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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

Picoscope 6

Comsol Multiphysics 5.3a

MATLAB R2016a
MATLAB packages:
PIVLab 1.41

Wolfram Mathematica 10.2

Avizo, version 9.0.1 (FEI, ThermoFisher Scientific)

R, version 3.3.0
R packages:
igraph v1.1.2
smoother v1.1
spatstat v1.54-0

ImageJ, version 1.51w

ImageJ plugins:
Extended Depth of Field

Data analysis

Picoscope 6

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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

The datasets generated during and/or analysed during the current study are available from the corresponding author upon reasonable request.

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

Life sciences study design

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

Sample size

Ten samples was deemed sufficient for the purposes of these experiments.

Data exclusions

Seeds for flow visualization were selected that were intact and not damaged in transport/storage.

Replication

All images are representative of 10 independent repeats. For all dandelion experiments, 10 samples were used. For each of the porous disk experiments, a single porous disk was used due to the challenging nature of making the disks.

Fig. 1: We observed similar results to a-c and e-f in n=10 independent biological replicates. In g and h, similar results were obtained in 10 similar experiments for (g) and 18 similar experiments for (h).

Fig. 2: The 95% confidence intervals for the mean values were obtained using bias-corrected accelerated bootstrapping. The number of technical repeats performed for each data point is indicated in the final two columns of Re-Cd-Natural-Seeds.csv in the source data.

Fig. 3: (d) Similar results were obtained in 18 independent experiments (each experiment at a different Reynolds number). The images in e and f were obtained for a single disk.

Fig. 4: (a) The error bars in the vertical direction on the green data point is the 95% confidence interval in the critical Reynolds number, obtained by bias-corrected bootstrapping the data from 10 dandelion seeds. The error bars in the horizontal direction on the green data point indicate the 95% confidence interval in the porosity of the pappus, obtained by bias-corrected bootstrapping the data from the 10 dandelion seeds. Each black dot in (a) is obtained by performing experiments of varying speed on a single disk at the stated porosity. (b) The vertical

errorbars give the 95% confidence interval for the mean Reynolds number of freely flying seeds, obtained through bias-corrected accelerated bootstrapping, and are identical to the horizontal red error bars in Fig 2a. The horizontal errorbars in (b) indicate the error due to the finite resolution of the microscope, which was obtained by computing the porosity of a sample at 5 different resolutions and measuring the error found at the resolution used to obtain the mean values that are used in the paper.

Extended Data Fig. 5: (a) Independent experiments were performed 5 times with similar results (each experiment at a different Reynolds number). (b-d) Independent experiments were repeated 10 times with similar results (each experiment at a different Reynolds number). (e) Independent experiments were repeated 7 times with similar results (each experiment at a different Reynolds number). (f-h) Independent experiments were repeated 10 times with similar results (each experiment at a different Reynolds number). (i-l) The experiments were repeated independently for n=10 biological replicates with similar results.

Randomization: Ten plants were grown, and a seed was chosen from a randomly selected seed head per plant.

Blinding: Sample selection was not blind to ensure samples selected were not damaged.

Reporting for specific materials, systems and methods

Materials & experimental systems

n/a	Involved in the study
☒	☐ Unique biological materials
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology
☐	☒ Animals and other organisms
☒	☐ Human research participants

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Animals and other organisms

Policy information about studies involving animals; ARRIVE guidelines recommended for reporting animal research

Laboratory animals: Laboratory animals were not involved in the experiments.

Wild animals: Wild animals were not involved in the experiments.

Field-collected samples: Dandelion seeds were collected from a single plant growing in Edinburgh (55.922684, -3.170703) in April 2014. Seeds were germinated in 10 cm round Petri dishes containing distilled water in 16h light/8h dark conditions (100 µmol m−2 s−1 25◦C day, 23◦C night) for 2 weeks. They were then transplanted to 7 × 7 × 8 cm pots with soil/perlite mix (60% v/v Levington's F2+S (Everris), 24% v/v standard perlite (Sinclair), 16% v/v washed horticultural sand, 0.3 g/L Exemptor (Everris)) and grown in 16h light/8h dark conditions in a controlled environment room (100 µmol m−2 s−1, 21◦ C) for 4 weeks. Plants were transplanted into 4 L pots with peat/sand mix (83% v/v medium peat (Clover), 21% v/v washed horticultural sand, 3 g/L garden limestone (Arthur Bowers), 1 g/L Osmocote Exact Standard 5-6 months (Everris), 0.4 g/L Exemptor (Everris)) and transferred to a glasshouse with ambient light supplemented to ensure a 16h day (minimum intensity of 250 µmol m−2 s−1 , 06:00 – 22:00 GMT) and temperature of 21◦C day, 18◦ C night. For µCT scans, seeds used were the offspring of the original collected plants. For all other experiments, seeds were from the following generation. All of these seeds from the second generation originated from the same parent plant. As T. officinale is apomictic, all seeds are assumed to be genetically identical. Throughout the paper, we use the term dandelion "seed" as a shorthand to refer to the entire diaspore (fruit-pappus unit).