

Weather Prediction Task

The Weather Prediction Task is a form of probabilistic classification learning that is used to study non-declarative learning, thought to be an equivalent to habit learning seen in animal studies. The task is of interest because it appears that people can improve their performance on the task in the absence of declarative knowledge of what they have learnt. Neuropsychological studies have linked declarative learning to processes in the medial temporal lobes, and non-declarative learning on the Weather Prediction Task to processing in the basal ganglia (Knowlton et al., 1996). The task involves participants looking at a series of visual stimuli and after each making a guess as to whether the stimuli predicts Rain or Sun. After the guess they are shown the result as feedback. This feels like guesswork to participants. However, over time their performance moves above 50% accuracy, showing that learning is taking place.

The version described here is presented in a PowerPoint file. This can be downloaded from www.gpluck.co.uk in either Spanish or English language versions. These notes are for either of those language versions, as the only difference is the words used for Rain (Lluvia) and Sun (Sol). The protocol described here is based on that described by Kincses et al., (2004), and adapted for use in Pluck et al., (2019). See Pluck et al. for further details of this procedure. The PowerPoint file has automatic transitions of slides to control the pace of the task. Once started as a presentation on a laptop or desktop computer the participant simply has to follow the instructions and keep responding verbally. The experimenter has to intervene at only one point, that is to start the test actual after the practice round by pressing a key to advance to the countdown. When the countdown has started the procedure will continue to the end automatically, including a 5 second pause for a break. When the presentation is running, the experimenter listens and records all of the responses made by the participants in the table below. Note that if the experiment is to be run on a tablet computer, the automatic transitions may not work. In that case it is best to convert the PowerPoint file to a movie clip and play that instead (but you must insert a 5 second delay for transition at the Ready / Listo slide. Conversion to movie clip is a save option in PowerPoint.

The versions given here have only 50 trials (in two blocks of 25). This is likely to be enough to elicit the non-declarative learning effect in healthy adult participants. However, many studies prefer more trials. The PowerPoint files could be extended by simply cutting and pasting the individual slides to make a version with 100 trials (in four blocks). Date recording is manual. The experimenter sits with the participant and records their responses in the table. For analysis the experimenter can count the number of correct guesses within a predefined period. Pluck et al. used the last 20 trials. To demonstrate that performance of a group is above chance, a one-sample t-test could be used. The chance guessing rate over 20 trials would be 10 correct, if a group scores significantly above 10, then they have demonstrated learning.

In Pluck et al., (2019) participants were also assessed for declarative knowledge after completing the Weather Prediction Task. This is a useful secondary measure as several authors have suggested that some participants do in fact develop declarative knowledge of the stimuli-outcome associations. If learning is completely non-declarative on the Weather Prediction Task, participants should not be able to give verbal report or draw the best stimuli to predict the weather. Pluck et al. asked all participants to draw from memory the shape or combination of shapes that best predicted Rain. And then the shape or combination of shapes that best predicted Sun. These drawings were then given points based on actually how good their declarative knowledge was. The scores are in tables below. For example, when asked to draw the best stimuli to predict rain, if they participant drew a square and a diamond shape, they would receive .5 points. If for the best predictor of sun the participant drew a square and triangle, they would receive 1 point. The participants total score would be 1.5. That is slightly above the chance guessing total score which would be 1. See Pluck et al (2019) for further details on this scoring system.

Probabilistic Classification Data Collection Page (in English)

This test is given on a computer using a file that contains a timer so that slides will advance automatically. The participant must give the responses speaking out loud (Sun or Rain) and the experimenter has to record their responses using the table. The words in bold indicate the correct responses, this will facilitate scoring later. Optionally, the participant can be asked to draw responses and the end of the page after the learning phase is completed.

Slide	Response	Score
1	Sun Rain	0 1
2	Sun Rain	0 1
3	Sun Rain	0 1
4	Sun Rain	0 1
5	Sun Rain	0 1
6	Sun Rain	0 1
7	Sun Rain	0 1
8	Sun Rain	0 1
9	Sun Rain	0 1
10	Sun Rain	0 1
11	Sun Rain	0 1
12	Sun Rain	0 1
13	Sun Rain	0 1
14	Sun Rain	0 1
15	Sun Rain	0 1
16	Sun Rain	0 1
17	Sun Rain	0 1
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25	Sun Rain	0 1

26	Sun Rain	0 1
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33	Sun Rain	0 1
34	Sun Rain	0 1
35	Sun Rain	0 1
36	Sun Rain	0 1
37	Sun Rain	0 1
38	Sun Rain	0 1
39	Sun Rain	0 1
40	Sun Rain	0 1
41	Sun Rain	0 1
42	Sun Rain	0 1
43	Sun Rain	0 1
44	Sun Rain	0 1
45	Sun Rain	0 1
46	Sun Rain	0 1
47	Sun Rain	0 1
48	Sun Rain	0 1
49	Sun Rain	0 1
50	Sun Rain	0 1

Draw the figure or figures that you think are the best for prediction of Rain

Draw the figure or figures that you think are the best prediction of Sun

Clasificación Probabilística Pagina por la Recolección de Datos (en español)

Esta prueba se da en la computadora usando un archivo que tiene un temporizador incorporado por lo cual las diapositivas con estímulos circularán de forma automática. El participante debe decir su respuesta en voz alta (Sol o Lluvia) y el investigador deberá marcar la respuesta usando una tabla que se verá como esta. Las palabras en **negrilla** indican la respuesta correcta lo cual facilitará la calificación posteriormente. Adicionalmente se le **pedirá al participante que dibuje** las combinaciones especificadas al final de la hoja.

Diapositiva	Respuesta	Puntaje
1	Sol Lluvia	0 1
2	Sol Lluvia	0 1
3	Sol Lluvia	0 1
4	Sol Lluvia	0 1
5	Sol Lluvia	0 1
6	Sol Lluvia	0 1
7	Sol Lluvia	0 1
8	Sol Lluvia	0 1
9	Sol Lluvia	0 1
10	Sol Lluvia	0 1
11	Sol Lluvia	0 1
12	Sol Lluvia	0 1
13	Sol Lluvia	0 1
14	Sol Lluvia	0 1
15	Sol Lluvia	0 1
16	Sol Lluvia	0 1
17	Sol Lluvia	0 1
18	Sol Lluvia	0 1
19	Sol Lluvia	0 1
20	Sol Lluvia	0 1
21	Sol Lluvia	0 1
22	Sol Lluvia	0 1
23	Sol Lluvia	0 1
24	Sol Lluvia	0 1
25	Sol Lluvia	0 1

26	Sol Lluvia	0 1
27	Sol Lluvia	0 1
28	Sol Lluvia	0 1
29	Sol Lluvia	0 1
30	Sol Lluvia	0 1
31	Sol Lluvia	0 1
32	Sol Lluvia	0 1
33	Sol Lluvia	0 1
34	Sol Lluvia	0 1
35	Sol Lluvia	0 1
36	Sol Lluvia	0 1
37	Sol Lluvia	0 1
38	Sol Lluvia	0 1
39	Sol Lluvia	0 1
40	Sol Lluvia	0 1
41	Sol Lluvia	0 1
42	Sol Lluvia	0 1
43	Sol Lluvia	0 1
44	Sol Lluvia	0 1
45	Sol Lluvia	0 1
46	Sol Lluvia	0 1
47	Sol Lluvia	0 1
48	Sol Lluvia	0 1
49	Sol Lluvia	0 1
50	Sol Lluvia	0 1

Dibuje la figura o figuras que cree tenían mayor probabilidad de lluvia

Dibuje la figura o figuras que cree tenía la mayor probabilidad de sol

Optional Score Table for Declarative Knowledge of Contingencies

These tables are for analyzing the drawings made.

Table in English

Pattern	Rain Score		Sun Score
SQUARE and TRIANGLE	0		1
SQUARE and TRIANGLE and CIRCLE	0		1
SQUARE	.14		.86
SQUARE and CIRCLE	.25		.75
TRIANGLE	.4		.6
SQUARE and DIAMOND	.5		.5
TRIANGLE and CIRCLE	.5		.5
SQUARE and CIRCLE and DIAMOND	.5		.5
SQUARE and TRIANGLE and DIAMOND	.5		.5
CIRCLE	.4		.4
TRIANGLE and DIAMOND	.25		.25
DIAMOND	.86		.14
TRIANGLE and CIRCLE and DIAMOND	1		0
CIRCLE and DIAMOND	1		0

Any other combinations score 0. Alternative vocabulary is allowed. Polygon is too ambiguous. Therefore scores 0. Trapezoid is wrong, scores 0. Rectangle is a legitimate alternative name for square. Missing data is scored as 99.

Table in Spanish

Pattern	Lluvia Score		Sol Score
CUADRADO Y TRIANGULO	0		1
CUADRADO Y TRIANGULO y CIRCULO	0		1
CUADRADO	.14		.86
CUADRADO Y CIRCULO	.25		.75
TRIANGULO	.4		.6
CUADRADO Y ROMBO	.5		.5
TRIANGULO y CIRCULO	.5		.5
CUADRADO Y CIRCULO y ROMBO	.5		.5
CUADRADO Y TRIANGULO y ROMBO	.5		.5
CIRCULO	.4		.4
TRIANGULO y ROMBO	.25		.25
ROMBO	.86		.14
TRIANGULO y CIRCULO y ROMBO	1		0
CIRCULO y ROMBO	1		0

Any other combinations score 0. Alternative vocabulary is allowed. Polygon is too ambiguous. Therefore scores 0. Trapecio is wrong, scores 0. Rectangulo is a legitimate alternative name for cuadrado. Missing data is scored as 99.

References

Knowlton, B. J., Mangels, J. A., & Squire, L. R. (1996). A neostriatal habit learning system in humans. *Science*, 273(5280), 1399-1402. <https://doi.org/10.1126/science.273.5280.1399>

Kincses, T. Z., Antal, A., Nitsche, M. A., Bártfai, O., & Paulus, W. (2004). Facilitation of probabilistic classification learning by transcranial direct current stimulation of the prefrontal cortex in the human. *Neuropsychologia*, 42(1), 113-117. [https://doi.org/10.1016/S0028-3932\(03\)00124-6](https://doi.org/10.1016/S0028-3932(03)00124-6)

Pluck, G., Mancero, P. B., Gavilanez, C. E. M., Alcívar, A. M. U., Encalada, P. A. O., Carrasco, E. T., ... & Trueba, A. F. (2019). Modulation of striatum based non-declarative and medial temporal lobe based declarative memory predicts academic achievement at university level. *Trends in Neuroscience and Education*, 14, 1-10. <https://doi.org/10.1016/j.tine.2018.11.002>

If you use these files in any published research, please cite Pluck et al. (2019).

Dr Graham Pluck, Quito, 24th November 2019