

Mizunami et al. Development of behavioral automaticity by extended Pavlovian training in an insect.
 Supplementary DATA set

Fig. 1a PI for rewarded odor (%)

Control group (n=22)		Devalued group (n=20)	
Control before	Control after	Devalued before	Devalued after
0	84.41558442	45.45454545	61.53846154
0	60.60606061	33.33333333	26.08695652
23.07692308	73.33333333	40	76.19047619
67.85714286	59.45945946	19.23076923	66.66666667
0	34.11764706	8	29.16666667
0	26.19047619	0	18.18181818
48.38709677	58.18181818	20.51282051	43.75
52.08333333	41.81818182	25	0
78.37837838	82.29166667	0	58.33333333
84.21052632	78.43137255	43.47826087	8.33333333
64.28571429	75.67567568	41.17647059	20
4.761904762	46.15384615	47.05882353	30
0	39.28571429	4.166666667	10
45.08196721	64.22018349	59.375	53.33333333
73.80952381	81.08108108	0	43.92523364
67.64705882	13.63636364	0	50
7.692307692	63.76811594	24.13793103	64.28571429
20	83.13253012	26.08695652	23.80952381
6.666666667	75.55555556	62.5	43.39622642
79.16666667	100	20	0
5.263157895	63.15789474		
56.09756098	59.57446809		

Fig. 1b

PI for rewarded odor (%)

sucrose before	sucrose after	sucrose devalued before	sucrose devalued after	water devalued before	water devalued after
48.93617021	100	22.58064516	100	0	27.27272727
62.06896552	27.5862069	24.32432432	82.05128205	22.85714286	43.75
9.523809524	0	8.333333333	48.14814815	50	65
0	46.66666667	29.54545455	100	12.82051282	10
36.36363636	31.70731707	52.27272727	79.36507937	0	28.57142857
19.04761905	0	50	54.54545455	0	0
35.29411765	66.66666667	30	33.33333333	0	35.29411765
13.63636364	65.11627907	61.11111111	100	54.38596491	56.66666667
40.42553191	72.4137931	13.33333333	40	43.47826087	50
9.090909091	66.66666667	58.82352941	41.66666667	44	37.93103448
0	57.77777778	0	100	20.58823529	47.91666667
18.33333333	56.8627451	41.66666667	58.33333333	25	18.18181818
20	48	10	18.51851852	44.44444444	55.55555556
0	46.2962963	61.36363636	50	13.04347826	14.75409836
56.4516129	51.85185185	0	81.81818182	37.93103448	21.21212121
21.42857143	75	0	0	22.58064516	65.75342466
20	77.14285714	NA	NA	54.54545455	25
NA	NA	NA	NA	54.16666667	31.81818182
NA	NA	NA	NA	47.61904762	0

Fig. 2a PI for rewarded odor (%)

control before	control after	devalued before	devalued after
78.43137255	62.96296296	58.82352941	56.25
33.33333333	65.82278481	51.35135135	64.44444444
4	71.92982456	79.41176471	42.85714286
37.83783784	45.65217391	37.5	100
0	56	0	68.18181818
55.55555556	0	20	80.64516129
35.29411765	78.37837838	44.44444444	68.75
43.47826087	79.6875	40	67.56756757
73.07692308	71.42857143	54.54545455	73.33333333
36.84210526	63.07692308	14.28571429	51.85185185
94.64285714	37.31343284	25.64102564	0
45.09803922	59.61538462	16.66666667	70
16	44.44444444	38.88888889	84.61538462
57.57575758	69.23076923	50	63.63636364
33.33333333	62.5	33.33333333	70
73.80952381	52.17391304	8.695652174	100
13.33333333	39.13043478	63.63636364	20
4.347826087	11.86440678	24.3902439	29.41176471
45	58.73015873	32	73.91304348
0	47.61904762	72.4137931	100
0	69.11764706	20	55.26315789
0	68.18181818	50	98.33333333
16.66666667	54.23728814	51.61290323	72.61904762
0	100	50	72.61904762
44.44444444	10	45.45454545	71.95121951
14.81481481	36.36363636	17.94871795	92.95774648
0	72	35.48387097	51.61290323
38.46153846	58.24175824	41.17647059	51.35135135
21.42857143	100	53.84615385	69.35483871
		10	30.3030303
		42.10526316	53.84615385
		61.29032258	69.23076923

Fig. 2b PI for rewarded odor (%)

control before	control after	devalued before	devalued after
21.73913043	48.14814815	18.18181818	80
50	53.19148936	40	7.692307692
0	50	0	39.28571429
28.57142857	47.61904762	0	16.66666667
0	47.05882353	33.33333333	6.25
0	35.71428571	42.10526316	21.05263158
0	29.72972973	6.25	12.5
13.33333333	52.17391304	5.263157895	17.64705882
27.27272727	83.01886792	13.33333333	9.523809524
29.41176471	35	15.38461538	27.5862069
31.25	54.54545455	28.57142857	28.20512821
33.33333333	65.625	30.43478261	22.58064516
34.375	50	32.25806452	28
37.5	53.57142857	33.33333333	39.28571429
41.66666667	56.25	36.36363636	20.58823529
46.15384615	63.15789474	40	23.52941176
49.01960784	58.97435897	42.85714286	25.80645161
54.16666667	25	47.61904762	57.89473684
NA	NA	50	43.33333333
NA	NA	55	15.15151515

Fig. 2c PI for rewarded odor (%)

control before	control after	devalued before	devalued after
60	73.91304348	31.70731707	30.85106383
45.45454545	56.75675676	23.91304348	10
50	55.55555556	89.65517241	35.29411765
60	55.26315789	50	32.96703297
25.80645161	100	44.82758621	42.10526316
37.03703704	54.16666667	86.66666667	100
16.17647059	59.375	63.63636364	53.19148936
48.64864865	65.625	31.94444444	13.63636364
55.88235294	61.53846154	25.80645161	10
70.27027027	75	57.14285714	80
69.23076923	48.64864865	50	50
59.375	44.68085106	43.90243902	55
9.523809524	0	50	58.82352941
79.16666667	81.08108108	25.58139535	38.46153846
33.33333333	84.375	71.01449275	57.57575758
40	100	35.29411765	50
51.1627907	75	40.90909091	74.19354839
54.90196078	60	37.14285714	40
0	39.13043478	30	61.53846154
34.61538462	71.01449275	50	58.33333333
47.05882353	65.51724138	11.11111111	76.92307692
0	24	57.57575758	36.84210526
27.5862069	73.17073171	45.45454545	58.33333333
30.64516129	67.9245283	34.21052632	72.72727273
0	66.66666667	26.13636364	63.63636364
83.33333333	50	67.44186047	50
65.45454545	83.33333333	33.33333333	59.09090909
44.44444444	43.24324324	52.17391304	0
23.80952381	54.05405405	41.79104478	20.3125
45.94594595	70	46.875	3.703703704
33.33333333	46.15384615	50	42.10526316
5.882352941	65.38461538	26.08695652	62.5
33.33333333	64.51612903	48.14814815	50
36.17021277	50	43.75	0
52.63157895	39.02439024		
48.88888889	64.9122807		
71.875	83.33333333		

Fig. 2d

PI for rewarded odor (%)

control before	control after	devalued before	devalued after
26.74418605	78.94736842	89.79591837	100
41.66666667	85.18518519	56.25	51.85185185
44.82758621	50	50	56.52173913
48	62.06896552	58.33333333	47.05882353
34.54545455	65.2173913	14.28571429	66.66666667
51.02040816	76.19047619	24.3902439	81.81818182
70	51.72413793	26.66666667	57.14285714
43.47826087	100	37.87878788	100
38.70967742	61.76470588	59.61538462	54.54545455
45.71428571	80	42.85714286	100
58.06451613	54.54545455	63.63636364	70
54.09836066	75.55555556	76.92307692	46.80851064
69.56521739	50.98039216	17.64705882	93.75
62.06896552	69.23076923	9.523809524	92.85714286
60	77.10843373	72.36842105	68
69.23076923	53.19148936	57.57575758	69.33333333
67.74193548	73.7704918	50	30.76923077
19.04761905	68.08510638	80	66.66666667
13.33333333	82.35294118	30.76923077	52.05479452
0	63.41463415	65.78947368	74.41860465
16.94915254	69.11764706	32.0754717	78.57142857
36.36363636	75	41.66666667	68.83116883
20	40.22988506	60	40
60	25	50	79.41176471
44.44444444	70.43478261	46.2962963	70
48.07692308	60.97560976	81.25	70.27027027
73.33333333	50	56.52173913	72.72727273
82.75862069	66.66666667	59.64912281	80.95238095
56.52173913	57.72357724	35.48387097	72.72727273
50	33.33333333	63.26530612	62.12121212
50	51.85185185	43.75	56.41025641
38.46153846	69.73684211	61.29032258	61.53846154
58.33333333	75.51020408	38.29787234	85.71428571
68.18181818	81.13207547	25.53191489	80.32786885
0	44.82758621	63.93442623	66.66666667
82.35294118	50	34.66666667	64.70588235
75	95.83333333	64.28571429	63.33333333
		46.875	60.97560976

Fig.4a

PI for rewarded odor (%)

saline before	saline after	Epinastine before	Epinatine after
69.23076923	89.79591837	68.18181818	51.61290323
32.25806452	66.66666667	14.28571429	29.41176471
10	13.33333333	42.85714286	45.45454545
25	68.75	2.564102564	80
57.57575758	53.65853659	50	64.28571429
48.8372093	75.38461538	45.45454545	46.42857143
73.68421053	36.36363636	10	27.27272727
32.55813953	47.36842105	30.76923077	54.54545455
0	16.66666667	50	0
54.54545455	33.33333333	42.85714286	30
45	42.85714286	64.44444444	40.54054054
27.27272727	76.19047619	61.36363636	43.47826087
0	64.70588235	15.90909091	25.92592593
0	33.33333333	0	42.85714286
53.84615385	28.57142857	0	37.5
0	17.24137931	60	30.76923077
36.66666667	47.05882353	60.60606061	21.21212121
28.57142857	59.45945946	57.14285714	15.38461538
39.02439024	41.66666667	1.438848921	20.68965517
70.96774194	100	68.57142857	46.66666667
20	55	52.5	50.66666667
63.63636364	80.55555556	30	43.33333333
28.57142857	25.86206897	24.3902439	50.68493151
69.41176471	61.40350877	49.46236559	55.17241379
62.96296296	79.06976744	36.11111111	71.73913043
0	93.33333333	43.75	49.38271605
48.88888889	72	44.89795918	46.875
0	35.71428571	36.11111111	55.17241379
0	50.84745763		
0	46.66666667		
28.30188679	82.75862069		
35.71428571	57.77777778		
42.85714286	70		

Fig.4b PI for rewarded odor (%)

saline before	saline after	epinatine before	epinatine after
81.25	57.14285714	37.93103448	85.71428571
33.33333333	75	38.70967742	64.51612903
27.27272727	61.9047619	22.22222222	65.27777778
57.14285714	27.45098039	40	55.26315789
8.33333333	51.42857143	25	85.71428571
0	42.37288136	8.823529412	79.06976744
34	56.25	5	50
0	70.58823529	19.04761905	59.25925926
10	60.60606061	42.85714286	68.18181818
7.692307692	48	27.27272727	52.38095238
60	63.15789474	36.36363636	64.86486486
46.66666667	53.19148936	29.16666667	74.74747475
3.703703704	25	31.66666667	100
0	45.23809524	46.15384615	65.51724138
65.2173913	77.77777778	90.0990099	0
68	45.45454545	66.66666667	57.14285714
46.26865672	78.37837838	60	88.23529412
0	65.38461538	23.68421053	16.66666667
16.36363636	60	69.56521739	47.22222222
33.33333333	44.82758621	60	28.57142857
75.67567568	33.33333333	48.97959184	31.25
7.5	71.42857143		
59.09090909	59.45945946		
42.85714286	91.42857143		
63.26530612	44.70588235		
85.48387097	57.89473684		

Fig.4c

PI for rewarded odor (%)

saline before	saline after	Epinastine before	Epinastine after
62.5	78.125	37.5	44.82758621
20	95	53.84615385	41.17647059
67.10526316	76.72413793	49.09090909	42.85714286
63.26530612	67.64705882	40	50
27.86885246	100	59.09090909	66.66666667
27.77777778	53.7037037	57.14285714	65.625
42.85714286	74.19354839	25.92592593	0
37.5	62.16216216	80	92.30769231
43.75	100	21.42857143	39.28571429
70	72.72727273	48.14814815	43.63636364
73.80952381	67.74193548	47.82608696	29.09090909
26.66666667	6.25	64	76.47058824
22.22222222	50	65.625	35.71428571
94.11764706	65	16.66666667	21.05263158
16.66666667	28.57142857	36.36363636	25.3968254
57.14285714	69.23076923	50	50
50	76.92307692	78.94736842	73.33333333
30.76923077	53.33333333	51.51515152	55.55555556
41.17647059	84.84848485	40	66.66666667
31.25	62.5	23.80952381	46.15384615
48.48484848	0	72.22222222	71.42857143
0	54.54545455	33.33333333	37.5
27.27272727	70	33.33333333	50
60	75	70	42.85714286
31.57894737	54.54545455	47.22222222	50
68.42105263	92.85714286	43.10344828	23.07692308
61.9047619	70	69.23076923	26.31578947
50	20.58823529	46.15384615	57.69230769
52.77777778	73.17073171	50	40
53.84615385	87.09677419	56.41025641	56.25
33.33333333	72.72727273	9.523809524	84.61538462
25	95.65217391	78.94736842	69.23076923
36.36363636	89.36170213	76.47058824	46.15384615
60.52631579	100	60	66.66666667
37.14285714	59.375	63.63636364	92.85714286
54.28571429	41.66666667	53.125	68.08510638
17.64705882	6.666666667	72.72727273	70.58823529
20	77.27272727	50	45.45454545
52.38095238	63.33333333	50	60
72.72727273	79.31034483	38.46153846	83.33333333
80	69.56521739	29.16666667	85.71428571
44.44444444	90		
46.66666667	95.34883721		
56.41025641	81.48148148		
63.41463415	0		
85.29411765	100		
100	77.77777778		

Fig.4d

PI for rewarded odor (%)

saline before	saline after	epinastine before	epinatine after
80	53.57142857	57.89473684	41.66666667
0	76.31578947	42.10526316	96.77419355
15.15151515	37.5	27.5862069	63.33333333
25	58.69565217	57.14285714	73.33333333
10.52631579	73.68421053	25	70.37037037
20	10.52631579	31.57894737	66.66666667
89.47368421	68.75	33.33333333	41.17647059
34.375	63.63636364	43.47826087	45.71428571
36.36363636	40.54054054	47.22222222	54.16666667
100	68.42105263	21.21212121	65.2173913
95.45454545	75	83.33333333	80
78.125	100	41.17647059	66
79.41176471	51.85185185	0	50
50	81.81818182	63.63636364	72.22222222
50	85.41666667	69.56521739	83.33333333
22.72727273	10	51.85185185	66.66666667
38.7755102	84.84848485	33.33333333	52
73.07692308	68.18181818	36.36363636	83.33333333
74.41860465	63.33333333	47.05882353	90.47619048
52.94117647	73.07692308	54.54545455	42.30769231
51.61290323	100	71.42857143	60
62.5	42.85714286	50	64.86486486
28	60	47.36842105	80
46.42857143	57.89473684	43.75	72.5
70.58823529	100	100	63.63636364
52.63157895	79.24528302	55.55555556	60.71428571
61.53846154	88.88888889	70	88.52459016
55.55555556	80.64516129	37.5	58.97435897
41.66666667	60		
65.71428571	82.35294118		
0	67.74193548		
50	37.14285714		
87.5	67.34693878		
72.22222222	81.81818182		
28.57142857	58.33333333		

FigS1a control before	Time to visit rewarded odor (s)			
	control after	devalued before	devalued after	
	0	65	5	8
	0	20	5	6
	3	11	6	16
	19	22	5	8
	0	29	2	7
	0	11	0	2
	15	32	8	7
	25	23	4	0
	58	79	0	7
	16	40	20	2
	27	28	14	2
	1	6	8	3
	0	11	1	1
	55	70	19	8
	31	60	0	47
	23	3	0	11
	2	44	7	9
	2	69	6	5
	1	34	10	23
	38	20	2	0
	1	12	3	2
	23	28	8	6
	2	4	2	0
	9	0	30	0

FigS1b Time to visit control odor (s)

control before	control after	devalued before	devalued after
30	12	6	5
30	13	10	17
10	4	9	5
9	15	21	4
18	56	23	17
13	31	10	9
16	23	31	9
23	32	12	18
16	17	55	5
3	11	26	22
15	9	20	8
20	7	9	7
19	17	23	9
67	39	13	7
11	14	45	60
11	19	20	11
24	25	22	5
8	14	17	16
14	11	6	30
10	0	8	23
18	7	18	6
18	19	5	0
8	0	8	2
44	5	10	0

Fig.S1c

Total time to visit odors (sec)

control, before	control, after	devalued, before	davalued, after
30	77	11	13
30	33	15	23
13	15	15	21
28	37	26	12
18	85	25	24
13	42	10	11
31	55	39	16
48	55	16	18
74	96	55	12
19	51	46	24
42	37	34	10
21	13	17	10
19	28	24	10
122	109	32	15
42	74	45	107
34	22	20	22
26	69	29	14
10	83	23	21
15	45	16	53
48	20	10	23
19	19	21	8
41	47	13	6
10	0	10	2
53	5	40	8

Fig S2	PI for peppermint odor	
before devaluation	after devaluation	
55.55555556	22.22222222	
7.8125	60.86956522	
9.090909091	66.66666667	
65.38461538	33.33333333	
15.55555556	7.407407407	
29.03225806	37.5	
29.03225806	15.78947368	
40	30	
26.66666667	0	
46.875	19.04761905	
0	0	
35.29411765	33.33333333	
13.04347826	0	
34.88372093	63.63636364	
53.33333333	31.25	
36.92307692	16.66666667	
27.86885246	28.57142857	
47.5	41.17647059	
40	21.42857143	

Fig.S3a PI for rewarded odor (%)

control before	control after	Devalued before	Devalued after
18.75	74.41860465	42.10526316	61.81818182
25	100	100	30.43478261
33.33333333	62.16216216	27.77777778	66.66666667
6.666666667	45.09803922	70	0
28.57142857	97.72727273	33.33333333	75.67567568
35.71428571	60	28.26086957	100
46.42857143	84.30232558	62.5	26.66666667
68.18181818	100	20	78.26086957
20.68965517	45.05494505	30	5.263157895
33.33333333	80.32786885	8.333333333	7.142857143
7.692307692	0	41.66666667	29.41176471
75	100	82.02247191	35.29411765
12.5	43.58974359	35	41.66666667
36.36363636	50.84745763	45.16129032	30.76923077
36.95652174	100	0	2.362204724
34.7826087	27.02702703	50	39.13043478
63.63636364	75	50	20.51282051
43.47826087	84.61538462	56	50
37.14285714	100	41.30434783	33.33333333
48.8372093	68	40	40
22.72727273	76.19047619	52.27272727	23.52941176
46.51162791	71.42857143	59.25925926	7.692307692
		52.63157895	0
		25	80
		27.27272727	72.72727273

Fig.S3b

PI for rewarded odor (%)

Control before	Control after	Devalued before	Devalued after
0	54.54545455	85.71428571	58.33333333
37.5	86.2745098	48.14814815	72.72727273
30.6122449	68.25396825	55.55555556	35.29411765
32.55813953	52.63157895	0	37.5
9.523809524	53.65853659	3.703703704	55.55555556
9.523809524	46.15384615	5.970149254	40
15.625	79.31034483	14.28571429	41.66666667
8.333333333	73.33333333	10	12.5
20	60.46511628	30.76923077	27.27272727
61.53846154	62.5	9.090909091	43.58974359
10	100	7.142857143	27.27272727
81.25	55.55555556	39.13043478	77.27272727
0	94.44444444	78.08219178	53.06122449
15.78947368	51.28205128	63.29113924	51.61290323
20.68965517	62.79069767	40	35.71428571
0	30.39215686	27.63157895	60
59.52380952	66.66666667	63.63636364	66.66666667
50	48.7804878	35.29411765	33.33333333
46.15384615	65.625	16.66666667	31.25
32.55813953	53.78151261	11.36363636	36.73469388
40.90909091	48.71794872	0	75
41.46341463	37.11340206	77.20588235	58.82352941
		0	23.07692308
		45.45454545	45.45454545

Fig.S4a

PI for rewarded odor (%)

saline before	saline after	Epinastine before	Epinastine after
81.08108108	70	44.73684211	63.88888889
0	83.33333333	0	68.42105263
90	100	72.22222222	40
30	50	30.76923077	54.54545455
63.04347826	94.11764706	61.53846154	45.45454545
72.72727273	70.58823529	52.38095238	22.22222222
61.11111111	62.5	67.64705882	78.125
68.18181818	72.72727273	54.16666667	53.57142857
50	100	77.77777778	68.75
41.17647059	40	6.66666667	68.18181818
0	50	56.52173913	50
86.20689655	62.5	10.52631579	67.34693878
50	28.57142857	50	43.47826087
37.5	50	21.42857143	68.75
58.49056604	100	60	43.75
35.71428571	60	60.46511628	90.90909091
37.5	41.66666667	66.66666667	54.54545455
28.57142857	100	66.66666667	54.54545455
60.71428571	80.35714286	60	42.85714286
75	66.66666667	36.36363636	56.25
50	100	82.60869565	44.44444444
NA	NA	33.33333333	23.52941176
NA	NA	58.33333333	45.45454545
NA	NA	44.44444444	81.81818182
NA	NA	50	59.375

Fig.S4b PI for rewarded odor (%)

saline before	saline after	epinastine before	epinastine afer
61.76	60.87	100	71.428571
42.86	56.76	53.333333	50
62.86	42.35	45.454545	46.666667
69.23	57.14	63.636364	27.272727
57.69	58.82	50	50
32.35	52.38	42.857143	76.923077
50.00	76.00	45.454545	100
38.64	59.62	31.818182	52.173913
60.61	37.50	82.608696	89.393939
41.67	50.00	30.769231	26.190476
50.00	88.24	66.666667	75
58.33	75.68	0	38.461538
40.54	71.43	68.965517	37.5
38.71	56.90	30.30303	78.571429
52.38	93.10	39.393939	60
32.69	88.00	43.589744	12.5
45.45	73.33	56	84.444444
37.50	75.00		
38.89	61.70		
66.67	55.00		
57.89	62.75		