T W H a Ha a A a M T O M U a a S R a Ta

H [1,2*], **D. D** [1,2], **L . M** [1,2]

1 Department of Psychology, New York University, New York, New York, United States of America, **2** Center for Neural Science, New York University, New York, New York, United States of America

A

In many motor tasks, optimal performance presupposes that human movement planning is based on an accurate internal model of the subject's own motor error. We developed a motor choice task that allowed us to test whether the internal model implicit in a subject's choices differed from the actual in isotropy (elongation) and variance. Subjects were first trained to hit a circular target on a touch screen within a time limit. After training, subjects were repeatedly shown pairs of targets differing in size and shape and asked to choose the target that was easier to hit. On each trial they simply chose a target – they did not attempt to hit the chosen target. For each subject, we tested whether the internal model implicit in her target choices was consistent with her true error distribution in isotropy and variance. For all subjects, movement end points were anisotropic, distributed as vertically elongated bivariate Gaussians. However, in choosing targets, almost all subjects effectively assumed an isotropic distribution rather than their actual anisotropic distribution. Roughly half of the subjects chose as though they correctly estimated their own variance and the other half effectively assumed a variance that was more than four times larger than the actual, essentially basing their choices merely on the areas of the targets. The task and analyses we developed allowed us to characterize the internal model of motor error implicit in how humans plan reaching movements. In this task, human movement planning – even after extensive training – is based on an internal model of human motor error that includes substantial and qualitative inaccuracies.

C : Zhang H, Daw ND, Maloney LT (2013) Testing Whether Humans Have an Accurate Model of Their Own Motor Uncertainty in a Speeded Reaching Task. PLoS Comput Biol 9(5): e1003080. doi:10.1371/journal.pcbi.1003080

E : Jörn Diedrichsen, University College London, United Kingdom

October 8, 2012; **A** April 18, 2013; May 23, 2013

F : HZ and LTM were supported by Grant EY019889 from the National Institutes of Health and LTM by an award from the Alexander v. Humboldt Foundation. NDD was supported by a Scholar Award from the McKnight Foundation and a James S. McDonnell Foundation Award in Understanding Human Cognition. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

C **I** : The authors have declared that no competing interests exist.

* E-mail: hang.zhang@nyu.edu

I

$\phi(x,y)$.

2A).

T_1 T_2 i^{th}

$$p_i = \int_{T_i} \phi(x,y)\, dx\, dy\,, \quad i = 1,2. \qquad (1)$$

B subject ? , $\psi(x,y)$.

$$p_i' = \int_{T_i} \psi(x,y)\, dx\, dy\,, \quad i = 1,2, \qquad (2)$$

χ,y

$w(p')$ p'

600 2. A

1,

12,

2

[illegible]

[illegible] ([illegible]) [illegible]

[illegible] 23 [illegible] B [illegible]
A. [illegible] B. [illegible] B. [illegible]
[illegible] A.

[illegible] 23 [illegible]

χ^2 … A … Δ … 95 … χ^2_2 …

C … 95% … σ/σ_0, α/α_0, α, α_0 … [28] … 1000 … [29] … (… 5) …

Fig … 1 … α … σ/σ_0 … (… σ_0) … 1, … R_0 … 4 … σ … α … R_0 … $\alpha = 1.44$ … $\alpha = 1$ … R_0 … α … σ/σ_0 …

… σ/σ_0 … σ/σ_0 … α … α … σ/σ_0 …

(…)

Fig … 2 … E … 1. … (…) … (…) … B … 1- … /2- … 2- … /1- … (…) …

(…)

A … C

… A …

1. … B, … (2011) … -B … 69: 1204–1215.
2. B … (2007) … 27: 6984–6994.
3. … (2007) … 7: 1–12.
4. … (2008) … B … 4: e10000130.
5. … (2008) … 19: 601–606.
6. … (2010) … 50: 2362–2374.
7. … (2003) … 16: 255–275.
8. … (2008) … 12: 291–297.
9. … (2004) B … 427: 244–247.
10. … A, … (1992) A … 5: 297–323.
11. … (2009) … A … A 106: 6088–6093.
12. … A, … A, B … (1974) …
13. … A, … B, … (1979) … A … 86: 415–451.
14. … B … (2009) … 63: 406–417.
15. … (2010) … 10: 1; … :10.1167/1110.1166.1161.
16. … (2006) …