

Electronic Supplementary Material for Effortful Bayesian Updating: A Pupil-Dilation Study

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Abstract

This document provides supplementary information for the manuscript “Effortful Bayesian Updating: A Pupil-Dilation Study” published in the *Journal of Risk and Uncertainty*. The Appendix consists of the translated instructions and example screenshots. The experiment was run in German. The color of the winning ball was counterbalanced across subjects; in this set of instructions, black is the winning color.

Translated Instructions and Example Screenshots

General Instructions

There are two containers (“urns”) displayed on the screen. These urns contain white and black balls. The objective of this game is to draw as many black balls as possible. For this you have to draw cleverly from both urns according to certain rules. The following part describes the elements on the screen and how to use the keyboard. The rules of the game are explained later.

Interface

- 1) The bottom half of the screen displays two urns. Each urn contains six balls. There are black and white balls which will be colored blue as long as they are “hidden” inside the urn. Below the urns are the balls that have already been drawn during this trial (e.g. a black and a white ball).

Note that: *When an urn is colored gray you cannot draw a ball out of this urn and you have to choose the other urn. After you make a choice the urns turn gray temporarily and you cannot select any urn.*

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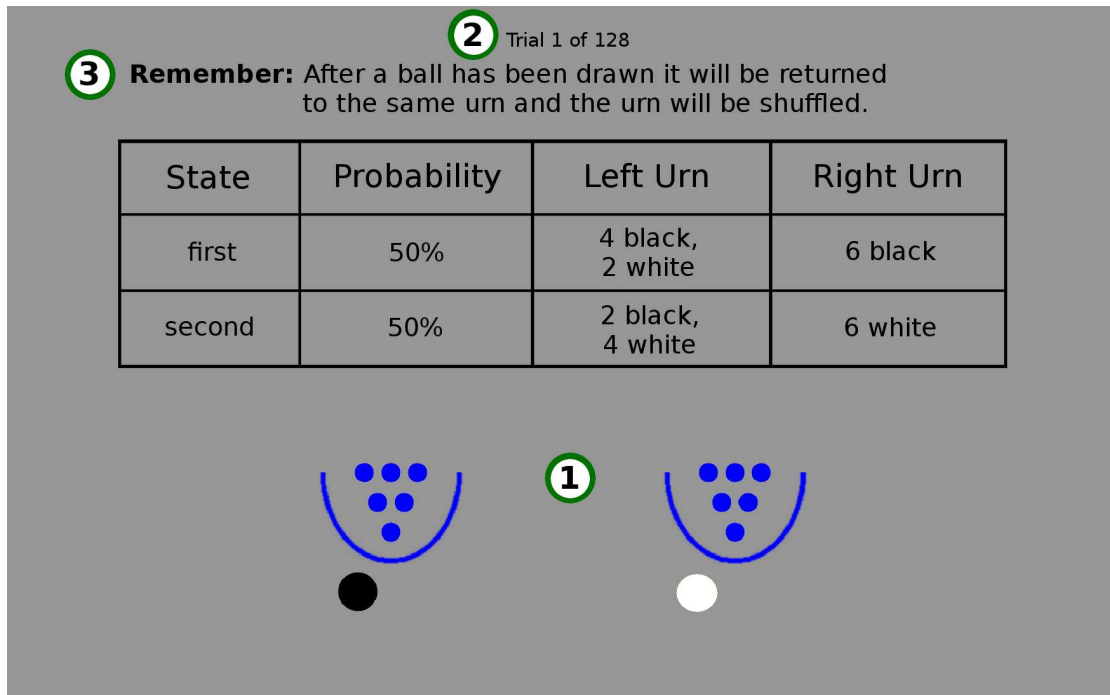


Figure A.1: Instructions screenshot

- 2) The number of the current trial is displayed at the center of the top of the screen display.
- 3) The upper part of the screen summarizes the most important information and the rules of the game.

To make decisions you only need three keys. Two of these keys are marked on the keyboard using small yellow dots. With the left key (“F”) you draw a ball out of the left urn and with the right key (“J”) out of the right urn. You start a new trial by pressing the space bar when you are prompted to do so on screen.

Rules

Procedure. There are a total of 128 trials, each of which consists of two draws. At the beginning of each trial you will be informed of how many cents you will earn for each black ball. Then you select an urn to draw a ball from it by pressing the appropriate key. In odd trials (trial 1, 3, 5, etc.) you have to draw the first ball out of a predetermined urn; in even trials (trial 2, 4, 6, etc.) you can freely choose out of which urn the first ball shall be drawn. You will recognize this by the color of the urns. You can only draw from an urn when the urn and balls in it are colored blue. After choosing the urn a random ball will be drawn from the urn. The result of the first draw (black or white) will be displayed below the urn and you will then draw again. After a ball is drawn both urns will turn gray for a moment, which means that you cannot draw another ball at that

time. When the urns turn blue you can draw again from the urns. The result of the second draw will be displayed below the appropriate urn. Finally, you will be prompted to press the space bar to start a new trial.

Note that: *A drawn ball will be replaced immediately into the same urn! Drawing a ball out of the urn will not change the composition of black and white balls in the urn between the first and second draw. You draw both times from the exact same urns.*

Payoff. For every black ball you draw you will earn either 3 cents or 12 cents; you will not earn anything for drawing a white ball. The two possible amounts (3 and 12 cents) will be balanced in the even and odd trials. That means there will be the same number of trials for which drawing the black ball will earn 3 cents and 12 cents in even and odd trials. How much you earn for drawing a black ball will be displayed at the beginning of the trial and does not change for the duration of the trial. With a bit of luck and clever drawing out of the urns you can earn a considerable amount of money!

States of the World. The most important part of the game is to understand how many black and white balls are in the urns. Please read the following part very carefully! In this experiment there are two states of the world:

In the **first state of the world**
there are 4 black and 2 white balls
in the left urn and 6 black balls in
the right urn.

In the **second state of the world**
there are 2 black and 4 white balls
in the left urn and 6 white balls in
the right urn.

As mentioned above, you draw one ball out of an urn, which will be put back into the urn, and then you draw a second time. However, you do not know whether the state of the world for this specific trial is the first or second one. The state of the world will be determined randomly by the computer. The chance for the first or second state of the world is 50%. The state of the world does not change during a trial!

Eye Tracking. At the beginning of each trial, a “fixation cross” appears. Please fixate your gaze upon the fixation cross and wait until it disappears. The amount you will earn for the black ball will be displayed at the exact same spot after the fixation cross disappears. The amount will be displayed for about 2 seconds and then disappear. After that, your first draw will follow. Depending on the trial number, either both or only one urn will be colored blue. By pressing the appropriate key a ball will drawn from a blue urn. After drawing the ball the urn(s) turn gray and you will have to wait about 2 seconds until the urns turn blue again and you can draw a second time by pressing the appropriate key. At the end of the trial you will be prompted to press the space bar after 2 seconds, and a new trial will start by displaying the fixation cross.

Summary. The table below summarizes the two states of the world:

State of the world	Chance in each trial	Left Urn	Right Urn
first	50%	4 black, 2 white	6 black
second	50%	2 black, 4 white	6 white

To be able to draw many black balls it is important that you understand the table above. If you have any questions, please ask the experimenter.

Remember: For every **black** ball you will earn either **3 cents** or **12 cents**. This will be displayed at the beginning of each trial.

Trial 1 of 128

Remember: After a ball has been drawn it will be returned to the same urn and the urn will be shuffled.

State	Probability	Left Urn	Right Urn
first	50%	4 black, 2 white	6 black
second	50%	2 black, 4 white	6 white


12 cents


Figure A.2: Translated sample screenshot with incentives shown (not part of the instructions)