

Reporting Summary

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Statistical parameters

When statistical analyses are reported, confirm that the following items are present in the relevant location (e.g. figure legend, table legend, main text, or Methods section).

n/a Confirmed

- The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement
- An indication of whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
- The statistical test(s) used AND whether they are one- or two-sided
Only common tests should be described solely by name; describe more complex techniques in the Methods section.
- A description of all covariates tested
- A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
- A full description of the statistics including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
- For null hypothesis testing, the test statistic (e.g. F , t , r) with confidence intervals, effect sizes, degrees of freedom and P value noted
Give P values as exact values whenever suitable.
- For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
- For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
- Estimates of effect sizes (e.g. Cohen's d , Pearson's r), indicating how they were calculated
- Clearly defined error bars
State explicitly what error bars represent (e.g. SD, SE, CI)

Our web collection on [statistics for biologists](#) may be useful.

Software and code

Policy information about [availability of computer code](#)

Data collection

Behavioural data were collected using Psychtoolbox 3.0 implemented on Matlab (version 8.6; The Mathworks Inc., Natick, MA, USA). In Experiment 1 and Experiment 2, eye tracking data were extracted using the open source eye tracking software MrGaze (<https://github.com/jmtyszka/mrgaze/>) and the EyeMMV toolbox (Krassanakis et al., 2014). In Experiment 3 and Experiment 4, eye tracking data were collected with an EyeLink 1000 Plus desktop-mounted eye tracker.

Data analysis

All statistical analyses were conducted using the RStudio software 1.0.36 with R 3.4.3 (2009-2016 RStudio, Inc)

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors/reviewers upon request. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Research [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A list of figures that have associated raw data
- A description of any restrictions on data availability

Data from the four studies reported in this manuscript are available through the Open Science Framework repository: <https://osf.io/rve2p/>

Field-specific reporting

Please select the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

Life sciences Behavioural & social sciences Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see [nature.com/authors/policies/ReportingSummary-flat.pdf](https://www.nature.com/authors/policies/ReportingSummary-flat.pdf)

Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

Sample size	The planned sample size was motivated by a power analysis conducted with G*power. The effect sizes of interest we focused on was the Pavlovian influence on pupil dilation. For Experiment 1 to 3, these effects were extracted from a previous study and from an independent pilot study (n = 11) using a paradigm similar to the one we used in Experiment 1 (dz = .62, dz = .57). The analysis revealed that sample size of 20 participants per group was required to obtain a power of 80%. For Experiment 4, we averaged the previous effect sizes with the effect size we obtained in Experiment 1 and Experiment 2 (dz = .33, dz = .39). The analysis revealed that a sample size of 34 participants was required to obtain a power of 80%.
Data exclusions	In Experiment 4 data from one participant was excluded from the analysis for not liking any of the snack options proposed (the most liked option for that participant was rated 3 out of 10).
Replication	We ran 4 variations of the same task and replicated the main finding each time. These 4 studies are reported in the main text.
Randomization	Allocation to experimental conditions was either randomized, counterbalanced or sequential.
Blinding	Blinding was not possible: The experimenter administered the devaluation procedure and therefore was aware of the outcome stimulus that was being devalued.

Reporting for specific materials, systems and methods

Materials & experimental systems

n/a	Involved in the study
<input checked="" type="checkbox"/>	<input type="checkbox"/> Unique biological materials
<input checked="" type="checkbox"/>	<input type="checkbox"/> Antibodies
<input checked="" type="checkbox"/>	<input type="checkbox"/> Eukaryotic cell lines
<input checked="" type="checkbox"/>	<input type="checkbox"/> Palaeontology
<input checked="" type="checkbox"/>	<input type="checkbox"/> Animals and other organisms
<input type="checkbox"/>	<input checked="" type="checkbox"/> Human research participants

Methods

n/a	Involved in the study
<input checked="" type="checkbox"/>	<input type="checkbox"/> ChIP-seq
<input checked="" type="checkbox"/>	<input type="checkbox"/> Flow cytometry
<input checked="" type="checkbox"/>	<input type="checkbox"/> MRI-based neuroimaging

Human research participants

Policy information about [studies involving human research participants](#)

Population characteristics	Forty participants (24 females) with a mean age of 26 years (SD = 6.95 years) were recruited for Experiment 1, which was a between subjects design. Twenty participants (14 females, 1 agender) with a mean age of 25.1 years (SD = 9 years) were recruited for Experiment 2, which was a within subjects design. Forty-two participants (23 females) with a mean age of 25.7 years (SD = 8.6 years) were recruited for Experiment 3, which was a between subjects design. Thirty-four participants (23 females) with a mean age of 28 years (SD = 10.57 years) were recruited for Experiment 4.
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Recruitment

Participants were recruited through flyers posted on campus and libraries. Note that while Experiments 1 to 3 were conducted at the California Institute of Technology in Pasadena, CA, Experiment 4 was conducted at the University of Geneva, Switzerland.