

Supplementary Online Content

Baez S, Couto B, Torralva T, et al. Comparing the moral judgments of patients with frontotemporal dementia and frontal stroke. *JAMA Neurol*. Published online July 21, 2014. doi: 10.1001/jamaneurol.2014.347.

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eReferences

This supplementary material has been provided by the authors to give readers additional information about their work.

eAppendix 1. Methods

1.1. Instruments

The general cognitive status was assessed using the Mini-Mental State Examination (MMSE). All participants were also evaluated with the INECO frontal screening (IFS) ¹, a useful tool for detecting the executive impairment of populations with prefrontal cortex involvement. The premorbid intellectual level was evaluated by the word accentuation test (WAT-BA) ².

1.1.1. Moral judgment task

In total, eight possible versions of the 24 scenarios with six trials of each of the four conditions were presented. The stimuli were presented in pseudorandom order and the conditions were counterbalanced across participants. After reading each story, the participants were asked to rate the scenario on a Likert-scale ranging from totally permissible (7) to totally forbidden (1). The entire text remained in front of the participants, to decrease the working memory load.

1.2. Data analysis

In order to evaluate whether the content (neutral vs. negative) of intentions and outcomes were discriminated, paired-samples t tests were used comparing intra-group performances in (a) conditions with the same intention but different outcome and (b) conditions with different intention but the same outcome. For these comparisons we include all control subjects in a single group.

eAppendix 2. Results

2.1 General cognitive status

BvFTD patients showed lower performance than controls on the MMSE ($F(1,36)=4.43$, $p<0.05$) and the IFS ($F(1,36)=16.64$, $p<0.01$). No significant differences between PFL patients and controls were observed on the MMSE ($F(1,14)=0.50$, $p=0.48$) or the IFS ($F(1,14)=2.32$, $p=0.15$) (Table 1).

2.2. Moral judgments

2.2.1. PFL patients vs. controls

Actions with neutral intentions and neutral outcomes were judged as more permissible than actions with negative intentions and negative outcomes [main effects of intention ($F(1,14)=115.89$, $p<0.01$) and outcome ($F(1,14)=50.33$, $p<0.01$)]. Furthermore, accidental harms were judged as more permissible than intentional harms [intention x outcome interaction ($F(1,14)=17.93$, $p<0.01$)]. No significant differences were observed for non-harms ($F(1,14)=0.18$, $p=0.67$), accidental harms ($F(1,14)=0.25$, $p=0.62$) or successful attempts to harm ($F(1,14)=1.36$, $p=0.26$).

2.2.2. bvFTD patients vs. controls

Actions with neutral intentions and neutral outcomes were judged as more permissible than actions with negative intentions and negative outcomes [main effects of intention ($F(1,36)=293.68$, $p<0.01$) and outcome ($F(1,36)=155.85$, $p<0.01$)]. Moreover, accidental harms were judged as more permissible than intentional harms [intention x outcome interaction ($F(1,36)=21.42$, $p<0.01$)].

There were no significant differences for non-harms ($F(1,14)=0.75$, $p=0.39$) or successful attempts to harm ($F(1,14)=2.30$, $p=0.13$).

2.2.3. PFL vs. bvFTD patients

There were no significant differences in any of the conditions: non-harm ($F(1,24)=1.46, p=0.23$), accidental harm ($F(1,24)=2.24, p=0.14$), attempted harm ($F(1,24)=0.12, p=0.72$) or successfully attempted harm ($F(1,24)=0.05, p=0.81$). The covariate with the control condition (paired cases) did not show a significant effect in any of the analyses

Considering that the statistical significance depends on the variability within each group (among other factors), we have reanalyzed the data on the PFL and bvFTD patients, excluding the subjects who were below (minus 2 SD) or above (plus 2 SD) the group mean. In total, three bvFTD patients were excluded, two in the second condition (accidental harm) and one in the third condition (attempted harm). The results showed that patients with bvFTD judged accidental harm as less permissible than did PFL patients ($F(1,22)=5.98, p<0.05$). No significant differences between the groups were observed for attempted harm ($F(1,23)=0.11, p=0.73$).

2.2.4. Intra-group comparisons

PFL patients. There were significant differences between attempted harms and non-harms ($t(7) = 6.58, p = 3 \times 10^{-4}$) and between accidental harms and successful attempts to harm ($t(7) = 5.12, p = 0.001$). Judgments of PFL patients reflected differences between attempted harms and successful attempts to harm ($t(7) = 5.39, p = 0.001$), as well as between non-harms and accidental harms ($t(7) = 4.81, p = 0.001$). Thus, they were able to distinguish the content of intentions and outcomes. Nonetheless, no significant differences were observed ($t(7) = 1.10, p = 0.30$) between attempted and accidental harms.

We also compared the performance of patients with PFL with and without VMPC involvement. No significant differences were detected in any condition: non-harms ($Z=-0.44, p=0.65$), accidental harms ($Z=0.74, p=0.44$), attempted harms ($Z=-0.14, p=0.88$) and successful attempts to harm ($Z=0.89, p=0.97$).

BvFTD patients. Judgments for attempted harms were significantly different of non-harms ($t(18) = 5.43, p = 3.7 \times 10^{-5}$). Judgments for accidental harms and successful attempts to harm ($t(18) = 7.12, p = 1 \times 10^{-6}$) also differed. Moreover, there were differences between attempted harms and successful attempts to harm ($t(18) = 6.21, p = 7 \times 10^{-7}$) and between non-harms and accidental harms ($t(18) = 9.96, p = 1 \times 10^{-8}$). Thus, bvFTD patients correctly discriminated neutral from negative intentions and outcomes. Surprisingly, although did not reach significance ($t(18) = 1.21, p = 0.24$), they judged attempted harms as more permissible than accidental harms.

Control subjects. There were differences between attempted harms and non-harms ($t(24) = 22.47, p = 1 \times 10^{-8}$) and between accidental harms and successful attempts to harm ($t(24) = 11.70, p = 1 \times 10^{-8}$). Furthermore, there were differences between attempted harms and successful attempts ($t(24) = 2.82, p = 0.009$), and between non-harms and accidental harms ($t(24) = 6.68, p = 1 \times 10^{-6}$). Thus, controls could discriminate the content of intentions and outcomes. Finally, they judged accidental harms as more permissible than attempted harms ($t(24) = 10.89, p = 1 \times 10^{-8}$).

We performed single-case analyses to compare the score of each patient with VMPC to the scores obtained by the group of patients without VMPC lesions. The results showed no significant differences between Subject 1 ($t = 0.65, p = 0.27, z_{cc} = 0.72$), Subject 2 ($t = -0.74, p = 0.25, z_{cc} = -0.81$) or Subject 3 ($t = -0.41, p = 0.35, z_{cc} = -0.45$) and the group of patients without VMPC damage.

eTable. Demographic data and general cognitive status assessment.

		FL (n=8)	FL CTR (n=8)	FL vs CTR	FTD (n=19)	FTD CTR (n=19)	FD vs CTR
Demographics	Age (years)	47.5(14.3)	46.8(14.7)	NS	41.4 (5.6)	42.4 (4.2)	NS

	Gender (F:M)	2:6	2:6	NS	8:11	9:10	NS
	Education (years)	14.3 (3.8)	26.6 (17.5)	NS	14.7 (4.3)	17.1 (9.8)	NS
	WAT	40.7 (3.3)	40.2 (3.8)	NS	41.4 (5.6)	42.4 (4.2)	NS
Cognitive status	MMSE	28.3 (1.7)	29.0 (1.6)	0.04	26.5 (2.8)	28.1 (1.5)	NS
	IFS Total Score	22.7 (5.2)	25.9 (2.3)	0.0002	18.5 (5.8)	24.7 (2.1)	NS
	Motor series	2.9 (0.4)	2.9 (0.4)	NS	2.6 (0.8)	2.9 (0.2)	NS
	Conflicting instructions	2.9 (0.4)	3 (0.0)	NS	2.5 (0.8)	2.9 (0.3)	NS
	Go- no go	1.9 (1.5)	2.9 (0.4)	NS	1.8 (1.0)	2.4 (0.5)	NS
	Backward digits span	3.7 (1.1)	4.4 (0.9)	0.01	3.5 (1.0)	4.2 (0.6)	NS
	Verbal Working memory	1.6 (0.8)	2.0 (0.0)	0.04	1.6 (0.7)	1.9 (0.2)	NS
	Spatial working memory	2.0 (1.0)	2.6 (0.7)	NS	1.8 (0.9)	2.1 (0.8)	NS
	Abstraction capacity	1.9 (1.0)	2.9 (0.2)	0.0006	1.7 (1.0)	2.7 (0.4)	0.01
	Verbal inhibitory control	3.6 (2.4)	5.9 (0.4)	0.0005	3.5 (1.9)	5.3 (0.6)	0.01

FTD=Frontotemporal dementia; FL=Frontal lesions; WAT=Word accentuation test; MMSE=Minimental State Examination; IFS=INECO Frontal Screening.

eReferences

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2. Burin DI, Jorge RE, Arizaga RA, Paulsen JS. Estimation of premorbid intelligence: the word accentuation test-- Buenos Aires version. *J Clin Exp Neuropsychol.* 2000;22(5):677-685.