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Expanding the Ecological Validity of WAIS-IV and WMS-IV With the Texas Functional Living Scale

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Abstract

Assessment of functional status is an important aspect of clinical evaluation. As part of the standardization of the Wechsler Adult Intelligence Scale–Fourth Edition (WAIS-IV) and Wechsler Memory Scale–Fourth Edition (WMS-IV), participants completed the Texas Functional Living Scale (TFLS), a measure of Instrumental Activities of Daily Living. The relationships between TFLS and WAIS-IV and WMS-IV were examined in both normally developing and clinical samples. In general, the highest correlations were between TFLS and measures of general cognitive ability (WAIS-IV FSIQ [Full Scale IQ] and GAI [General Ability Index]) and working memory (WAIS-IV WMI [Working Memory Index] and WMS-IV VWMI [Visual Working Memory Index]). Across the clinical populations, working memory subtests were generally strongly related to TFLS performance, although this relationship was more consistent with WAIS-IV than WMS-IV. Contrast scaled scores are presented for the TFLS based on WAIS-IV or WMS-IV performance. These scores allow the evaluation of functional abilities within the context of cognitive and memory ability, enhancing and expanding the utility of the WAIS-IV and WMS-IV.

Keywords

IADL; WAIS-IV; WMS-IV; TFLS; functional assessment

The Wechsler Adult Intelligence Scale (WAIS) and Wechsler Memory Scale (WMS) are two of the most widely used assessments of cognitive ability and memory functioning. They are administered to both normally developing and aging individuals as well as to patients with a variety of clinical diagnoses, although the functional implications of results vary

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Standardization data from the Wechsler Adult Intelligence Scale–Fourth Edition (WAIS-IV). Copyright © 2008 NCS Pearson, Inc. Used with permission. All rights reserved. Standardization data from the Wechsler Memory Scale–Fourth Edition (WMS-IV). Copyright © 2009 NCS Pearson, Inc. Used with permission. All rights reserved. Standardization data from the Texas Functional Living Scale (TFLS). Copyright © 2009 NCS Pearson, Inc. Used with permission. All rights reserved.

Declaration of Conflicting Interests

The author(s) declared a potential conflict of interest (e.g. a financial relationship with the commercial organizations or products discussed in this article) as follows: Dr. Drozdick is a Research Director with Pearson, the publisher of the WAIS-IV, WMS-IV, and TFLS. Dr. Cullum is an author on the TFLS.

based on the clinical referral question or purpose of the evaluation. The recent publication of the WAIS-IV (Wechsler, 2008) and WMS-IV (Wechsler, 2009) offered the opportunity to expand the utility of these instruments by co-collecting them with a direct measure of functional status.

Functional ability refers to the skills required to live independently, such as physical self-care, management of finances and medications, and completion of other everyday tasks. Impairment in functional abilities is a requirement for several diagnostic categories in the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (*DSM-IV*), including dementia, and adequate functional skills are required to remain independent in the community. Functional abilities are typically divided into basic activities of daily living (ADLs) and instrumental activities of daily living (IADLs). Basic ADLs refer to rudimentary self-care tasks, such as dressing, feeding, toileting, and simple communication. IADLs are more complex and require greater cognitive skill and include tasks such as cooking, shopping, transportation, and managing money or medications.

IADLs are further divided into physical IADLs that require more physical strength and less cognitive skill, such as shopping, and more cognitively oriented IADLs that require a higher degree of mental ability, such as managing finances (Ng, Niti, Chiam, & Kua, 2006; Patrick, Johnson, Goins, & Brown, 2004). Increased focus has been placed on IADL assessment as deficits in IADL ability are some of the earliest abnormalities observed in dementia, and impairment in IADLs has been found to predict later diagnosis of dementia (Pérès et al., 2008). Moreover, functional impairment or decline is frequently identified as a risk factor for institutionalization (Bharucha, Pandav, Shen, Dodge, & Ganguli, 2004), progression from mild cognitive impairment (MCI) to dementia (Artero et al., 2008; Rozzini et al., 2007) and mortality (Bo et al., 2003; Ponzetto et al., 2003). The ability of neuropsychological tests to predict everyday functional abilities and to demonstrate ecological validity has also become an important topic in the field (Chaytor & Schmitter-Edgecombe, 2003; Rabin, Burton, & Barr, 2007; Sbordone & Long, 1996) and is an issue with which clinicians struggle on a regular basis.

Research consistently supports a relationship between functional status and general cognitive ability (Acker & Davis, 1989; Bertrand, Willis, & Sayer, 2001; Burton, Strauss, Hultsch, & Hunter, 2006; Cahn-Weiner, Malloy, Boyle, Marran, & Salloway, 2000; Farmer & Eakman, 1995), with adequate cognitive ability required to perform IADL tasks. For example, Ford et al. (2008) found a moderate correlation ($r = .43$) between WISC-IV and WAIS-III Full Scale IQ (FSIQ) scores and Vineland Adaptive Behavior Scales composite score in individuals diagnosed with learning disability. Overall cognitive status as assessed by a variety of instruments strongly predicts functional ability (Burton et al., 2006). The Mini-Mental State Examination (MMSE; Folstein, Folstein & McHugh, 1975, 2001), a popular brief cognitive screening measure, has been extensively studied in relation to measures of functional ability in a variety of clinical populations, showing at least moderate associations (e.g., Cullum et al., 2001; Ng et al., 2006; Weiner, Fields, Hynan, & Cullum, 2008).

Cognitive impairment, as measured by a variety of cognitive, neuropsychological, and intellectual assessment instruments, has also been demonstrated to be a good predictor of functional decline (Bennett et al., 2002). Sauvaget, Yamanda, Fujiwara, Sasaki, and Mimori (2002) reviewed longitudinal studies on cognitive impairment and functional disability, and found that cognitive impairment significantly predicted subsequent ADL and IADL disability. Farmer and Eakman (1995) found performance on different individual IADL tasks, such as financial management or housework, was related to different cognitive abilities. Evaluation of functional status using neuropsychological instruments has further elucidated the relationship between adaptive and cognitive functioning (see Burton et al., 2006; Cahn-Weiner et al., 2000). Not unexpectedly, measures of executive functioning appear to be particularly useful in predicting functional impairment (Bertrand et al., 2001; Boyle, Paul, Moser, & Cohen, 2004; Cahn-Weiner et al., 2000; Yochim, Lequerica, MacNeill, & Lichtenberg, 2008). Moreover, categorization and deductive reasoning (both aspects of executive functioning) are related to and predictive of IADL performance (Goverover, 2004; Goverover & Hinojosa, 2002).

Memory ability also relates to IADL status (Farmer & Eakman, 1995; Soderback, 1988) and changes in basic ADLs (Drachman, O'Donnell, Lew, & Swearer, 1990, cited by Jefferson et al., 2006). Farmer and Eakman (1995) found memory functioning positively correlated with global ratings of competency to live independently and engage in community activities. Global memory ability also predicts functional independence in community dwelling older adults (Burton et al., 2006). Schmitter-Edgecombe, Woo, and Greeley (2009) examined various memory tasks in relation to functional abilities and found that difficulties in different types of memory predicted different IADL limitations. For example, prospective memory and temporal-order memory predicted medication use and household activities, while source memory predicted social functioning. However, similar to findings with other aspects of cognitive ability, executive functioning appears to partially mediate the relation between memory and functional status (Cahn-Weiner et al., 2000; Royall, Palmer, Chiodo, & Polk, 2005; Plehn, Marcopulos, & McLain, 2004).

During the normative data collection for the WAIS-IV and WMS-IV, participants also completed the most current version of the Texas Functional Living Scale (TFLS; Cullum, Weiner, & Saine, 2009), a cognitively oriented, direct measure of functional ability. Direct assessment of functional abilities enhances the assessment of cognitive and memory functioning by providing information on the deficits in daily functioning frequently observed in individuals with a variety of cognitive disorders. Previous research on earlier versions of the TFLS demonstrated moderate to high correlations with the MMSE (.58 in normally aging older adults and .89 in older adults diagnosed with Alzheimer disease, Cullum et al., 2001; 0.88 in dementia patients, Weiner, Gehrmann, Hynan, Saine, & Cullum, 2006), sensitivity to drug effects in Alzheimer disease (Cullum et al., 2001; Saine et al., 2002), differentiation between individuals with MCI and normal controls (Binegar, Hynan, Lacritz, Weiner, & Cullum, 2009), differentiation between demented individuals requiring various levels of care (Weiner et al., 2007), and sensitivity to changes in functional ability over time in Alzheimer disease (Weiner et al., 2008).

The current study describes the relationships between cognitive and memory functioning as assessed by the WAIS-IV and WMS-IV and functional ability as measured by the TFLS, a direct measure of IADLs. In addition, the derivation and use of contrast scaled scores across the three instruments is described. These scores allow the evaluation of functional abilities within the context of cognitive and memory ability, enhancing and expanding the utility of the WAIS-IV and WMS-IV.

Method

Participants

As part of the WAIS-IV standardization, the TFLS and the WAIS-IV were administered to 1,200 normally developing and aging examinees ranging in age from 16 to 90 years with a mean testing interval of 5 days. The TFLS and the WMS-IV were administered to 1,210 normally developing and aging examinees over the same age range. The samples are representative of the U.S population of adults and stratified according to age, gender, race/ethnicity, education level, and geographic region. The samples are described in detail elsewhere (Cullum et al., 2009).

In addition, the TFLS and the WMS-IV were administered to 212 examinees, aged 16 to 90 years, diagnosed with a variety of clinical disorders, including Alzheimer disease ($n = 35$), Mild Intellectual Disability ($n = 32$), Moderate Intellectual Disability ($n = 30$), Major Depressive Disorder ($n = 44$), Traumatic Brain Injury ($n = 29$), Schizophrenia ($n = 22$), and Autism ($n = 20$). Detailed demographic information on this group is provided elsewhere (Cullum et al., 2009).

Materials and Procedure

Texas Functional Living Scale—The TFLS (Cullum et al., 2009) contains 24 performance-based items assessing various direct or depicted aspects of IADLs. Representative tasks include using an analog clock, calendar, check book, and phone, and setting a microwave. Other tasks include calculations involving time and money and recall of information within a 15-minute span. Four subscale scores are derived (a) Time, (b) Money and Calculation, (c) Communication, and (d) Memory, in addition to a total score. Cumulative percentages are provided for the subscale scores and a normed T -score is provided for the TFLS Total Score.

Wechsler Adult Intelligence Scale—Fourth Edition—The WAIS-IV is an individually administered assessment designed to measure the cognitive ability of adolescents and adults. It is comprised of 15 subtests, 10 of which are “core” and contribute to six composite scores: Verbal Comprehension Index (VCI), Perceptual Reasoning Index (PRI), Working Memory Index (WMI), Processing Speed Index (PSI), General Ability Index (GAI), and FSIQ. Scaled scores are derived for each subtest and standard scores are derived for each composite score.

Wechsler Memory Scale—Fourth Edition—The WMS-IV is an individually administered battery designed to measure various memory and working memory abilities in

adolescents and adults. It is comprised of seven subtests, six of which contribute to the five primary index scores: Auditory Memory Index (AMI), Visual Memory Index (VMI), Visual Working Memory Index (VWMI), Immediate Memory Index (IMI), and Delayed Memory Index (DMI). In addition, an optional cognitive screener, the Brief Cognitive Status Exam (BCSE), classifies individuals according to one of five cognitive ability levels.

Statistical Analysis

Pearson correlation coefficients were derived to examine the relationship between the TFLS and the WAIS-IV and WMS-IV. The score range obtained in the normative sample was restricted due to the tendency of normally developing and aging individuals to obtain relatively high scores. The correlations were then corrected for the score range restriction within the TFLS sample (Guilford & Fruchter, 1978). The correlations obtained in the clinical samples were not corrected for range restriction.

For this investigation, contrast scaled scores were derived between the TFLS and the GAI, VCI, and PRI scores from the WAIS-IV and the DMI score from the WMS-IV. The contrast scaled score approach was introduced by Holdnack (2007) and incorporated into the WMS-IV. This method yields normative data on the dependent measure (i.e., the TFLS score), adjusting for the ability of the examinee on the control variable (i.e., the WAIS-IV or WMS-IV index scores). For example, the GAI versus TFLS contrast scaled score derives a new TFLS score based on the examinee's GAI, which compares the individual to others with similar GAI scores. The contrast score enhances the interpretation of TFLS scores in relation to cognitive ability by answering the clinical question, *Are functional abilities unexpectedly low given the examinee's general cognitive ability?* Alternately, when assessing individuals with mild disability who have participated in training and support programs, *Are functional abilities unexpectedly high given the examinee's general cognitive ability?* Contrast scores are scaled scores and follow the same metric of a mean of 10 and a standard deviation of 3 as with standard scaled scores.

The new method yields normative data on the dependent measure, controlling for the ability of the examinee on the control variable. First, the distribution of TFLS Total scores was obtained for each score range on the control variable (e.g., GAI). Then, norming methods were applied independently to each control variable range. The resulting score is the scaled score for the dependent measure, adjusted for the control variable. In the GAI versus TFLS Contrast Scaled Score example, this would be the scaled score on TFLS, adjusting for the GAI score. The distribution of scores for the dependent measure may have different variances along the range of the control variable ability groups. However, the norming process takes this into account and yields a score that is directly comparable across ability levels. Scores in the middle of the scaled score distribution (e.g., 8–12) indicate performance on the control and dependent measures is similar.

The reliability of the contrast scaled scores is difficult to determine due to the methodology used to derive them. The reliability of difference scores tends to be lower than the reliability of the individual contributing scores and is heavily influenced by the correlation between variables. An average reliability was estimated using the reliability of difference scores methodology and ranged from .58 to .64 across scores.

Results

TFLS and WAIS-IV

TFLS mean scores for the clinical samples are provided in the TFLS manual (Cullum et al., 2009). Table 1 provides the correlations between the TFLS and the WAIS-IV subtest and composite scores. In the normative sample, the correlations were small to moderate, with WAIS-IV composite scores being slightly higher than the correlations with subtests. The highest subtest-level correlation was observed between the TFLS and Arithmetic ($r = .32$), a working memory subtest. At the index level, the PRI and WMI produced the highest correlations with TFLS ($r = .35$ for both), outside the overall cognitive ability scores. The low to moderate correlations observed in this analysis were likely influenced by the restricted range of TFLS scores observed in normally developing and aging adults and adolescents, since a majority of such individuals obtain perfect or nearly perfect scores on TFLS.

To gain a greater understanding of the relationship between cognitive functioning and performance on the TFLS, TFLS and WAIS-IV scores were also examined in the clinical sample. It was expected that the correlations would be higher in this sample than those seen in the normally developing and aging group because of greater variability in cognitive ability and adaptive functioning. The WAIS-IV and TFLS were administered from 0 to 39 days apart, with a mean testing interval of 5 days. Table 1 presents the correlations between the TFLS *T*-score and the WAIS-IV subtest and composite scores in the individual and overall clinical samples.

As expected, the correlations were higher in the overall clinical sample than in the normative group. Correlations between the TFLS *T*-score and the WAIS-IV subtest scores were moderate to high (range = .63 to .80). Letter–Number Sequencing, a working memory subtest, produced the highest correlation overall with TFLS ($r = .80$). In general, the highest correlations for each clinical group were with working memory subtests. As expected, the Major Depressive Disorder group produced low correlations with TFLS, more closely resembling the normative sample than the other clinical groups. The composite score correlations were highest for the VCI and WMI ($r = .74$ for both), outside of the global cognitive scores. These results indicate a moderate to large relationship between cognitive ability and IADLs.

Given the moderate relation between the WAIS-IV index scores and the TFLS, contrast scores were developed for the TFLS and GAI, VCI, and PRI. These are presented in Tables 2, 3, and 4, respectively. To obtain contrast scaled scores, the clinician must first derive the TFLS Total Score and the appropriate index score for the contrast scaled score of interest (e.g., GAI). For example, to obtain the WAIS-IV PRI versus TFLS Total Contrast Scaled Score, the PRI and the TFLS Total Score must first be derived. To use the contrast scaled score tables, one would need to find the range in the top row that includes the examinee's obtained score for the variable listed at the top of the table (i.e., GAI, PRI, VCI, or DMI). In the column under the selected range, find the range that includes the examinee's obtained score for the TFLS Total Score. Read across from this score to the extreme right Contrast Scaled Score column to obtain the contrast scaled score. For example, in Table 2, if an

examinee obtained a GAI score of 123 and a TFLS Total Score of 55, the GAI versus TFLS Total Contrast Scaled Score is 10.

TFLS and WMS-IV

Table 5 describes the correlations between the TFLS and the WMS-IV subtest and index scores. Overall, the correlations were small to moderate (range = .20 to .40), with the index score correlations slightly higher than those observed at the subtest level, similar to those between the TFLS and WAIS-IV. Within the normative group, the highest subtest-level correlation was observed between TFLS and Spatial Addition ($r = .35$), a Visual Working Memory subtest. At the index-level, the VWMI produced the highest correlation with TFLS ($r = .40$). Once again, the low to moderate correlations are likely influenced by the smaller range of TFLS scores observed in normally developing and aging adults and adolescents.

To further examine the relationship between memory ability and performance on the TFLS, scores from the TFLS and the WMS-IV were also examined within the clinical sample. It was expected that the correlations would be higher in the clinical sample than those seen in the normally developing and aging group because of greater variability in memory ability and adaptive functioning. The WMS-IV and TFLS were administered on the same day. Table 5 presents the correlations between the TFLS T -score and the WMS-IV subtest and index scores in the individual and overall clinical samples.

As expected, the correlations were higher in the overall clinical sample than in the normative sample. Overall the correlations between the TFLS T -score and the WMS-IV subtest scores were moderate to high, ranging from .52 to .71. Symbol Span, a visual working memory subtest, produced the highest correlation overall with the TFLS ($r = .71$). As observed with the correlations between the TFLS and WAIS-IV, the Major Depressive Disorder group produced low correlations, more closely resembling the normally developing and aging group than the other clinical groups, which is not unexpected given the general cognitive normality of this sample. The overall index score correlations were highest for the VWMI ($r = .80$). These results indicate that memory functioning is moderately related to IADL as measured by the TFLS in clinical populations, which has been reported in other investigations (e.g., Farmer & Eakman, 1995; Schmitter-Edgecombe et al., 2009; Soderback, 1988).

One subtest on the WMS-IV, the BCSE, was not normed with a scaled score. Instead, the BCSE total raw score, along with the examinee's age and education were used to classify performance into one of five categories: *average*, *low average*, *borderline*, *low*, and *very low*, representing the following percentile ranges: 25%, 10% to 24%, 5% to 9%, 2% to 4%, and < 2%. The TFLS and BCSE were administered to 798 normally developing and aging examinees, aged 16 to 90 years on the same day. Table 6 presents the means, standard deviations, and correlation of the BCSE Classification Level and the TFLS Total Score. The observed correlation was low ($r = .21$), likely because of the low variability of performance on these measures in the normally developing and aging groups.

Given the moderate correlations between the WMS-IV index scores and the TFLS, contrast scores were developed for the TFLS and the WMS-IV DMI. As a result of the different

WMS-IV subtests included in the adult and older adult populations, two contrast scores were developed, one for the Adult battery and one for the Older Adult battery. These are presented in Tables 7 and 8, respectively.

Discussion

The relationship between cognitive and memory test performance and everyday functional ability remains an important topic of research and clinical interest. The recent publication of the WAIS-IV and WMS-IV presented a unique opportunity to co-norm an instrument assessing functional status (i.e., the TFLS) in a large stratified normally developing and aging population. In addition, a large mixed group of individuals with clinical diagnoses was collected, allowing the examination of the relationship between the instruments in a variety of populations.

In general, the highest correlations were between TFLS and measures of general cognitive ability (WAIS-IV FSIQ and GAI) and measures of working memory (WAIS-IV WMI and WMS-IV VWMI). This reinforces the research demonstrating the role of this aspect of executive function skills in adaptive functioning (Cahn-Weiner et al., 2000). Across the clinical populations, working memory subtests were generally moderately related to TFLS performance, although this relationship was more consistently observed with the WAIS-IV than the WMS-IV. Several WMS-IV scores showed significant correlations with the TFLS, suggesting that episodic memory skills also contribute to performance on the TFLS and are no doubt related to everyday functioning as well. This is consistent with previous investigations showing that verbal memory was among the most highly predictive abilities of everyday functioning (Puig et al., 2008). Overall, performance on the TFLS was moderately to strongly related to performance on the WAIS-IV and WMS-IV.

As the TFLS was originally designed as a brief IADL measure to be used in patients with dementia, it was expected that correlations with WAIS-IV and WMS-IV scores would generally be higher within the clinical samples and particularly among those groups demonstrating greater cognitive impairment. As noted above, the TFLS includes many basic, cognitively oriented IADL-type tasks that tend to be easy for non- or lesser-impaired populations to complete. Given the wider range of scores among more impaired clinical groups, the stronger relationships in these samples was not surprising.

The contrast scaled scores derived for this investigation provide a unique indicator of overall functioning. As developed by Holdnack (2007), contrast scores are interpreted in the same way as traditional scaled scores, but the meaning and thus the interpretation of the score is different from the standard TFLS *T*-score. The TFLS *T*-score describes the overall ability of the examinee in relation to the normative sample and is interpreted as the examinee's functional ability. For example, a TFLS *T*-score of 42 indicates a low average performance by an examinee. However, this score may mean something different in examinees with different cognitive ability. For an individual with a GAI of 115, a TFLS *T*-score of 42 would result in a GAI versus TFLS contrast scaled score of 6. Thus, the examinee's performance would be interpreted as a low average performance in relation to individuals with the same cognitive ability. In this case, the two scores result in the same interpretation; however,

consider examinees at the tail ends of the cognitive ability distribution who obtain the same TFLS *T*-score of 42, interpreted as low average performance. For a high-ability examinee with a GAI of 125, a *T*-score of 42 would result in a contrast scaled score of 5, indicating borderline performance on the TFLS, at best. In this situation, the examinee is performing at a much lower level than same-cognitive ability peers, and further evaluation would likely be warranted. Alternately, a low cognitive ability individual with a GAI of 75 and a TFLS *T*-score of 42 would obtain a contrast scale score of 9, reflecting an average performance given his/her cognitive ability. In this situation, the examinee is performing as expected given his/her overall cognitive ability level. It is important to interpret these scores within the context of the other scores, as interpreting a contrast score as indicating an individual is competent to live independently when the normed *T*-score is impaired would not be appropriate. The contrast score suggests that the examinee is doing better than same-ability peers, but he or she may still be impaired.

Assessment of IADL and everyday functional skills represents an important area for the field of neuropsychology, as issues of ecological validity and the quest for everyday correlates of specific test scores continues. IADL tasks such as those tapped by the TFLS may map onto so-called “real-world” behaviors better among patients with more serious cognitive disability than traditional neurocognitive measures as they more closely mimic some of the more basic cognitive IADL tasks. Translating the concept of “impairment” on many traditional neuropsychological tests can be a challenge for patients and family members, whereas most IADL items from the TFLS have clear face validity. As such, examiners may be able to better describe TFLS tasks to patients and family members in order to demonstrate the nature and extent of an individual’s cognitive strengths and weaknesses and to aid in their appreciation of the underlying cognitive disabilities. This initial examination of the relationships between the TFLS and WAIS-IV and WMS-IV provides additional support for the TFLS as a cognitively oriented measure of IADLs. Whereas these results suggest a variety of significant relationships between the TFLS and these popular measures of cognitive and memory function, the use of the contrast scaled scores allows the examiner to adjust the TFLS score for the examinee’s cognitive or memory ability, allowing a more accurate assessment of adaptive functioning and adding additional utility to the assessment.

The TFLS is a new instrument, with strong clinical utility and psychometric properties. However, further research is needed on its utility in a variety of clinical populations, as some of the clinical groups included in the WAIS-IV/WMS-IV samples are relatively small. Whereas the TFLS has shown sensitivity to dementia, effect of cognitive enhancers, and need for different levels of dementia care (Cullum et al., 2009), there is more to be learned about the TFLS in other clinical and research settings. For example, investigating TFLS and neuropsychological performance in relation to patients’ actual functioning during everyday activities (e.g., shopping) would be of interest, although such research, particularly outside the laboratory, poses many methodological challenges. The data from this investigation demonstrate moderate to strong relationships between the TFLS and cognitive and memory functioning that can be further examined through the use of the contrast scores. However, the contrast score methodology is new and the strengths and weaknesses of this approach

have not been fully examined. It is hoped that further evaluation will validate and support their use as an additional interpretive tool.

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Table 1

Correlations of WAIS-IV Subtest and Index Scores With TFLS, by Group

WAIS-IV Subtest	Overall Normative Sample (<i>n</i> = 1,200) ^a	Alzheimer Disease (<i>n</i> = 35)	Autism (<i>n</i> = 20)	Major Depressive Disorder (<i>n</i> = 44)	Intellectual Disability		Traumatic Brain Injury (<i>n</i> = 29)	Overall Clinical Sample (<i>n</i> = 190)
					Mild (<i>n</i> = 32)	Moderate (<i>n</i> = 30)		
Similarities	.25	.63	.21	.05	.29	.04	.42	.68
Vocabulary	.29	.47	-.04	.08	.11	.09	.39	.67
Information	.29	.57	.49	.00	.32	.28	.42	.74
Comprehension	.29	.53	-.06	.15	.28	.18	.40	.68
Block design	.28	.50	.17	.16	.19	.49	.31	.64
Matrix reasoning	.30	.45	.52	.14	.17	.32	.47	.67
Visual puzzles	.29	.41	.42	.24	-.11	.23	.39	.63
Figure weights	.27	—	.56	.18	.21	.33	.50	.77
Picture completion	.28	.68	.23	.36	-.19	.32	.46	.71
Digit span	.30	.58	.56	-.09	.41	.07	.42	.71
Arithmetic	.32	.63	.61	.11	.17	.23	.58	.71
Letter-number sequencing	.27	—	.82	.16	.30	.19	.24	.80
Symbol search	.30	.59	.58	.10	.16	.54	.41	.69
Coding	.30	.75	.38	-.02	.37	.37	.41	.65
Cancellation	.18	—	.52	.02	.11	.37	.30	.66
Verbal Comprehension Index	.32	.63	.29	-.00	.36	.18	.43	.74
Perceptual Reasoning Index	.35	.50	.43	.22	.09	.52	.46	.71
Working Memory Index	.35	.65	.67	.0	.35	.25	.53	.74
Processing Speed Index	.33	.81	.55	-.00	.28	.49	.44	.71
General Ability Index	.37	.62	.46	.12	.26	.45	.49	.77
Full Scale IQ	.41	.68	.68	.09	.36	.47	.53	.79

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^aCorrelations were corrected for the variability of the TFLS normative sample (Guilford & Fruchter, 1978).

Table 2

WAIS-IV General Ability Index Versus TFLS Total Contrast Scaled Score

	WAIS-IV General Ability Index Standard Score Range															Contrast Scaled Score
	<70	70-74	75-79	80-84	85-89	90-94	95-99	100-104	105-109	110-114	115-119	120-124	125-129	130-160		
TFLS Total T-Score Range	20	20-21	20-22	20-23	20-24	20-25	20-26	20-27	20-28	20-29	20-30	20-31	20-32	20-32	1	
	21	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-30	30-31	31-32	32-33	33-34	33-34	2	
	22	24-25	25-26	26-27	27-28	28-29	29-30	30-31	31-32	32-33	33-34	34-36	35-37	35-37	3	
	23-24	26-27	27-28	28-29	29-30	30-31	31-32	32-33	33-34	34-35	35-37	37-38	38-39	38-39	4	
	25-26	28-29	29-30	30-32	31-33	32-34	33-35	34-36	35-37	36-38	38-40	39-41	40-42	40-42	5	
	27-28	30-31	31-33	33-34	34-35	35-36	36-37	37-38	38-39	39-41	41-42	42-44	43-45	43-45	6	
	29-30	32-34	34-36	35-37	36-38	37-38	38-40	39-41	40-42	42-43	43-45	45-47	46-48	46-48	7	
	31-33	35-37	37-39	38-40	39-41	39-41	41-43	42-44	43-45	44-46	46-48	48-50	49-51	49-51	8	
	34-36	38-40	40-42	41-43	42-44	42-45	44-46	45-47	46-49	47-50	49-52	51-53	52-54	52-54	9	
	37-40	41-43	43-46	44-47	45-48	46-49	47-50	48-51	50-53	51-54	53-56	54-57	55-57	55-58	10	
	41-43	44-47	47-50	48-51	49-52	50-53	51-54	52-56	54-57	55-58	57-60	58-60	58-60	59-61	11	
	44-46	48-50	51-53	52-55	53-56	54-57	55-58	57-60	58-60	59-61	61-63	61-63	61-63	62-63	12	
	47-49	51-53	54-56	56-58	57-60	58-61	59-62	61-63	61-63	62-64	64-65	64-65	64-65	64-65	13	
	50-52	54-56	57-59	59-61	61-62	62-63	63-64	64-65	64-65	65-66	66	66	66	66	14	
	53-55	57-59	60-61	62-63	63-64	64-65	65	66	66	—	—	—	—	—	15	
	56-58	60-61	62-63	64-65	65	66	66	—	—	—	—	—	—	—	16	
	59-61	62-63	64-65	66	66	—	—	—	—	—	—	—	—	—	—	17
	62-63	64-65	66	—	—	—	—	—	—	—	—	—	—	—	—	18
	64-66	66	—	—	—	—	—	—	—	—	—	—	—	—	—	19

Note. Scores in the table rows represent score ranges for the TFLS Total T-Score. Standardization data from the Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV). Copyright © 2008 NCS Pearson, Inc. Used with permission. All rights reserved. Standardization data from the Texas Functional Living Scale (TFLS). Copyright © 2009 NCS Pearson, Inc. Used with permission. All rights reserved.

Table 3

WAIS-IV Verbal Comprehension Index Versus TFLS Total Contrast Scaled Score

	WAIS-IV General Ability Index Standard Score Range																Contrast Scaled Score	
	<70	70-74	75-79	80-84	85-89	90-94	95-99	100-104	105-109	110-114	115-119	120-124	125-129	130-160				
TFLS Total T-Score Range	20	20-23	20-24	20-25	20-26	20-27	20-27	20-28	20-29	20-30	20-31	20-32	20-33	20-33	20-33		1	
	21	24	25	26	27	28	28	29	30	31	32	33	34	34	34		2	
	22	25	26	27	28-29	29-30	29-30	30-31	31-32	32-33	33-34	34-35	35-36	35-36	35-36		3	
	23	26-27	27-28	28-29	30-31	31-32	31-32	32-33	33-34	34-35	35-37	36-37	37-38	37-38	37-38		4	
	24-25	28-29	29-30	30-31	32-33	33-34	33-34	34-35	35-37	36-38	38-40	38-40	39-41	39-41	39-41		5	
	26-27	30-31	31-32	32-34	34-36	35-37	35-37	36-38	38-40	39-41	41-43	41-43	42-44	42-44	42-44		6	
	28-29	32-33	33-35	35-37	37-39	38-40	38-40	39-41	41-43	42-44	44-46	44-46	45-47	45-47	45-47		7	
	30-31	34-36	36-39	38-41	40-42	41-43	41-43	42-44	44-46	45-47	47-49	47-49	48-50	48-50	48-50		8	
	32-34	37-40	40-43	42-44	43-45	44-46	44-46	45-48	47-49	48-50	50-52	50-52	51-53	51-53	51-53		9	
	35-37	41-44	44-47	45-48	46-49	47-50	47-50	49-52	50-53	51-54	53-55	53-55	54-56	54-56	54-56		10	
	38-41	45-48	48-51	49-52	50-53	51-54	51-54	53-56	54-57	55-58	56-59	56-59	57-60	57-60	57-60		11	
	42-45	49-52	52-54	53-56	54-57	55-58	55-58	57-59	58-60	59-61	60-62	60-62	61-63	61-63	61-63		12	
	46-49	53-55	55-57	57-59	58-60	59-61	59-61	60-62	61-63	62-64	63-65	63-65	64-65	64-65	64-65		13	
	50-53	56-58	58-60	60-61	61-62	62-63	62-64	63-64	64-65	65-66	66	66	66	66	66		14	
	54-56	59-61	61-62	62-63	63-64	64-65	65-66	65-66	66	—	—	—	—	—	—		15	
	57-59	62-63	63-64	64-65	65-66	66	—	—	—	—	—	—	—	—	—		16	
	60-62	64-65	65-66	66	—	—	—	—	—	—	—	—	—	—	—		17	
	63-65	66	—	—	—	—	—	—	—	—	—	—	—	—	—		18	
	66	—	—	—	—	—	—	—	—	—	—	—	—	—	—		19	

Note. Scores in the table rows represent score ranges for the TFLS Total T-Score. Standardization data from the Wechsler Adult Intelligence Scale—Fourth Edition (WAIS-IV). Copyright © 2008 NCS Pearson, Inc. Used with permission. All rights reserved. Standardization data from the Texas Functional Living Scale (TFLS). Copyright © 2009 NCS Pearson, Inc. Used with permission. All rights reserved.

Table 4

WAIS-IV Perceptual Reasoning Index Versus TFLS Total Contrast Scaled Score

	WAIS-IV General Ability Index Standard Score Range														Contrast Scaled Score	
	<70	70-74	75-79	80-84	85-89	90-94	95-99	100-104	105-109	110-114	115-119	120-124	125-129	130-160		
TFLS Total T-Score Range	20-21	20-22	20-23	20-24	20-25	20-26	20-27	20-28	20-30	20-32	20-34	20-36	20-37	20-37	1	
	22	23	24	25	26	27	28	29	31	33	35	37	38	38	2	
	23	24	25	26	27	28	29	30	32	34	36	38	39	39	3	
	24	25-26	26-27	27-28	28-29	29-30	30-31	31-32	33-34	35-36	37-38	39-40	40-41	40-41	4	
	25-26	27-28	28-29	29-30	30-32	31-33	32-33	33-35	35-37	37-39	39-40	41-42	42-43	42-43	5	
	27-28	29-30	30-31	31-33	33-35	34-36	34-36	36-38	38-40	40-41	41-43	43-45	44-46	44-46	6	
	29-30	31-32	32-34	34-36	36-37	37-38	37-38	39-40	41-42	42-44	44-45	46-47	47-48	47-48	7	
	31-32	33-34	35-37	37-39	38-40	39-41	39-41	41-43	43-45	45-47	46-48	48-50	49-51	49-51	8	
	33-34	35-37	38-40	40-43	41-44	42-45	42-45	44-47	46-49	48-51	49-52	51-54	52-55	52-55	9	
	35-37	38-40	41-44	44-47	45-48	46-49	46-49	48-51	50-53	52-55	53-56	55-58	56-59	56-59	10	
	38-40	41-44	45-48	48-51	49-52	50-53	50-53	52-55	54-57	56-59	57-60	59-61	60-62	60-62	11	
	41-43	45-48	49-52	52-55	53-56	54-57	54-57	56-59	58-61	60-62	61-63	62-64	63-65	63-65	12	
	44-47	49-52	53-56	56-58	57-60	58-61	58-61	60-62	62-63	63-64	64-65	65	66	66	13	
	48-51	53-56	57-59	59-61	61-63	62-63	62-63	63-64	64-65	65-66	66	66	—	—	14	
	52-55	57-59	60-62	62-64	64-65	64-65	64-65	65-66	66	—	—	—	—	—	15	
	56-58	60-62	63-64	65	66	66	66	—	—	—	—	—	—	—	16	
	59-61	63-64	65	66	—	—	—	—	—	—	—	—	—	—	17	
	62-63	65	66	—	—	—	—	—	—	—	—	—	—	—	—	18
	64-66	66	—	—	—	—	—	—	—	—	—	—	—	—	—	19

Note. Scores in the table rows represent score ranges for the TFLS Total T-Score. Standardization data from the Wechsler Adult Intelligence Scale—Fourth Edition (WAIS-IV). Copyright © 2008 NCS Pearson, Inc. Used with permission. All rights reserved. Standardization data from the Texas Functional Living Scale (TFLS). Copyright © 2009 NCS Pearson, Inc. Used with permission. All rights reserved.

Table 5

Correlations Between WMS-IV Subtest and Index Scores With TFLS, by Group

Subtest	Overall Normative Sample (<i>n</i> = 1200) ^a	Alzheimer Disease (<i>n</i> = 35)	Autism (<i>n</i> = 20)	Major Depressive Disorder (<i>n</i> = 44)	Intellectual Disability		Schizophrenia (<i>n</i> = 22)	Traumatic Brain Injury (<i>n</i> = 29)	Overall Clinical Sample (<i>n</i> = 212)
					Mild (<i>n</i> = 32)	Moderate (<i>n</i> = 30)			
Logical memory I	.32	.60	.57	-.15	.26	.62	.55	.42	.63
Logical memory II	.28	.46	.34	-.12	.18	.81	.61	.42	.63
Verbal paired associates I	.24	.58	-.25	.05	-.05	.37	.10	.57	.52
Verbal paired associates II	.24	.60	-.23	.14	-.10	.31	.21	.58	.55
Designs I	.25	—	.28	.22	-.03	.50	.19	.69	.65
Designs II	.20	—	.73	.11	-.12	.48	.32	.44	.57
Visual reproduction I	.29	.60	.24	.01	.08	.55	.39	.34	.63
Visual reproduction II	.26	.56	.33	.09	-.11	.28	.42	.50	.63
Spatial addition	.35	—	.46	.13	.29	.41	.44	.60	.69
Symbol span	.31	.50	.58	.16	.28	.72	.39	.55	.71
Auditory Memory Index	.33	.62	.18	-.02	.10	.66	.40	.58	.67
Visual Memory Index	.31	.66	.59	.18	-.03	.60	.37	.54	.70
Visual Working Memory Index	.40	—	.58	.17	.35	.64	.48	.66	.80
Immediate Memory Index	.37	.67	.40	.02	.20	.77	.48	.61	.71
Delayed Memory Index	.35	.57	.52	.07	-.15	.69	.48	.56	.71

Note. Standardization data from the Wechsler Memory Scale—Fourth Edition (WMS-IV). Copyright © 2009 NCS Pearson, Inc. Used with permission. All rights reserved. Standardization data from the Texas Functional Living Scale (TFLS). Copyright © 2009 NCS Pearson, Inc. Used with permission. All rights reserved.

^aCorrelations were corrected for the variability of the TFLS normative sample (Guilford & Fruchter, 1978).

Table 6

Correlations Between WMS-IV BCSE Level and TFLS

	TFLS Total Score	BCSE		
		Mean	SD	<i>n</i>
BCSE	0.21	3.7	0.7	798
TFLS				
Mean	50.0			
SD	10.0			
<i>n</i>	798			

Note. The Brief Cognitive Status Exam (BCSE) Classification Levels were coded as 0 to 4 with 0 as the lowest level. Standardization data from the Wechsler Memory Scale–Fourth Edition (WMS-IV). Copyright © 2009 NCS Pearson, Inc. Used with permission. All rights reserved. Standardization data from the Texas Functional Living Scale (TFLS). Copyright © 2009 NCS Pearson, Inc. Used with permission. All rights reserved.

WMS-IV Delayed Memory Index Versus TFLS Total Contrast Scaled Score, Adult Battery

Table 7

	WMS-IV Delayed Memory Index Standard Score Range (Adult Battery)														Contrast Scaled Score	
	<70	70-74	75-79	80-84	85-89	90-94	95-99	100-104	105-109	110-114	115-119	120-124	125-129	130-160		
TFLS Total T-Score Range	20-25	20-27	20-29	20-30	20-31	20-31	20-32	20-33	20-34	20-35	20-36	20-38	20-38	20-40	1	
	26	28	30	31	32	32	33	34	35	36	37	39	39	41	2	
	27	29	31	32	33	33	34	35	36	37	38	40	40	42	3	
	28	30	32	33-34	34-35	34-35	35-36	36-37	37-38	38-39	39-40	41-42	41-42	43-44	4	
	29	31	33-34	35-36	36-37	36-38	37-38	38-39	39-40	40-41	41-42	43-44	43-44	45-46	5	
	30	32-33	35-36	37-38	38-39	39-40	39-41	40-42	41-43	42-43	43-45	45-47	45-47	47-48	6	
	31-32	34-35	37-38	39-40	40-42	41-43	42-44	43-45	44-46	44-46	46-48	48-50	48-50	49-51	7	
	33-34	36-38	39-41	41-43	43-45	44-46	45-47	46-48	47-49	47-49	49-51	51-53	51-53	52-54	8	
	35-36	39-41	42-44	44-46	46-47	47-49	48-50	49-51	50-51	50-52	52-54	54-56	54-56	55-57	9	
	37-39	42-44	45-47	47-49	48-50	50-52	51-54	52-55	52-55	53-56	55-58	57-59	57-59	58-60	10	
	40-42	45-47	48-51	50-53	51-54	53-56	55-57	56-58	56-59	57-59	59-61	60-62	60-62	61-63	11	
	43-45	48-50	52-54	54-57	55-58	57-60	58-60	59-61	60-61	60-62	62-63	63-64	63-65	64-65	12	
	46-48	51-53	55-57	58-60	59-61	61-63	61-63	62-64	62-64	63-64	64-65	65-66	66	66	13	
	49-51	54-56	58-60	61-62	62-63	64-65	64-65	65-66	65-66	65-66	66	—	—	—	14	
	52-54	57-59	61-62	63-64	64-65	66	66	—	—	—	—	—	—	—	15	
	55-57	60-61	63-64	65	66	—	—	—	—	—	—	—	—	—	16	
	58-60	62-63	65	66	—	—	—	—	—	—	—	—	—	—	17	
	61-63	64-65	66	—	—	—	—	—	—	—	—	—	—	—	18	
	64-66	66	—	—	—	—	—	—	—	—	—	—	—	—	19	

Note. Scores in the table rows represent score ranges for the TFLS Total T-Score. Standardization data from the Wechsler Memory Scale-Fourth Edition (WMS-IV). Copyright © 2009 NCS Pearson, Inc. Used with permission. All rights reserved. Standardization data from the Texas Functional Living Scale (TFLS). Copyright © 2009 NCS Pearson, Inc. Used with permission. All rights reserved.

Table 8

WMS-IV Delayed Memory Index Versus TFLS Total Contrast Scaled Score, Older Adult Battery

	WMS-IV Delayed Memory Index Standard Score Range (Older Adult Battery)															Contrast Scaled Score
	<70	70-74	75-79	80-84	85-89	90-94	95-99	100-104	105-109	110-114	115-119	120-124	125-129	130-160		
TFLS Total T-Score Range	20-22	20-22	20-22	20-23	20-25	20-25	20-26	20-28	20-29	20-31	20-33	20-35	20-35	20-35	1	
	23	23	23	24	26	26	27	29	30	32	34	36	36	36	2	
	24	24	24	25	27	27	28	30	31	33	35	37	37	37	3	
	25	25	25	26	28	28	29	31	32	34	36	38	38	38	4	
	26	26	26	27	29	29	30	32	33	35	37	39	39	39	5	
	27-28	27-28	27-28	28-29	30-31	30-31	31-32	33-34	34-35	36-37	38-39	40-41	40-41	40-41	6	
	29-30	29-30	29-30	30-31	32-33	32-33	33-34	35-36	36-37	38-39	40-41	42-43	42-43	42-43	7	
	31-32	31-32	31-32	32-33	34-35	34-35	35-36	37-38	38-39	40-41	42-43	44-45	44-45	44-45	8	
	33-34	33-34	33-34	34-35	36-37	36-37	37-38	39-41	40-42	42-44	44-46	46-48	46-48	46-48	9	
	35-36	35-36	35-36	36-38	38-40	38-40	39-41	42-44	43-45	45-47	47-49	49-51	49-51	49-51	10	
	37-39	37-39	37-39	39-41	41-44	41-44	42-45	45-47	46-48	48-50	50-52	52-54	52-54	52-54	11	
	40-42	40-42	40-42	42-45	45-48	45-48	46-49	48-51	49-52	51-54	53-56	55-58	55-58	55-58	12	
	43-44	43-44	43-45	46-49	49-52	49-53	50-54	52-55	53-56	55-58	57-60	59-62	59-62	59-62	13	
	45-47	45-47	46-49	50-53	53-56	54-58	55-59	56-59	57-60	59-62	61-63	63-65	63-65	63-65	14	
	48-50	48-50	50-53	54-57	57-60	59-62	60-63	60-63	61-64	63-65	64-65	66	66	66	15	
	51-54	51-54	54-57	58-60	61-63	63-65	64-66	64-66	65-66	66	66	—	—	—	16	
	55-57	55-57	58-60	61-63	64-65	66	—	—	—	—	—	—	—	—	—	17
	58-60	58-60	61-62	64-65	66	—	—	—	—	—	—	—	—	—	—	18
	61-66	61-66	63-66	66	—	—	—	—	—	—	—	—	—	—	—	19

Note. Scores in the table rows represent score ranges for the TFLS Total T-Score. Standardization data from the Wechsler Memory Scale, Fourth Edition (WMS-IV). Copyright © 2009 NCS Pearson, Inc. Used with permission. All rights reserved. Standardization data from the Texas Functional Living Scale (TFLS). Copyright © 2009 NCS Pearson, Inc. Used with permission. All rights reserved.