Universität Basel

Fakultät für Psychologie

Impact of Explicit Goals on Exploration Behavior and Goal Achievement in Risky Foraging Decisions and Two Modes of Learning

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Study personnel:	NA
Planned start of project:	01.05.2021
Planned termination of project	01.03.2022
Further information:	NA

The project leader approves the research plan version 4 on (09.02.2021)

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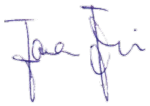

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Basel, (19.04.2021)

1. ETHICAL AND REGULATORY ASPECTS

1.1 Participant Information and Informed Consent

Each participant receives written informed consent prior to starting the study. Consent includes information about goals, duration, harms (no harms), compensation, incentives, data storage and usage, anonymization, and voluntariness. Consent is administered through the software administering the study (see 8.1 Appendix A – Consent form).

2. INTRODUCTION

2.1 Background

This Study investigates whether human decision making in situations entailing risk is moderated by different goals (low, adequate, high), goals being explicit (knowing of the goal during sampling), and modes of learning (decisions from description vs. decisions from experience).

Regarding different goals, studies in behavioral psychology have shown that humans faced with risky foraging tasks tend to behave according to risk-sensitive foraging theory (Pietras & Hackenberg 2001; Hayden & Platt 2009; Bickel, Giordano & Badger 2004). Foraging tasks differ from other risky choices typically used in behavioral psychology research. Instead of having decision makers choose independent options one after the other, foraging tasks have decision makers choose options in relation to a goal over a fixed time e.g., “reach goal X in 5 decisions between two risky options”. Decisions in foraging tasks consequently require a lot more planning than traditional risky choices (Jarecki & Rieskamp, 2020). Predictions of risk-sensitive foraging theory are that decision makers will prefer a safer option with less outcome variability if this option satisfies their needs (or goals). However, if the safer option does not meet their needs (or goals), decision makers will prefer the risky option with higher outcome variability. The assumption is that this behavior will most likely ensure reaching a state where the decision maker’s needs are met (Stephens 1981; McNamara & Huston 1992).

Regarding explicit goals, research in behavioral psychology has also shown that explicit goals have an impact on decisions entailing risk in the sense that explicit goals affect cognitive and behavioral effort. Adequate goals can lead to increased cognitive and behavioral effort, while small goals lead to a decrease in cognitive and behavioral effort (Schiebener, Wegman, Pawlikowski & Brand 2014). Goals that are relatively high, however decrease cognitive and behavioral effort, leading to an inverse U-shaped function describing the interrelation between goals and performance in risky choice tasks (Schiebener, Wegman, Pawlikowski & Brand 2014; Locke & latham 2002).

Regarding modes of learning, in behavioral psychology there are two distinct modes of learning about the risks in risky choice tasks: Learning from experience and learning from description, where learning from experience is a mode in which decision makers learn about the distribution of outcomes underlying their decisions firsthand by sampling from this distribution. Learning from description describes a mode in which decision makers learn about outcome distributions underlying their decisions from a numerical or mathematical description. The mode of learning has been shown to impact the underlying outcome distributions that form in decision makers minds. Learning from experience leads decision makers to underestimate rare events, while learning from description leads decision makers to overestimate rare events (Wulff, Mergenthaler-Canseco, Hertwig, 2018).

While these concepts are researched and empirical findings are available, to the best of my knowledge, there is no prior research combining goals and modes of learning in risk-sensitive foraging tasks.

2.2 Rationale for the research project

The research question concerns: How do different goals (low, adequate, high) impact performance and sampling behavior in risk-sensitive foraging tasks. Besides this, the effect of modes of learning on goal achievement will be explored.

2.3 Risk-Benefit Assessment

Harms: *none*

No physical harms

No psychological harms
Anonymized data collection
Storage of data at the Univ. Basel after the data collection

No particularly vulnerable participant pool (healthy adult population)

Benefits: *compensation*
Participation will receive a monetary compensation for their time, please *see 3.2: Reimbursement* for further detail.

3. PROJECT DESIGN

3.1 Type of research and general project design

Behavioral discrete choice experiment using an incentivized repeated risky choice task from description and from experience. This risk-sensitive foraging design has been used before in a study by Jarecki & Rieskamp (2020).

Experimental Paradigm: After instruction and familiarization, participants engage in repeated risky choices between two options with a finite time horizon and a goal to be reached at the end of the time horizon. A goal is a pre-specified number of points (for example "reach 10 points in five choices"). Participants decide between two risky options, with two outcomes per option. They decide five times between these two options. After each choice they receive an outcome drawn from the option that they have chosen and collect the outcome as points. Participants' goal is to have a point total after the fifth decision that exceeds a pre-specified point goal.

Example: There may be two options (here called gamble A and gamble B). A has two outcomes $A_1 = 7$, $p = 0.2$ and $A_2 = 1$, $p = 0.8$. B has two outcomes $B_1 = 3$, $p = 0.2$ and $B_2 = 2$, $p = 0.8$. The goal the participant must reach is $g = 10$. Option A is the risky option and option B the safe option in this example. The EV of the options is the same ($EV_A = EV_B = 2.2$) whereas the variance is not the same ($Var_A = 5.76$, $Var_B = 0.16$). If the participant chooses option A five times, they must be lucky and draw 7 at least one time to be able to reach the goal. If they pick option B five times, they are sure to reach the goal of 10 even if they are not lucky and draw a 3.

3.2 Recruitment, Screening, and Reimbursement

Recruitment:
Participants will be recruited either through Mturk or Prolific Academic (Instead of BAPS, as students in the bachelor`s degree of the University of Basel are no longer required to collect "Unterschriften" through participation in experiments.)

Sample size: See 4.1: determination of sample size

Screening: Not necessary.

Reimbursement:
Participants will be reimbursed according to Mturk`s or Prolific Academic`s guidelines, with a minimum wage of £5.00/$6.50 per hour for Prolific and $7.50 per hour for MTurk. In addition to this fixed remuneration, there will be a bonus payment to incentivize choices: Participants will be entered into a raffle every time they reach a goal. The raffle will have a monetary payout. The height of the bonus payment will be between $0 and $3.

3.3 Procedures

Repeated discrete choice experiment, to be conducted online.

Design:
The study is a 3x2x2 (goal height x goal knowledge x mode) design, in which goals height (low, adequate, high) will be tested within-subject, and prior goal knowledge (vs. goal not known) and mode of learning (decision from description vs. decision from experience) will be tested between-subjects.

Between-subjects Conditions: Half of the participants will be randomized into the decisions from **experience condition** in which they will "sample" from the underlying outcome distribution before making

the risky choice with the goal. In this condition, participants will not know the probabilities of the risky options' outcomes. Sampling means that they can draw an outcome from a risky option by clicking on it, as many times as they want, to get an idea of the probabilities underlying the two options. In the sampling phase the points drawn from the options do not count towards the goal. The remaining participants will be in the decisions from **description condition** and will not sample, instead they will see the probabilities of the two outcomes (they can inspect them as long as they want) afterwards they will proceed to the decisions that count towards the goal (choice phase). Half of the participants in each condition will be informed about the goal prior to sampling in the **goal known condition**, and the other half will be informed about the goal only after sampling in the **goal unknown condition**.

Within-subject Conditions: The height of the goal (low, adequate, high) will be defined through the statistical task properties (height of the risky outcomes and goals); the difficulty conditions will be determined mathematically based on the probability that an optimal agent who knows the properties of the gamble reaches the goal in five decisions. This probability will be calculated by the optimal model for solving risky choices with goals (McNamara, J. M., Huston, A. I. 1992).

Please see Section 8.2 Appendix B - Schematic Illustration of Experimental Paradigm for an illustration of the stimulus material.

The experiment will involve the following procedure:

Phase 1: Consent and instruction
Phase 2: Familiarization with the task and one trial familiarization block
Phase 3: Eliciting gender to match into conditions

- Procedure in the decision from ***description*** condition:
  - In the goal ***known*** condition:
    - Phase 4: Presentation of descriptive mode and being informed about the goal
    - Phase 5: Choice Phase: ca. 21 blocks
      - Block 1: Make five choices given current goal <x> and options <o1 and o2>

        …

        [Repetition of blocks according to design, randomizing goal known during sampling vs goal not known during sampling while randomizing goals as a sequence of the same level (e.g., 7 blocks low goals, 7 blocks high goals, 7 blocks adequate goals]

        [ca.7 repetitions per factor level combination]
  - In the goal ***unknown*** condition:
    - Phase 4: Presentation of descriptive mode
    - Phase 5: Choice Phase: ca. 21 blocks and being informed about the goal
      - Block 1: Make five choices given current goal <x> and options <o1 and o2>

        …

        [Repetition of blocks according to design, randomizing goal known during sampling vs goal not known during sampling while randomizing goals as a sequence of the same level (e.g., 7 blocks low goals, 7 blocks high goals, 7 blocks adequate goals]]

        [ca.7 repetitions per factor level combination]
- Procedure in the decisions from ***experience*** condition:
  - In the goal ***known*** condition:
    - Phase 4: Being informed about the goal and sampling
    - Phase 5: Choice Phase: ca. 21 blocks
      - Block 1: Make five choices given current goal <x> and options <o1 and o2>

        …

        [Repetition of blocks according to design, randomizing goal known during sampling vs goal not known during sampling while randomizing goals as a sequence of the same level (e.g., 7 blocks low goals, 7 blocks high goals, 7 blocks adequate goals]

        [ca.7 repetitions per factor level combination]

- In the goal ***unknown*** condition:
  - Phase 4: Sampling
  - Phase 5: Choice Phase: ca. 21 blocks and being informed about the goal
    - Block 1: Make five choices given current goal <x> and options <o1 and o2>

      …

      [Repetition of blocks according to design, randomizing goal known during sampling vs goal not known during sampling while randomizing goals as a sequence of the same level (e.g., 7 blocks low goals, 7 blocks high goals, 7 blocks adequate goals]

      [ca.7 repetitions per factor level combination]

Phase 6: Demographics (other than gender) and control variables.

Demographics and control variables are: Demographics (age, income, education (highest current degree) and occupation), self-reported attention (Likert-type scale) and numeracy.

3.4 Objectives

Hypotheses:

H1 (exploration hypothesis): People in the decision from experience condition with explicit goals (goal known during sampling) will make more draws during the sampling phase (= more exploration) than people in the decision from experience condition without explicit goals.

H2 (goal-achievement hypothesis): People with high exploration (quasi-experimental condition), adequate goals and explicit goals (goal known during sampling) will achieve their goals more often than people with low exploration, low or high goals and no explicit goal (goal known during choice phase).

H3 (modes-of-learning hypothesis): There is a difference between people in the decisions from description compared to the decisions from experience in regards to how often a goal is achieved.

3.5 Outcome variables

Dependent variables:

- Number of sampling trials (fist hypothesis)
- Goal achievement (yes/no) (second and third hypothesis, quasi-experimental condition)

Predictor variables:

- Goals (three levels, low, adequate, high)
- Goal known during sampling (vs not known during sampling)
- High amount of sampling trials (vs. low amount of sampling trials, quasi-experimental condition)
- Modes of learning (decisions from description vs. decisions from experience)

3.6 Other study variables

Demographics and numeracy. Numeracy will be elicited using the scale by Lipkus, Samsa and Rimer (2001), demographic measures are age, income, education (highest current degree), and occupation. We will also measure self-reported attention during the task on a Likert-type scale. Recency will be controlled for following Wulff, Mergenthaler-Canseco & Hertwig, (2018).

PROJECT POPULATION and SAMPLE

Healthy adult target population

3.7 Inclusion criteria

The included age range will be 18 to 60.

The expected age range is 18 to 60

The gender we expect to recruit is 50% - 50% female – males. Genders will be matched into the different conditions.

3.8 Exclusion criteria

Subjects below 18 years of age. Further, exclusion of participants who completed less than 95% of the online tasks that they signed up for, which is a standard procedure in online recruitment (e.g., Crump, McDonnell, & Gureckis, 2013).

3.9 Criteria for withdrawal / discontinuation of participants

Withdrawal of informed consent, abortion is possible anytime during the study. After data collection has finished, consent can be withdrawn formally but practically, the data cannot be removed from the data set anymore because of the anonymization; information about this will be given in the informed consent.
[Note to ethics committee: legally speaking, the consent to use the data can be withdrawn, but practically speaking the data cannot be removed. This phrase is formulated as per the University of Basel's ethics committee request by the University of Basel in most previous applications regarding this matter.]

4. STATISTICAL METHODOLOGY

4.1 Determination of Sample Size

The Sample size will be determined following the *optional stopping* approach using Bayesian statistics (Schönbrodt, Wagenmakers, Zehetleitner & Perugini, 2017). Participants will be recruited in batches (starting with a batch of $N = 50$) at the start, afterwards recruiting between 10 to 15 participants per batch, with a limit of 100 participants). After each batch Bayesian analysis will be performed until the data provides evidence for or against the first hypothesis H1 (exploration hypothesis) A Bayes Factor of > 3 will be interpreted as evidence for the hypothesis, while a BF of $< 1/3$ will be interpreted as evidence against the hypothesis.

5. DATA AND QUALITY MANAGEMENT

5.1 Data handling and record keeping / archiving

Data collection will be done through the "oTree" online platform and hosted on the Heroku web service.
During data collection the data will be stored on a web service (Heroku, https://www.heroku.com), which is a cloud platform with integrated data services. After data collection, the data will be retrieved from the database and stored within the University of Basel servers and on the computer of myself during the time of data processing. The data will be deleted from the web platform after data collection ends, only for the duration of data collection will the web service be used. The Heroku webservice stores data in a European SQL database, transmits data encrypted (TLS/SSL), possesses ISO 27001, 27017, and 27018 certifications, as outlined in its privacy and security statement (https://devcenter.heroku.com/articles/security-privacy-compliance).
Storing data on web services during data collection, and retrieving the data afterwards is common practice in web-based psychological research, being hosted on web platforms like Unipark, or Qualtrics (e.g., Buhrmester, Kwang, & Gosling, 2011; Crump, McDonnell, & Gureckis, 2013; Paolacci, Chandler, & Ipeirotis, 2010; Schulz, Speekenbrink, & Shanks, 2014).
Note that the experiment is fully anonymized, and no contact data will be collected during the experiment. Thus, I believe the web-based data storage during data collection poses minimal risks to respondents' privacy. Post publication, the data will be made available in a public repository (OSF or journal-specific repositories)

5.2 Confidentiality, Data Protection

Confidentiality will be ensured due to alphanumeric anonymization of the study data.
Personalized data will only be used for recruiting participants and will not be stored jointly with the data from the study.

5.3 Coding

NA (no personal data will be stored)

5.4 Debriefing

After participation, participants can sign up for more detailed information, receiving an email after all data is collected.

5.5 Archiving and Destruction

Anonymized data will be stored in a public repository to facilitate open science policies (participants will be informed about this in the informed consent).

6. FUNDING AND SUPPORT

The project will be funded by the University of Basel, Economic Psychology.
There are no conflicts of interest.

7. REFERENCES

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8. APPENDICES

8.1 Appendix A – Consent form

The exact wording of the consent form might be subject to minimal changes (e.g., typos, precise study time estimate) after pre-testing.

Consent form

Introduction
Thank you for showing interest in this study.
The aim of this study is to investigate human decision making. The study will take around 40 minutes to complete. In this study you will be asked to answer risky choices (foraging tasks, meaning risky choices

with goals over multiple risky choices). Afterwards you will be asked to answer demographic questions as well as some short questionnaires about potential confounding variables.
Your participation will be compensated at £3.50 for this study **[note to the committee: this amount is based on an estimated time of 40 minutes and will be adjusted according to the time after the pre-test to match the specified hourly minimum wage].** You can win a bonus compensation, for every achieved goal in the study your name will be entered one time into a raffle with a monetary payout.

Risks
Participation in this study poses no risk to your health. The questionnaires can contain questions of personal nature. This study is financed by the chair of economic psychology of the university of Basel.

Data Collection and Storage
All data collected in this study will be stored and analyzed anonymized and will only be used for scientific research. The findings of this study will be presented in an anonymized and summarized way when presented to a scientific conference, a scientific journal or if publicized in any other medias.
The de-identified data – referring to the portion of data without any means of identifying your person – will be publicized in online databanks for other researchers to use, to accelerate scientific progress. Before publicizing the data, we will delete or alter all data that could, with the latest scientific means, lead to an identification of your person. Especially any data concerning your IP-address, name, date of birth and e-mail address will be deleted or altered. The data made public will include age, income, education (highest current degree), occupation, numeracy, and self-reported attention during the task.

Withdrawal
Your participation is voluntary. You can, at any time, stop your participation without stating any reason. Your consent to the use of your data can be withdrawn, at any time **during** the study and without stating any reason. Withdrawal of consent to usage of data can be done after ending the study formally, however practically removal of the data can`t be done, because of the anonymization of data performed before storage of data. Please copy/screenshot this consent form for your records.

☐ I am at least 18 years old and have read and understood the listed terms and conditions, and had enough time come to a decision. I am willing to participate in this study, under the listed terms and conditions.

8.2 Appendix B – Schematic Illustration of Experimental Paradigm