The Use of Profanity During Letter Fluency Tasks in Frontotemporal Dementia and Alzheimer's Disease

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Abstract

Objective—To assess whether the production of profanity during letter fluency testing distinguishes frontotemporal dementia (FTD) and Alzheimer's disease (AD) patients.

Background—Alterations in language and social behavior typify FTD spectrum disorders. Nonetheless, in can be difficult to distinguish pathologically-defined frontotemporal lobar degeneration (FTLD) from AD clinically. Assessing verbal fluency by having patients generate as many words as they can beginning with specific letters in a given period of time can yield diverse information of diagnostic utility.

Method—Words produced during FAS letter fluency testing were reviewed and instances of the use of "f*ck", "*ss", and "sh*t" and other words felt to be inappropriate were sought. The frequency of these words was compared between clinically diagnosed FTD and AD patients using chi-square tests.

Results—We found that 6/32 (18.8%) patients with FTD generated the word "f*ck" during the "F" trial as opposed to none of 38 patients with AD (p = 0.007). Patients who said "f*ck" had diagnoses of either behavioral variant FTD (3/15), progressive non-fluent aphasia (2/8), or semantic dementia (1/3).

Conclusions—Though the specific neuropathology in these cases is uncertain, generation of "f*ck" during letter fluency testing appears to have utility in differentiating FTD from AD.

Keywords

Profanity; Alzheimer's disease; frontotemporal dementia; letter fluency; expletives

Introduction

Alzheimer's disease (AD) and the frontotemporal lobar degenerations (FTLD) are categories of chronic neurodegenerative diseases that we are currently imperfect at diagnosing during patients' lives[1]. Furthermore, FTLD consists of multiple different conditions with distinct underlying pathologies[2] that have overlapping clinical features[3]. Therefore, the clinical diagnosis of frontotemporal dementia syndrome (FTD) or frontotemporal dementia spectrum disorder is sometimes employed. These include clinically diagnosed behavioral variant FTD (bvFTD), progressive non-fluent aphasia (PNFA), and semantic dementia (SD)[4], and sometimes corticobasal degeneration (CBD), and progressive supranuclear palsy (PSP)[5]. Though existing treatments for this group of illnesses are inadequate, there are medications approved for AD that are of modest benefit. These treatments have either not been tested in

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FTD or have not consistently been found to be beneficial[6, 7]. In light of this fact and because of differences between the illnesses with regard to prognosis, it is advantageous to differentiate between them during life.

Both AD and FTD are ultimately accompanied by the disintegration of social proprieties though this is an early and characteristic feature of many patients with FTD. In the diagnostic schema of Neary et al[4], "ecline in social and personal conduct" is a core criterion of bvFTD. Examples of changes in social behavior that have been reported to occur in FTD include social withdrawal or excessive familiarity with strangers, increased use of profanity or inappropriate humor, antisocial and illegal activities, and disinhibited sexual behaviors such as inappropriate propositions, public disrobing, and exhibitionism.

Different patterns of cognitive deficits have been described in FTD and AD as well. Pronounced deficits in episodic memory typify AD[8] with decline in visuospatial function and executive function[9] also being prevalent. In FTD deficits in executive function and language are more pronounced with relatively spared memory and visuospatial function[10, 11]. Deficits in working memory occur though episodic memory is only variably affected. Verbal fluency, assessed by measuring one's ability to rapidly generate words in a given category, is a skill that places demands upon executive processes requiring the efficient organization of verbal retrieval and recall, as well as self-monitoring (i.e. keeping track of responses already given), effortful self-initiation, and inhibition of responses[12]. As it depends on many underlying cognitive processes, verbal fluency is diminished in a variety of neurological conditions, including both AD and the FTD. As FTD syndromes typically involve many of the component processes underlying verbal fluency, these patients tend to have more verbal fluency impairment than patients with AD[13].

The words generated during verbal fluency testing can also give insights into the nature of persons' thought processes and use of profanity during such testing might suggest behavioral disinhibition. Though social impropriety is classically encountered in bvFTD, it is also more common in SD than in PNFA and AD[14]. It might therefore be anticipated that persons with bvFTD or SD would have an increased tendency to generate expletives on letter fluency testing. This is consistent with our clinical impression as we observed a single patient with clinical bvFTD and motor neuron disease, who on letter fluency testing ("F") in the clinic, generated only the words "f*ck" and "fart" in one minute. When interviewed in a case conference three months later and confronted with the same task, she again generated only the words "f*ck" and "fart." Therefore, in the current study, we sought to objectively document and quantify the occurrence of this behavior in an independent patient population. We hypothesized that persons with FTD would have a greater tendency to generate profanity during letter fluency testing than patients with AD and that this might assist in the differential diagnosis of FTD and AD. We also sought to determine which expletives were generated most often. In addition, we performed exploratory comparisons among FTD subtypes in regard to generation of profanity. Though such analyses would necessarily be exploratory with the small numbers of subjects in each group, we hypothesized that increased profanity during verbal fluency testing might be present in bvFTD and SD due to behavioral disinhibition but might also be present in PNFA secondary to restricted verbal fluency. We did not expect to see increased use of profanity in CBD or PSP relative to AD. In a series of dementia patients presenting to a tertiary dementia clinic, we compared the frequency with which clinically diagnosed FTD and AD patients generated "f*ck," "ss," and "sh*t" as well as other inappropriate expletives during letter fluency testing using the letters "F", "A", and "S".

Materials and Methods

Participants

The database at the Mary S. Easton Center for Alzheimer's Disease Research at UCLA was queried for subjects who had received a consensus diagnosis of an FTD spectrum disorder and for whom raw data for letter fluency testing with the letters "F," "A", and "S" were available. The criteria proposed by Neary et al[4] were used to diagnose behavioral variant FTD (bvFTD), progressive non-fluent aphasia (PNFA), and semantic dementia (SD). The criteria of Lang et al[15] were employed to diagnose corticobasal degeneration (CBD) and the criteria of Litvan et al[16] were used to diagnose progressive supranuclear palsy (PSP). Thirty-two such subjects were identified. Thirty-eight subjects with probable or possible AD, diagnosed using the criteria of McKhann et al[17], matched for gender and Mini-Mental Mental Status Examination (MMSE)[18] scores who also had letter fluency testing data available were identified for comparison.

Procedures

Letter fluency[19] testing had been administered to each participant as part of a larger neuropsychological test battery. Specifically, participants were sequentially asked to generate as many unique words as they could beginning with the letters *F, A,* and *S* in one-minute. This resulted in three separate one-minute trials of each letter. Several word-generation rules were also explained to the participants: 1) no word could be a proper noun, 2) no word could be a number, and 3) no word could be repeated with a different ending (i.e., "big" and "bigger"). Each word spoken by the participants was manually recorded.

Subjects' clinical, laboratory, imaging, and cognitive data were presented at a consensus conference attended by a multidisciplinary team consisting of neurologists, psychiatrists, a nurse practitioner, neuropsychologists, and other staff where a diagnosis was established. A family conference was then held during which the diagnosis was communicated and treatment options discussed and consent for forwarding clinical data to a database obtained. Approval from the UCLA Institutional Review Board for this inquiry into the database was subsequently obtained.

Through this database inquiry, subjects fitting the above-described criteria were identified. The original response sheets for FAS testing were de-identified and re-coded according to unique identifiers. Two investigators (EK and DLF), blinded to diagnosis and all other clinical information, independently highlighted and counted all uses of the words "f*ck," "*ss", and "sh*t" as well as other expletives or words deemed potentially inappropriate. Where these investigator's ratings differed, a third blinded rater (MFM) adjudicated the discrepancies. These data were entered into a database along with other clinical information including diagnoses.

Age, gender, and years of education, were compared between FTD and AD patients using chi-square tests for categorical variables and t-tests for continuous variables. MMSE scores, number of words beginning with "F," "A," and "S" as well as total FAS scores were compared between FTD spectrum and AD groups and among FTD subtypes and the AD group using independent samples Mann-Whitney U tests and Kruskal-Wallis Tests respectively. The frequencies of the occurrence of the words "f*ck," "*ss", and "sh*t," as well as of any profane or inappropriate words were compared between persons with FTD and AD using chi-square tests. Examples of words counted as such are given in the Results section below. Results different at the 95% confidence level were considered significant. Statistical analyses were performed using the Statistical Package for the Social Sciences, Version 11.0.2.

In an attempt to establish if there were neuropsychological measures of disinhibition that correlated with profanity use, we examined the subjects' performance on the Stroop Test[20], a measure of a specific aspect of executive functioning requiring inhibitory control. We calculated z-scores for the interference trial using published age-adjusted normative data[21]. We then compared these z-scores between patients that generated any profanity and those that did not as well as between those that generated "f*ck" and those that did not by student's T-tests.

Results

Thirty-two patients with FTD and 38 with probable (n = 35) or possible (n = 3) AD comprised the study population. Clinical diagnoses among the 32 FTD patients were bvFTD (15), PNFA (8), CBD (4), SD (4), and PSP (1). Mean MMSE score, ethnicity, and gender did not differ between the FTD and AD groups though MMSE score was missing in one FTD patient. MMSE scores of the diagnostic subgroups were as follows: bvFTD = 22.1, PNFA = 21.4, SD = 20.0, CBD = 14.3, PSP = 23.0, AD = 21.4. These scores were not different using the Kruskal-Wallis Test. Mean years of education was marginally higher in FTD patients (15.8 vs. 14.5, p = 0.053, see Table 1). FTD patients were significantly younger than AD patients (63.0 vs. 71.0, p < 0.001). Among AD patients, one was African American, two were Hispanic and the rest were Caucasian. Among the FTD patients, one was Asian, one was Hispanic, and the rest were Caucasian.

FTD patients generated non-significantly fewer words beginning with the letters "F," "A," and "S" and there were no significant differences among FTD subtypes and AD with regard to the number of words generated. One FTD patient generated no words during FAS testing. Words other than "f*ck," "*ss" and "sh*t" that were counted as inappropriate were "fart" (x3) and "fag." During "F" testing, 2 FTD patients and no AD patients generated no words. Nonetheless, FTD patients generated the word "f*ck" significantly more frequently than did AD patients, with 6 FTD patients (18.8%) saying it compared to none of the AD patients (Fisher's Exact test, p = 0.007). Though a numerically higher percentage of FTD patients said "*ss" and "sh*t" and other words deemed inappropriate during letter fluency testing, these rates were not statistically higher. Among the FTD patients, 3/15 bvFTD, 2/8 PPA, and 1/3 SD patients said "f*ck."

As inclusion of patients with CBD and PSP in the FTD category is controversial, we also looked at whether or not FTD patients said "f*ck" during letter fluency testing when patients with these diagnoses were excluded. As neither the 4 CBD patients nor the single PSP patient said "f*ck" during testing, their exclusion from the FTD group increases the frequency of subjects producing "f*ck" from 18.8% to 28.6% and makes the difference in frequency between the FTD and AD groups significant at the 0.005 level.

Stroop Interference scores were available for 61 of the subjects (34 with AD and 27 with FTD). There were no differences in these scores between subjects that generated profanity during FAS testing and those that did not nor between subjects that generated "f*ck" and those that did not.

Discussion

In this study we demonstrated that patients with clinically-diagnosed FTD were significantly more likely to generate the word "f*ck" on letter fluency testing during neuropsychological assessment than AD patients. This was true despite the overall decreased verbal fluency of FTD patients relative to the AD patients. Even though the sensitivity was modest, none of

the 38 AD subjects generated the word "f*ck," thus the production of this particular word was pathognomonic in this patient population.

There was a trend for FTD patients to produce fewer words overall during letter fluency testing, consistent with FTD patients having diminished verbal abilities overall relative to the patients with AD. Greater deficits in language abilities in general and letter fluency in particular[22] have been reported in FTD relative to AD with AD and clinically-defined subgroups of FTD (semantic dementia and primary progressive aphasia) exhibiting differences in the patterns of deficit in category and letter fluency tasks[13]. Lesion studies suggest that decreased letter fluency occurs with damage to the left frontal lobe[23] and functional imaging studies suggest a role of the left inferior prefrontal cortex in both semantic and phonological fluency[24]. The reason for increased production of expletives in FTD over AD may be related to impaired interpersonal conduct, diminished language abilities, or both. Impaired self-monitoring abilities, e.g. for whether or not one is offending someone, is well-described in FTD[25]. However, we were unable to demonstrate an association between diminished capacity for response inhibition as measured with the Stroop interference score and production of "f*ck" or profanity in general. This could be due to the incompleteness of the data with regard to the Stroop test or that diminished response inhibition as measured with the Stroop test is fundamentally different from that which leads to increased profanity use during letter fluency testing. Nonetheless, as orbitofrontal lesions are associated with diminished empathy and impaired social comportment[26], degenerative changes in these areas may underlie the observed usage of profanity during letter fluency testing.

Another contributing factor might be related to the hemispheric lateralization of language. It is thought that the left hemisphere mediates propositional aspects of language whereas the right hemisphere subserves emotional and prosodic attributes of communication[27]. Preserved use of expletives in otherwise severely aphasic persons with left hemisphere damage is a well-recognized phenomenon[28]. Described as far back as the 1870s by Hughlings Jackson[29] and then elaborated on by Critchley in the 1970's[30] it is thought that the ability to conceptualize propositions is impaired in left-hemisphere damaged subjects, leaving relatively intact more automatic expressive abilities performed by the right hemisphere. Generation of the word "f*ck" was slightly but not significantly more common in the subjects with PNFA or SD (27%) than in those with bvFTD (20%). It may therefore be that having disproportionate left hemisphere relative to right hemisphere damage in degenerative dementias contributes to the use of profanity during letter fluency testing.

We hypothesize that decreased frontal cortical inhibition of subcortical networks is the underlying neuroanatomic basis of increased use of expletives in FTD. The basal ganglia are thought to play a role in automatically executing motor programs that are regulated by cortical input[31]. Disregulated basal ganglia function is thought to underlay the impulsive behaviors seen in Tourette's syndrome[32] which can include coprolalia. It has been demonstrated, using voxel-based morphometry, that cortical atrophy occurs preferentially in the left anterior insula and inferior frontal lobe in PNFA and that mutism occurs when this atrophy has extended to basal ganglia structures[33]. We hypothesize that restricted language abilities from left interior frontal and anterior insula damage or decreased behavioral inhibition of socially inappropriate responses due to orbitofrontal damage, or both, coupled with relatively intact basal ganglia function explain the increased use of expletives during verbal fluency testing in our population with FTD. Without verification with pathological or imaging correlation, this remains somewhat speculative.

In a retrospective chart review of bvFTD in which pathological diagnosis had been determined, Hu et al[34] found that tau-negative bvFTD cases (FTLD-U and FTLDMND)

were more likely than tau-positive bvFTD cases (including PSP and CBD) to have "impaired regulation of personal conduct." Though the neuropathological changes occurring in the current population can at best be speculated on, our findings are consistent with this observation. We found that patients with bvFTD, PNFA, and SD, but not those with CBD or PSP, generated "f*ck" during letter fluency testing. As clinically-defined corticobasal syndrome may be due to AD pathology in as many as 29% of cases[35], inclusion of the four patients in this group in the FTD cohort may have diluted the difference between FTD and AD groups with regard to the usage of expletives. As the nosology of clinically-defined PSP is also controversial[36], one could also argue to exclude this single patient from the FTD group. Exclusion of the CBD and PSP patients increases the frequency of patients with FTD producing "f*ck" to 28.6% and enhances this difference between the FTD and AD groups.

Of note, no significant differences with regard to the use of "*ss," "*hit," or other expletives were observed. This could be due to these words being less frequently used overall or because the word "f*ck" has special qualities as an emotional expression. Words obtain a taboo quality in a given language or social context, depending on many influences. Words considered profane frequently reflect sexual themes, bodily functions, associated body parts, and religious themes. "f*ck," though generally considered inappropriate in most social and professional contexts, is nonetheless frequently used in the society in which this study occurred. In at least two surveys of profanity use in normal English-speaking populations, "f*ck" was the most commonly expressed word[37,38]. It is used as a guttural expression of the act of sexual intercourse, as a gerund to emphasize the emotional salience of something, or as an emotional outburst in itself. The explanation for its relatively specific usage in the disinhibited output during verbal fluency testing in FTD patients is not entirely certain. In the coprolalic speech of persons with Tourette's syndrome (TS), it has been noted that "f*ck" is the most commonly used profanity[39] and that it and words describing body functions and sexual organs are more commonly uttered than words referring to religious themes. Notably, a computer algorithm that strings random letter sequences together to create word-like forms more often produces words of this nature than other types of profanity, apparently due to their phonemic simplicity[39]. It was therefore argued that the tendency to produce words such as "f*ck" in TS has more to do with their linguistic structure rather than their emotional or social valence or specific taboo quality. Though this is a contentious proposition[28], if true it could be the case with regards to output in FTD as well.

There are several limitations to this study. The relatively small number of subjects raises the likelihood that this observation might have been a chance artifact of the population studied. Given a large enough population of AD patients, it would seem likely that at least a few of them would produce the word "f*ck", reducing the specificity of this finding. Though our populations were matched for gender and ethnicity, it is possible that other factors unrelated to neurodegenerative disease that might affect subjects' tendency to use profanity (e.g. premorbid tendency to swear, socioeconomic status) were not matched between groups. It might be anticipated that persons with lower education might have a greater proclivity to use profanity but it is notable that level of education was marginally *higher* in the FTD group. Though it is possible that the lower mean age of FTD subjects may be related to an increased tendency to swear, it is unlikely to fully explain the observed difference in frequency of the "f*ck" response. Mean age did not differ significantly between FTD patients that said "f*ck" (59 years) and those that did not (64 years, p = 0.21).

There were no significant differences between groups with regard to the instrument employed to measure disease stage (MMSE). However, since the MMSE is particularly subject to influence by linguistic abilities and FTD and AD patients can vary dramatically in this regard, it is not the ideal measure to use for this purpose. Finally, though the specific words expressed by patients during verbal fluency testing is not typically discussed at

diagnostic consensus conferences, it is possible that the generation of profanity during verbal fluency testing may have influenced the diagnosis at some level. We think this is unlikely to be a relevant factor however as subjects in this study underwent a comprehensive evaluation with the ultimate consensus diagnoses based on currently accepted research criteria, taking the entire clinical picture into account.

In conclusion, we found that generation of the word "f*ck" during letter fluency testing was specific for the clinical diagnosis of FTD compared to AD but with limited sensitivity. We hypothesize that this is due to diminished concern for social propriety as well as constrained verbal abilities. It was seen in clinically-defined bvFTD, PNFA, and SD but the degree to which it distinguishes underlying FTLD pathology from AD and other non-AD dementias (e.g. vascular dementia) is uncertain and would require clinical neuropathological correlation.

Acknowledgments

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Table 1

Subject characteristics and letter fluency scores.

	FTD patients (n = 32)	AD patients (n = 38)	
Age (s.d.)	63.0 (8.6)	71.1 (9.0)	*p < 0.001*[*]
Gender, # female (%)	16 (50%)	23 (61%)	p = 0.471 [†]
MMSE score (s.d.)	20.7 (6.3)	21.4 (5.3)	p = 0.215 [††]
Years of education (s.d.)	15.8 (2.8)	14.5 (2.7)	*p = 0.053*[*]
Total FAS score (s.d.)	20.0 (9.2)	24.6 (13.1)	p = 0.148 [††]
F word score (s.d.)	7.5 (4.3)	8.6 (4.4)	p = 0.292 [††]
A word score (s.d.)	4.9 (3.1)	6.5 (4.0)	p = 0.123 [††]
S word score (s.d.)	7.2 (3.4)	9.3 (5.5)	p = 0.130 [††]
Frequency of use of "f*ck" on F testing (%)	6/32 (18.8%)	0/38 (0%)	*p = 0.007*[†]

Results of t-tests (*), chi-square tests (†), and Mann-Whitney tests (††) are shown.