Supplementary Materials

Heterogeneity and Parsimony in Intertemporal Choice

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Supplemental Methods

Consent forms

Consent Form for Choice Experiment at UIUC

Purpose and Procedures:

This is a research project intended to investigate how people make choices between immediate and delayed rewards. If you agree to take part in this study, you will be asked to complete a computer program soliciting your choices between many pairs of rewards with different delays. The experiment takes about half an hour.

Voluntariness:

Your participation in this research is voluntary. You may refuse to participate or discontinue participation at any time. If you do not complete the experiment, you will receive a prorated portion of the minimum payment, based on the number of choices you made. Your decision to discontinue the experiment will remain confidential and will not affect your grades or status at this university.

Risks and Benefits:

By participating in this research, we hope you will learn something about your personal process of decision making. We are not aware of any risks to you beyond those incurred in everyday life.

Compensation:

There will be one session. During the experiment, you will make a series of choices between pairs of rewards involving hypothetical monetary outcomes. Each pair of choices will be structured as follows: Receive $A1 with a given delay of T1 days, receive $A2 with a given delay of T2 days, or state indifference. At the end of the session, a pair of (possibly delayed) rewards will be drawn from the set of all choices you made during the session, and a real money reward will be given with a corresponding delay. If You will have a chance to receive a monetary reward up to $31. The delay period varies from 0 to 100 days. If you do not complete a session, you will receive a prorated portion of the typical payment based on the number of choices you made. The payment will be made by means of a gift code to a major on-line retailer.

Confidentiality:

Your name only appears on this form and on a note card. The note card keeps track of your name and an ID number. That number is the only link between your identity and the data. The note card will be destroyed after you have completed the experiment, thereafter ensuring your anonymity. In the event of publication of this research, no personally identifying information will be disclosed.

Who to Contact with Questions:

Questions about this research study should be directed to Anna Popova or the primary research investigator Dr. Michel Regenwetter in the Department of Psychology. Questions about your rights as a research participant should be directed to the UIUC Institutional Review Board Office. You will receive a copy of this consent form.

Dissemination of Results:

The results will be disseminated to the academic community via journal articles, papers, conference presentations, and potentially PhD theses. The data collected may also be shared with investigators doing research in similar fields at other research centers.

May We Share Your (De-Identified) Choice Data With Researchers at Other Institutions? Yes/No

I certify that I have read this form and volunteer to participate in this research study. I am 18 years of age or older. From an immigration law and tax law point of view, I am permitted to earn monetary compensation in the United States.

Consent Form for Choice Experiment at MPI

In der Studie "Transitivity in intertemporal choice" wollen wir untersuchen, wie der Faktor Zeit sich auf Ihre Entscheidungen auswirkt. Dazu werden Sie zwischen einer Reihe von Geldbeträgen wählen, welche zu verschiedenen Zeitpukten verfügbar sind. Als Vergütung erhalten Sie eine zufällig ausgewählte Entscheidungen. Ihre Daten werden mittels Computer aufgezeichnet und anonym ausgewertet.

Das Max-Planck-Institut für Bildungsforschung ist eine Einrichtung zur Förderung der Wissenschaft. Unsere Arbeit folgt streng den Bestimmungen des Datenschutzes. Die im Rahmen der Studie erbetenen Angaben unterliegen der Schweigepflicht und werden unter Wahrung der Bestimmungen des Datenschutzgesetzes gespeichert und wissenschaftlich ausgewertet. Die Weitergabe personenbezogener Daten an Dritte erfolgt nicht. Die Daten werden ausschließlich zu Forschungszwecken und nur innerhalb des Max-Planck-Institutes für Bildungsforschung sowie an unserer Partneruniversität in Illinois verwendet. Personenbezogene Kontaktdaten und Untersuchungsdaten werden getrennt voneinander gespeichert und streng vertraulich behandelt. Die Teilnahme an der Studie ist freiwillig und Sie haben zu jeder Zeit die Möglichkeit, Ihre Mitarbeit zu beenden. Sie können die Einwilligung zur Verwendung Ihrer Daten jederzeit mit Wirkung für die Zukunft widerrufen.

Die Studie dauert ca. 2 Stunden. Für die Teilnahme zahlen wir Ihnen eine Aufwandsentschädigung von 17-36 Euro.

Ich habe die aufgeführten Bedingungen zur Kenntnis genommen und bin damit einverstanden, an dieser Studie teilzunehmen (erforderlich für Studienteilnahme). (Ja/Nein)

Ich bin damit einverstanden, auf Basis der in dieser Studie erhobenen Daten für weitere Studien kontaktiert zu werden (optional). (Ja/Nein)

Instructions at UIUC

Practice Session Instructions

You will now have a chance to make some practice decisions. In each decision you will choose between two rewards. To choose a reward, click on it.

Note that the following ten warm-up decisions are not part of the experiment. We have designed them to familiarize you with the computer program. During each practice decision you will see a pair of rewards and you need to choose one.

Transition Instructions Between Practice Trials to 1st Experimental Trial

The practice session is complete. In the experiment you will make many such decisions. The computer will record each choice you make in a "basket" of chosen rewards. As you make those choices, please always remember that you will receive one of those rewards from your "basket" for real.

Your payment for participation works as follows. When you complete the session, the computer will draw one reward from your "basket." We will pay you the amount of money specified in that reward, and at the date specified in the reward. For example, if the reward states $15 in 21 days, we will pay you fifteen dollars, three weeks from today. You will receive a gift code by e-mail on the specified day.

If you have any questions, please let your host know. Otherwise, we can start the session now....

Instructions at End of Experiment, Right Before Reward Screen

The first half of the experiment is complete. In the next screen, you will find out which question was selected and which option you chose. You will receive the chosen amount after the appropriate time delay.

After advancing to the next screen, please contact the experimenter. Please also confirm with the experimenter when you are coming back for the second half of the experiment.

Instructions to Begin the 2nd Session of the Experiment (Different Day than First Session)

Welcome back to the second half of the experiment. These questions will be similar to the ones that you answered previously.

Your payment for participation again works as follows. When you complete the session, the computer will draw one reward from your "basket." We will pay you the amount of money specified in that reward, and at the date specified in the reward. For example, if the reward states $15 in 21 days, we will pay you fifteen dollars, three weeks from today. You will receive a gift code by e-mail on the specified day.

Press Continue when you are ready to begin.

Instructions at MPI

Practice Session Instructions

Die folgenden zehn Entscheidungen sind nicht Teil des Experiments. Bei jeder Entscheidung stehen Ihnen zwei Optionen zur Verfügung. Klicken Sie auf die von Ihnen bevorzugte Option, um diese auszuwählen.

Transition Instructions Between Practice Trials to 1st Experimental Trial

Ihre Vergütung für die Teilnahme hängt unmittelbar von Ihren Entscheidungen ab. Nach Beendigung jeder Sitzung wählt der Computer zufällig eine der von Ihnen getroffenen Entscheidungen aus. Die entsprechende Geldmenge wird Ihnen dann zu dem genannten Zeitpunkt übereignet. Zum Beispiel: Wenn Sie die Option 17 € in 7 Tagen wählen, werden wir Ihnen, von heute an gerechnet, in einer Woche 17 € überweisen.

Bitte treffen Sie ihre Entscheidungen so, wie Sie sie wirklich bevorzugen würden. Wenn Sie Fragen haben, dann wenden Sie sich bitte an den Versuchsleiter. Drücken Sie Fortsetzen, wenn Sie bereit sind, anzufangen.

Instructions at End of Experiment, Right Before Reward Screen

Die erste Hälfte des Experiments ist nun abgeschlossen. Auf dem nächsten Bildschirm wird Ihnen die zufällig ausgewählte Frage angezeigt und die Option, für die Sie sich entschieden haben.

Sie erhalten den Geldbetrag nach der entsprechenden Zeit. Nachdem Sie den nächsten Bildschirm erreicht haben, kontaktieren Sie bitte den Versuchsleiter. Sie werden nun fünf Minuten Pause haben, bevor Sie mit dem zweitem Teil des Experiments beginnen.

Instructions to Begin the 2nd Session of the Experiment (Different Day than First Session)

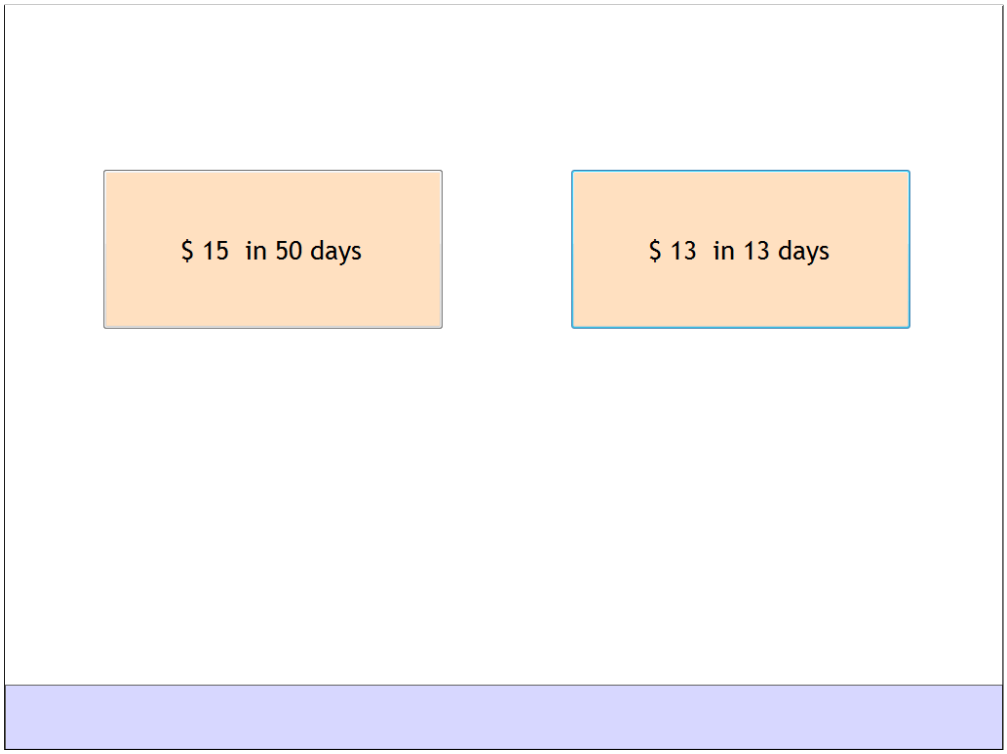
Willkommen zur zweiten Hälfte des Experiments. Die Fragen werden ähnlich wie die in der ersten Hälfte sein. Auch hier gilt wieder, dass eine der Fragen am Ende ausgewählt wird, und Ihre Entscheidung die Höhe und den Zeitraum der Auszahlung bestimmt. Bitte treffen Sie ihre Entscheidungen so, wie Sie sie wirklich bevorzugen würden. Drücken Sie auf Fortsetzen, wenn Sie bereit sind.

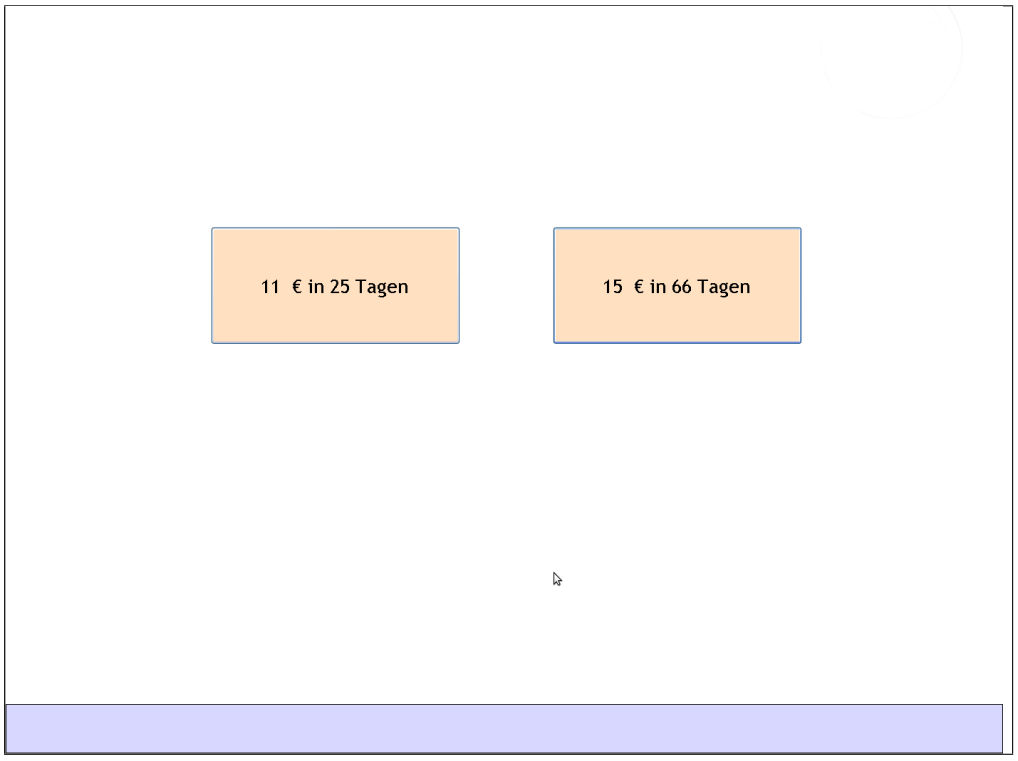
Payment

Prior to beginning this experiment, we created participant-specific stimulus files. In each of the files one of the following questions was chosen as the payment question, such that each question was chosen equally over all participants. The participants did not know in advance which question would be chosen, nor did they know which questions were in the subset of questions that could be chosen.

UIUC	**MPI**
$13 in 13 days vs. $15 in 50 days	€13 in 13 Tagen vs. €15 in 50 Tagen
$14 in 9 days vs. $18 in 45 days	€14 in 9 Tagen vs. €18 in 45 Tagen
$17 in 29 days vs. $19 in 86 days	€17 in 29 Tagen vs. €19 in 86 Tagen
$13 in 3 days vs. $10 in 78 days	€13 in 3 Tagen vs. €10 in 78 Tagen
$15 in 2 days vs. $17 in 66 days	€15 in 2 Tagen vs. €17 in 66 Tagen
$18 in 4 days vs. $11 in 7 days	€18 in 4 Tagen vs. €11 in 7 Tagen

Screenshots





Supplemental Results

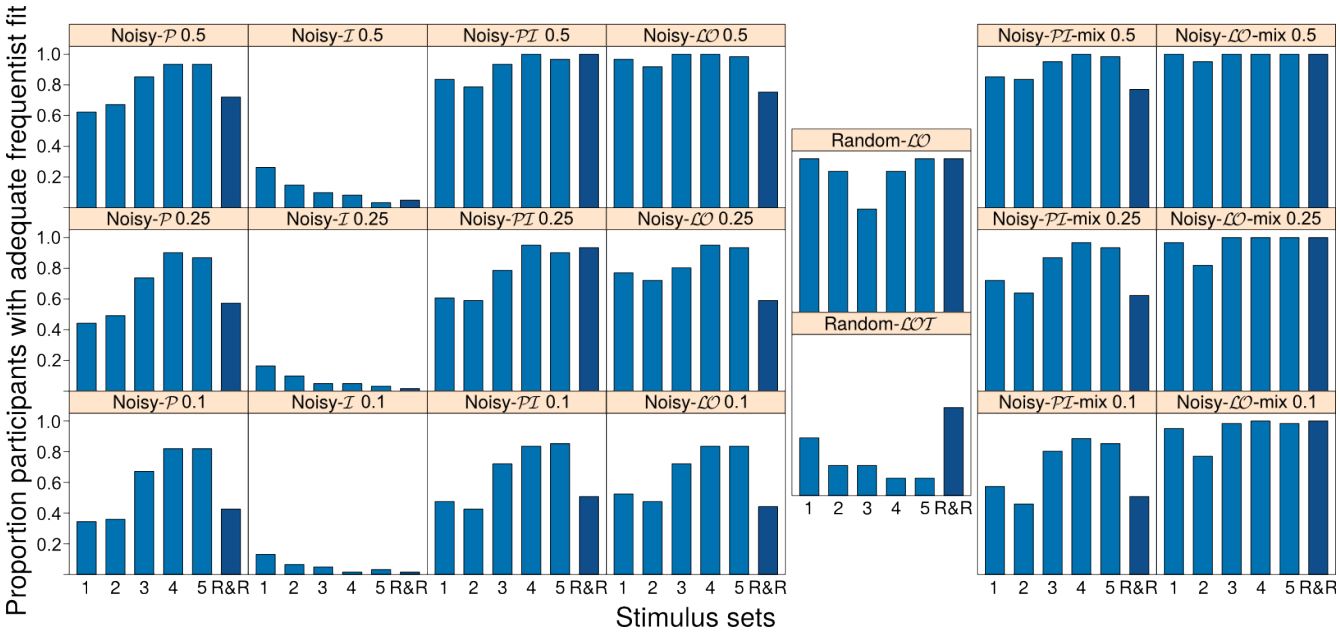


Figure S1: Frequentist p-values in Experiment 1. Each panel shows the results for one model, with the level of τ indicated in the header after the model name (where applicable). Each panel reports the proportion of participants (out of 61) with adequate fits (frequentist p-value > 0.05), on the vertical axis, separately for the six stimulus sets.

Table S1: Experiment 1 - Maximum Bayes factors ($\log_{10}$ transformed) for each respondent in each stimulus set.

UIUC Sample							**MPI Sample**						
Respondent	**Set 1**	**Set 2**	**Set 3**	**Set 4**	**Set 5**	**R&R**	**Respondent**	**Set 1**	**Set 2**	**Set 3**	**Set 4**	**Set 5**	**R&R**
1	2.71	2.68	4.81	8.25	8.62	1.70	1	7.56	6.92	9.06	8.95	8.95	7.6
2	8.40	8.65	8.47	9.35	8.51	7.30	2	8.25	7.86	8.18	9.5	8.8	6.4
3	9.50	9.35	8.65	7.26	4.76	5.80	3	1.72	1.98	5.38	6.35	5.02	2.2
4	9.20	9.09	9.50	9.50	9.35	8.10	4	4.48	8.12	9.5	9.35	9.5	7.2
5	9.35	9.09	8.36	9.06	9.20	8.10	5	0.36	3.69	6.58	3.82	9.5	3.3
6	9.50	9.50	9.35	9.50	9.35	8.50	6	4.67	7.12	8.65	9.2	8.54	7.3
7	8.80	3.99	0.85	7.85	4.28	2.30	7	6.06	1.13	9.5	9.2	9.2	3.7
8	7.01	2.27	9.50	9.50	9.50	8.40	8	5.95	6.08	5.32	5.94	8.91	6.4
9	9.35	9.35	8.65	9.35	9.35	8.40	9	9.5	7.71	9.2	9.5	9.35	8.5
10	1.07	1.43	4.10	7.71	8.80	2.10	10	9.35	7.06	9.2	9.35	9.35	8.3
11	4.06	0.70	0.08	9.35	6.40	1.30	11	9.09	8.73	9.2	9.5	8.8	8.1
12	2.46	4.29	6.05	6.79	9.20	3.20	12	6.76	2.79	2.32	5.38	1.66	0.5
13	7.42	6.77	8.40	9.50	9.09	6.90	13	9.2	9.35	9.5	9.35	9.35	8.3
14	-0.87	-2.76	6.18	9.50	8.80	2.40	14	0.36	-1.58	1.98	9.06	9.35	2
15	1.89	2.72	2.88	5.09	4.27	2.60	15	4.66	6.66	7.41	8.54	8.54	5.7
16	9.50	9.50	8.36	4.26	7.19	1.70	16	2.03	3.58	8.65	8.91	9.35	2
17	0.66	-0.12	1.30	2.58	2.05	0.50	17	7.56	8.26	9.35	9.5	9.06	7.8
18	9.50	2.90	0.15	8.18	0.09	0.50	18	5.48	-0.12	8.91	9.5	9.5	3.2
19	7.42	8.26	9.06	8.95	9.20	8.00	19	9.09	8.73	9.5	9.5	9.5	8.5
20	2.22	0.37	8.03	8.80	8.51	1.00	20	1.34	-1.97	9.2	9.5	9.35	4.3
21	4.07	4.21	9.20	9.35	9.50	8.10	21	2.71	0.78	1.16	8.8	3.56	2
22	4.40	4.19	4.35	4.00	7.85	1.70	22	-0.48	-0.67	9.35	9.35	9.2	2
23	9.09	8.95	8.10	4.66	5.24	2.00	23	8.69	9.2	9.35	9.09	9.5	8.5
24	0.14	0.56	9.20	9.50	9.20	1.50	24	3.14	2.7	3	3.47	2.44	3.1
25	2.23	0.20	0.81	4.73	0.71	2.90	25	3.01	1.6	8.95	9.5	9.06	3.1
26	3.60	0.57	9.50	8.95	9.09	7.20	26	7.57	7.57	7.57	7.57	7.57	2.5
27	1.62	0.57	5.57	9.50	9.35	2.20	27	3.31	2.55	8.4	9.2	8.91	7.1
28	3.47	4.23	4.69	8.91	7.41	2.40	28	5.49	1.99	8.58	9.35	9.2	6.4
29	9.35	9.50	9.50	9.50	9.50	8.30	29	7.57	7.27	8.1	8.73	8.95	7.2
30	6.24	5.28	1.48	1.21	2.25	0.60	30	4.04	1.29	3.64	4.05	5.74	1.4
31	8.40	3.76	0.87	7.38	7.77	2.20	-	-	-	-	-	-	-

Table S2: Experiment 1: Bayes factor ($\log_{10}$ transformed) for each model for the Joint (GBF) and Pooled (PBF) analyses, in each stimulus set (column), combined across locations.

		Joint (GBF)						**Pooled (PBF)**					
Model	τ	**Set 1**	**Set 2**	**Set 3**	**Set 4**	**Set 5**	**R&R**	**Set 1**	**Set 2**	**Set 3**	**Set 4**	**Set 5**	**R&R**
noisy-$\mathcal{P}$	0.10	-2684.64	-1677.26	-879.07	-223.21	-27.27	-925.80	-Inf	-Inf	-144.60	7.80	9.38	-Inf
noisy-$\mathcal{P}$	0.25	-1368.30	-855.99	-346.65	-40.63	90.64	-396.50	-126.89	-95.63	6.02	6.02	6.02	-39.60
noisy-$\mathcal{P}$	0.50	-547.20	-348.26	-86.92	19.40	89.69	-123.70	2.95	0.64	3.01	3.01	3.01	2.71
noisy-$\mathcal{I}$	0.10	-7009.14	-8743.99	-9177.95	-10643.29	-10652.46	-8184.30	-Inf	-Inf	-Inf	-Inf	-Inf	-Inf
noisy-$\mathcal{I}$	0.25	-3929.86	-5080.24	-5275.53	-6285.32	-6257.15	-4712.40	-Inf	-Inf	-Inf	-Inf	-Inf	-Inf
noisy-$\mathcal{I}$	0.50	-1759.92	-2404.08	-2440.91	-3043.77	-2998.94	-2189.10	-Inf	-Inf	-Inf	-Inf	-Inf	-Inf
noisy-$\mathcal{PI}$	0.10	-473.86	-385.74	-52.35	348.24	258.92	-497.30	-	-	-	-	-	-
noisy-$\mathcal{PI}$	0.25	-69.17	-95.94	128.55	285.90	246.74	-151.40	-	-	-	-	-	-
noisy-$\mathcal{PI}$	0.50	52.03	8.45	118.03	157.69	144.98	-19.90	-	-	-	-	-	-
noisy-$\mathcal{LO}$	0.10	-202.13	-73.73	-30.67	256.11	221.57	3.20	-	-	-	-	-	-
noisy-$\mathcal{LO}$	0.25	42.50	43.63	93.85	186.87	177.81	89.10	-	-	-	-	-	-
noisy-$\mathcal{LO}$	0.50	40.37	13.22	41.30	54.43	50.78	22.70	-	-	-	-	-	-
random-$\mathcal{LO}$		3.00	-73.44	-3.77	-5.13	-18.26	6.00	1.32	-4.16	1.32	1.32	1.32	0.53
random-$\mathcal{LOT}$		-138.75	-254.16	-217.48	-264.71	-288.84	-94.30	1.32	-Inf	-Inf	-Inf	-Inf	0.53
noisy-$\mathcal{PI}$-mix	0.10	97.24	-53.57	278.38	378.74	341.23	-125.10	-Inf	-Inf	7.98	8.00	8.00	-Inf
noisy-$\mathcal{PI}$-mix	0.25	82.16	-18.82	193.37	253.29	228.18	-76.80	4.50	-Inf	4.52	4.52	4.52	-Inf
noisy-$\mathcal{PI}$-mix	0.50	45.24	-7.01	91.96	107.52	99.17	-24.90	1.97	1.97	1.97	1.97	1.97	1.71
noisy-$\mathcal{LO}$-mix	0.10	18.14	-38.12	14.67	12.23	7.76	10.40	0.94	0.63	0.94	0.94	0.94	0.36
noisy-$\mathcal{LO}$-mix	0.25	9.40	-20.46	11.79	9.07	10.78	0.20	0.54	0.54	0.54	0.54	0.54	0.20
noisy-$\mathcal{LO}$-mix	0.50	-16.62	-27.92	-28.24	-38.72	-37.32	-12.60	0.17	0.17	0.17	0.17	0.17	0.06
saturated		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table S3: Experiment 2: Pooled Bayes factor ($\log_{10}$ transformed) for each model in each stimulus set (column), combined across locations.

Model	τ	**Set 1**	**Set 2**	**Set 3**	**Set 4**	**Set 5**	**R&R**
noisy-$\mathcal{P}$	0.10	-47.66	-10.69	-8.60	9.04	7.89	-12.73
noisy-$\mathcal{P}$	0.25	-10.33	1.41	3.32	6.01	5.90	-0.18
noisy-$\mathcal{P}$	0.50	1.12	2.65	2.98	3.01	3.01	2.50
noisy-$\mathcal{I}$	0.10	-145.96	-238.99	-230.15	-Inf	-Inf	-258.71
noisy-$\mathcal{I}$	0.25	-62.46	-124.89	-117.49	-193.91	-197.24	-140.82
noisy-$\mathcal{I}$	0.50	-12.58	-45.91	-40.12	-89.57	-92.88	-58.14
noisy-$\mathcal{PI}$	0.10	-	-	-	-	-	-
noisy-$\mathcal{PI}$	0.25	-	-	-	-	-	-
noisy-$\mathcal{PI}$	0.50	-	-	-	-	-	-
noisy-$\mathcal{LO}$	0.10	-	-	-	-	-	-
noisy-$\mathcal{LO}$	0.25	-	-	-	-	-	-
noisy-$\mathcal{LO}$	0.50	-	-	-	-	-	-
random-$\mathcal{LO}$		1.29	0.50	1.12	0.04	-0.42	0.08
random-$\mathcal{LOT}$		1.29	-0.66	0.70	-7.74	-8.47	-0.09
noisy-$\mathcal{PI}$-mix	0.10	2.35	0.69	4.04	7.38	6.15	-5.21
noisy-$\mathcal{PI}$-mix	0.25	2.55	2.10	3.82	4.52	4.41	-0.12
noisy-$\mathcal{PI}$-mix	0.50	1.84	1.81	1.97	1.76	1.60	1.56
noisy-$\mathcal{LO}$-mix	0.10	0.94	0.64	0.93	0.05	-0.56	0.38
noisy-$\mathcal{LO}$-mix	0.25	0.55	0.38	0.66	-0.04	-0.55	0.26
noisy-$\mathcal{LO}$-mix	0.50	0.14	0.03	0.30	-1.20	-0.50	-0.05
saturated		0.00	0.00	0.00	0.00	0.00	0.00