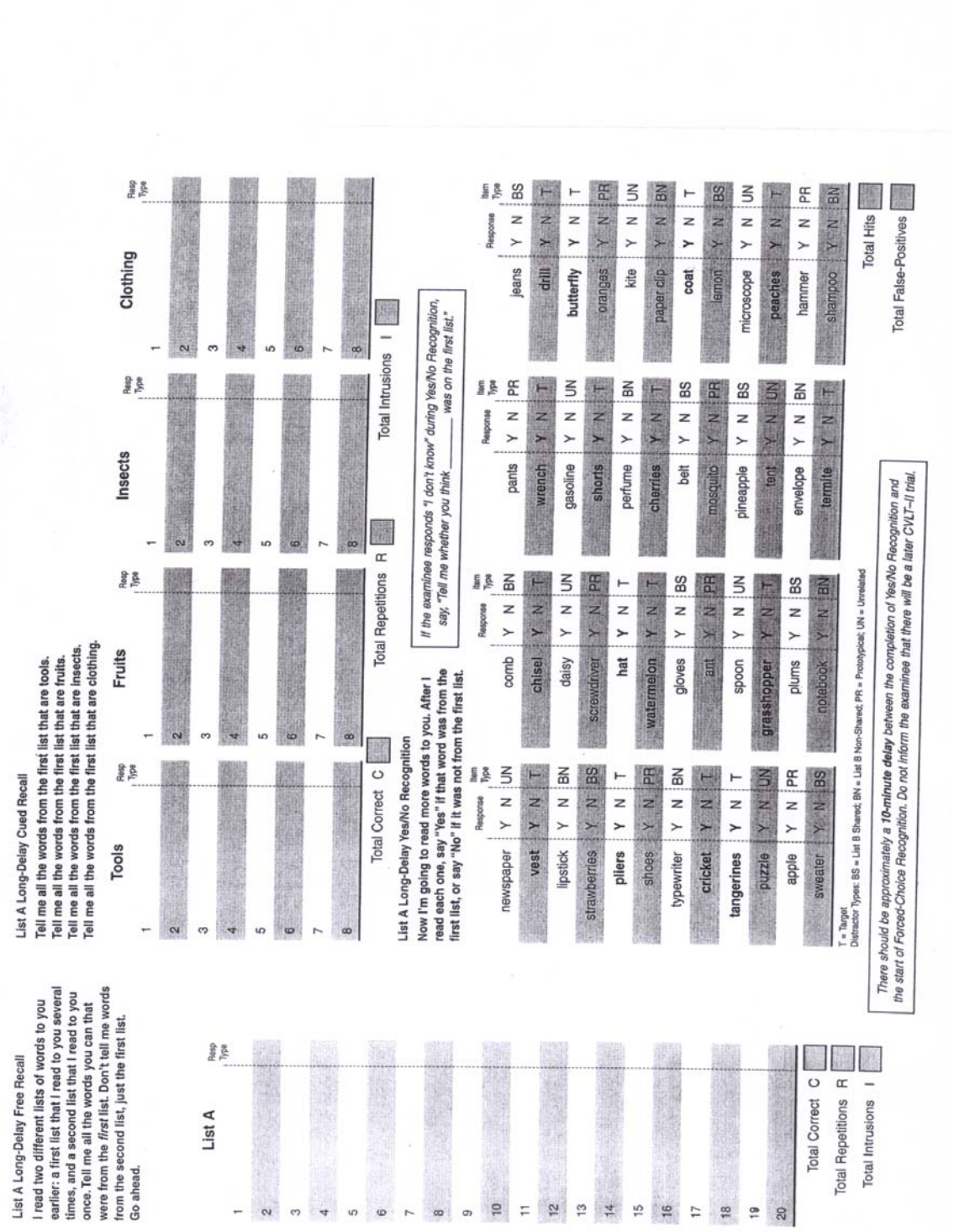
Tell me all the words from the first list that are tools.
Tell me all the words from the first list that are fruits.
Tell me all the words from the first list that are insects.
Tell me all the words from the first list that are clothing.

Tools	Resp Type	Fruits	Resp Type
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	

Insects	Resp Type	Clothing	Resp Type
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	

Total Correct C ☐ Total Repetitions R ☐
Total Intrusions I ☐

There should be approximately a ***20-minute delay*** *between the completion of Short-Delay Cued Recall and the start of Long-Delay Free Recall. Do not inform the examinee that there will be later CVLT–II trials.*



2. Logical Memory I *(continued)*

	Score 0 or 1		
Story A	**Story Unit**	**Thematic Unit**	**Scoring Criteria**
Anna			*Anna* or variant of the name
Thompson			*Thompson* is required
of South			*South* (in any context)
Boston,			*Boston* (in any context)
			indication of a main character who is female
employed			indication that she held a job
as a cook			*cook* or some form of the word is required
in a school			*school* is required
cafeteria,			*cafeteria* is required
			indication that main character is employed or is working
reported			indication that a formal statement was made to someone in authority (in any context)
at the police			*police* (in any context)
station			*station* (in any context) or a word or phrase denoting a police station
that she had been held up			indication that she had been held up (i.e., gunpoint or knife)
on State Street			*State Street* (in any context)
the night before			indication that the hold-up occurred the previous night
and robbed			indication that a robbery took place
of fifty-six dollars.			indication that an amount of money greater than $49 but less than $60 was taken from her
			indication that main character reported that she was robbed
She had four			*four* is required together with an indication that the children were hers
small children,			*children* or a synonym is required
			indication that main character had children
the rent was due,			a phrase indicating that the rent was due
and they had not eaten			indication that her children or the family were without food
for two days.			*two days* is required, or a phrase meaning about two days
			indication that characters were in need or required assistance
The police,			a word or phrase signifying one or more members of the police department (in any context)
touched by the woman's story,			indication that her story evoked sympathy
			indication that the police felt sympathy for the woman
took up a collection			a phrase indicating that money was collected
for her.			indication that the money collected was for her or her children
			indication that the police directly responded to her need

Story A Recall Unit Score Range = 0 to 25 ____ Story A Thematic Unit Score Range = 0 to 7

Story B–1st Recall **2. Logical Memory I** *(continued)*

At 6:00 on Monday evening, Joe Garcia of San Francisco was watching television as he dressed to go out. A weather bulletin interrupted the program to warn that thunderstorms would move into the area within the next two to three hours and remain until morning. The announcer said the storm could bring hail and up to four inches of rain and cause the temperature to drop by fifteen degrees. Joe decided to stay home. He took off his coat and sat down to watch old movies.

	Score 0 or 1		
Story B — 1st Recall	Story Unit	Thematic Unit	Scoring Criteria
At 6:00			*6:00* is required
on Monday			*Monday* is required
evening,			*evening* (in any context)
Joe			*Joe* or variant of the name
Garcia			*Garcia* is required
of San Francisco			*San Francisco* is required
			indication of a main character who is male
was watching television			indication that he was watching/listening to the television
as he dressed			indication that he was getting dressed
to go out.			indication that he was going out
			indication that the character was preparing to leave
A weather bulletin			indication that there was an announcement about weather
interrupted the program			indication of a break in the regularly scheduled program
			indication of a weather announcement
to warn that thunderstorms			indication that there was a warning about a storm
would move into the area			indication that the storm was coming
			indication of a storm moving into the area
within the next 2 to 3 hours			a phrase meaning about 2 or 3 hours
and remain until morning.			indication that the storm would stay until morning
			indication of storm duration
The announcer said			indication that someone was reporting about a storm
the storm could bring hail			indication that hail was possible
and up to 4 inches			*4 inches* is required
of rain			*rain* is required
and cause the temperature to drop			indication that the temperature would drop or decrease
by 15 degrees.			a relative decrease of 15 degrees is required
			indication of storm's activity
Joe decided to stay home.			indication that he decided to stay home
			indication that the character decided to stay in
He took off his coat			indication that he took off outer clothing
and sat down			indication that he was sitting down
to watch old movies.			indication of viewing movies is required
			indication that the character decided to watch a movie or TV

Story B — 1st Recall Unit Score Range = 0 to 25 ☐☐ Story B — 1st Recall Thematic Unit Score Range = 0 to 8

1st Recall Total Score Calculation

☐ + ☐ = ☐ (1st Recall Total Score Range = 0 to 50)

Story A Recall Unit Score Range = 0 to 25 + Story B —1st Recall Unit Score Range = 0 to 25

12. Logical Memory II *(continued)*

Recognition

RECORDING: Circle Y or N.

SCORING RULE: 0–1 pt. for each item

Item	Circle Y or N	Score 0 or 1
Story A		
1. Was the woman's name Diana Thompson?	Y **N**	
2. Was the story setting in South Boston?	**Y** N	
3. Was the woman a cook?	**Y** N	
4. Did she work in a restaurant?	Y **N**	
5. Did she have four children?	**Y** N	
6. Were the children teenagers?	Y **N**	
7. Did the robbery take place on Sixth Street?	Y **N**	
8. Did the woman report being robbed two nights before?	Y **N**	
9. Did she report the robbery at the Police Station?	**Y** N	
10. Was the woman robbed of 75 dollars?	Y **N**	
11. Did the family go without food for four days?	Y **N**	
12. Was the rent due?	**Y** N	
13. Did the police catch the thief?	Y **N**	
14. Did the police feel sorry for the woman?	**Y** N	
15. Did the police take up a collection?	**Y** N	
Story B		
16. Was the man's name Joe Garcia?	**Y** N	
17. Was it Sunday evening?	Y **N**	
18. Was it 6:00?	**Y** N	
19. Was the story setting in Seattle?	Y **N**	
20. Was Joe dressing to go out?	**Y** N	
21. Was Joe watching television?	**Y** N	
22. Was the program interrupted?	**Y** N	
23. Was the storm expected to move into the area on Tuesday?	Y **N**	
24. Was the storm expected to stay in the area through the night?	**Y** N	
25. Was the temperature predicted to drop 30 degrees?	Y **N**	
26. Did the announcer predict 10 inches of rain?	Y **N**	
27. Did the announcer warn of possible flooding?	Y **N**	
28. Did the announcer warn that it could hail?	**Y** N	
29. Did Joe decide to stay home?	**Y** N	
30. Did Joe sit down to watch a sports program?	Y **N**	

Recognition Total Score
Range = 0 to 30

Percent Retention Calculation

[ ] ÷ [ ] x 100 = [ ] Percent Retention Range = 0 to 100%

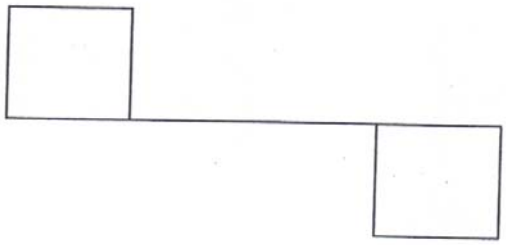
Logical Memory II Recall Total Score Range = 0 to 50

Logical Memory I Story A Recall Unit Score + Story B–2nd Recall Unit Score Range = 0 to 50

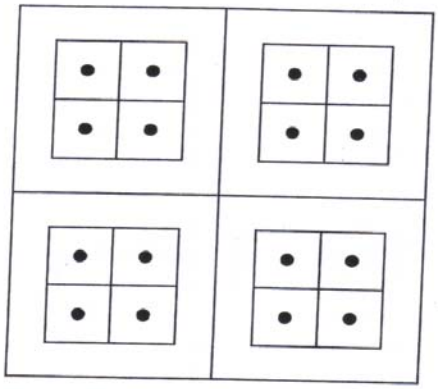
Appendix M: Visual Reproduction

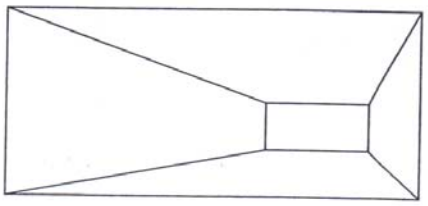
Place page 2 of the Response Booklet in front of the examinee so that the words *Design A* face the examinee. Say **I am going to show you some designs, one page at a time. You will have just 10 seconds to look at each design. Then I will cover it and ask you to draw the design from memory here on this sheet** (point to the Response Booklet). **Don't begin to draw until I tell you to. Are you ready?**

Turn the page and expose Design A.



Appendix M: Visual Reproduction (Continued)





Appendix N: Digit Symbol

DIGIT SYMBOL - Coding

* 120"

1	2	3	4	5	6	7	8	9
—	⊥	⊐	L	⊔	○	∧	×	=

Sample Items

2	1	3	7	2	4	8	2	1	3	2	1	4	2	3	5	2	3	1	4

5	6	3	1	4	1	5	4	2	7	6	3	5	7	2	8	5	4	6	3

7	2	8	1	9	5	8	4	7	3	6	2	5	1	9	2	8	3	7	4

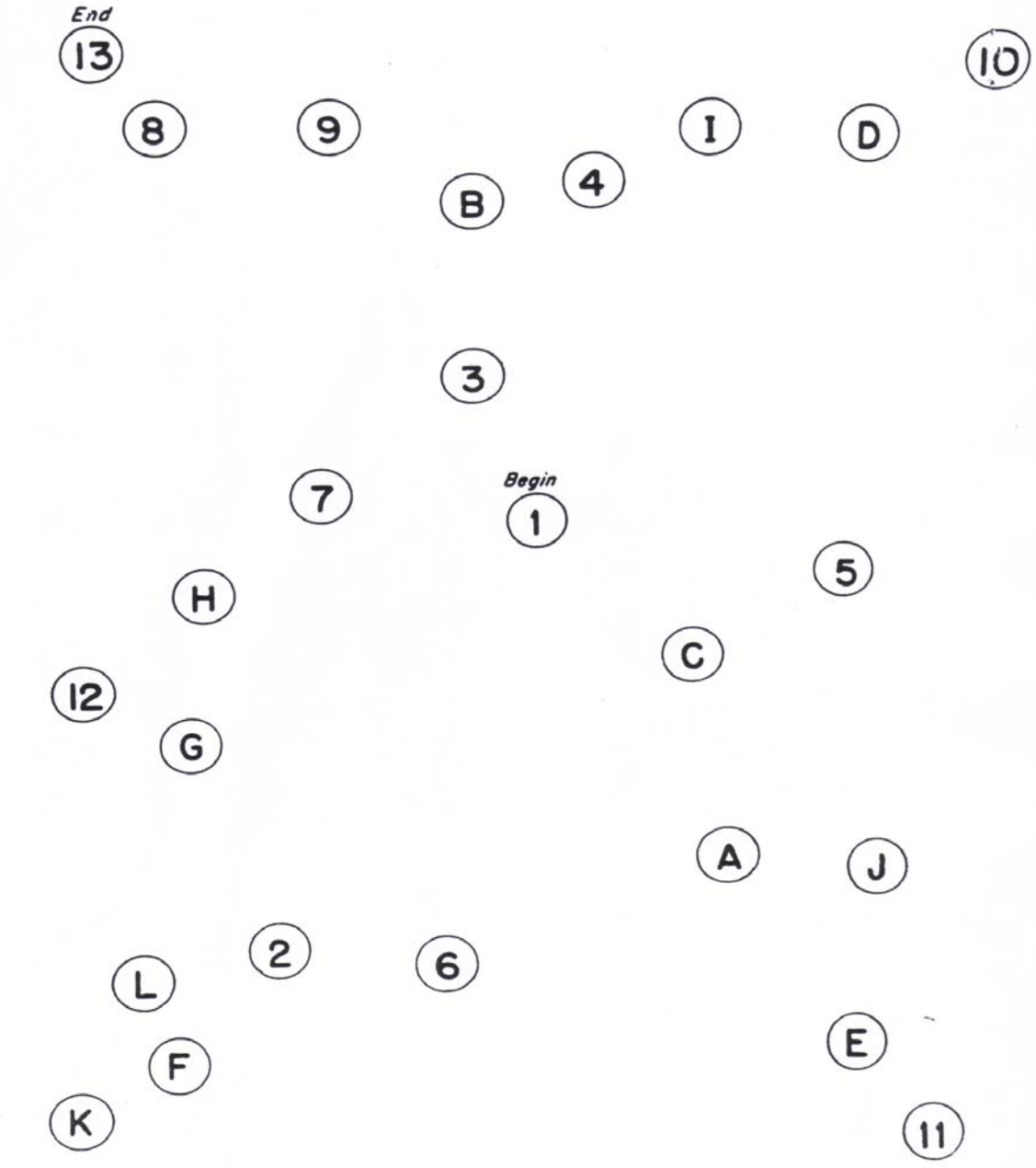
6	5	9	4	8	3	7	2	6	1	5	4	6	3	7	9	2	8	1	7

9	4	6	8	5	9	7	1	8	5	2	9	4	8	6	3	7	9	8	6

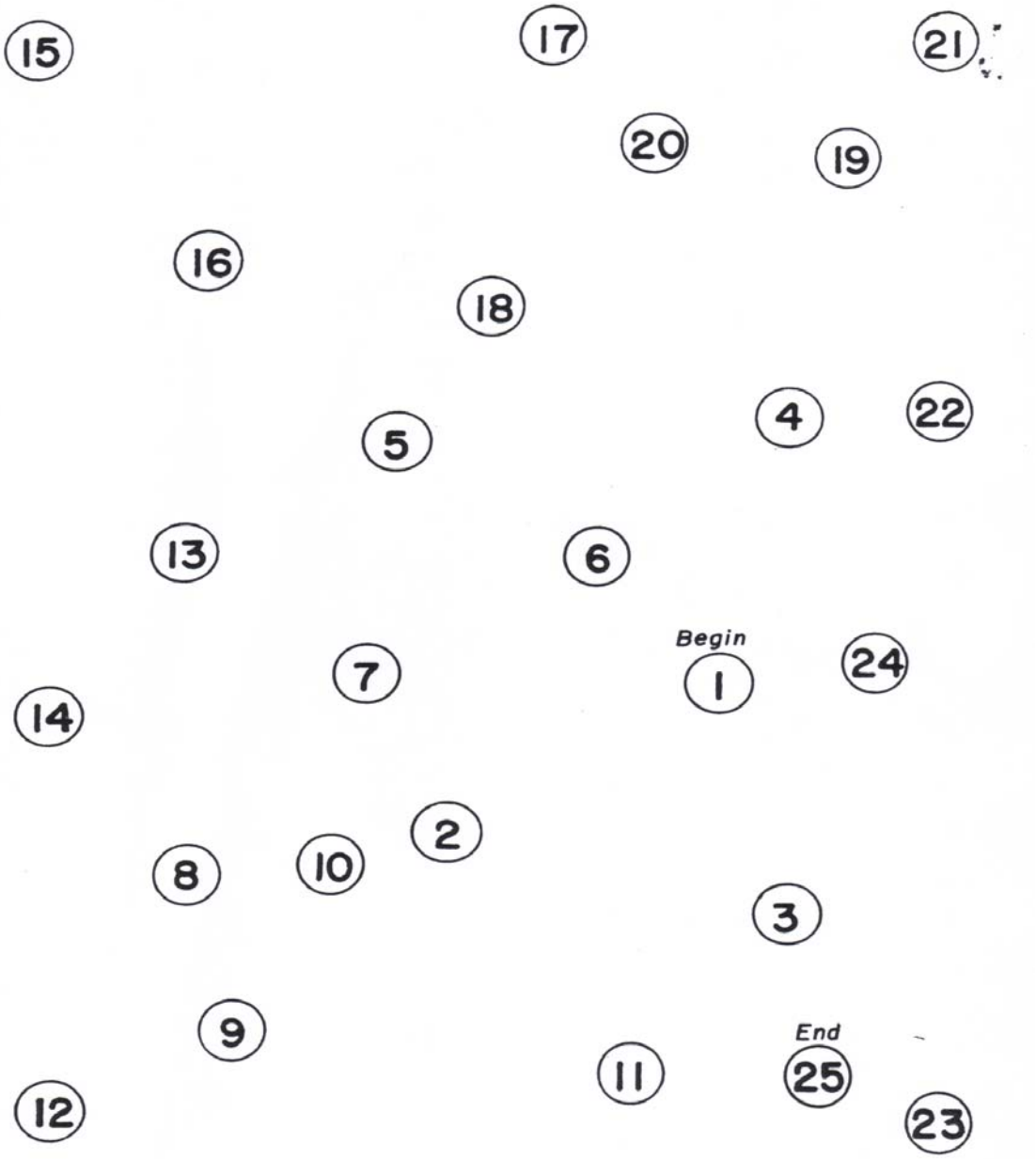
2	7	3	6	5	1	9	8	4	5	7	3	1	4	8	7	9	1	4	5

7	1	8	2	9	3	6	7	2	8	5	2	3	1	4	8	4	2	7	6

Appendix O: Trail Making Test A



Appendix P: Trail Making Test B



Appendix Q: Controlled Oral Word Association

CONTROLLED ORAL WORD ASSOCIATION - COWA

Instructions: " I will say a letter of the alphabet. Then I want you to tell me as many words that begin with that letter as quickly as you can. For instance, if I say "B", you might say 'bad', 'battle', 'bed'...I do not want you to use words that are proper names such as 'Boston', 'Barbara', or 'Brillo'. Also, do not use the same word again with a different ending such as 'bat' and 'batting'. Any questions? Your first letter is..." (Proceed with one minute trials. Prompt and encourage as appropriate.)

	C	F	L
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			

TOTAL = ____ CORRECTION = ____ ADJUSTED TOTAL = ____

Form C-W Responses – Color-Word Task

1 RED_____	29 BLUE_____	57 BLUE_____	85 TAN_____
2 BLUE_____	30 TAN_____	58 TAN_____	86 RED_____
3 GREEN_____	31 GREEN_____	59 RED_____	87 GREEN_____
4 BLUE_____	32 RED_____	60 GREEN_____	88 BLUE_____
5 RED_____	33 BLUE_____	61 TAN_____	89 TAN_____
6 TAN_____	34 GREEN_____	62 RED_____	90 GREEN_____
7 BLUE_____	35 BLUE_____	63 GREEN_____	91 RED_____
8 RED_____	36 GREEN_____	64 BLUE_____	92 TAN_____
9 TAN_____	37 RED_____	65 GREEN_____	93 BLUE_____
10 GREEN_____	38 TAN_____	66 TAN_____	94 GREEN_____
11 BLUE_____	39 BLUE_____	67 BLUE_____	95 RED_____
12 RED_____	40 RED_____	68 GREEN_____	96 TAN_____
13 TAN_____	41 BLUE_____	69 RED_____	97 RED_____
14 BLUE_____	42 TAN_____	70 BLUE_____	98 GREEN_____
15 GREEN_____	43 RED_____	71 RED_____	99 RED_____
16 RED_____	44 TAN_____	72 GREEN_____	100 BLUE_____
17 TAN_____	45 BLUE_____	73 BLUE_____	101 RED_____
18 GREEN_____	46 RED_____	74 TAN_____	102 BLUE_____
19 BLUE_____	47 GREEN_____	75 GREEN_____	103 TAN_____
20 RED_____	48 BLUE_____	76 BLUE_____	104 GREEN_____
21 TAN_____	49 TAN_____	77 RED_____	105 RED_____
22 GREEN_____	50 GREEN_____	78 TAN_____	106 TAN_____
23 BLUE_____	51 RED_____	79 GREEN_____	107 BLUE_____
24 GREEN_____	52 TAN_____	80 RED_____	108 TAN_____
25 TAN_____	53 GREEN_____	81 TAN_____	109 RED_____
26 BLUE_____	54 TAN_____	82 BLUE_____	110 BLUE_____
27 TAN_____	55 BLUE_____	83 GREEN_____	111 GREEN_____
28 RED_____	56 RED_____	84 BLUE_____	112 TAN_____

Appendix S: Grooved Pegboard

Grooved Pegboard

"This is a pegboard test and these are the pegs."
(Point out each, then pick up one of the pegs and continue.)

"All the pegs are the same. They have a groove, that is, a round side and a square side and so do the holes in the boards. What you must do is match the groove of the peg with the groove of the board and put the pegs into the holes like this."
(Demonstrate by filling the top row. Remove the pegs and put them back in the tray.)

Right Hand Trial: Demonstrate that the pegs are places from left to right.
Left Hand Trial: Demonstrate that the pegs are places from right to left.

"You will try this test with each hand, but we will begin with your (dominant) hand. When I say 'go', begin here and put the pegs into the board as fast as you can using only your (dominant) hand. Fill the top row completely from this side. Do not skip any. Fill each row the same way you filled the previous row. Any questions? Ready, as fast a you can, Go."

Repeat with non-dominant hand.

Discontinue: If it takes longer than 60 seconds on first two tows or if it takes longer than 5 minutes for the entire board.

Grooved Pegs	Time	Drops	T-score	or	Z-score
Right Hand	_____ secs				
Left hand	_____ secs				