**Supplementary Text**

Our patient sample reflected the range of tic severity and tic frequency typical of adolescents with Gilles de la Tourette syndrome (GTS). We could therefore investigate the relation between different dependent variables related to volition in the patient group, to test our hypothesis that conscious intention depended on clear perceptual separation between voluntary and involuntary activities. Because the main focus of our work was the relation between GTS considered as a movement disorder, and experimental measures of action awareness, we prioritised clinical scores related to motor control in GTS. Specifically, we reasoned that a clear perception of conscious intention would correspond to early W judgements [1](#_ENREF_1). Crucially, our signal-to-noise model of volition suggests the occurrence of tics would not, in itself, prevent clear perception of conscious intention, but a perceptual similarity between tics and voluntary actions would. Many patients report premonitory urges before tics. These urges have some of the phenomenology of “wanting to act” that also underlies intentional action [2](#_ENREF_2). We therefore predicted that patients with strong premonitory urges, as measured by the Premonitory Urge for Tics Scale (PUTS) [3](#_ENREF_3),[4](#_ENREF_4), should have greater perceptual overlap between voluntary and involuntary movements, leading to delayed experience of intention. A second, very different, approach to perceptual separation of voluntary and involuntary movements comes from active control. Many patients are able to intentionally suppress their tics, at least briefly. Indeed, tic suppression may become an intrinsic part of voluntary action control in GTS [5](#_ENREF_5). We reasoned that patients who could suppress their tics would have better learned the characteristic experience of voluntary action. Intentionally suppressing the noise levels due to involuntary movements and urges would allow a better learning environment for volition, leading to earlier conscious intention.

Some general factors that are not specific to tics, might also be expected to influence the perceived time of conscious intention. First, detecting a signal in noise is always a matter of criterion setting [6](#_ENREF_6),[7](#_ENREF_7). In general, the time at which a gradually increasing signal is detected amongst noise depends strongly on the criterion used for discriminating signal from noise. An early experience of intention on average can always be achieved by setting a liberal criterion. However, this will also produce increased variability across trials, since fluctuating background noise will exceed a liberal criterion more often than a conservative criterion. Criterion-setting is highly idiosyncratic, and varies between individuals, but the signal-detection problem that underlies the relation between average and variability of time of detection is not specific to tics. We therefore predicted that patients with earlier times of conscious intention would also show greater trial-to-trial variability, for general reasons of criterion setting.

Second, perception of conscious intention is known to depend strongly on attention, for general reasons of perceptual selectivity [1](#_ENREF_1). In addition, the strong attentional demands of the Libet task are widely acknowledged [8](#_ENREF_8). We therefore predicted poorer attention would be associated with later experience of conscious intention in the patient group.

References:

1 Matsuhashi, M. & Hallett, M. The timing of the conscious intention to move. *Eur J Neurosci* 28, 2344-2351, doi:10.1111/j.1460-9568.2008.06525.x (2008).

2 Jackson, S. R., Parkinson, A., Kim, S. Y., Schuermann, M. & Eickhoff, S. B. On the functional anatomy of the urge-for-action. *Cognitive neuroscience* 2, 227-243, doi:10.1080/17588928.2011.604717 (2011).

3 Rössner V, Müller-Vahl K, Neuner I (2010) PUTS - premonitory urge tics scale: Fragebogen für Kinder. In: Müller-Vahl K, editor. Tourette-Syndrom und andere Tic-Erkrankungen im Kindes- und Erwachsenenalter. Berlin: MWV Medizinische Wissenschaftliche Verlagsgesellschaft.

4 Woods, D. W., Piacentini, J., Himle, M. B. & Chang, S. Premonitory Urge for Tics Scale (PUTS): initial psychometric results and examination of the premonitory urge phenomenon in youths with Tic disorders. *J Dev Behav Pediatr* 26, 397-403 (2005).

5 Heise, K. F. *et al.* Altered modulation of intracortical excitability during movement preparation in Gilles de la Tourette syndrome. *Brain* 133, 580-590, doi:10.1093/brain/awp299 (2010).

6 Graves, T. L., Maniscalco, B. & Lau, H. in *Conscious Will and Responsibility: A Tribute to Benjamin Libet* (eds W. Sinnott-Armstrong & L. Nadel) (Oxford University Press, 2010).

7 Hallett, M. Volitional control of movement: the physiology of free will. *Clin Neurophysiol* 118, 1179-1192, doi:10.1016/j.clinph.2007.03.019 (2007).

8 Haggard, P. & Cole, J. Intention, attention and the temporal experience of action. *Conscious Cogn* 16, 211-220, doi:10.1016/j.concog.2006.07.002 (2007).