

## RESEARCH ARTICLE

# Evidence for a dissociation between moral reasoning and moral decision-making in Tourette syndrome

Carmelo Mario Vicario<sup>1</sup>  | Nicoletta Maugeri<sup>2</sup> | Chiara Lucifora<sup>3</sup> |  
Adriana Prato<sup>1,2</sup> | Massimo Mucciardi<sup>1</sup> | Davide Martino<sup>4,5,6</sup> |  
Renata Rizzo<sup>2</sup>

<sup>1</sup>Department of Cognitive Sciences, Psychology, Education and Cultural Studies, University of Messina, Messina, Italy

<sup>2</sup>Child Neuropsychiatry Unit, Department of Clinical and Experimental Medicine, University of Catania, Catania, Italy

<sup>3</sup>STLab, ISTC-CNR, Rome, Italy

<sup>4</sup>Department of Clinical Neurosciences, University of Calgary, Calgary, Alberta, Canada

<sup>5</sup>Hotchkiss Brain Institute, University of Calgary, Calgary, Alberta, Canada

<sup>6</sup>Alberta Children's Hospital Research Institute, University of Calgary, Calgary, Alberta, Canada

## Correspondence

Carmelo Mario Vicario, Department of Cognitive Sciences, Psychology, Education and Cultural Studies, University of Messina, via concezione n 6, Messina, 98122, Italy.  
Email: [cvicario@unime.it](mailto:cvicario@unime.it)

## Abstract

Despite the growing interest on how Tourette syndrome (TS) affects social cognition skills, this field remains to date relatively under-explored. Here, we aim to advance knowledge on the topic by studying moral decision-making and moral reasoning in a group of adolescents with TS and a group of healthy controls. Overall, we found higher endorsement (i.e. a greater 'yes' response rate) for utilitarian solutions of incidental and instrumental moral dilemmas in TS compared to controls. By contrast, we reported an overall higher tendency of TS individuals to apply principles described in the moral foundation questionnaire to establish whether something is morally right or wrong. Our results document intact moral reasoning in TS and suggest that a deficit in suppressing inappropriate behaviours and/or altered sense of agency might be responsible for their higher utilitarian moral decision-making.

## KEYWORDS

moral decision-making, moral reasoning inhibitory control, Tourette syndrome

## INTRODUCTION

Tourette syndrome (TS) is a neurodevelopmental disorder characterized by a wide range of behavioural deficits that may involve cognitive control (Jackson et al., 2011), time processing (Vicario et al., 2010, 2016) and language and decision-making processes (Albin, 2018; Vicario et al., 2020, 2021). Despite the growing interest on how TS affects social cognition skills (e.g. Albin, 2018; Eddy, 2018) and the potential implications for clinical management, the field remains relatively under-explored.

This is an open access article under the terms of the [Creative Commons Attribution](https://creativecommons.org/licenses/by/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2023 The Authors. *Journal of Neuropsychology* published by John Wiley & Sons Ltd on behalf of The British Psychological Society.

A recent cohort study (Mataix-Cols et al., 2022) documented a higher risk for both experiencing violent assault and being perpetrators of violence in individuals with TS or chronic tic disorder (see also Martino et al., 2022 for a discussion). Moreover, it was (Vicario et al., 2021) recently reported that persons with TS consider utilitarian actions suggested to solve different types of moral dilemmas as more acceptable compared to typically developing individuals (Lotto et al., 2014). Finally, it has been observed that a subgroup of persons with TS can manifest limited ability to suppress socially inappropriate, although unintentional, behaviour (Senberg et al., 2021).

Building on the existing evidence, we aimed to expand knowledge on morality in TS by evaluating in the same clinical sample both moral decision-making, which requires to take an ethical decision on hypothetical scenarios, and moral reasoning, which refers to the acceptance of specific principles to establish whether something is morally right or wrong, in order to assess whether a dissociation exists between these two aspects of morality-related cognition in TS. To test moral decision-making, participants were asked to decide if they would endorse (would perform) the hypothetical (utilitarian) resolutions described in a small set of moral dilemmas (Lotto et al., 2014). In these resolutions, one individual is (instrumentally or incidentally) killed to save a group of people who would have died otherwise. Filler dilemmas are also included as control conditions (the described actions do not imply to kill someone). For moral reasoning, participants completed the Moral Foundation Questionnaire (MFQ-30, Graham et al., 2011), which explores the different dimensions of morality categorized according to the Moral Foundations Theory (Haidt & Joseph, 2004).

We also explored the emotional experience more frequently associated with the different scenarios (Lotto et al., 2014) to investigate whether any group difference in moral decision-making can be associated with a specific affective experience in TS. We focused on disgust and anger emotions, which are more frequently associated with the experience of ethical violation (Russell & Giner-Sorolla, 2013; Vicario, 2016; Vicario et al., 2018, 2022; Vicario & Rafal, 2017).

## MATERIALS AND METHODS

### Subjects

Twenty-one adolescents (seven females [F]; mean age: 14.71, 1.73 standard deviation [SD]), with a diagnosis of TS (Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition) were enrolled, all of whom untreated and without co-morbid obsessive-compulsive disorder or attention deficit hyperactivity disorder. Twenty-one age-matched healthy controls recruited in middle school (8F; mean age: 14.85, SD: 1.62). TS subjects were recruited from outpatients referred to a tertiary center for TS and related disorders. Tic severity ( $M = 14.76$  SD = 7.08) was assessed with the Yale Global Tic Severity Scale (YGTSS). Anxiety was measured with the Multidimensional Anxiety Scale for Children (MASC); mean anxiety levels were low in both TS ( $M = 36.14$ , SD = 11.20) and control ( $M = 34.00$ , SD = 12.99) participants. Depression was measured using the Children's Depression Inventory (CDI), with normal mean scores in both TS ( $M = 7.76$ , SD = 4.71) and control participants ( $M = 9.42$ , SD = 4.22). Disgust sensitivity was measured with the Disgust Sensitivity Scale (DS-Scale, version 1; Haidt et al., 1994). Table 1 includes demographic data. The study was approved by the local Ethics committee. Written consent was obtained from all participants and their adult carers.

### Behavioural measures

#### Instruments

##### *Moral dilemmas*

As in a previous study (Lucifora, Grasso, et al., 2021; Lucifora, Martino, et al., 2021), to test moral decision-making, we used three subsets of the 75 dilemmas created by Lotto et al. (2014). We chose

TABLE 1 Demographic and DS-Scale results.

	Sex	Age	DS-scale	MASC	CDI	YGTSS
Tourette syndrome	Male = 14	$M = 14.71$	$M = 19.14$	$M = 36.14$	$M = 7.76$	$M = 14.76$
	Female = 7	$SD = 1.73$	$SD = 5.03$	$SD = 11.20$	$SD = 4.71$	$SD = 7.08$
Controls	Male = 13	$M = 14.85$	$M = 14.90$	$M = 34.00$	$M = 9.42$	NA
	Female = 8	$SD = 1.62$	$SD = 6.98$	$SD = 12.99$	$SD = 4.22$	
Statistical comparison	$\chi^2 = .10$ $p = .747$	$t = -.27$ $p = .780$	$t = -2.25$ $p = .029^*$	$t = .57$ $p = .570$	$t = 1.20$ $p = .234$	NA

Note: (\*) Indicates significant difference.

these subsets to explore moral decision-making in different relevant scenarios. One subset included *Incidental dilemmas*, that is, scenarios where the sacrifice of one person is an expected but unwanted consequence of an action aimed at saving a greater number of people. A second subset included *Instrumental dilemmas*, that is, scenarios where the sacrifice of one person is essential to save more people. In both these categories of dilemmas, scenarios were varied to directly implicate participants (self-involvement) or not (others' involvement) as causing the death of others. A final subset of *Filler dilemmas* included scenarios describing moral issues such as stealing, lying and dishonesty, but never involved death (Lotto et al., 2014). For this study, we used 15 dilemmas, consisting of 6 incidental dilemmas (three with self-involvement and three with other involvement), six instrumental dilemmas (three with self-involvement and three with other involvement) and three filler dilemmas.

For the *incidental dilemmas* with other involvement, we used *hospital, nurse* and *quarantine*. For *incidental dilemmas* with self-involvement, we used *nuclear power plant, window* and *bodyguard*. For *instrumental dilemmas* with other involvement, we used *door, transplant* and *vitamins*. For *instrumental dilemmas* with self-involvement, we used *helicopter, jeep* and *kidnapping and escape*. For the *filler dilemmas*, we used *charity, supermarket* and *wallet* (see Lotto et al., 2014 for the detailed content of the adopted dilemmas). Participants were asked to express a binary judgement as to whether the described actions, which propose a utilitarian solution (i.e. minimize losses), are acceptable or unacceptable. Moreover, they were asked to report the emotion perceived within each moral scenario.

### MFQ-30

This 30-item self-report scale, divided into two parts (Graham et al., 2011), allows to evaluate different dimensions of moral reasoning by asking participants to rate the moral relevance and agreement with items related to five moral foundations:

- H - *Harm/care* (Harming, Hurting, Caring) which covers everything that has to do with protecting and caring for other people considered vulnerable or needy.
- F - *Fairness/reciprocity* (Justice, Equity, Reciprocity) which includes aspects concerning justice, correctness, reciprocity in behaviours and relationships.
- I - *Ingroup/loyalty* (Membership in the group, Loyalty) which recalls some aggregating functions in favour of the group, such as loyalty and patriotism.
- A - *Authority/respect* which includes aspects centred on respect for authority, obedience and leadership.
- P - *Purity/sanctity*: which includes aspects such as purity and spirituality.

This scale explores the relevance of specific principles guiding on whether something is morally right or wrong and how the five moral foundations are concretely used in ethical evaluation. The higher the score, the greater the adherence of the participants to the principles provided by the MFQ-30.

### DS-R

To measure the disgust sensitivity (DS) trait, we used the DS-R scale (Haidt et al., 1994). This scale includes 32 items, encompassing two true-false and two disgust-rating items for each of seven domains

of disgust elicitors (food, animals, body products, sex, body envelope violations, death and hygiene) and for a domain of magical thinking (via similarity and contagion) that cuts across the seven domains of elicitors (Haidt et al., 1994).

## Procedure

All questionnaires were administered verbally to participants (patients or controls) via Skype interview by a single interviewer (always visible on the screen), using a uniform procedure. Participants were asked to remain visible to the interviewer throughout the interviews. This approach was adopted due to COVID-19 restrictions, which did not permit in-person face-to-face interactions with participants. Each participant received a digital copy of questionnaires to provide education about their contents prior to interview responses.

## Data analysis

Data normality was assessed by visual inspection and using the Shapiro–Wilk test. In the case of not normal distribution, we planned to apply the Mann–Whitney  $U$  test to compare TS and control responses (i.e. endorsement rate and emotional experience) for incidental, instrumental and filler dilemmas and Spearman correlation analyses to investigate possible relationships between moral MFQ-30, tic severity (in TS only) and disgust sensitivity. We also considered any difference between self-involvement and other involvement related to incidental and instrumental scenarios. Finally, we compared TS and control responses associated with the different MFQ-30 subscales. Bonferroni correction was applied for multiple comparisons. Significant correlations are indicated by  $p$ -value  $\leq .007$  (.05/7 subscales of the MFQ-30).

## RESULTS

### Moral dilemmas

*Endorsement:* data for all comparisons were not normally distributed ( $p \leq .013$ ). Therefore, a non-parametric test was applied. Results documented a higher endorsement rate for all ethical violations in TS participants, compared to controls (see [Table 2](#) for details).

*Emotions:* data for all comparisons were not normally distributed ( $p \leq .008$ ). Therefore, a non-parametric test was applied. TS mentioned the emotion of disgust less frequently than controls in ‘other involvement’ incidental and in filler moral scenarios (see [Table 2](#) for details). Moreover, TS mentioned the emotion of anger more frequently than controls in incidental moral scenarios, but less frequently than controls in instrumental (self-related) and filler scenarios. Details are reported in [Table 3](#).

### MFQ-30

Data for all comparisons were not normally distributed ( $p \leq .050$ ). Mann–Whitney  $U$  test documented a significant difference on three of the five subscales of MFQ-30. We reported higher scores for TS compared to controls (see [Table 4](#) for details).

Finally, no significant correlations were found between MFQ-30 scores and YGTSS and DS-R scores (see [Table 5](#)).

TABLE 2 Mann–Whitney *U* test on endorsement rate associated with incidental, instrumental and filler moral dilemmas.

	Rank sum – TS	Rank sum - controls	<i>U</i>	<i>Z</i>	<i>p</i> -value
Incidental self	625.50	277.50	46.50	4.38	<.001*
Incidental others	624.00	279.00	48.00	4.34	<.001*
Instrumental self	661.50	241.50	10.50	5.28	<.001*
Instrumental others	652.50	250.50	19.50	5.06	<.001*
Fillers	569.00	334.00	103.00	2.96	.003*

\*Indicates statistically significant differences.

TABLE 3 Mann–Whitney *U* test on disgust and anger experiences associated with incidental, instrumental and filler moral dilemmas.

	Rank sum - TS	Rank sum - controls	<i>U</i>	<i>Z</i>	<i>p</i> -value
Disgust self-incidental	446.50	456.50	215.50	-.13	.899
Disgust other incidental	294.00	609.00	63.00	-3.96	<.001*
Disgust self-instrumental	407.00	496.00	176.00	-1.12	.262
Disgust other instrumental	447.50	455.50	216.50	-.10	.919
disgust Filler	304.00	599.00	73.00	-3.71	<.001*
Anger self-incidental	545.50	357.50	126.50	2.36	.018*
Anger other incidental	565.00	338.00	107.00	2.86	.004*
Anger self-instrumental	309.50	593.50	78.50	-3.57	<.001*
Anger other instrumental	514.50	388.50	157.50	1.58	.113
Anger filler	356.50	546.50	125.50	-2.39	.017*

\*Statistically significant differences.

TABLE 4 Mann–Whitney *U* test on scores associated with the five MFQ-30 subscales and control questions.

	Rank sum - TS	Rank sum - controls	<i>U</i>	<i>Z</i>	<i>p</i> -value
Harm/care	624.00	279.00	48.00	4.34	<.001*
Fairness/reciprocity	645.00	258.00	27.00	4.87	<.001*
Ingroup/loyalty	625.50	277.50	46.50	4.38	<.001*
Authority/ respect	545.00	358.00	127.00	2.35	.018*
Purity/sanctity	552.00	351.00	120.00	2.53	.011*
Question 6	462.00	441.00	210.00	.26	.791
Question 22	462.00	441.00	210.00	.26	.791

\*Statistically significant differences.

## DISCUSSION

In this study, we investigated two important dimensions of morality-related social cognition, moral reasoning and moral decision-making (Grasso et al., 2020; Lucifora et al., 2020; Lucifora, Grasso, et al., 2021; Lucifora, Martino, et al., 2021; Vicario & Lucifora, 2021), to the best of our knowledge still unexplored in TS. Overall, we found greater endorsement (i.e. a greater ‘yes’ response rate) of utilitarian solutions to incidental, instrumental and filler moral dilemmas in TS compared to controls. Moreover, no difference was found between self-involvement and other involvement. Finally, TS mentioned the

TABLE 5 Spearman correlation between YGTSS, DS-R and MFQ-30 subscales.

	Harm/Care	Fairness/ Reciprocity	Ingroup/ loyalty	Authority/ respect	Purity/ Sanctity	Question 6	Question 22
YGTSS	$r = -.094$ $p = .684$	$r = .144$ $p = .532$	$r = .143$ $p = .534$	$r = -.122$ $p = .597$	$r = -.140$ $p = .544$	$r = -.260$ $p = .253$	$r = -.283$ $p = .212$
DS-R (TS)	$r = .262$ $p = .250$	$r = -.006$ $p = .976$	$r = -.105$ $p = .642$	$r = .015$ $p = .946$	$r = .242$ $p = .288$	$r = .279$ $p = .220$	$r = .000$ $p = 1.00$
DS-R (CT)	$r = -.346$ $p = .123$	$r = .055$ $p = .812$	$r = -.372$ $p = .096$	$r = .129$ $p = .557$	$r = .203$ $p = .376$	**	$r = -.271$ $p = .233$

Abbreviations: A, authority/respect; F, fairness/reciprocity; H, harm/care; I, ingroup/loyalty; P, purity/sanctity.

\*\*Not applicable as there is no variability in data distribution.

experience of disgust less frequently than controls in the case of incidental—‘other involvement’—and in filler moral scenarios. On the other hand, TS mentioned the emotion of anger more frequently than controls in incidental (self and other) scenarios, but less frequently than controls in instrumental (self-involvement) and filler scenarios. The reported emotional pattern does not provide a straightforward explanation for the higher endorsement rate of TS, compared to controls, documented for the three types of moral scenarios. The reduced disgust sensitivity in TS is in line with the literature on a negative relationship between incidental disgust and moral disapproval (e.g. Eskine et al., 2011). A similar interpretation can be mentioned for anger (known to be associated with higher moral disapproval, Piazza & Landy, 2020), which is reduced only for instrumental (self-involvement) and filler scenarios. However, the absence of between-group differences for the experience of disgust associated with instrumental scenarios and the higher (instead of lower) experience of anger with incidental scenarios, suggest that other variables, not investigated in the current study, could have contributed to explaining the higher endorsement rate of TS participants.

We also documented an overall greater MFQ-30 score in TS, compared to controls, with statistically significant differences in all the five subscales of this instrument. This suggests that principles described in the subscales of MFQ-30 are particularly relevant to establish whether something is morally right or wrong in TS, as the higher the score, the greater the adherence of the participants to the principles provided by the MFQ-30. This suggests that TS individuals are characterized by a greater utilitarian moral attitude compared to controls when they are called to reason on moral content. A possible, albeit speculative, explanation for the current finding could relate to deficits in inhibitory control (Morand-Beaulieu et al., 2017; Wright et al., 2012) and increased impulsivity (Atkinson-Clement et al., 2020) of the TS patients, in line with the evidence of a higher utilitarian moral attitude in individuals with greater impulsivity (Lucifora, Grasso, et al., 2021; Lucifora, Martino, et al., 2021). This is also in line with the evidence of altered involvement of the ventromedial prefrontal cortex (VMPFC), as part of the corticostriatal pathways, in TS (Singer, 2013), in keeping with the evidence of higher utilitarian moral decisions in patients with VMPFC damage (Koenigs et al., 2007). Although the VMPFC is not formally considered a part of the inhibitory control network, the study by Yu et al. (2015) has shown a direct involvement of this region in the overall response inhibition process.

On the other hand, the greater MFQ-30 score in TS suggests a dissociation between moral decision-making and moral reasoning in this clinical population. This dissociation might be explained in line with the evidence that TS patients can suffer from an irrepressible tendency to socially inappropriate, although unintentional, behaviour (Kurvits et al., 2020; Senberg et al., 2021), for example, coprolalia, which consists of unintentional (mostly automatic and ‘ego-dystonic’), obscene and socially inappropriate vocalization (Van Lancker & Cummings, 1999. See also Senberg et al., 2021, *for a review*). Moreover, about 5% of TS individuals suffer from uncontrollable violence and temper (Cheung et al., 2007). Accordingly, one might speculate that the greater endorsement provided by TS individuals for utilitarian solutions might reflect the unintentional/unwanted tendency to put in action behaviours not in line with their moral principles. This hypothesis is also corroborated by a recent study (Zapparoli et al., 2020) reporting an impaired sense of agency in TS patients. Sense of agency refers to the degree of intentionality and awareness in doing something including

the implications or results of that action (Zanatto et al., 2021). Since the sense of agency is a crucial element of the decision-making process, it could be hypothesized that the increased utilitarian moral attitude observed in patients with TS is a consequence of their altered sense of agency which would lower their sense of responsibility, thus increasing the acceptability of utilitarian solutions. However, the absence of a difference in approval rating between self-involvement and other involvement suggests some caution about the sense-of-agency hypothesis.

Alternatively, this dissociation between moral decision-making and moral reasoning in TS could be explained in terms of a greater tendency of these individuals to conform with solutions provided from the outside, as this would help to improve their difficulty in dealing with conflicting decisions (Metzloff et al., 2022), that can arise when dealing with moral dilemmas. This hypothesis could also be useful to explain the greater concordance of TS, compared to controls, for ethical principles investigated by MFQ-30.

In conclusion, our study expands the emerging literature on social cognition in TS by providing evidence for a dissociation between moral decision-making and moral reasoning. The current findings might also have implication for clinical practice suggesting that the TS's higher risk of being involved in violent assault or criminal conviction (Mataix-Cols et al., 2022) may not stem from altered ethical reasoning but could reflect their failure to suppress inappropriate behaviour. Further investigation is needed to provide more direct evidence for this hypothesis.

## AUTHOR CONTRIBUTIONS

**Carmelo Mario Vicario:** Conceptualization; data analysis; writing – original draft; writing – review and editing. **Nicoletta Maugeri:** Data collection/investigation. **Chiara Lucifora:** Writing – review and editing. **Adriana Prato:** Investigation. **Massimo Mucciardi:** Data analysis. **Davide Martino:** Review and editing. **Renata Rizzo:** Conceptualization; review and editing; resources.

## CONFLICT OF INTEREST STATEMENT

All authors declare no conflict of interest.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

## ORCID

Carmelo Mario Vicario  <https://orcid.org/0000-0001-7557-9078>

## REFERENCES

- Albin, R. L. (2018). Tourette syndrome: A disorder of the social decision-making network. *Brain*, *141*(2), 332–347.
- Atkinson-Clement, C., Sofia, F., Fernandez-Egea, E., de Liege, A., Beranger, B., Klein, Y., Deniau, E., Roze, E., Hartmann, A., & Worbe, Y. (2020). Structural and functional abnormalities within sensori-motor and limbic networks underpin intermittent explosive symptoms in Tourette disorder. *Journal of Psychiatric Research*, *125*, 1–6.
- Cheung, M. Y., Shahed, J., & Jankovic, J. (2007). Malignant Tourette syndrome. *Movement Disorders*, *22*(12), 1743–1750.
- Eddy, C. M. (2018). Social cognition and self-other distinctions in neuropsychiatry: Insights from schizophrenia and Tourette syndrome. *Progress in Neuro-Psychopharmacology & Biological Psychiatry*, *82*, 69–85.
- Eskine, K. J., Kaciniuk, N. A., & Prinz, J. J. (2011). A bad taste in the mouth: Gustatory disgust influences moral judgment. *Psychological Science*, *22*(3), 295–299.
- Graham, J., Nosek, B. A., Haidt, J., Iyer, R., Koleva, S., & Ditto, P. H. (2011). Mapping the moral domain. *Journal of Personality and Social Psychology*, *101*(2), 366–385.
- Grasso, G. M., Lucifora, C., Perconti, P., & Plebe, A. (2020). Integrating human acceptable morality in autonomous vehicles. *Advances in Intelligent Systems and Computing*, *1131*, 41–45.
- Haidt, J., & Joseph, C. (2004). Intuitive ethics: How innately prepared intuitions generate culturally variable virtues. *Daedalus*, *133*, 55–66.
- Haidt, J., McCauley, C., & Rozin, P. (1994). Individual differences in sensitivity to disgust: A scale sampling seven domains of disgust elicitors. *Personality and Individual Differences*, *16*(5), 701–713.
- Jackson, S. R., Parkinson, A., Jung, J., Ryan, S. E., Morgan, P. S., Hollis, C., & Jackson, G. M. (2011). Compensatory neural reorganization in Tourette syndrome. *Current Biology*, *21*(7), 580–585.

- Koenigs, M., Young, L., Adolphs, R., Tranel, D., Cushman, F., Hauser, M., & Damasio, A. (2007). Damage to the prefrontal cortex increases utilitarian moral judgements. *Nature*, *446*(7138), 908–911.
- Kurvits, L., Martino, D., & Ganos, C. (2020). Clinical features that evoke the concept of disinhibition in Tourette syndrome. *Frontiers in Psychiatry*, *11*, 21.
- Lotto, L., Manfrinati, A., & Sarlo, M. (2014). A new set of moral dilemmas: Norms for moral acceptability, decision times, and emotional salience. *Journal of Behavioral Decision Making*, *27*, 57–65.
- Lucifora, C., Grasso, G. M., Perconti, P., & Plebe, A. (2020). Moral dilemmas in self-driving cars. *Rivista Internazionale di Filosofia e Psicologia*, *11*(2), 238–250.
- Lucifora, C., Grasso, G. M., Perconti, P., & Plebe, A. (2021). Moral reasoning and automatic risk reaction during driving. *Cognition, Technology and Work*, *23*(4), 705–713.
- Lucifora, C., Martino, G., Curcuruto, A., Salehinejad, M. A., & Vicario, C. M. (2021). How self-control predicts moral decision making: An exploratory study on healthy participants. *International Journal of Environmental Research and Public Health*, *18*(7), 3840.
- Martino, D., Leckman, J. F., & Okun, M. S. (2022). Why some individuals with Tourette syndrome experience assault and perpetrate criminal behavior. *JAMA Neurology*, *79*(5), 442–444.
- Mataix-Cols, D., Virtanen, S., Sidorchuk, A., Fernández de la Cruz, L., Larsson, H., Lichtenstein, P., & Latvala, A. (2022). Association of tourette syndrome and chronic tic disorder with violent assault and criminal convictions. *JAMA Neurology*, *79*(5), 459–467.
- Metzlaff, J., Finis, J., Münchau, A., Müller-Vahl, K., Schnitzler, A., Bellebaum, C., Biermann-Ruben, K., & Niccolai, V. (2022). Altered performance monitoring in Tourette syndrome: An MEG investigation. *Scientific Reports*, *12*(1), 8300.
- Morand-Beaulieu, S., Grot, S., Lavoie, J., Leclerc, J. B., Luck, D., & Lavoie, M. E. (2017). The puzzling question of inhibitory control in Tourette syndrome: A meta-analysis. *Neuroscience and Biobehavioral Reviews*, *80*, 240–262.
- Piazza, J., & Landy, J. F. (2020). Folk beliefs about the relationships anger and disgust have with moral disapproval. *Cognition and Emotion*, *34*(2), 229–241.
- Russell, P. S., & Giner-Sorolla, R. (2013). Bodily moral disgust: What it is, how it is different from anger, and why it is an unreasoned emotion. *Psychological Bulletin*, *139*(2), 328–351.
- Senberg, A., Münchau, A., Münte, T., Beste, C., & Roessner, V. (2021). Swearing and coprophenomena - a multidimensional approach. *Neuroscience and Biobehavioral Reviews*, *126*, 12–22.
- Singer, H. S. (2013). Motor control, habits, complex motor stereotypies, and Tourette syndrome. *Annals of the New York Academy of Sciences*, *1304*, 22–31.
- Van Lancker, D., & Cummings, J. L. (1999). Expletives: Neurolinguistic and neurobehavioral perspectives on swearing. *Brain Research. Brain Research Reviews*, *31*(1), 83–104.
- Vicario, C. M. (2016). Emotional appraisal of moral dilemmas: What neuroimaging can tell about the disgust-morality link. *The Journal of Neuroscience*, *36*(2), 263–264.
- Vicario, C. M., Gulisano, M., Martino, D., & Rizzo, R. (2016). Timing recalibration in childhood Tourette syndrome associated with persistent pimozide treatment. *Journal of Neuropsychology*, *10*(2), 211–222.
- Vicario, C. M., Gulisano, M., Maugeri, N., Albin, R. L., & Rizzo, R. (2021). Moral decision-making in adolescents with Tourette syndrome. *Movement Disorders*, *36*(9), 2205–2206.
- Vicario, C. M., Gulisano, M., Maugeri, N., & Rizzo, R. (2020). Delay reward discounting in adolescents with Tourette's syndrome. *Movement Disorders*, *35*(7), 1279–1280.
- Vicario, C. M., Kuran, K. A., Rogers, R., & Rafal, R. D. (2018). The effect of hunger and satiety in the judgment of ethical violations. *Brain and Cognition*, *125*, 32–36.
- Vicario, C. M., & Lucifora, C. (2021). Neuroethics: What the study of brain disorders can tell about moral behavior. *AIMS Neuroscience*, *8*(4), 543–547.
- Vicario, C. M., Martino, D., Spata, F., Defazio, G., Giacchè, R., Martino, V., Rappo, G., Pepi, A. M., Silvestri, P. R., & Cardona, F. (2010). Time processing in children with Tourette's syndrome. *Brain and Cognition*, *73*(1), 28–34.
- Vicario, C. M., & Rafal, R. D. (2017). Relationship between body mass index and moral disapproval rating for ethical violations. *Personality and Individual Differences*, *104*, 8–11.
- Vicario, C. M., Rafal, R. D., di Pellegrino, G., Lucifora, C., Salehinejad, M. A., Nitsche, M. A., & Avenanti, A. (2022). Indignation for moral violations suppresses the tongue motor cortex: Preliminary TMS evidence. *Social Cognitive and Affective Neuroscience*, *17*(1), 151–159.
- Wright, A., Rickards, H., & Cavanna, A. E. (2012). Impulse-control disorders in Gilles de la Tourette syndrome. *The Journal of Neuropsychiatry and Clinical Neurosciences*, *2*, 16–27.
- Yu, J., Tseng, P., Hung, D. L., Wu, S. W., & Juan, C. H. (2015). Brain stimulation improves cognitive control by modulating medial-frontal activity and preSMA-vmPFC functional connectivity. *Human Brain Mapping*, *36*(10), 4004–4015.
- Zanatto, D., Chattington, M., & Noyes, J. (2021). Sense of agency in human-machine interaction. In H. Ayaz, U. Asgher, & L. Paletta (Eds.), *Advances in Neuroergonomics and cognitive engineering. AHFE 2021. Lecture Notes in Networks and Systems* (Vol. 259). Springer. [https://doi.org/10.1007/978-3-030-80285-1\\_41](https://doi.org/10.1007/978-3-030-80285-1_41)
- Zapparoli, L., Seghezzi, S., Devoto, F., Mariano, M., Banfi, G., Porta, M., & Paulesu, E. (2020). Altered sense of agency in Gilles de la Tourette syndrome: Behavioural, clinical and functional magnetic resonance imaging findings. *Brain Communications*, *2*(2), fcaa204.

**How to cite this article:** Vicario, C. M., Maugeri, N., Lucifora, C., Prato, A., Mucciardi, M., Martino, D., & Rizzo, R. (2023). Evidence for a dissociation between moral reasoning and moral decision-making in Tourette syndrome. *Journal of Neuropsychology*, 00, 1–9. <https://doi.org/10.1111/jnp.12350>