

Knowability predicts curiosity and learning

Supplementary Materials

The role of candidates on curiosity

TABLE S1

Average correlation coefficients across participants for the relationship between curiosity and confidence per candidate category.

Exp 1

Level	Pearson's r	df	t value	p
0 candidate	-0.03	1078	-1.00	0.32
1 candidate	-0.22	1563	-8.66	< 0.001
2 candidates	0.01	539	0.20	0.84
3+ candidates	-0.10	284	-1.68	0.09

Exp 2

Level	Pearson's r	df	t value	p
0 candidate	-0.03	1092	-1.15	0.25
1 candidate	-0.17	1883	-7.37	< 0.001
2 candidates	0.01	282	0.23	0.82
3+ candidates	-0.03	207	-0.52	0.60

Exp 2 (controlling for prior knowledge)

Level	Pearson's r	df	t value	p
0 candidate	-0.04	1071	-1.20	0.23
1 candidate	-0.02	1095	-0.52	0.61
2 candidates	0.10	176	1.34	0.18
3+ candidates	-0.03	171	-0.39	0.70

Mixed-effect models

The tables below provide the individual coefficients (betas), t-values and p-values for the main mixed-effect models. When category is a predictor, we report the table for the individual betas. For the reference level given in the main text analyses, the p-value relates to the difference from 0. For the remaining levels, it indicates difference from the reference level. For completeness, below we report corresponding analyses with other possible reference categories, to give relevant statistics for all possible pairwise comparisons.

The role of candidates on curiosity

The table below shows the individual values for each category of answer candidates as a predictor of curiosity (normalised), with participant and question type as random intercepts.

TABLE S2

curiosity ~ factor(Candidates) + (1 | Participant_id) + (1 | Question_id)

Exp 1 (with 0 candidate as reference)

Level	Estimate (β)	t value	p
0 candidate (reference)	-0.04	-0.92	0.36
1 candidate	-0.03	-0.82	0.41
2 candidates	0.22	4.15	< 0.001
3+ candidates	0.29	4.48	< 0.001

Exp 1 (with 1 candidate as reference)

Level	Estimate (β)	t value	p
1 candidate (reference)	-0.08	-1.75	0.08
0 candidate	0.03	0.82	0.41
2 candidates	0.25	5.18	< 0.001
3+ candidates	0.32	5.18	< 0.001

Exp 1 (with 2 candidates as reference)

Level	Estimate (β)	t value	p
2 candidates (reference)	0.17	3.17	0.002
0 candidate	-0.22	-4.15	< 0.001
1 candidate	-0.25	-5.18	< 0.001

3+ candidates	0.07	1.06	0.29
---------------	------	------	------

Exp 1 (with 3+ candidates as reference)

Level	Estimate (β)	t value	p
3+ candidates (reference)	0.25	3.68	< 0.001
0 candidate	-0.29	-4.48	< 0.001
1 candidate	-0.32	-5.18	< 0.001
2 candidates	-0.07	-1.06	0.29

Exp 2 (with 0 candidate as reference)

Level	Estimate (β)	t value	p
0 candidate (reference)	-0.01	-0.35	0.73
1 candidate	-0.03	-0.79	0.43
2 candidates	0.20	2.93	0.003
3+ candidates	0.24	3.19	0.001

Exp 2 (with 1 candidate as reference)

Level	Estimate (β)	t value	p
1 candidate (reference)	-0.04	-1.30	0.20
0 candidate	0.03	-0.79	0.43
2 candidates	0.23	3.62	< 0.001
3+ candidates	0.27	3.77	< 0.001

Exp 2 (with 2 candidates as reference)

Level	Estimate (β)	t value	p
2 candidates (reference)	0.18	2.85	0.004
0 candidate	-0.20	-2.93	0.003
1 candidate	-0.23	-3.62	< 0.001
3+ candidates	0.05	0.51	0.62

Exp 2 (with 3+ candidates as reference)

Level	Estimate (β)	t value	p
3+ candidates (reference)	0.23	3.11	0.002
0 candidate	-0.24	-3.19	0.001
1 candidate	-0.27	-3.77	< 0.001
2 candidates	-0.05	-0.51	0.62

Exp 2 (controlling for prior knowledge)

Level	Estimate (β)	t value	p
0 candidate (reference)	-0.03	-0.81	0.42
1 candidate	0.11	2.50	0.01
2 candidates	0.27	3.34	0.001
3+ candidates	0.27	3.36	0.001

Exp 2 (controlling for prior knowledge, with 1 candidate as reference)

Level	Estimate (β)	t value	p
1 candidate (reference)	0.08	2.36	0.02
0 candidate	-0.11	-2.50	0.01
2 candidates	0.16	2.02	0.04
3+ candidates	0.16	2.05	0.04

Exp 2 (controlling for prior knowledge, with 2 candidates as reference)

Level	Estimate (β)	t value	p
2 candidates (reference)	0.24	3.17	0.002
0 candidate	-0.27	-3.34	0.001
1 candidate	-0.16	-2.02	0.04
3+ candidates	0.005	0.045	0.96

Exp 2 (controlling for prior knowledge, with 3+ candidates as reference)

Level	Estimate (β)	t value	p
3+ candidate (reference)	0.24	3.20	0.001
0 candidate	-0.27	-3.36	0.001
1 candidate	-0.16	-2.05	0.04
2 candidates	0.005	0.045	0.96

The role of candidates in predicting learning outcomes

The table below shows the individual values for each category of answer candidates as a predictor of memory (correct_recall), with participant and question type as random intercepts. This is a logistic model (correct_recall is a binary variable).

TABLE S3

correct_recall ~ factor(Candidates) + (1 | Participant_id) + (1 | Question_id)

Exp 1

Level	Estimate (β)	z value	p
0 candidate (reference)	-0.73	-3.75	< 0.001
1 candidate	0.87	7.24	< 0.001
2 candidates	0.59	3.89	< 0.001
3+ candidates	0.64	3.33	< 0.001

Exp 2

Level	Estimate (β)	z value	p
0 candidate (reference)	-0.12	-0.66	0.52
1 candidate	1.16	10.31	< 0.001
2 candidates	0.78	4.18	< 0.001
3+ candidates	0.48	2.24	0.025

Exp 2 (controlling for prior knowledge)

Level	Estimate (β)	z value	p
0 candidate (reference)	-0.16	-0.95	0.34
1 candidate	0.58	4.74	< 0.001
2 candidates	0.34	1.59	0.11
3+ candidates	0.21	0.90	0.37

Confidence in Session 2 as an alternative measure of learning

The table below shows the individual values for each category of answer candidates as a predictor of confidence (normalised), with participant and question type as random intercepts.

TABLE S4

confidence ~ factor(Candidates) + (1 | Participant_id) + (1 | Question_id)

Exp 1

Level	Estimate (β)	t value	p
0 candidate (reference)	-0.20	-3.16	0.002
1 candidate	0.33	8.22	< 0.001
2 candidates	0.16	2.99	0.003
3+ candidates	0.07	3.27	0.001

Exp 2

Level	Estimate (β)	t value	p
0 candidate (reference)	-0.30	-5.93	< 0.001
1 candidate	0.46	11.68	< 0.001
2 candidates	0.38	5.71	< 0.001
3+ candidates	0.30	4.03	< 0.001

Exp 2 (controlling for prior knowledge)

Level	Estimate (β)	t value	p
0 candidate (reference)	-0.12	-2.17	0.03
1 candidate	0.25	5.47	< 0.001
2 candidates	0.23	2.83	0.005
3+ candidates	0.21	2.56	0.01

Average number of candidates per confidence level

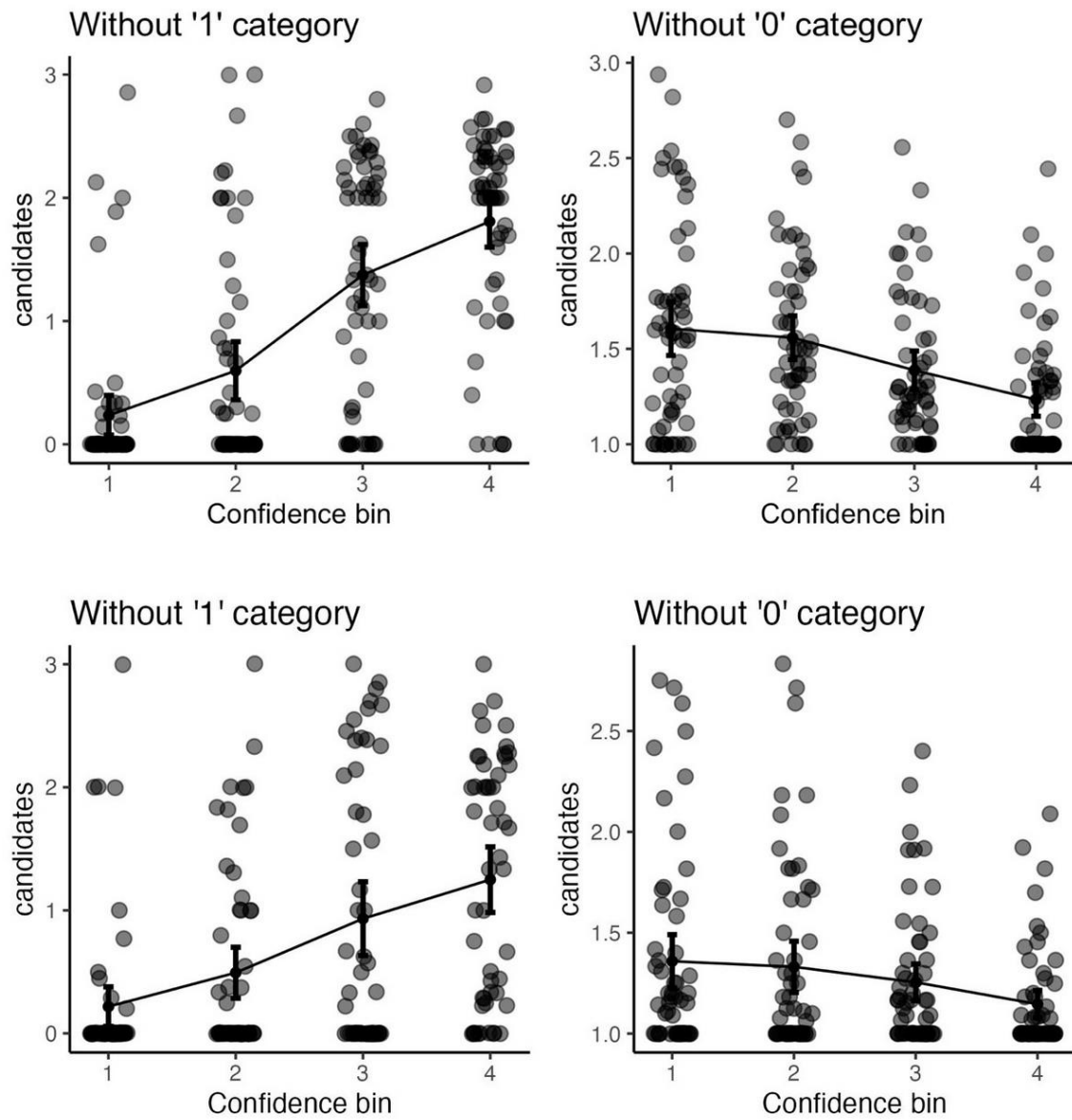


Figure S6: Average number of answer candidates as a function of confidence quantiles for Exp 1 (top row) and Exp 2 (bottom row), when excluding the '1' response candidates' category (left panel), or when excluding the '0' candidates' category.

List of trivia questions

Question	Answer
What do birds rely on to swallow?	Gravity
What is the only country in the world that has a bible on its flag?	Dominican Republic

Which planet in our solar system was the last to be discovered?	Neptune
What is the name of the instrument used to measure wind speed?	Anemometer
What is the name of the biggest constellation in the sky?	Hydra
What is the fastest healing body part on a human?	Tongue
What is the most common blood type in humans?	O positive
What is the monetary unit in Korea?	Won
What is the name of the brightest star in the sky, excluding the sun?	Sirius
Which is the only continent without a desert?	Europe
Which drink gets its name from a town on the Red Sea coast of Yemen?	Mocha
Which planet in the solar system is the only one that rotates clockwise?	Venus
Which city was the first in the world to have a public bus service?	Paris
What is the correct term for a female elephant?	Cow
What disability did Thomas Edison suffer from?	Deafness
Where in the world is the world's largest building (the Burj Khalifa) located?	Dubai
What is the name of the largest desert on earth?	Antarctica
What is the largest temple in Egypt?	Karnak
What island country lies off the south-east coast of India?	Sri Lanka
What body part is low-density lipoprotein most likely to clog?	Arteries
Which animal sleeps with one eye open?	Dolphin
Who is the Greek God of music?	Apollo
What wild animal in Africa has killed the most people?	Hippo
What taste are cats unable to detect?	Sweet
Which popular Greek philosopher is said to have tutored Alexander the Great?	Aristotle
What body of water does the Danube River flow into?	Black Sea
What is the last name of the scientist who discovered radium?	Curie
In what century was Leonardo da Vinci born?	15th
Copper and what else are the two main constituents of bronze?	Tin
What musical note do most American car horns beep in?	F

What is the last name of the first person to complete a solo flight across the Atlantic Ocean?	Lindbergh
What flavor is the extract of fermented and dried pods of several species of orchids?	Vanilla
What nation started giving gas masks to its citizens before the Persian Gulf War?	Israel
In what century did mathematicians first use plus and minus signs?	16th
Which land mammal has the highest blood pressure?	Giraffe
What is the country with the highest population density?	Monaco
What water-dwelling creature can make a sound loud enough to break glass?	Pistol Shrimp
Which country has a national anthem that consists of only 32 syllables?	Japan
Which famous religious leader is depicted in the largest statue in the world?	Buddha
Which animal tastes with its feet?	Butterfly
What is the most abundant gas in the atmosphere?	Nitrogen
South America first saw the cultivation of what vegetable in 200 A.D.?	Potato
What spice is extremely poisonous if injected intravenously?	Nutmeg
What Spanish city is the capital of Catalonia?	Barcelona
What is the only rock that floats in water?	Pumice
In which country are the ruins of the City of Carthage situated?	Tunisia
What was the original Dutch name of New York City?	New Amsterdam
Who was first to publish the theory that the Earth revolves around the sun?	Copernicus
Which animal has the shortest lifespan?	Mayfly
What Polish political movement got the support of Pope John Paul II in the 1980's	Solidarity
What is the only internal human organ capable of natural regeneration of lost tissue?	Liver
Who was the first ruler of the Holy Roman Empire?	Charlemagne
What was the surname of the first president to appear on a U.S coin?	Lincoln
What is the only animal that can turn its stomach inside out?	Starfish
Which poisonous snake secretes an odor like cucumbers?	Copperhead Snake
What is the name of the fountain in Rome into which coins are thrown in for good luck?	Trevi
What color flag was historically first displayed to indicate sickness aboard a ship?	Yellow
What is the longest venomous snake?	King Cobra

What chemical compound comes from the Greek word for 'primary'?	Protein
What is the fastest creature on two legs?	Ostrich
The title of what animal literally means 'Terrible lizard'?	Dinosaur
What is the largest bear on earth?	Polar Bear

Scoring

We conducted a manual scoring to allow for small orthographic approximation in the free-recall paradigm of the second session. The following are examples of responses counted as correct despite being orthographically wrong:

Q: What animal literally means 'Terrible lizard'?

R: dinausaurus; dinoasaur;

Q: Which famous religious leader is depicted in the largest statue in the world?

R: budah; budda;

Q: Which popular Greek philosopher is said to have tutored Alexander the Great?

R: aristotale; aristotle; artistotle;

Q: What disability did Thomas Edison suffer from?

R: deaf; deafness;

Q: What is the name of the instrument used to measure wind speed?

R: anenometer; anemometer;

Q: Who is the Greek God of music?

R: apolo

