

Collision Velocities and Ln Mass Ratios (MR) for Experiment 1

Collision	Pre-collision				Post-collision				Ln MR
	Red Ball		Blue Ball		Red Ball		Blue Ball		
	CA	SA	CA	SA	CA	SA	CA	SA	
Training Collisions									
1	-19.9	17.5	-21	17.8	-21.3	17.5	-20.1	17.8	-0.45
2	23.6	9.6	21.9	1.3	22.7	9.6	24.4	1.3	1.02
3	5.8	1.2	-5	2.3	-4.2	1.2	6.5	2.3	0.14
4	2.8	1.3	-4.2	0.6	-3.7	1.3	3.3	0.6	0.14
5	23.2	2.8	1.1	0.1	-0.4	2.8	21.6	0.1	-0.14
6	-1.7	24.8	-10	18	-10.6	24.8	-2.2	18	-0.13
7	2.7	18.2	-11.5	4.8	-8.6	18.2	5.6	4.8	0.41
8	5.1	12.6	-6	22.2	-8.3	12.6	2.8	22.2	-0.42
9	-5.9	21.4	-25.7	10	-21.6	21.4	-1.9	10	0.42
10	6.8	12.5	-13.9	22.3	-18.2	12.5	2.5	22.3	-0.42
11	23.2	11.3	-2.2	13.5	-16.4	11.3	9.1	13.5	-1.24
12	17	18.6	-7.7	13.8	-18.9	18.6	5.8	13.8	-0.97
13	10.3	18.8	-16	0.7	-24.8	18.8	1.5	0.7	-0.69
14	13.3	17.7	-1.1	18.2	3.7	17.7	18.2	18.2	0.70
15	10	23.1	-9.9	0.1	-0.9	23.1	18.9	0.1	0.97
16	5.1	2.2	-17.3	9.7	-4.9	2.2	17.6	9.7	1.25
17	13.7	6.4	2.6	17.8	-3.6	6.4	7.5	17.8	-1.27
18	-9.9	7.7	-16.3	11.6	-19.2	7.7	-12.8	11.6	-0.97
19	-7.6	15.4	-14.5	24	-16.9	15.4	-9.9	24	-0.71
20	3.4	2	0.2	19.9	0.4	2	3.6	19.9	0.12
21	16.7	22.5	9.8	21.4	12.1	22.5	19.1	21.4	0.70
22	5.7	16.5	2.3	7.3	4.2	16.5	7.5	7.3	1.24
23	-2.9	2.1	-6	22.9	-7.7	2.1	-4.6	22.9	-1.24
24	9.5	10.8	-3.6	12.6	-9.6	10.8	3.6	12.6	-0.97

Collision	Pre-collision				Post-collision				Ln MR
	Red Ball		Blue Ball		Red Ball		Blue Ball		
	CA	SA	CA	SA	CA	SA	CA	SA	
25	20.4	5.6	6.9	17.1	2.4	5.6	15.9	17.1	-0.69
26	8.3	4.8	-22	12.1	-24.1	4.8	6.2	12.1	-0.14
27	6.5	7.4	4.1	15.1	4.6	7.4	6.9	15.1	0.39
28	9.2	17.2	-16.5	6.1	-7.9	17.2	17.8	6.1	0.70
29	-12.1	15.6	-23.9	9.6	-18.5	15.6	-6.7	9.6	0.99
30	0.9	0.4	-6.9	7.4	-2.6	0.4	5.3	7.4	1.25
Transfer Collisions									
31	-19.7	17.7	-21.9	17.6	-20.9	17.7	-18.7	17.6	0.98
32	24.9	8.5	23.5	1	22.8	8.5	24.2	1	-1.11
33	6.4	1.3	-5.3	2.1	-6.1	1.3	5.6	2.1	-0.14
34	4.5	1.5	-3.3	0.3	-3.9	1.5	4	0.3	-0.14
35	24.9	2.2	0.8	0.3	-0.9	2.2	23.3	0.3	-0.14
36	-2.4	24.5	-10.3	18.5	-10.9	24.5	-2.9	18.5	-0.14
37	2.7	0	-11.5	0	-8.6	0	5.6	0	0.41
38	5.1	0	-6	0	-8.3	0	2.8	0	-0.42
39	-5.9	0	-25.7	0	-21.6	0	-1.9	0	0.42

Notes. Pre-collision and post-collision velocities are measured in degrees/sec. MR is $\text{Mass}_{\text{Red}}/\text{Mass}_{\text{Blue}}$. CA and SA are the Collision and Sweep Axes, respectively.

Best Fitting Variance Parameters for the Invariant Models for Each Participant of Experiment 1.

Model Parameter	Participant 1	Participant 2	Participant 3	Participant 4
I_S	0.04	0.26	0.06	0.31
I_W	~6.00	~10.00	~7.00	~12.00
I_A	1.02	2.34	3.16	1.70

Notes. I_S and I_W are the strong and weak mass invariant models; I_A is the angle change invariant model; The best fitting parameters for I_W are approximate because the model was simulated.

Best Fitting Parameters for the Exemplar Models for Each Participant of Experiment 1.

Parameter	Participant 1		Participant 2		Participant 3		Participant 4	
	E _R	E _D	E _R	E _D	E _R	E _D	E _R	E _D
c	15.51	28.91	9.15	140.49	11.46	298.75	11.09	18.90
w_1	0.25	0.00	0.25	0.00	0.25	0.89	0.25	0.00
w_2	0.25	0.32	0.25	0.04	0.25	0.01	0.25	0.08
w_3	0.25	0.00	0.25	0.85	0.25	0.10	0.25	0.75
w_4	0.25	0.68	0.25	0.11	0.25	0.00	0.25	0.17

Notes. c is the sensitivity parameter; w_1 - w_4 are the weights parameters for Dimensions 1-4, respectively; E_R and E_D are the restricted and full exemplar models; In the E_R model, the weights were fixed at 0.25.

Proportion of Variance Accounted For Over All Collisions (PVAF_{All}) and the Transfer Collisions (PVAF_{Trans}) for the Best Fitting Models for Each Participant of Experiment 1.

Statistic	Model				
	I _S	I _W	I _A	E _R	E _D
Participant 1					
PVAF _{All}	-0.08	~-0.08	-0.04	0.99	0.99
PVAF _{Trans}	-0.98	~-0.21	-1.46	0.99	0.99
Participant 2					
PVAF _{All}	-0.04	~-0.04	0.00	0.42	0.82
PVAF _{Trans}	-1.68	~-1.15	-2.15	-0.87	0.44
Participant 3					
PVAF _{All}	-0.01	~-0.20	-0.00	0.64	0.64
PVAF _{Trans}	-0.83	~-0.01	-2.09	0.31	0.97
Participant 4					
PVAF _{All}	-0.07	~-0.05	-0.05	0.78	0.85
PVAF _{Trans}	-1.19	~-0.69	-1.62	0.46	0.63

Notes. I_S and I_W are the strong and weak mass invariant models; I_A is the angle change invariant model; E_R and E_D are the restricted and full exemplar models; The fits for I_W are approximate because they were simulated. The models were fit to the training and transfer data. The PVAF for I_A is only calculated over Collisions 1-36 only.

Best Fitting Model Parameters for All Participants of Experiment 2.

I _S	I _{SR}	I _W	E _R	I _{SP}	I _{WP}	I _{AP}	E _{RP}
Participant 1							
$\sigma^2 = 0.65$	$\sigma^2 = 1.67$	$\sigma^2 = \sim 45$	$c = 5.25$	$\sigma^2 = 0.03$	$\sigma^2 = \sim 15$	$\lambda = \infty$	$\lambda = 0.86$
			$\gamma = 0.65$	$\lambda = 1.78$	$\lambda = \sim 1.00$		$\gamma = 1.07$
Participant 2							
$\sigma^2 = 0.34$	$\sigma^2 = 0.91$	$\sigma^2 = \sim 21$	$c = 7.81$	$\sigma^2 = 0.07$	$\sigma^2 = \sim 18$	$\lambda = 26.10$	$\lambda = 0.65$
			$\gamma = 0.63$	$\lambda = 0.96$	$\lambda = \sim 0.50$		$\gamma = 1.11$
Participant 3							
$\sigma^2 = 0.42$	$\sigma^2 = 1.47$	$\sigma^2 = \sim 30$	$c = 5.67$	$\sigma^2 = 0.29$	$\sigma^2 = \sim 16$	$\lambda = 18.44$	$\lambda = .49$
			$\gamma = 0.78$	$\lambda = 0.29$	$\lambda = \sim 0.60$		$\gamma = 1.04$

Notes: I_S, I_{SR}, and I_W are the strong, strong ratio, and weak mass invariant models; E_R is the restricted exemplar model; I_{SP}, I_{WP}, and E_{RP} are the appropriate models augmented with pre-training strategies; I_{AP} is the angle change invariant model augmented with pre-training strategies; For the E_{RP} model, c was fixed at 11.80; The I_A, P, and T models were parameter free. The best fitting parameters for I_W and I_{WP} are approximate because the model was simulated.

Rotated 4-Dimensional MDS Coordinates for Experiment 1

Collision	D1	D2	D3	D4
Training Collisions				
1	1.0085	1.0216	2.1639	-0.6934
2	0.5370	0.1553	0.9510	-2.1875
3	0.0402	-1.8393	0.5989	1.0273
4	0.5035	-1.6318	1.2010	1.0104
5	2.2021	-0.7315	-0.9867	0.2511
6	-0.7624	0.9940	0.1058	-0.8283
7	-1.1809	0.5337	-0.8574	0.2211
8	-1.4030	0.3252	0.0511	-0.2013
9	0.1013	1.4289	-0.8069	0.6768
10	-0.9720	0.9156	-0.7025	0.7207
11	-0.5649	0.5133	-0.8103	1.4085
12	-0.9304	0.6528	-0.6411	0.9407
13	0.0987	0.1900	-2.0253	0.7852
14	-0.5146	1.2317	-0.5920	0.3643
15	0.0712	-0.1296	-2.0894	-0.0558
16	-0.7134	-1.1421	-1.0507	0.9602
17	-0.8627	-0.0705	-0.7577	-0.5844
18	0.5853	1.0495	1.0154	-0.1130
19	-0.4450	1.2430	0.8990	-0.6347
20	-0.9137	-1.0854	0.5767	-1.8726
21	0.1426	1.2186	0.8882	-0.6127
22	-0.6728	-0.0506	0.3540	-1.6816

23	-0.4519	-0.5094	0.3177	-1.9546
24	-0.9397	0.1381	0.1151	1.1221
25	0.1608	0.5178	-1.1533	-0.6254
26	0.2802	0.5088	-1.3580	1.1705
27	-0.8063	-0.1619	0.8446	-1.9359
28	-0.6143	0.3431	-1.4044	0.8630
29	0.4866	1.5101	0.0903	0.1843
30	-0.9095	-1.2333	0.9844	0.6474

Transfer Collisions

31	0.6372	1.0906	1.8279	-0.7957
32	0.8883	0.1692	1.1253	-1.9800
33	-0.1280	-1.4824	0.9015	1.3049
34	0.6905	-1.7804	0.6447	1.0118
35	1.8172	-1.2375	-1.4445	-0.1359
36	-0.6725	1.1646	0.8233	-0.3314
37	0.9978	-1.7345	0.0232	0.8609
38	1.0136	-1.3611	0.6854	1.3060
39	2.1953	-0.7342	-0.5080	0.3863

Notes. D1-D4 are Dimensions 1-4 and were rotated to correspond to verticality, overall speed, entrance groupiness, and asymmetry, respectively.