# Protocol for an experimental study of iterated learning and language evolution: supplementary information

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## Participant information sheet

### You are invited to take part in a research study

Before you decide your participation, please take time to read this information carefully so you understand what the study involves. If anything is unclear, or you have any questions, please contact us via details provided below. Please read the following description, and take as much time as you need to consider your participation.

### What is this study about?

The purpose of this study is to examine how people learn, remember and use language over a short period, using interactive tasks.

### What will you need to do?

Around 30 minutes of total activity for a payment of £4.50.

You will be asked to complete language learning tasks involving an artificial language. Instructions for each task will be provided on screen during the study.

During the task, you will be shown a series of abstract moving pictures and asked to remember how these pictures are described in the artificial language. Then you will be tested, for example by showing you pictures and asking you to input a suitable description in the artificial language.

Following the learning tasks, you will also be asked to complete a brief questionnaire with questions about your first language and your knowledge of other languages. We will also ask for feedback about your experience during the session. This questionnaire should take only a few additional minutes.

## Additional Information

**Please do not complete this experiment on a mobile phone.** We recommend using a desktop computer or laptop to avoid issues that may interfere with the tasks.

## Eligibility

- You should have sufficient proficiency in English to understand the study instructions.
- You should be able to easily distinguish between the colors red, blue, and black. Please do not proceed if you have color blindness affecting your ability to differentiate these colors.

## What is your reward?

**You will be paid £4.50 for successful completion. An additional bonus of £1 will be awarded to the top 20% best performing participants.**

## Do I have to take part?

Taking part in this study is entirely voluntary. You are free to withdraw at any time without giving a reason. If you choose to participate, you will be asked to provide electronic consent before starting the study.

You can stop participating at any point by closing the window; however, in that case, we will not be able to offer any payment. Alternatively, a withdrawal button will appear at the end of different stages throughout the experiment. If you choose to click "withdraw", we will have access to your partial data and

may provide a proportionate payment based on how much of the study you have completed.

Should you wish to stop at any point, we encourage you to use the button as it helps us to track participation accurately. If you would like us to delete any data collected up to that point, please contact us via email or Prolific Messenger.

## Anonymity, data sharing, and transparency

Since this is a Prolific study, we will have no way to identify you. We do collect your Prolific ID which we will use for administrative tasks such as checking payments. Your Prolific ID will be deleted from our dataset within one month of the conclusion of data gathering. It will not be included in any data sharing.

Your data will be made openly available online after the study is completed; the data will be placed in a suitable non-commercial repository such as `osf.io`, `zenodo.org`, or `data.bris`. All data will be completely anonymised before sharing.

Open data means that data are made available, free of charge, to anyone interested in the research, or who wishes to conduct their own analysis of the data. This means we will have no control over how the data are used. Other people might use it, for example, in their own research, or it might be read by a machine learning algorithm. However, all data will be anonymous and therefore there will be no way to identify you.

At the end of your participation, we will provide you with more detailed information about the scientific motivation and hypotheses behind this research.

## Complaints

If you are unhappy about any aspect of this study, you can complain to the research governance team at the University of Bristol:

- `https://www.bristol.ac.uk/research-enterprise-innovation/research-governance`
- `research-governance@bristol.ac.uk`

## Consent form

**By clicking the "I consent and continue" button below, you confirm that you agree to the following:**

- I have read and understood the participant information.
- I consent voluntarily to be a participant in this study.
- I understand that I can refuse to answer questions and that I can withdraw from the study at any time, without having to give a reason.
- I understand that taking part in the study involves viewing abstract images labelled in an artificial language and then being tested on my understanding of the artificial language.
- I understand that I will also be asked some simple questions about my knowledge of languages, my experience of language learning, and my experience during the study.
- I understand that I cannot be identified by the researchers.
- I agree that the data collected during my participation in the experiment can be shared as open data without any restriction on use.
- I know that my Prolific ID will be deleted before the data are shared. I understand that anything I write in response to questions that could make me identifiable will also be deleted.

### Detailed instructions

*After the training phase, $B_9$ or $P_9$, and before the test phase, $T_m$, this text appears.*

> You will now see an image that may or may not be familiar to you. Your task is to type the word that you believe the alien would use to label this image.
>
> It is okay if you are not completely confident–just do your best to respond for each image based on what you have learned so far. Please

provide an answer for every image you are shown.

*In Experiment 3 between $T_m$ and the choice session $C_m$ this text appears.*

> You will now be presented with pairs of images, each labelled with the words you provided in the previous stage. Click the image that corresponds the displayed label.

*In all three experiments the participants are offered a break of up to two minutes after each test phase, $T_8$ or $TC_m$.*

> You may now take a short break of up to 2 minutes. You do not need to wait the full 2 minutes. Click “Continue" whenever you’re ready to proceed, or “Withdraw" if you wish to stop participating. If you do not click “Continue", the experiment will automatically continue after 2 minutes.

*This screen has continue and withdraw buttons.*

# 1 Debrief

## Thank you for taking part in this study!

This experiment is part of a line of research investigating how language evolves over time. It is a simplified, controlled replication of a laboratory experiment originally conducted by Simon Kirby, Hannah Cornish, and Kenny Smith. The key idea behind this research is that languages are not just handed down as fixed systems, but instead are constantly being reshaped through learning and use.

When a person learns a language, they do not simply memorise a perfect copy of what they hear; they interpret patterns, generalise from examples, and sometimes introduce new structures or words. These small changes can accumulate across generations of learners.

In this study, you were asked to learn an artificial language for a set of abstract animations that varied in shape, colour, and motion. You saw some of these examples during training, then were asked to label both familiar and unfamiliar images during testing. Your responses may be used to train the next participant,

just as your training may have been based on a previous participant's responses. This process is known as an *iterated learning model*; it simulates how language is transmitted from one generation to the next.

Over multiple generations, what we expect to observe is some simplification and regularisation of the language as it changes; for example, the introduction of more consistent patterns for certain colours or shapes, even if there was no deliberate intention to alter the language in that way. This helps us understand how languages in the real world may have become compositional and easier to learn over time.

## Further Information

The hypothesis being tested in this study is that the biases that a sequence of people bring to the task of learning and reproducing an artificial language will gradually shape the language to become more structured, even though the people are not deliberately intending to do so.

In the original study, this process led to the emergence of languages that resembled natural language in their systematic use of language components — for example, consistently using syllables to convey shape, colour, and motion.

If you are interested and would like to know more, you can read about the original study here: `https://www.pnas.org/doi/10.1073/pnas.0707835105` Cumulative cultural evolution in the laboratory: An experimental approach to the origins of structure in human language.

Thank you again for your time and contribution to this research.

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