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Observation of Social Behavior in Frontotemporal Dementia

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Abstract

Background—The most characteristic manifestations of behavioral variant frontotemporal dementia (bvFTD) are abnormalities in social behavior. However, distinguishing bvFTD based on social behavior can be difficult in structured clinical settings.

Methods—Using a Social Observation Inventory, 10 patients with bvFTD and 10 patients with Alzheimer’s disease (AD) were compared to their caregiver interlocutors on 1-hour mealtime, in-home videotaped segments.

Results—Compared to caregivers and patients with AD, patients with bvFTD were significantly disturbed in social behavior. In contrast, patients with AD were indistinguishable from their caregivers. The lack of “you” comments and decreased tact and manners distinguished 92.6% of the patients with bvFTD from patients with AD and caregivers. The Social Observation Inventory scores correlated with scores on frontal-executive tests and socioemotional scales.

Conclusions—The systematic observation of social behavior during routine activities may be one of the best ways to distinguish patients with bvFTD from normal individuals and from patients with other dementias.

Keywords

dementia; frontotemporal lobar degeneration; Alzheimer’s disease; social behavior; autism

Introduction

Behavioral variant frontotemporal dementia (bvFTD) is a neurodegenerative disorder characterized by alterations in social behavior. After Alzheimer’s disease (AD), bvFTD is the most common neurodegenerative dementia with an early age of onset (<65 years).¹ Behavioral variant frontotemporal dementia is associated with social disengagement and

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apathy, disinhibition and loss of social tact and propriety, and loss of empathy or sympathy for others as well as compulsive or stereotypical behavior, dietary or oral behavioral changes, and a dysexecutive neuropsychological profile.^{2,3} Investigators have shown that patients with bvFTD have deficits in perceiving and reacting to social cues,⁴ social tact and propriety,^{5,6} interpersonal responsiveness and empathic concern,^{7,8} and the ability to see that others have thoughts, feelings, and beliefs (Theory of Mind [ToM]).^{9,10} The diagnosis of bvFTD depends on clinical criteria that include alterations in social and emotional behavior, supplemented by frontotemporal changes on neuroimaging.^{2,11,12}

The diagnostic criteria for bvFTD rely predominantly on historical information of disturbed social and other behaviors obtained from caregiver informants.² The main manifestations of this dementia are alterations in interpersonal interactions with others, which may be difficult to determine on clinical examinations. Moreover, any disturbances in social behavior in a clinic may be due to inexperience or discomfort in an unfamiliar or public setting. Social behavior is context dependent,¹³ and intrinsically disturbed social behavior is most evident through dedicated observation of patients interacting with others in their most comfortable and familiar settings. Hence, clinicians can more accurately assess disturbances in social behavior by observing the patients' interactions in their homes during routine activities. Using the observational methods of ethnography, investigators can code recordings of patients with bvFTD during routine interpersonal interactions. This methodology may be one of the best ways to distinguish patients with bvFTD from normal controls and from patients with other dementias.

This study aimed to characterize alterations in social behavior in patients with bvFTD using systematic observation of in-home videotaped segments, in comparison to patients with early-onset AD and normal controls (the caregiver-interlocutors). We hypothesize that patients with bvFTD would have persistent social interpersonal alterations when examined in their homes, during a family meal, whereas patients with AD may look quite normal and difficult to distinguish from their caregiver interlocutors. This study sought to assess the value of direct social observation and whether it could reveal the presence of bvFTD, lead to observational guidelines of specific behaviors, and make recommendations for the recognition of bvFTD outside of the clinic and in comparison to patients with AD and normal caregivers.

Methods

Patients

This study enrolled 20 patients including 10 patients with bvFTD and 10 patients with early-onset AD, plus 20 normal age-matched controls who comprised the patient's caregiver interlocutors. The patients and their historically normal caregivers were recruited from a large university-based clinical program and gave informed consent. This project was approved by the institutional review board.

The patients met diagnostic criteria after an extensive evaluation involving clinical, neuropsychological, and neuroimaging assessments. Patients with bvFTD met the International Behavioral Variant FTD Criteria Consortium (FTDC).^{2,14} The FTDC criteria,

which emphasize persistent or recurrent symptoms of disinhibition, apathy or inertia, loss of sympathy or empathy, perseverative or related behaviors and hyperorality, and dietary changes, have high interrater reliability.^{2,14} The FTDC criteria were supported by predominant frontal or anterior temporal hypometabolism on positron emission tomography (PET) imaging. The patients with AD met National Institute on Aging-Alzheimer's Association (NIA-AA) criteria for clinically probable AD.¹⁵ The NIA-AA criteria emphasize the insidious onset over months to years of worsening amnesic or nonamnesic cognitive symptoms.¹⁵ The NIA-AA criteria were supported by predominant parietal and posterior cingulate hypometabolism on PET. The patients with AD were early onset in order to be comparable in age to the patients with bvFTD. The severity of the disease and comparability of patients with bvFTD and AD were further assessed with the Mini-Mental State Examination (MMSE),¹⁶ the Montreal Cognitive Assessment (MoCA),¹⁷ and the Clinical Dementia Rating (CDR) Scale,¹⁸ augmented with 2 additional items, a Behavioral Comportment and Personality Domain and a Language Domain, for the assessment of patients in the FTD-spectrum.¹⁹ Other inclusion/exclusion criteria included the ability to understand and provide consent/assent, English speaking and able to carry on a conversation, the presence of a caregiver able to consent and participate in the videotaping, and the absence of complicating medical or psychiatric illnesses or medications (none of these patients were on psychoactive medications).

Procedures

As part of their initial evaluation, the dementia groups underwent neuropsychological tests.²⁰ These assessed attention and processing speed (digit span, Trailmaking A), language (Boston Naming Test, FAS-word fluency, and animal category fluency), visuospatial skills (Rey-Osterrieth Complex Figure [ROCF]), memory (Wechsler Adult Intelligence Scale-III [WMS-III], logical memory I and II, ROCF 3-minute delay, and WMS-III visual reproduction I and II), frontal-executive functions (Delis-Kaplan Executive Functioning System [D-KEFS] Tower Test and Design fluency²¹), and 3 behavioral scales (Geriatric Depression Scale,²² Social Norms Questionnaire [adapted with permission from K. P. Rankin et al], Scale of Emotional Blunting.^{23,24}

The study obtained 1-hour videotaped scenarios of the patients in their homes. The recordings consisted of a relaxed conversation during a mealtime between patients and their caregiver interlocutors. Just prior to the recording session, the investigators set up the recording equipment in locations deemed to be inconspicuous and unobtrusive and then left the home. The participants were all aware of being recorded during the subsequent mealtime interaction. No specific instructions or techniques were otherwise involved except to specify that the caregivers of patient should behave and interact as they normally would if the camera were not there. After 1 hour, the investigators returned and collected the recording equipment.

Two raters independently coded the videotaped interactions on a Social Observation Inventory (maximum scores of 100; inter-rater reliabilities of 0.9 or more). The raters were blind to which of the interacting pairs was the patient or the caregiver interlocutor and to the patient's diagnosis, that is, bvFTD or AD. The Social Observation Inventory consisted of 10

verbal and 10 nonverbal behavioral deficits rated on a 5-point Likert-type scale, which were derived from compiling the potentially socially relevant observable behavioral deficits described in prior publications on bvFTD^{2,3,5,6,8-10,24-29}. The verbal items were observed deficits in: (1) spontaneous verbal behavior, (2) verbal responsiveness to others' comments (eg, facilitation and reflective comments), (3) appropriate timing of verbal responses (eg, lack of latency and turn taking), (4) elaboration of verbal responses (more than minimal answers), (5) "on-topic" verbal responses, (6) "others" references ("you" statements), (7) "self" references ("I" statements), (8) absent verbal disinhibition (inappropriate comments), (9) absent incongruous vocalizations (eg, out-of-context laughter), and (10) absent stereotypical/repetitive speech. The nonverbal items were observed deficits in (1) spontaneous nonverbal behavior, (2) physically staying with the interaction (vs getting up or leaving during the interaction), (3) joint or shared attention, (4) gaze/eye contact during the interaction, (5) facial responses appropriate to interaction, (6) head orientation toward the interlocutor during the conversation, (7) body orientation toward the interlocutor, (8) social tact and manners, (9) absent nonverbal disinhibition, and (10) absent stereotypical/repetitive motor behavior.

Statistical Analysis

Data analysis used SPSS version 20 (IBM, Inc., Armonk, New York) to calculate parametric (analysis of variance [ANOVA]) and nonparametric (χ^2) differences between the groups. There was an initial repeated-measures ANOVA for the bvFTD-caregiver and AD-caregiver pairs followed by 1-way between group ANOVAs (bvFTD, AD, and caregiver-interlocutor groups). For the ANOVAs, we used Tukey post hoc analyses. A logistical regression evaluated the group predictive value of the Social Observation Inventory Items. Correlations were additionally obtained between the total Social Observation Inventory scores and the neuropsychological test scores.

Results

There were no group differences in demographic variables (see Table 1). All participants were Caucasian from similar socioeconomic backgrounds. Although the AD group had proportionally more women, this did not reach statistical significance. The results on measures of dementia severity were mixed: patients with AD were significantly more impaired on the MMSE; patients with bvFTD were worse on augmented CDR-Sum of Boxes (CDR-SB) scores; and the 2 groups were comparable on the MoCA and standard CDR-SB scores (see Table 1).

Social Observation Inventory

On repeated-measures ANOVA, the total scores distinguished patients with bvFTD and AD from their respective caregiver interlocutors ($F = 63.34$, $df\ 18.1$, $P < .01$). When comparing the bvFTD-caregiver with the AD-caregiver pair groups, the total scores distinguished between them on within pair group differences ($F = 28.89$, $P < .001$) and between pair groups ($F = 22.06$, $P < .001$). These findings were also true for verbal subtest scores (verbal within pairs: $F = 70.31$, $df\ 18.1$, $P < .001$; within pair groups: $F = 25.16$, $P < .001$; between pair groups: $F = 21.06$, $P < .001$) and nonverbal subtest scores (within pairs: $F = 38.52$, df

18.1, $P < .001$; within pair groups: $F 22.36$, $P < .001$; between pair groups: $F 15.43$, $P = .001$).

In order to evaluate the value of the individual Social Observation Inventory items, scores on the items were directly compared across the bvFTD, AD, and pooled normal caregivers (see Table 2). The majority of the items were significantly worse among patients with bvFTD compared to the other groups. Although the patients with AD were worse on the verbal item subtotal, the Total Inventory scores did not differentiate between those with AD, and normal caregivers.

On logistic regression, inclusion of verbal item #6 (“You” statements) in Step 1 discriminated 81.5% of the patients with bvFTD ($R^2 = 0.60$) and inclusion of nonverbal item #8 (tact/manners) in Step 2 discriminated 92.6% ($R^2 = 0.75$; see Table 3).

Neuropsychological Tests

Patients with bvFTD were worse than the patients with AD on frontal-executive tests (FAS-word fluency, D-KEFS Design fluency, D-KEFS Tower Test) and the Scale of Emotional Blunting (see Table 4). Not unexpectedly, patients with AD were worse on visual memory measures (WMS-III visual reproduction I and II).

The Social Observation Inventory total scores were correlated with the neuropsychological test results across the groups. The Total Social Observation Inventory scores were significantly correlated with the FAS-word fluency, D-KEFS Design fluency, D-KEFS Tower Test, the Social Norms Questionnaire, and the Scale of Emotional Blunting (see Table 4).

Discussion

This study found that patients with bvFTD were easily recognizable on observation of their social behavior in a familiar setting. Not only were they distinguishable from their normal caregiver interlocutors but they were also quite different from patients with AD. In contrast, patients with AD were often not distinguishable from their normal caregivers. These findings emphasize that bvFTD is a unique disorder of the “social brain” and that these patients with dementia are most evident on systematic observation of their social behavior. For the diagnosis of bvFTD, direct observation of social behavior overcomes the dependence on reliable history and the observation skills of informants, as well as problems trying to assess social behavior in the usual limited context of a clinical visit.

The most salient differences in observable behavior among the patients with bvFTD are failure to take the speaker into account, for example, absence of “you” statements or questions during conversation, followed by a decrease in conventional tact and manners, as assessed in in-home mealtime videotapes. The absence of “you” statements indicates a lack of emotionally experiencing the presence of another person or an inability to inhibit their “self” perspective in favor of an “other,” similar to diminished empathy and ToM.^{25,26} In other words, patients with bvFTD behave as if they are alone in a social situation. Furthermore, their lack of tact and manners in reaching for items during meals, excusing

themselves when appropriate, rate, manner of eating, and so on emphasizes the value of observing nonverbal behavior during routine daily activities, rather than just focusing on verbal behavior.

Behavioral variant frontotemporal dementia affects multiple levels of social behavior. There are social awkwardness, tactlessness, decreased propriety and manners, disagreeableness, unacceptable physical contact, or improper verbal or physical acts as well as changes in affect and emotional responsiveness to others.^{5,6} In a retrospective study of 19 neuropathologically verified patients with bvFTD, investigators report impaired social interactions in every one of the patients.²⁷ On investigating these behavioral changes, patients with bvFTD show deficits in the perception of facial emotions,²⁸ selective attention to significant social cues,⁴ ToM, and the ability to form socioemotional scripts,^{9,10} both emotional and cognitive aspects of empathy,^{7,8} inhibition and social regulation,^{2,5} and even personal moral behavior.^{30,31}

In FTD, disturbed social behavior correlates with disease in right ventromedial–orbitofrontal and anterior cingulate–anterior insulae regions³²; There are microvacuolation, astrocytic gliosis, neuronal loss, and frequent characteristic intraneuronal inclusion bodies in these regions as well as in the the anterior temporal lobes and amygdalae.³³ The involvement of the anterior temporal lobes and amygdalae contributes to interpersonal coldness, decreased empathic concern, poor awareness of the humanness of others, and impaired social concepts.^{24,34–36} These socially undesirable behaviors are more frequent with right-sided involvement.³⁷ Behavioral variant frontotemporal dementia focuses its pathology on a social neural network for social behavior in the right frontotemporal lobes.⁴ In this study, the Social Observation Inventory results correlate with poor performance on frontal-executive neuropsychological measures (verbal and design fluency and Tower Test) and on socioemotional scales, thus supporting the validity of social observational techniques for bvFTD.

This study suggests that clinicians need to identify the social interactions outside the clinic that disrupt the lives of patients with bvFTD and their caregivers. Relatively brief structured interviews and tests in a clinic may omit, minimize, control, or overlook typical bvFTD behaviors. Moreover, any social awkwardness observed in clinic may fail to distinguish those with bvFTD compared to AD and other dementias, as social awkwardness could reflect an unfamiliar, strange, or stressful clinic environment. The augmentation of a clinical examination with systematic observation of behavior in familiar environments, however, is too time consuming and travel dependent to be easily implemented as a clinical tool. Hence, the practical value of this study is to hone the clinician's interviews on specific social behavioral disturbances including indications that the patient is unaware of others, such as the absence of "you" statements, consistent with decreased ToM,^{9,10} and indications of loss tact and propriety, such as the loss of manners at mealtimes and consistent with decreased social regulation.^{2,5} These findings from the Social Observation Inventory add to self-report and informant measures and help in the recognition and differentiation of this frequently misdiagnosed dementia.

This study had some potential limitations. First, the numbers were small. Nevertheless, there were sufficient patients to reveal significant differences in social behavior. Second, the AD patient group had more women. This gender difference did not reach significance. Third, there appeared to be differences in measures of disease severity. The MMSE, which emphasizes memory and language impairments, was worse in AD, the augmented CDR-SB, which includes behavioral and personality changes, was worse in bvFTD, but the MoCA and CDR-SB did not differ between the 2 groups, suggesting that dementia severity measures were comparable in the aggregate. Nevertheless, the fact that patients with bvFTD scored significantly more impaired on the augmented CDR-SB than the patients with AD remains a limitation of this study. Fourth, the in-home situation with a known camera may still have been artificial. The awareness of being recorded may have influenced the participants to behave in a careful and proper manner. Even if it affected those with AD and the normal caregivers, it did not appear to impact on the patients with bvFTD who seemed just as oblivious to the camera as to other people in the room. Fifth, the Social Observation Inventory was biased toward detecting bvFTD and was dependent on the biases and skill of individual raters. Indeed, this Inventory requires some training for interrater reliability and in order to standardize variable interpretations of “unacceptable” social behaviors. Nevertheless, the behavioral changes among patients with bvFTD were quite overt and facilitated by the ongoing comparison with their normal caregiver, with whom they were interacting.

In conclusion, among patients with bvFTD, this study found easily detectable disturbances in interpersonal interactions on social observations in familiar settings. Abnormalities in social behavior were directly observable and not dependent on an informant’s report. Their behavior reflected decreased awareness of the presence of others, exemplified by their absence of “you” statements and in their loss of the usual tact and manners. Surveying for these behaviors among patients suspected of bvFTD might improve on traditional history taking, neurological examination, neuropsychological testing, or structural neuroimaging for the clinical recognition of bvFTD. Future research may further evaluate the role of direct observation of social behavior in the diagnosis of this disorder, whether it is superior to informant-based or self-report measures and whether the observed changes in social behavior apply to broader and more diverse samples of participants.

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Table 1

Characteristics of Patients With bvFTD Versus Patients With AD.

	bvFTD 10	AD 10	NC 20	Significance NS
Sex, M/F	4/6	2/8	10/10	NS
Age, years	59.2 (6.9)	56.5 (4.7)	60.7 (13.9)	NS
Duration, years	2.3 (2.1)	3.2 (2.6)	–	NS
Education, years	15.5 (2.2)	16.9 (2.2)	15.6 (2.3)	NS
MMSE scores	25.38 (3.16)	21.13 (5.11)	–	$t = 2.37, P < .05$
MOCA scores	17.01 (4.85)	18.20 (6.30)	–	NS
Standard CDR-SB ^a	5.9(1.7)	5.3 (1.5)	–	NS
Augmented CDR-SB ^b	8.3 (2.0)	6.3 (1.8)	–	$t = 2.58, P < .05$

Abbreviations: bvFTD, behavioral variant frontotemporal dementia; AD, Alzheimer's disease; NC, normal control; M, male; F, female; MMSE, Mini-Mental State Examination; MOCA, Montreal Cognitive Assessment; CDR-SB, Clinical Dementia Rating Scale-Sum of Boxes; NS, not significant.

^aStandard Clinical Dementia Rating Scale with 6 item Sum of Boxes Scores.

^bAugmented Clinical Dementia Rating Scale with 8 item Sum of Boxes scores = CDR-SB plus Behavioral Compartment and Personality Domain and Language Domain.

Table 2

Social Observation Inventory Items.

	bvFTD	AD	NC	Significance
Verbal deficits				
Spontaneity ^{a,b,c}	7.75 (2.66)	2.80 (2.54)	0.50 (0.89)	$F = 47.43, P < .001$
Responsiveness ^{a,b,c}	5.38 (1.07)	1.96 (1.62)	0.49 (0.82)	$F = 62.87, P < .001$
Timing ^{a,b}	4.30 (1.70)	1.00 (1.25)	0.40 (0.82)	$F = 36.75, P < .001$
Elaboration ^{a,b,c}	8.30 (1.95)	3.20 (2.74)	0.60 (1.14)	$F = 57.81, P < .001$
On-Topic	1.15 (1.56)	0.75 (1.09)	0.33 (0.73)	$F = 2.04, ns$
“You” statements ^{a,b}	8.15 (2.60)	2.10 (2.20)	0.50 (1.00)	$F = 59.49, P < .001$
“I” statements ^{a,b}	7.30 (2.96)	1.90 (2.22)	0.53 (0.97)	$F = 40.99, P < .001$
Absent disinhibition	0.50 (0.71)	0.40 (0.57)	0.15 (0.40)	$F = 1.68, ns$
Absent vocalizations ^c	1.00 (1.05)	0.70 (0.72)	0.20 (0.44)	$F = 4.73, P < .05$
Absent Stereotypy	0.44 (0.73)	0.20 (0.42)	0.11 (0.32)	$F = 1.62, ns$
Subtotal ^{a,b,c}	44.23 (8.92)	15.01 (13.28)	3.79 (6.27)	$F = 66.31, P < .001$
Nonverbal deficits				
Spontaneity ^{a,b,c}	6.55 (2.79)	1.65 (2.16)	0.35 (0.71)	$F = 39.59, P < .001$
Physically staying ^{a,b}	4.40 (2.68)	0.60 (0.97)	0.40 (0.82)	$F = 58.15, P < .001$
Attention ^{a,b}	5.70 (3.37)	1.00 (0.94)	0.25 (0.44)	$F = 103.28, P < .001$
Gaze ^{a,b}	4.95 (2.8)	0.70 (1.40)	0.33 (0.56)	$F = 76.41, P < .001$
Face ^{a,b}	5.30 (2.53)	1.65 (2.00)	0.33 (0.56)	$F = 82.92, P < .001$
Head ^{a,b}	4.30 (2.44)	0.95 (1.74)	0.35 (0.61)	$F = 53.93, P < .001$
Body ^{a,b}	5.06 (2.65)	1.05 (1.39)	0.31 (0.53)	$F = 77.89, P < .001$
Tact/manners ^{a,b}	2.89 (2.15)	0.40 (0.52)	0.11 (0.32)	$F = 24.99, P < .001$
Absent disinhibition ^d	2.10 (1.85)	0.85 (1.25)	0.70 (0.97)	$F = 4.08, P < .05$
Absent stereotypy ^d	2.60 (1.84)	1.45 (1.34)	2.32 (2.23)	$F = 7.08, P < .01$
Subtotal ^{a,b}	43.59 (20.18)	10.30 (11.71)	5.93 (9.65)	$F = 39.36, P < .001$
Total ^{a,b,c}	87.81 (25.31)	26.95 (24.25)	6.61 (10.63)	$F = 61.73, P < .001$

Abbreviations: bvFTD, behavioral variant frontotemporal dementia; AD, Alzheimer's disease; NC, normal control; ns, not significant.

^aPost-hoc significance: bvFTD versus NC; $P < .001$.^bPost-hoc significance: bvFTD versus AD, $p < .001$.^cPost-hoc significance AD versus NC, $p < .01$.^dPost-hoc significance: bvFTD versus NC; $p < .05$.

Table 3

Social Observation Inventory Logistic Regression: Significant Items.

	β	SE	Wald χ^2	<i>P</i>	OR
“You” statements	−.909	.328	7.676	.006	.403
Tact/manners	−.677	.297	5.215	.022	.508

Abbreviations: SE, standard error; OR, odds ratio.

Table 4

Neuropsychological Tests: Means (Standard Deviations) and Correlations With Total Social Observation Inventory Scores Across Groups.^a

	bvFTD (n = 10)	AD (n = 10)	R	P
Digit Span, scaled score	6.00 (0.63)	7.40 (4.72)	-.27	NS
Trailmaking A ^b , seconds	48.00 (19.61)	53.83 (24.77)	-.19	NS
Boston Naming Test	47.83 (12.24)	53.40 (6.84)	-.19	NS
FAS-word fluency ^c	10.50 (5.32)	23.75 (8.02)	-.82	<.01
Category fluency-animals	7.83 (4.71)	11.14 (5.18)	-.53	NS
Rey-OCFT copy	24.90 (3.75)	30.25 (37.85)	-.39	NS
WMS-III logical memory I	18.33 (12.88)	11.00 (14.98)	-.05	NS
WMS-III logical memory II	9.67 (9.00)	4.75 (3.30)	-.05	NS
Rey-OCFT 3-minute delay	9.80 (3.95)	12.00 (12.53)	-.14	NS
WMS-III visual reproduction ^d	46.83 (13.56)	20.43 (18.25)	.02	NS
WMS-III visual reproduction II ^d	19.50 (19.27)	0.00 (0.00)	.13	NS
D-KEFS Tower Test violation ^{b,c}	7.00 (2.50)	3.00 (2.24)	.55	<.05
D-KEFS Design fluency ^{b,c}	11.83 (4.58)	1.83 (2.99)	.69	<.05
WCST perseverative errors ^b	37.40 (17.59)	25.67 (16.38)	.37	NS
WCST conceptual responses	17.40 (17.07)	22.33 (17.15)	-.45	NS
Geriatric Depression Scale ^b	5.33 (5.24)	7.50 (5.51)	-.15	NS
Social Norms Questionnaire ^b	9.75 (1.5)	9.40 (9.71)	.70	<.05
Scale of Emotional Blunting ^{b,d}	14.17 (12.61)	1.00 (1.00)	.81	<.01

Abbreviations: bvFTD, behavioral variant frontotemporal dementia; AD, Alzheimer's disease; WAIS-III, Wechsler Adult Intelligence Scale, third edition; Rey-OCFT, Rey-Osterrieth Complex Figure Test; WMS-III, Wechsler Memory Scale, third edition; D-KEFS, Delis-Kaplan Executive Functioning System; WCST, Wisconsin Card Sorting Test; NS, not significant.

^a All scores are raw scores unless indicated. Significant values are in bold.

^b Indicates that higher scores correspond to worse performance or more dysfunction.

^c $P < .001$.

^d $P = .01$.