

## LETTER TO THE EDITOR

### Towards a neurocomputational account of social dysfunction in neurodegenerative disease

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Sir,

We were excited by the recent findings of Melloni and colleagues (2016) showing preserved immediate responses to offers during a social bargaining task in behavioural variant frontotemporal dementia (bvFTD) and frontal lesion patients. In contrast, deficits emerged at the more complex level of social bargaining requiring successful integration of self and others' preferences. Our study published earlier this year in *Brain* echoed this dissociation: bvFTD patients retained basic fairness judgements during social bargaining, but failed to adjust their behaviour to accommodate additional information about another's perspective (O'Callaghan *et al.*, 2016). Together these emphasize intact self-preferences with impaired ability to integrate others' perspectives. But how do the observed dissociations in both studies relate to (i) neurocomputational accounts of social bargaining behaviour; and (ii) clinical symptomatology?

In neurocomputational accounts of social bargaining independent outcome values are determined for the self and other, then integrated in an overall value signal. Anatomically, the anterior cingulate cortex gyrus—chiefly the subgenual region—is particularly responsive to other-oriented social information when decisions are made that impact another person (Lockwood *et al.*, 2016). Computations here incorporate value and prediction error relating to the outcomes of others' behaviour (Apps *et al.*, 2016). Adjacent regions in the ventromedial prefrontal cortex encode the overall value of a choice incorporating both self and other information (Hutcherson *et al.*, 2015). For adaptive social behaviour the relative weight assigned

to self versus other information needs to be flexibly updated according to their uncertainty—i.e. the quality of those estimates (Rushworth and Behrens, 2008; Lee and Seo, 2016). In bvFTD and frontal lesions, information about others' perspectives would be persistently low quality, and hence unreliable. A relative preservation of self-perspective in this context may inevitably bias the overall value signal in favour of self-benefit. This is captured in neurocomputational models where the relative weight assigned to self versus other pay-offs determines the extent to which a choice will be prosocial or selfish (Crockett, 2016).

These neurocomputational accounts, and the experimental data from the two recent studies, offer a first glimpse at a computational basis for the egocentric and socially inconsiderate behaviours common to bvFTD and frontal lesion patients—that is, an overweighting of self-preference in social decision-making will lead to more self-centred behaviours. Identifying changes in the subgenual region, such as atrophy or lesion, seems critical in preparing the patient and their family for the potential evolution of these behavioural changes. In particular in bvFTD where the subgenual region can be affected from the earliest disease stages (Seeley *et al.*, 2008). Identifying the origin of these symptoms not only has implications for diagnosis and prognostication, but also the potential to treat these deficits. Non-pharmacologically, tailored carer/family training can alleviate the distressing nature of these symptoms (O'Connor *et al.*, 2015). Pharmacologically, ongoing efforts in non-clinical fields to link other-regarding social computations to specific neuromodulators (e.g. serotonin)

(Crockett and Cools, 2015) could have significant implications for therapeutic strategies in these patient groups.

Taken together, the exciting findings by Melloni and colleagues (2016), along with our previous findings and neurocomputational account, have the potential to delineate the complex behavioural symptoms often seen in patients with frontal lobe changes. In turn, this knowledge will pave the way for new therapeutic strategies.

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