Problem: Computational Model (based on Daw et al., 2011) does not reflect the same pattern of results as seen in the behavioral data using stay behavior.

  Behavioral Results (regressions):
- Age x Condition x Transition x Outcome interaction (p=0.001130)
    - Younger Adults:
        - Condition
        - Transition
        - Outcome
        - Condition x Transition
        - Transition x Outcome
        - Condition x Transition x Outcome
            - 6040: Outcome, Transition x Outcome
            - 8020: Transition, Outcome, Transition x Outcome
    - Older Adults:
        - Outcome
        - Transition x Outcome
        - Condition x Transition x Outcome
            - 6040: Outcome
            - 8020: Outcome, Transition x Outcome

  Computational Model Results (Daw et al., 2011):

Parameter	
Beta parameter at stage 1	Age Group (p= 0.00009) *
Beta parameter at stage 2	Age Group (p= 0.0028) *
Alpha at stage 1	
Alpha at stage 2	Age Group (p= 0.013) *
Lambda	Condition (p= 0.047) *
Omega (model-based weight)	Age Group (p= 0.0029) *
Choice stickiness	Age Group (p= 0.000000047) *

Question: What can be done to solve this discrepancy?
- Can the model be modified?
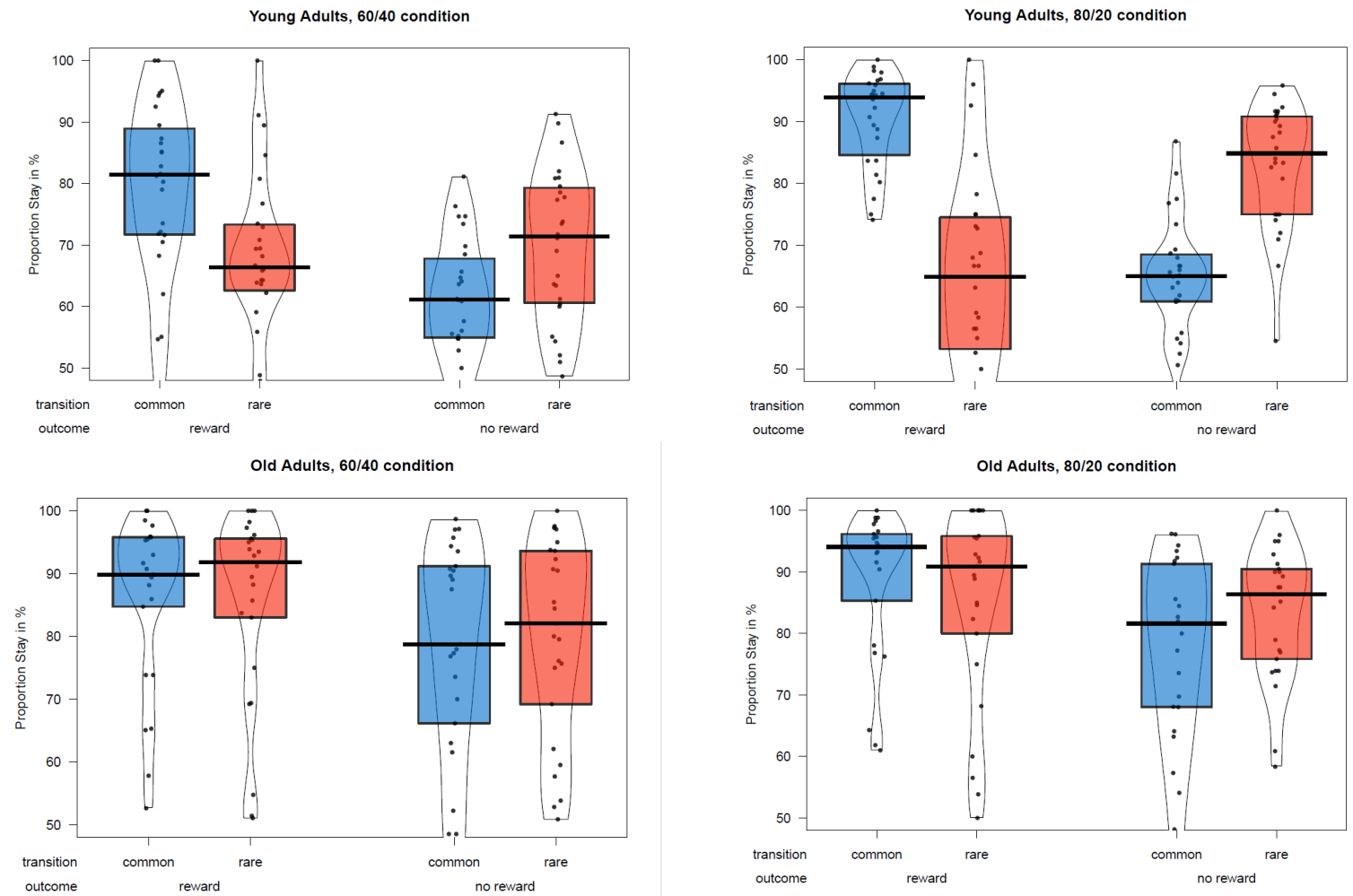
Behavioral Results

Figure X. Probability of repeating first choice (stay behavior) as a function of the transition on the previous trial (common or rare transition) and the outcome on the previous trial (reward or no reward). Stay probabilities are displayed separately for each condition (60-40 and 80-20) across both age groups (younger and older adults). Vertical black lines represent the median, while boxes represent the inter-quartile range. Black dots represent individual participants' data, and the black outline represents the overall distribution.
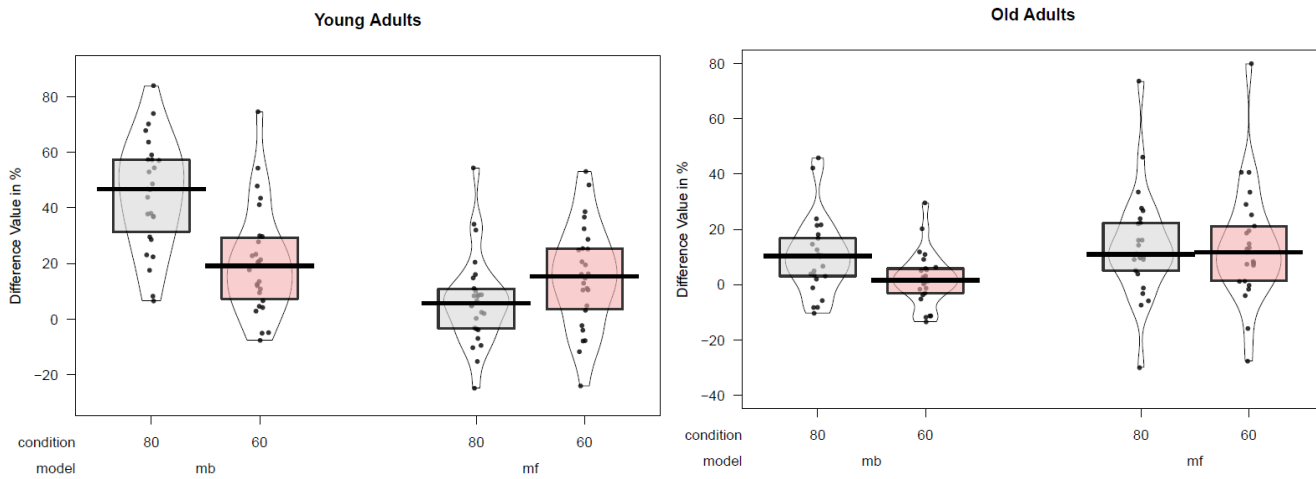
Figure X. Difference values (stay probability) for model-based behavior ((common reward + rare no reward) – (rare reward + common no reward)) and model-free behavior ((common reward + rare reward) – (common no reward + rare no reward)). Difference values are displayed separately for each condition (60-40 and 80-20). Vertical black lines represent the mean, while boxes represent the 95% confidence interval around the mean. Black dots represent individual participants' data, and the black outline represents the overall distribution.

Predictor	β	SE	p
(Intercept)	1.538	0.107	< 2e-16
Age group	-0.400	0.107	0.000189
Condition	-0.110	0.043	0.010254
Transition	0.054	0.029	0.060371
Outcome	0.280	0.046	1.43e-09
Age group x Condition	-0.096	0.043	0.023359
Age group x Transition	0.073	0.028	0.010343
Condition x Transition	-0.033	0.021	0.107384
Age group x Outcome	-0.061	0.046	0.185781
Condition x Outcome	-0.001	0.021	0.966840
Transition x Outcome	0.304	0.021	< 2e-16
Age group x Condition x Transition	-0.030	0.020	0.144209
Age group x Condition x Outcome	0.020	0.021	0.329659
Age group x Transition x Outcome	0.177	0.021	< 2e-16
Condition x Transition x Outcome	-0.148	0.020	3.66e-13
Age group x Condition x Transition x Outcome	-0.066	0.020	0.001130

Table X. Mixed-effects logistic regression Coefficients indicating the effects of age group, condition, previous transition and previous outcome on first-stage choice.

	Predictor	β	*SE*	*p*
Younger Adults	Intercept	1.133	0.100	< 0.001
	Condition	-0.206	0.045	< 0.001
	Transition	0.125	0.040	0.002
	Outcome	0.219	0.058	< 0.001
	Condition x Transition	-0.059	0.026	0.021
	Condition x Outcome	0.024	0.026	0.358
	Transition x Outcome	0.479	0.026	< 0.001
	Condition x Transition x Outcome	-0.215	0.026	< 0.001
Older Adults	Intercept	1.955	0.196	< 0.001
	Condition	-0.002	0.079	0.980
	Transition	-0.014	0.040	0.715
	Outcome	0.332	0.073	< 0.001
	Condition x Transition	-0.011	0.032	0.745
	Condition x Outcome	-0.028	0.033	0.396
	Transition x Outcome	0.130	0.032	< 0.001
	Condition x Transition x Outcome	-0.081	0.032	0.010

Table X. Mixed-effects logistic regression Coefficients indicating the effects of condition, previous transition and previous outcome on first-stage choice for both younger and older adults.

Computational Model Results

Descriptives:

Inverse Temperature (Stage 1)	Age Group	Mean values
	Younger adults	60/40: 6.789491952 80/20: 7.114860717
	Older adults	60/40: 4.285251583 80/20: 4.366639578
Omega (model-based weight)	Younger adults	60/40: 0.557883093 80/20: 0.569596318
	Older adults	60/40: 0.484785148 80/20: 0.38852263

ANOVA Results:

Parameter	
Beta parameter at stage 1	Age Group (p= 0.00009) * Condition (p= 9.68) Interaction (p= 0.808)
Beta parameter at stage 2	Age Group (p= 0.0028) * Condition (p= 0.32) Interaction (p= 0.370)
Alpha at stage 1	Age Group (p= 0.34) Condition (p= 0.52) Interaction (p= 0.93)
Alpha at stage 2	Age Group (p= 0.013) * Condition (p= 0.31) Interaction (p= 0.30)
Lambda	Age Group (p= 0.89) Condition (p= 0.047) * Interaction (p= 0.41)
Omega (model-based weight)	Age Group (p= 0.0029) * Condition (p= 0.22) Interaction (p= 0.11)
Choice stickiness	Age Group (p= 0.000000047) * Condition (p= 0.82) Interaction (p= 0.38)

Correlations: Parameters and Stay

Younger Adults, 60/40 condition:

	id	stay	mbweights	learns1	learns2	invtemps1	invtemps2	eligtrace	choicestick
id	1	-0.29	-0.06	0.26	0.03	-0.27	-0.3	0.25	0.45
stay	-0.29	1	0.58	0	0.3	0.68	0.1	-0.24	-0.22
mbweights	-0.06	0.58	1	0.38	0.04	0.31	0.21	-0.46	0.04
learns1	0.26	0	0.38	1	0.32	-0.26	-0.02	0.22	0.44
learns2	0.03	0.3	0.04	0.32	1	-0.11	-0.42	0.31	0.2
invtemps1	-0.27	0.68	0.31	-0.26	-0.11	1	0.33	-0.12	-0.52
invtemps2	-0.3	0.1	0.21	-0.02	-0.42	0.33	1	-0.24	0.13
eligtrace	0.25	-0.24	-0.46	0.22	0.31	-0.12	-0.24	1	0.13
choicestick	0.45	-0.22	0.04	0.44	0.2	-0.52	0.13	0.13	1

n=   26

P-values

	id	stay	mbweights	learns1	learns2	invtemps1	invtemps2	eligtrace	choicestick
id		0.1464	0.754	0.1964	0.8948	0.1845	0.1396	0.2133	0.0198
stay	0.1464		0.002	0.9891	0.1313	0.0001	0.6329	0.2459	0.2909
mbweights	0.754	0.002		0.054	0.8482	0.1219	0.3082	0.019	0.8348
learns1	0.1964	0.9891	0.054		0.1077	0.1933	0.904	0.2891	0.0251
learns2	0.8948	0.1313	0.8482	0.1077		0.5935	0.0316	0.1248	0.3281
invtemps1	0.1845	0.0001	0.1219	0.1933	0.5935		0.1011	0.5646	0.0067
invtemps2	0.1396	0.6329	0.3082	0.904	0.0316	0.1011		0.2392	0.5374
eligtrace	0.2133	0.2459	0.019	0.2891	0.1248	0.5646	0.2392		0.5177
choicestick	0.0198	0.2909	0.8348	0.0251	0.3281	0.0067	0.5374	0.5177	

Young Adults, 80/20 condition

	id	stay	mbweights	learns1	learns2	invtemps1	invtemps2	eligtrace	choicestick
id	1	-0.06	-0.14	0.02	0.08	-0.2	-0.18	0.02	0.39
stay	-0.06	1	0.47	0.46	0.58	-0.08	-0.13	-0.3	-0.33
mbweights	-0.14	0.47	1	0.52	0.26	-0.33	-0.03	0.07	0.06
learns1	0.02	0.46	0.52	1	0.28	-0.41	-0.16	-0.03	-0.01
learns2	0.08	0.58	0.26	0.28	1	-0.47	-0.51	-0.18	0.22
invtemps1	-0.2	-0.08	-0.33	-0.41	-0.47	1	0.73	-0.18	-0.58
invtemps2	-0.18	-0.13	-0.03	-0.16	-0.51	0.73	1	-0.25	-0.45
eligtrace	0.02	-0.3	0.07	-0.03	-0.18	-0.18	-0.25	1	0.06
choicestick	0.39	-0.33	0.06	-0.01	0.22	-0.58	-0.45	0.06	1

n=   26

P-values

	id	stay	mbweights	learns1	learns2	invtemps1	invtemps2	eligtrace	choicestick
id		0.7767	0.4937	0.9198	0.7019	0.3346	0.3753	0.9119	0.048
stay	0.7767		0.0153	0.0175	0.0021	0.6927	0.5169	0.1427	0.0993
mbweights	0.4937	0.0153		0.0069	0.2005	0.0963	0.8977	0.7465	0.7737
learns1	0.9198	0.0175	0.0069		0.165	0.0357	0.4229	0.8856	0.943
learns2	0.7019	0.0021	0.2005	0.165		0.0146	0.0079	0.3857	0.2777
invtemps1	0.3346	0.6927	0.0963	0.0357	0.0146		0	0.3752	0.0019
invtemps2	0.3753	0.5169	0.8977	0.4229	0.0079	0		0.224	0.0222
eligtrace	0.9119	0.1427	0.7465	0.8856	0.3857	0.3752	0.224		0.7809
choicestick	0.048	0.0993	0.7737	0.943	0.2777	0.0019	0.0222	0.7809	

**Old Adults,
60/40 condition**

	id	stay	mbweights	learns1	learns2	invtemps1	invtemps2	eligtrace	choicestick
id	1	-0.07	0.07	0.11	-0.31	0.17	0.41	0.38	-0.12
stay	-0.07	1	0.25	-0.18	0.36	-0.3	-0.21	-0.26	-0.15
mbweights	0.07	0.25	1	-0.01	-0.11	-0.46	0.08	-0.38	-0.05
learns1	0.11	-0.18	-0.01	1	0.23	-0.45	-0.11	0.56	-0.06
learns2	-0.31	0.36	-0.11	0.23	1	-0.4	-0.57	0.24	0.14
invtemps1	0.17	-0.3	-0.46	-0.45	-0.4	1	0.4	-0.03	0.22
invtemps2	0.41	-0.21	0.08	-0.11	-0.57	0.4	1	-0.12	0.14
eligtrace	0.38	-0.26	-0.38	0.56	0.24	-0.03	-0.12	1	0.06
choicestick	-0.12	-0.15	-0.05	-0.06	0.14	0.22	0.14	0.06	1

n=   25

P-values

	id	value	mbweights	learns1	learns2	invtemps1	invtemps2	eligtrace	choicestick
id		0.753	0.7349	0.6085	0.1294	0.4215	0.0431	0.0642	0.5656
stay	0.753		0.2305	0.4009	0.0796	0.142	0.3134	0.2186	0.4828
mbweights	0.7349	0.2305		0.9717	0.5932	0.0208	0.7157	0.0615	0.8303
learns1	0.6085	0.4009	0.9717		0.2739	0.0239	0.5988	0.0039	0.7612
learns2	0.1294	0.0796	0.5932	0.2739		0.0477	0.0029	0.2384	0.519
invtemps1	0.4215	0.142	0.0208	0.0239	0.0477		0.0499	0.8929	0.3017
invtemps2	0.0431	0.3134	0.7157	0.5988	0.0029	0.0499		0.5831	0.4986
eligtrace	0.0642	0.2186	0.0615	0.0039	0.2384	0.8929	0.5831		0.7723
choicestick	0.5656	0.4828	0.8303	0.7612	0.519	0.3017	0.4986	0.7723	

Older Adults, 80/20 condition

	id	stay	mbweights	learns1	learns2	invtemps1	invtemps2	eligtrace	choicestick
id	1	-0.02	-0.12	0.11	-0.04	0.13	0.07	0.2	0.01
stay	-0.02	1	0.23	0.08	0.11	0.14	-0.16	0.19	-0.63
mbweights	-0.12	0.23	1	0.03	-0.56	0.1	0.38	-0.17	-0.31
learns1	0.11	0.08	0.03	1	-0.02	-0.07	-0.05	0.29	0.16
learns2	-0.04	0.11	-0.56	-0.02	1	-0.4	-0.64	0.31	0.06
invtemps1	0.13	0.14	0.1	-0.07	-0.4	1	0.52	-0.06	-0.34
invtemps2	0.07	-0.16	0.38	-0.05	-0.64	0.52	1	-0.33	-0.02
eligtrace	0.2	0.19	-0.17	0.29	0.31	-0.06	-0.33	1	-0.21
choicestick	0.01	-0.63	-0.31	0.16	0.06	-0.34	-0.02	-0.21	1

n=   25

P-values

	id	stay	mbweights	learns1	learns2	invtemps1	invtemps2	eligtrace	choicestick
id		0.9299	0.5654	0.6048	0.8443	0.5393	0.7366	0.3397	0.9467
stay	0.9299		0.2781	0.7088	0.5975	0.5102	0.4588	0.3599	0.0008
mbweights	0.5654	0.2781		0.8795	0.0033	0.6321	0.0628	0.4098	0.1319
learns1	0.6048	0.7088	0.8795		0.906	0.7333	0.8079	0.1573	0.4474
learns2	0.8443	0.5975	0.0033	0.906		0.0474	0.0005	0.1285	0.7615
invtemps1	0.5393	0.5102	0.6321	0.7333	0.0474		0.0071	0.7745	0.0914
invtemps2	0.7366	0.4588	0.0628	0.8079	0.0005	0.0071		0.107	0.9177
eligtrace	0.3397	0.3599	0.4098	0.1573	0.1285	0.7745	0.107		0.3098
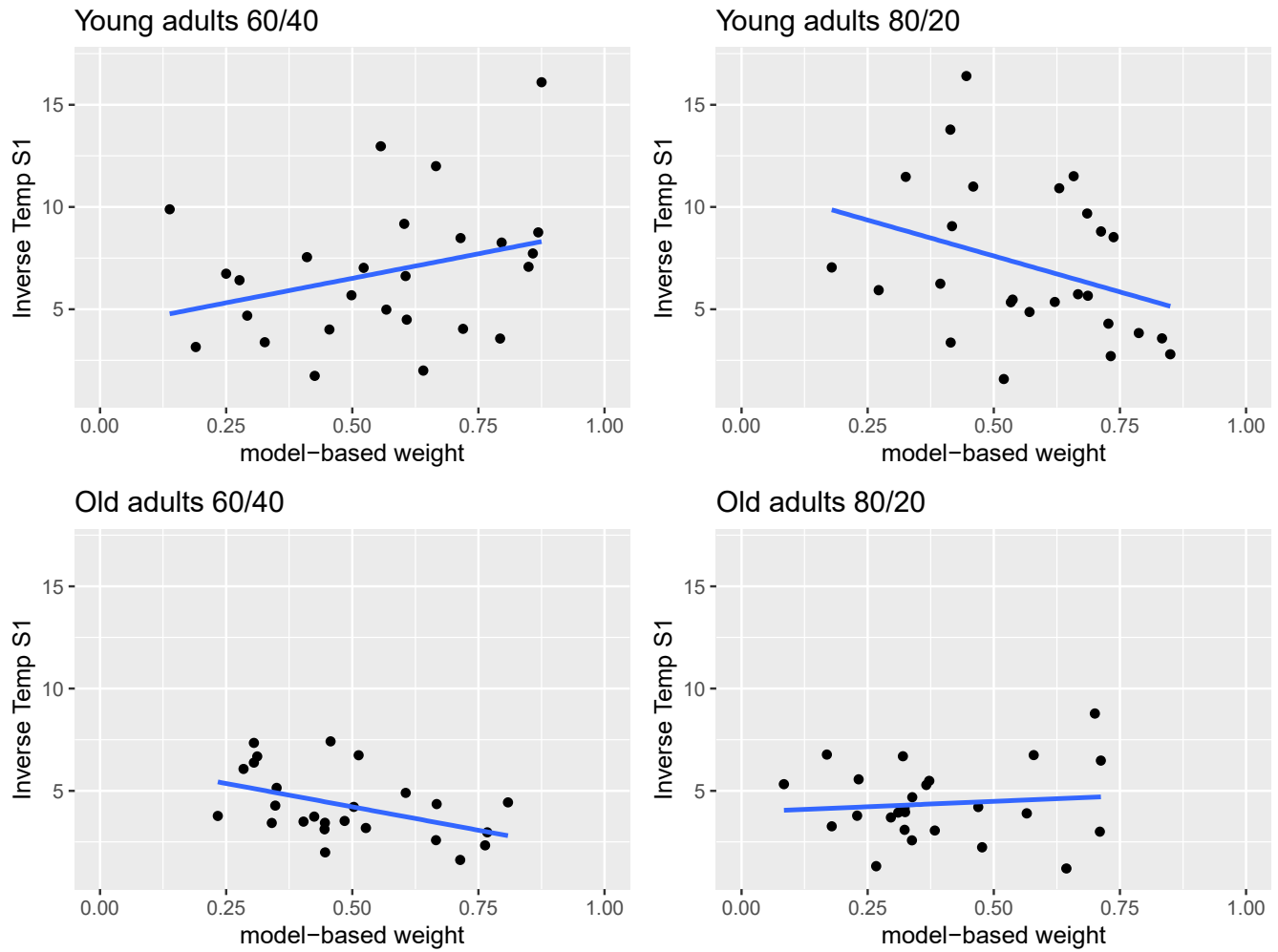
Figure X. Correlations between the model-based weights (omega) and the inverse temperature parameter (beta) at stage 1 for younger and older adults in both conditions.
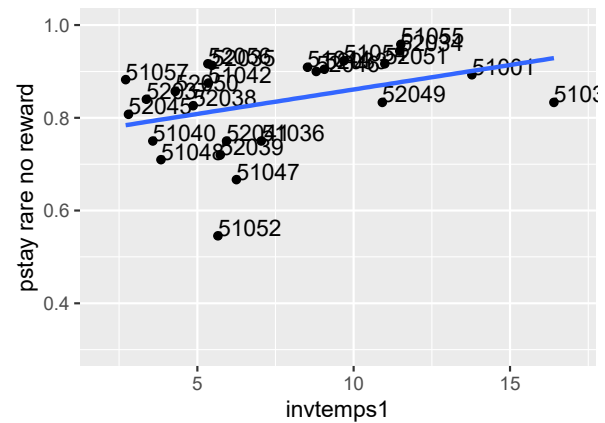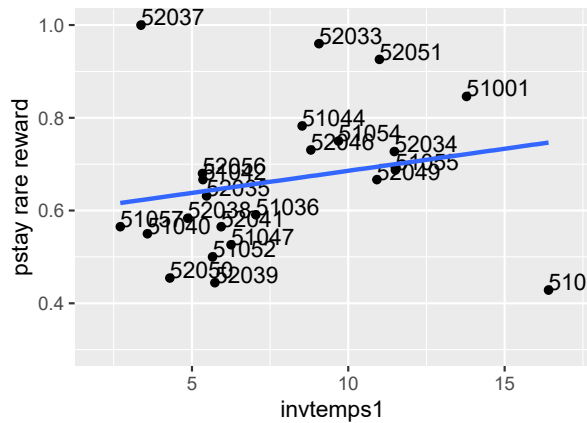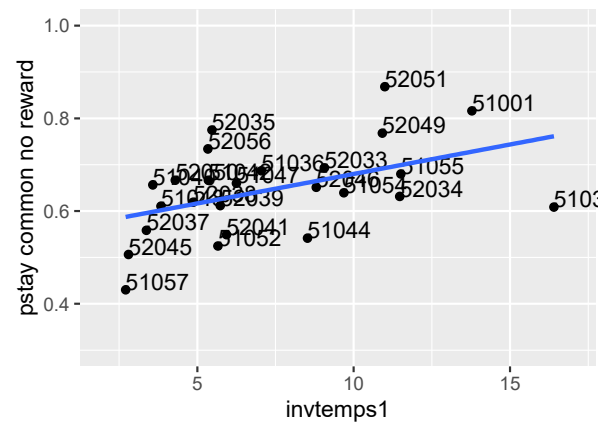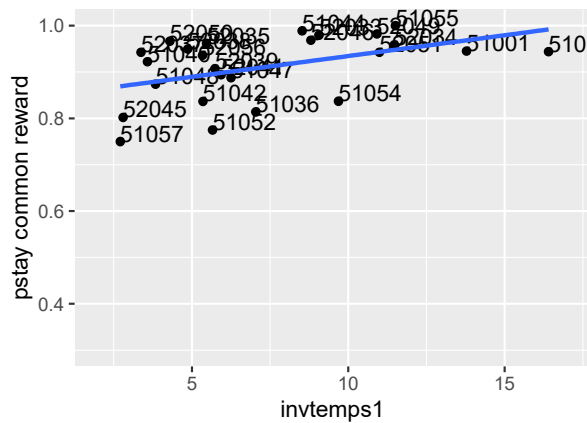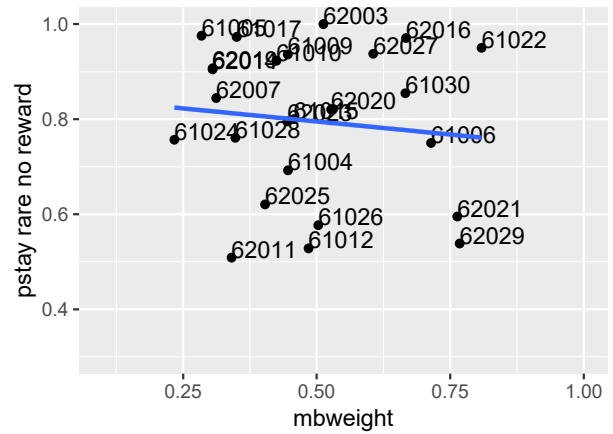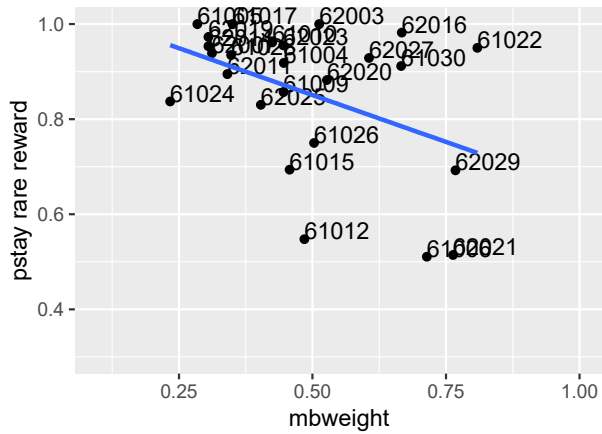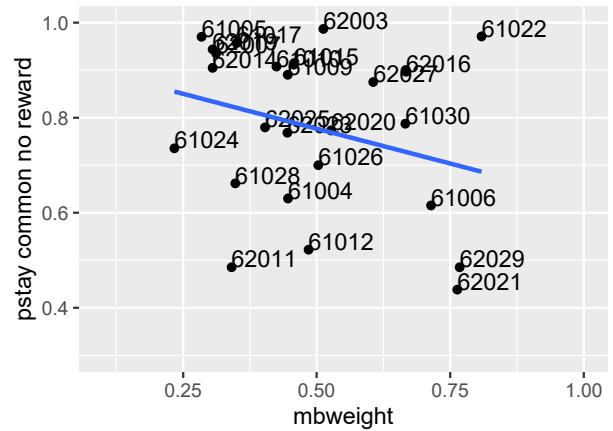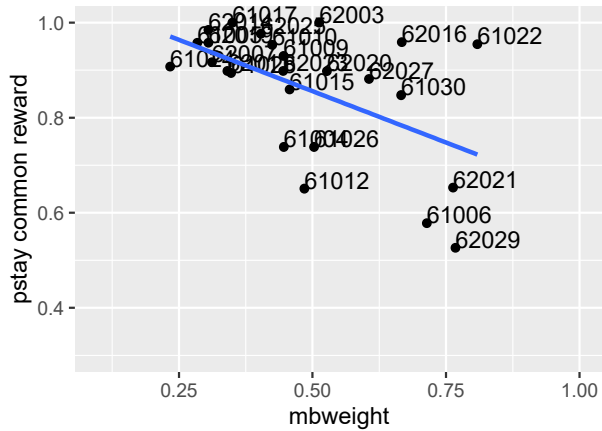
Young adults, 60/40, mb weight
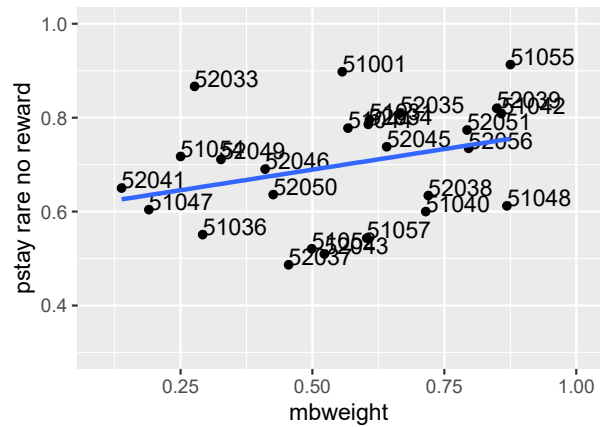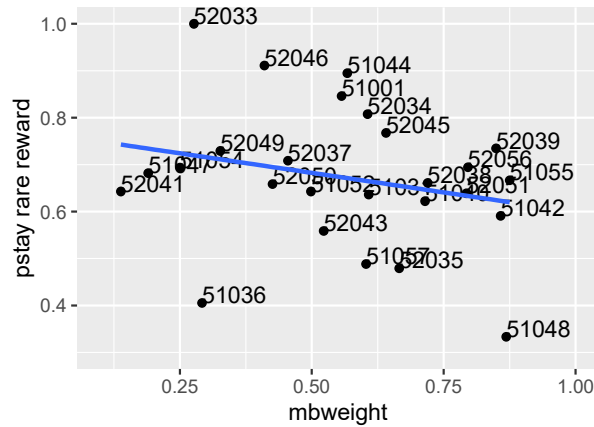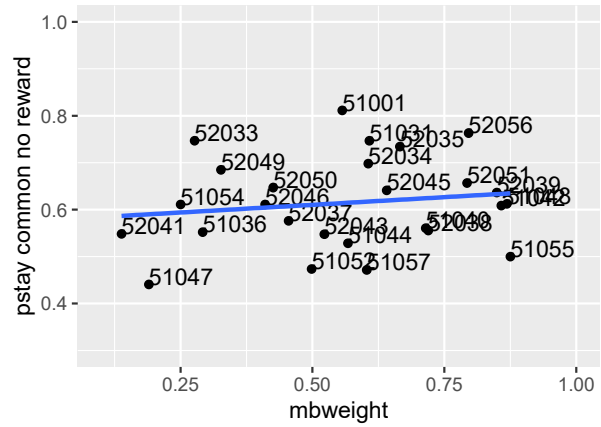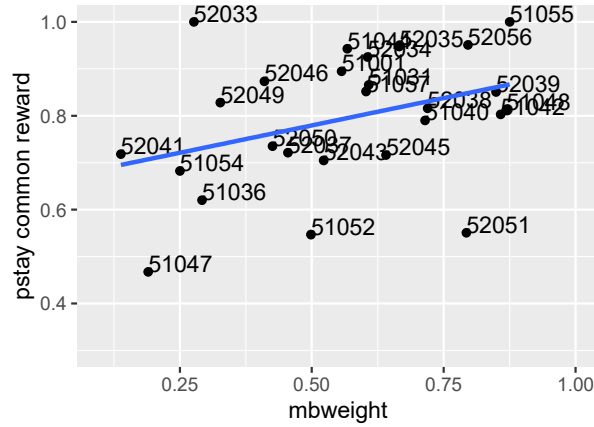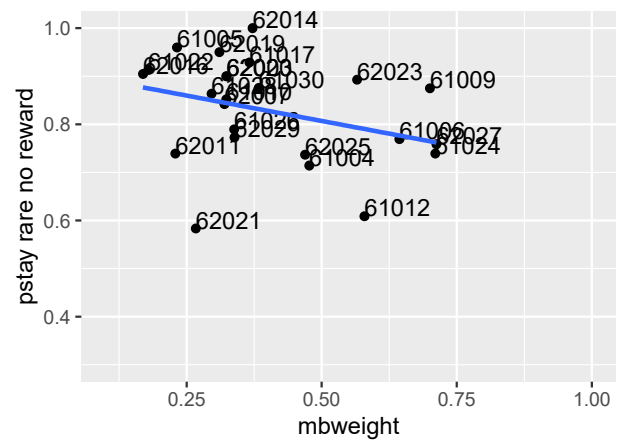
Young adults, 80/20, mb weight
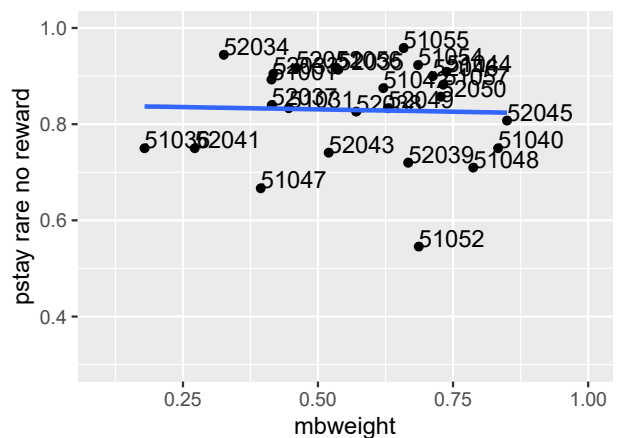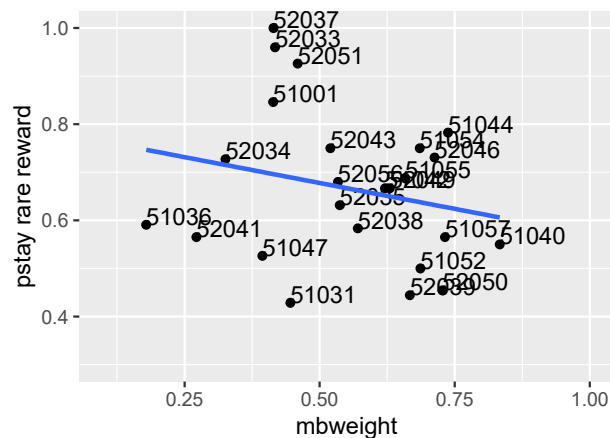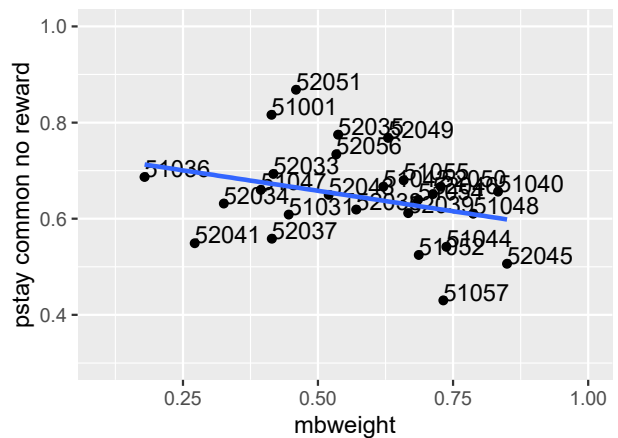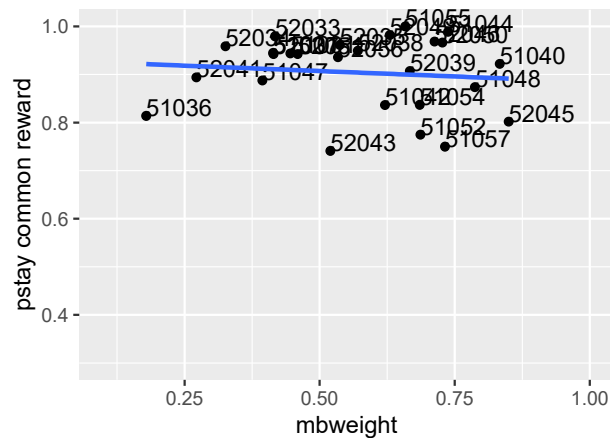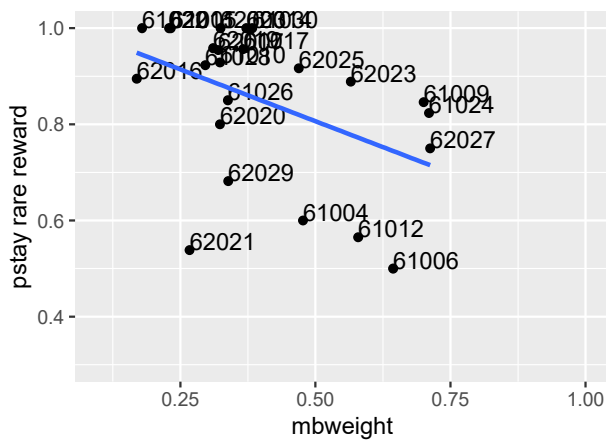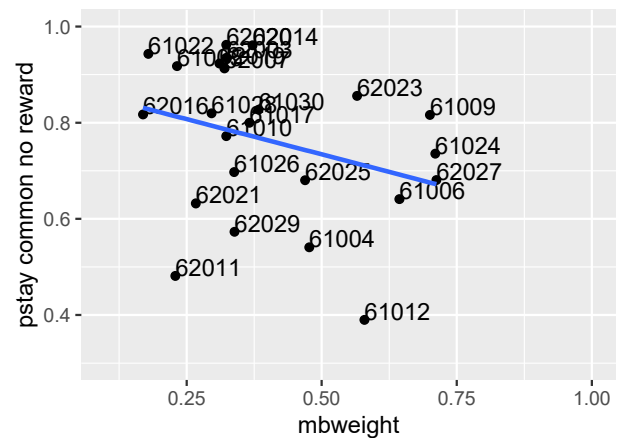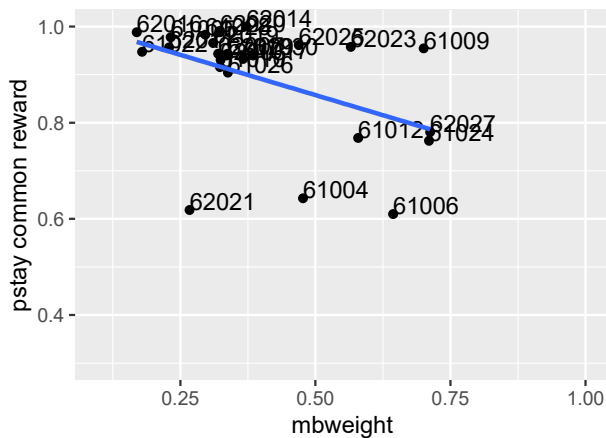
Young adults, 60/40, inverse temp S1
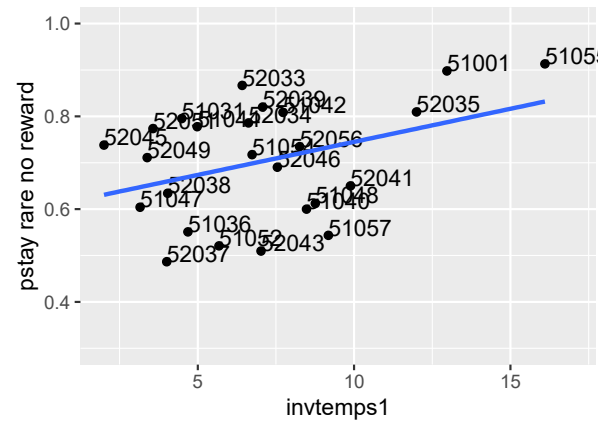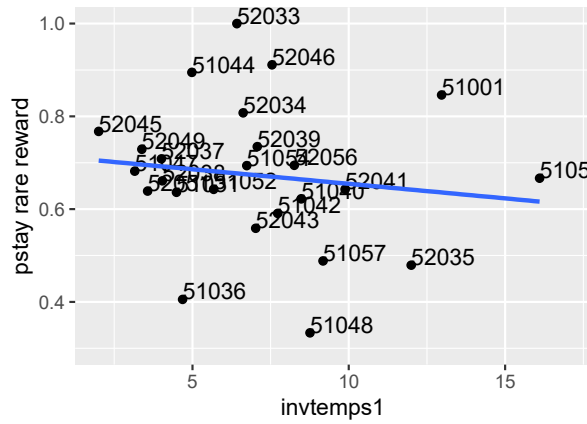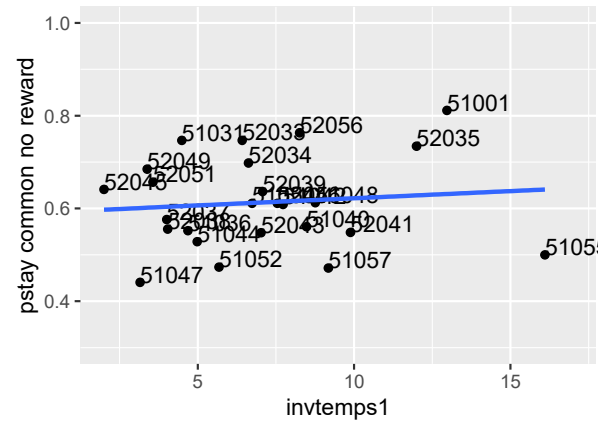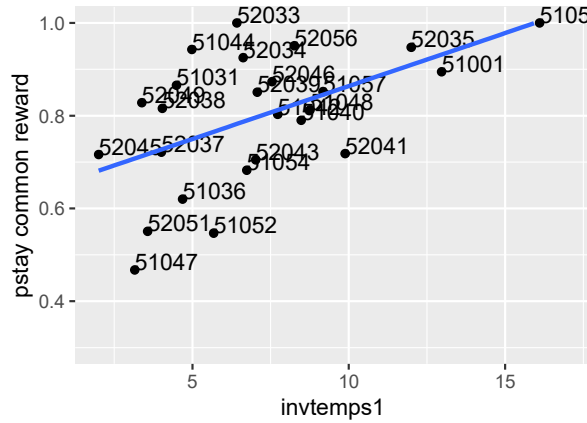
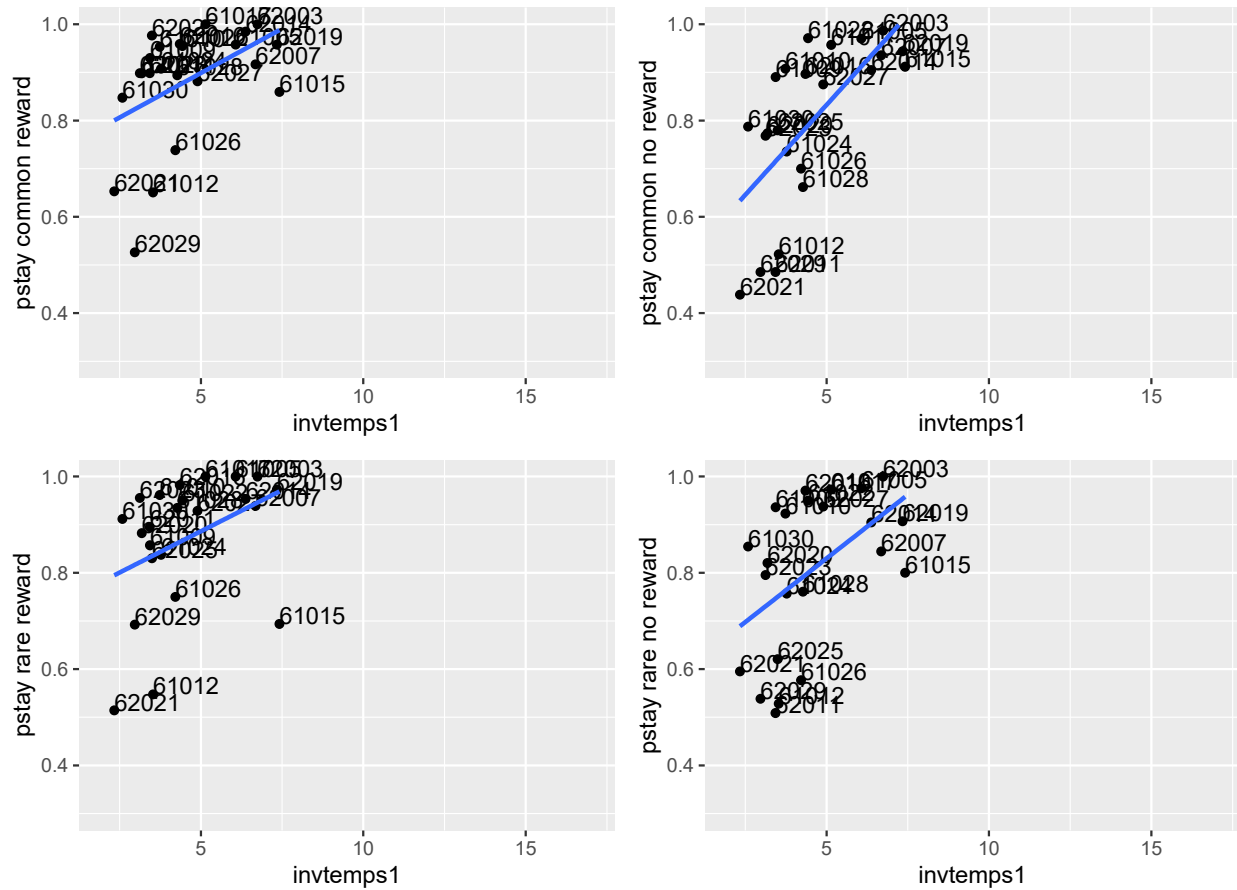Young adults, 80/20, inverse temp S1

Old adults, 60/40, mb weight

Old adults, 80/20, mb weight

Old adults, 60/40, inverse temp S1

Old adults, 80/20, inverse temp S1