Model fits

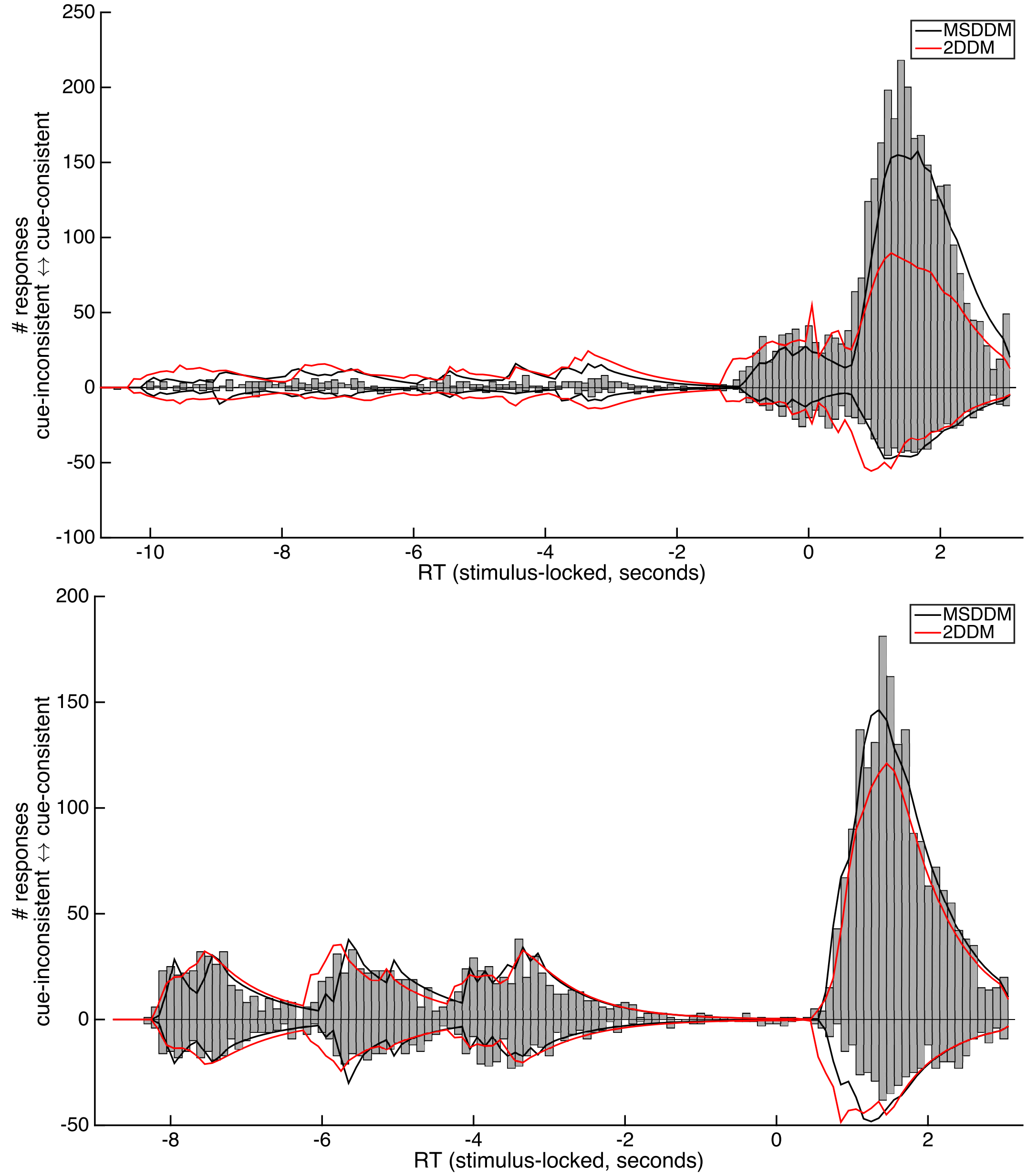

Figure S1: **MSDDM & 2DDM model fits overlaid on RT histograms**. The models provide similar fits to pre-probe responses, but diverge on second-stage responses. Specifically, the two-part, unconnected DDM (2DDM, red line) consistently overestimates the earlier portion of the error RTs, and underestimates the main portion of the correct RTs. This stems from the model's inability to capture the top-skewed starting point distribution that results from first-stage accumulation. (Top: Experiment 1. Bottom: Experiment 2.)

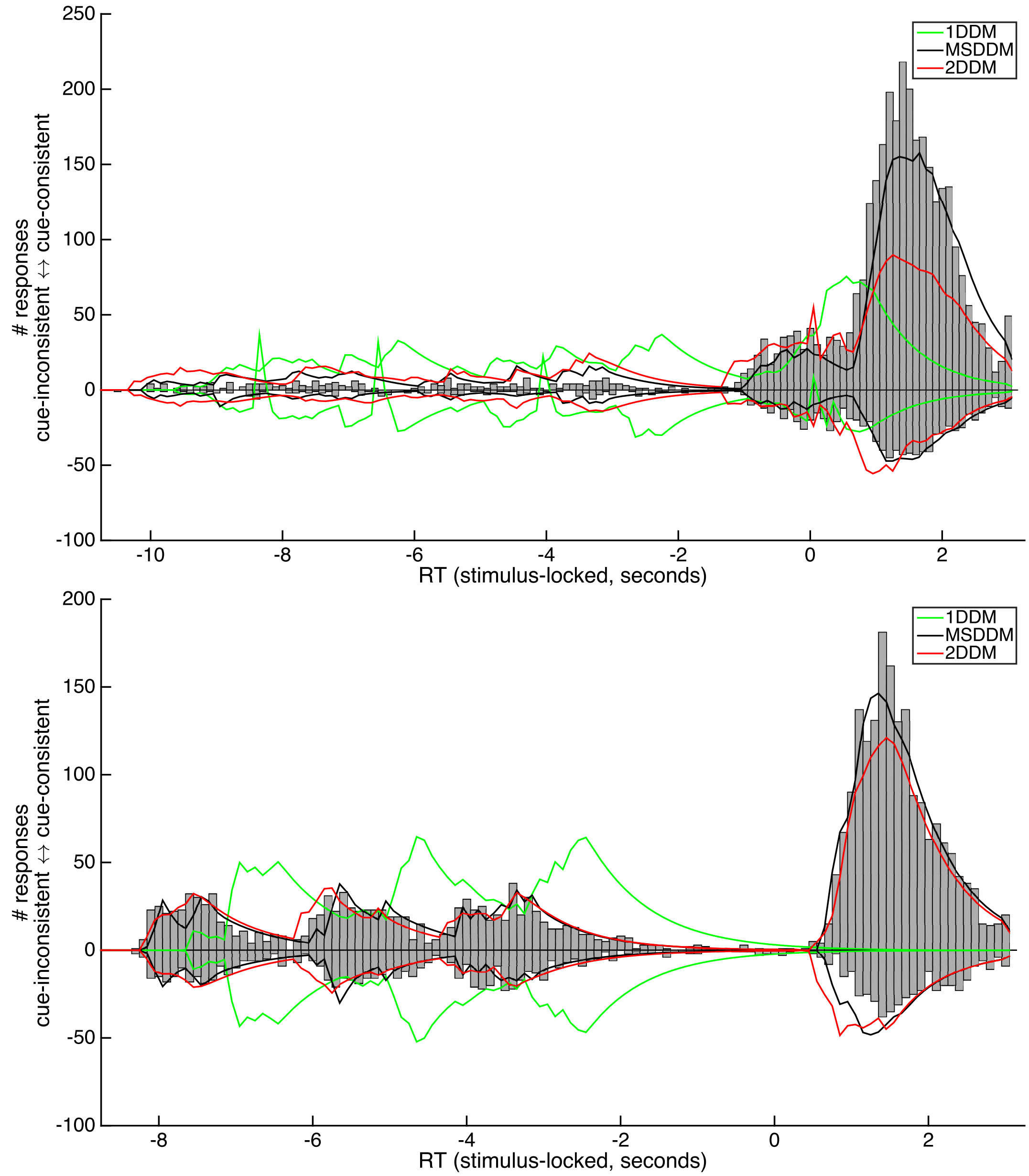

Figure S2: **Model fits overlaid on RT histograms, with addition of 1DDM**. The single-component DDM is clearly degenerate, trying to fit both modes by trading off non-decision time and drift rate. (Top: Experiment 1. Bottom: Experiment 2.)

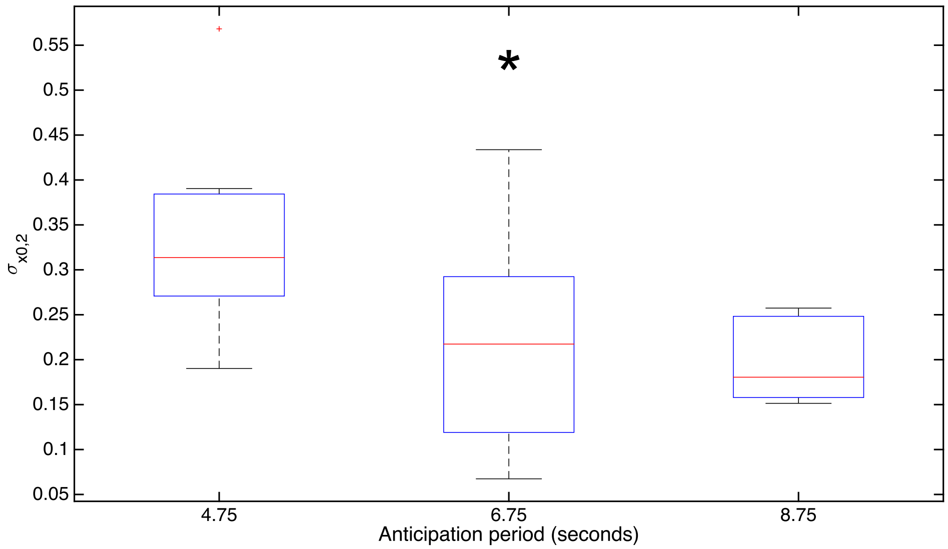

Figure S3: **Second-stage starting point variability decreases with ISI**. Although the *2DDM* was disfavored in our model comparison, the fitted parameter values can provide insight as to the nature of the second-stage inference process. Specifically, we investigated whether the variability in second-stage starting point decreased with the length of the preceding anticipation period. If, during this anticipation period, successive samples were drawn, and the resulting estimate carried forward to the second stage, then the resulting random variable should be of lower variance. If, on the other hand, first-stage evidence were due to one or a fixed number of samples, or not carried forward to the second stage, then the resulting second-stage starting point variance should be unaffected by the length of the anticipation period. Consistent with the hypothesis that second-stage starting point is set by a process that continues to add samples during the entire anticipation period, we found that, across all combinations of cue level and coherence, second-stage starting point variability decreased with ISI ($R = -.512$, $P = .011$).

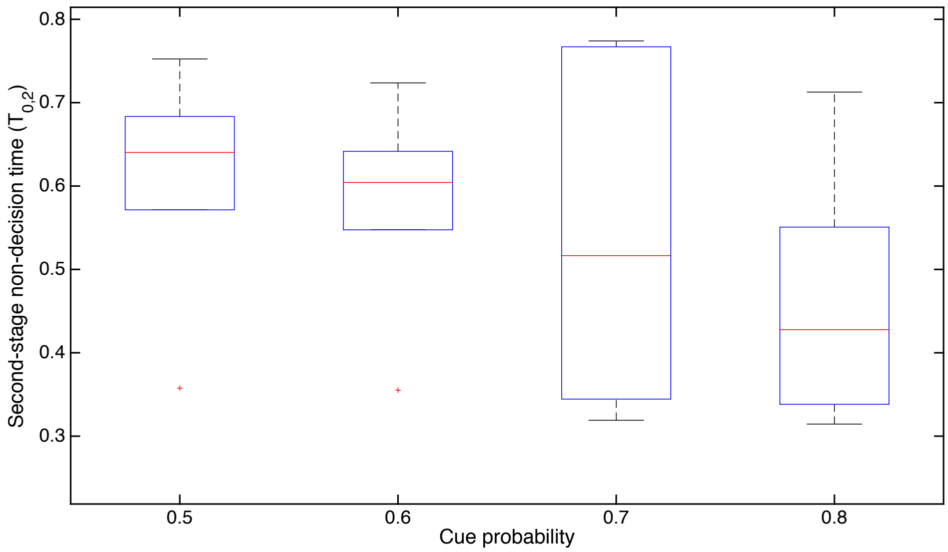

Figure S4: **Second-stage non-decision time decreases with cue probability.** A recent study interpreted pre-decision "ramping" in motor areas as indicating the consideration of countermanding motor plans [1]. They observed that the degree of this ramping corresponded with a delay in the onset of motor planning at decision time. In the terms of our current model, this would be inference over the prior, which, when it conflicts with the eventual motor decision, would appear to slow the onset of evidence accumulation towards that decision. Consistent with this intepretation, we observed that the second-stage starting point was marginally lower when cue information was more consistent ($R = -0.350$, $P = 0.094$).

cue	coh	ISI	η_1	η_2	$x_{0,1}$	$\sigma_{x_{0,1}}$	$x_{0,2}$	$\sigma_{x_{0,2}}$	$T_{0,1}$	$T_{0,2}$
0.50	0.65	0.50	-0.06	0.49	0.00	0.22	-0.08	0.33	0.59	0.71
		1.00	2.03	0.39	-0.06	1.36	-0.18	0.28	0.44	0.48
		4.00	-0.08	0.49	-0.14	0.34	-0.19	0.29	0.82	0.79
		6.00	0.05	0.43	0.12	0.69	-0.35	0.09	0.46	0.31
		8.00	-0.06	0.37	0.25	0.50	0.13	0.25	0.93	0.47
		10.00	-0.05	0.18	0.04	0.37	-0.35	1.30	0.42	0.27
	0.85	0.50	0.19	0.95	-0.08	0.00	-0.24	0.23	0.43	0.26
		1.00	0.80	0.56	-0.26	1.29	-0.22	0.39	0.54	0.31
		4.00	0.09	0.42	-0.11	0.28	0.32	0.26	0.62	0.58
		6.00	0.03	1.68	-0.36	0.20	-0.24	0.24	1.07	0.59
		8.00	0.65	1.62	-0.35	0.11	-0.21	0.14	1.07	0.71
		10.00	-0.05	0.18	0.10	0.37	-0.31	1.30	0.44	0.26
0.60	0.65	0.50	0.17	0.75	0.01	0.00	-0.15	0.54	0.52	0.72
		1.00	0.91	0.31	-0.48	0.92	-0.25	0.28	0.44	0.40
		4.00	0.08	0.65	0.10	0.28	-0.11	0.49	0.61	0.88
		6.00	0.51	0.69	0.82	1.93	-0.31	0.29	0.43	0.88
		8.00	2.16	0.40	-0.01	2.02	-0.11	0.27	0.50	0.90
		10.00	1.35	0.04	0.27	1.76	0.01	1.00	0.42	1.02
	0.85	0.50	0.34	0.88	-0.13	0.38	-0.20	0.15	0.77	0.33
		1.00	0.69	0.48	-0.07	1.51	-0.22	0.55	0.58	0.29
		4.00	0.26	0.37	0.07	0.66	-0.37	1.15	0.47	0.35
		6.00	0.21	0.94	-0.08	0.03	-0.00	0.45	1.10	0.46
		8.00	0.06	0.35	0.42	1.67	-0.64	1.17	0.98	0.42
		10.00	-0.06	0.18	0.05	0.35	-0.36	1.30	0.42	0.26
0.70	0.65	0.50	1.05	0.24	0.03	1.35	-0.17	0.83	0.63	0.30
		1.00	0.95	0.36	0.10	0.94	-0.20	0.38	0.46	0.32
		4.00	-0.09	0.70	0.24	0.34	-0.07	0.43	0.90	0.58
		6.00	-0.08	0.74	0.09	0.24	-0.03	0.55	0.90	0.65
		8.00	-0.10	0.10	0.09	0.25	0.14	0.28	1.03	0.57
		10.00	0.07	0.21	-0.01	0.37	-0.36	1.43	0.43	0.27
	0.85	0.50	0.53	1.03	-0.05	0.12	-0.02	0.49	0.50	0.64
		1.00	1.11	0.42	-0.56	0.77	-0.20	0.33	0.45	0.35
		4.00	1.00	1.31	0.19	0.92	-0.34	0.40	0.60	0.48
0.80	0.65	0.50	1.00	0.21	0.08	0.72	-0.09	0.98	0.49	0.30
		1.00	1.26	0.30	0.07	0.53	-0.26	1.24	0.44	0.38
		4.00	0.27	0.72	0.22	0.54	-0.35	0.93	0.42	0.31
		6.00	1.65	1.32	0.24	1.11	-0.19	1.23	1.01	0.90
		8.00	0.71	0.20	-0.05	0.26	-0.33	0.19	0.71	0.81
		10.00	-0.06	0.18	0.08	0.35	-0.36	1.30	0.42	0.26
	0.85	0.50	1.24	0.41	-0.53	0.54	-0.03	0.62	0.46	0.33
		1.00	1.01	0.91	-0.23	0.84	-0.30	0.34	0.54	0.35
		4.00	0.30	0.21	0.19	0.68	0.24	0.49	0.78	0.23
		6.00	-0.09	0.98	0.64	0.55	-0.08	0.31	0.92	0.58
		8.00	0.64	0.76	0.01	0.29	-0.09	0.48	0.57	0.47
		10.00	0.69	0.35	0.14	1.04	-0.32	1.05	0.42	0.78

Table S1: **Experiment 1: Parameter fits for two, unconnected DDMs (2DDM)**.

cue	coh	ISI	η_1	η_2	$x_{0,1}$	$\sigma_{x_{0,1}}$	$T_{0,1}$
0.50	0.65	0.50	0.26	0.47	0.96	4.99	1.02
		1.00	-0.06	0.47	0.98	4.95	0.97
		4.00	-0.07	0.44	-0.88	3.94	1.05
		6.00	0.71	0.35	0.39	2.09	1.01
		8.00	0.36	0.39	0.37	3.03	0.58
		10.00	0.08	0.50	0.19	3.20	0.55
	0.85	0.50	0.00	0.94	0.19	3.20	0.49
		1.00	0.47	0.79	0.17	2.85	0.59
		4.00	-0.06	0.88	0.97	3.00	0.50
		6.00	0.31	2.16	0.99	4.98	0.89
		8.00	1.40	1.24	0.15	2.95	0.91
		10.00	0.09	1.20	0.19	3.01	0.54
0.60	0.65	0.50	0.52	0.57	0.24	2.27	0.88
		1.00	0.78	0.38	0.23	2.31	0.90
		4.00	0.76	0.58	0.39	2.47	0.86
		6.00	-0.10	1.03	-0.99	5.00	1.09
		8.00	-0.04	0.33	-0.95	4.98	1.03
		10.00	0.89	0.20	0.27	2.49	1.04
	0.85	0.50	1.23	0.84	0.03	1.98	0.89
		1.00	0.57	0.91	0.08	1.97	0.71
		4.00	0.12	0.56	0.98	4.85	0.60
		6.00	0.22	0.89	0.23	3.97	0.45
		8.00	0.15	1.10	0.15	3.36	0.56
		10.00	0.02	1.14	0.17	3.18	0.46
0.70	0.65	0.50	0.75	0.59	0.17	2.42	0.80
		1.00	0.59	0.54	0.17	2.03	0.72
		4.00	0.17	0.50	0.18	2.13	0.51
		6.00	0.30	0.71	0.18	2.36	0.69
		8.00	0.09	0.25	0.94	4.93	0.71
		10.00	0.27	0.46	0.17	3.20	0.55
	0.85	0.50	0.95	0.93	-0.06	2.05	0.81
		1.00	0.93	0.77	0.41	2.03	0.78
		4.00	1.13	1.12	0.63	2.50	0.81
0.80	0.65	0.50	0.94	0.37	0.17	1.44	0.74
		1.00	1.64	0.24	-0.24	1.83	0.82
		4.00	0.36	0.92	0.89	1.96	0.62
		6.00	1.03	0.88	0.36	0.61	0.99
		8.00	0.79	-0.01	0.15	0.79	0.85
		10.00	0.62	0.79	-0.27	0.68	0.44
	0.85	0.50	0.54	1.24	0.99	3.46	0.56
		1.00	1.12	0.69	0.23	2.41	0.82
		4.00	0.78	0.78	-1.00	1.97	0.65
		6.00	0.64	0.92	0.80	2.13	0.84
		8.00	1.45	0.87	0.21	2.59	0.98
		10.00	0.63	0.73	-0.01	2.94	0.73

Table S2: **Experiment 1: Parameter fits for the Multi-Stage DDM (MS-DDM)**.

cue	coh	ISI	η_1	η_2	$x_{0,1}$	$\sigma_{x_{0,1}}$	$x_{0,2}$	$\sigma_{x_{0,2}}$	$T_{0,1}$	$T_{0,2}$
0.50	0.65	4.00	-0.04	0.37	-0.14	0.53	0.13	0.39	0.54	0.75
		6.00	0.02	0.44	-0.02	0.28	-0.07	0.07	0.45	0.57
		8.00	0.12	0.27	-0.06	0.33	0.12	0.15	0.48	0.68
	0.85	4.00	0.01	0.73	0.03	0.32	0.06	0.19	0.91	0.68
		6.00	0.09	0.44	0.24	0.72	-0.34	0.14	0.46	0.36
		8.00	0.03	1.04	0.15	0.24	-0.21	0.16	0.80	0.61
0.60	0.65	4.00	-0.02	0.44	0.10	0.43	-0.07	0.25	0.52	0.61
		6.00	0.08	0.39	0.43	0.72	-0.07	0.10	0.41	0.59
		8.00	-0.07	0.28	0.07	0.58	0.18	0.24	0.59	0.72
	0.85	4.00	0.25	1.19	0.09	1.58	-0.36	0.32	0.47	0.36
		6.00	0.33	0.56	0.19	1.33	-0.17	0.30	0.48	0.55
		8.00	0.04	0.84	0.13	0.64	-0.10	0.25	0.54	0.64
0.70	0.65	4.00	0.00	0.54	0.18	0.21	0.02	0.29	0.59	0.77
		6.00	0.16	0.46	0.24	0.85	-0.35	0.22	0.53	0.43
		8.00	-0.05	0.59	0.13	0.26	-0.01	0.26	0.57	0.77
	0.85	4.00	0.71	1.29	-0.07	0.82	-0.34	0.38	0.44	0.34
		6.00	0.25	0.72	0.03	1.02	-0.27	0.21	0.50	0.32
		8.00	0.16	0.85	0.16	0.61	0.10	0.16	0.59	0.60
0.80	0.65	4.00	0.73	0.63	0.17	0.79	-0.20	0.57	0.42	0.47
		6.00	0.42	0.44	0.32	0.74	-0.21	0.29	0.41	0.34
		8.00	0.02	0.29	0.25	0.45	0.17	0.20	0.57	0.71
	0.85	4.00	1.13	1.15	-0.05	0.71	-0.32	0.31	0.57	0.31
		6.00	0.41	0.65	0.30	0.80	-0.34	0.43	0.50	0.39
		8.00	0.54	1.26	0.03	0.27	-0.07	0.16	0.45	0.55

Table S3: **Experiment 2: Parameter fits for two, unconnected DDMs (2DDM)**.

cue	coh	ISI	η_1	η_2	$x_{0,1}$	$\sigma_{x_{0,1}}$	$T_{0,1}$
0.50	0.65	4.00	0.09	0.46	0.20	1.80	0.59
		6.00	0.12	0.27	0.39	1.77	0.65
		8.00	-0.00	0.40	-0.38	1.64	0.60
	0.85	4.00	0.40	0.69	0.06	1.91	0.90
		6.00	0.08	0.64	0.29	2.35	0.83
		8.00	-0.08	1.12	0.98	2.40	0.76
0.60	0.65	4.00	0.34	0.28	0.25	1.78	0.62
		6.00	0.11	0.32	0.34	1.83	0.65
		8.00	-0.04	0.47	0.35	1.71	0.64
	0.85	4.00	-0.08	1.06	-0.98	2.51	0.64
		6.00	0.66	0.82	0.16	2.45	0.77
		8.00	0.25	0.76	0.10	3.42	0.59
0.70	0.65	4.00	-0.04	0.60	0.90	2.08	0.91
		6.00	0.45	0.49	0.44	2.12	0.88
		8.00	-0.06	0.74	0.96	1.71	0.99
	0.85	4.00	0.37	1.39	0.23	1.93	0.61
		6.00	0.56	1.38	-0.35	1.52	0.62
		8.00	0.22	1.04	0.53	1.55	0.62
0.80	0.65	4.00	1.07	0.37	0.68	1.87	0.61
		6.00	0.49	0.43	0.41	1.90	0.61
		8.00	0.18	0.43	0.92	1.24	0.63
	0.85	4.00	0.77	1.26	0.42	0.99	0.62
		6.00	0.63	0.84	0.10	1.10	0.61
		8.00	0.92	0.94	0.32	1.34	0.62

Table S4: **Experiment 2: Parameter fits for the Multi-Stage DDM (MS-DDM)**.

References

[1] Christopher K Hauser, Dantong Zhu, Terrence R Stanford, and Emilio Salinas. Motor selection dynamics in FEF explain the reaction time variance of saccades to single targets. *eLife*, pages 1–32, 2018.