

Supplementary Material

May 24, 2023

1 What strategy did the MGPS Tutor teach?

To understand what participants in the MGPS Tutor condition were taught, we inspected the strategy discovered by MGPS. We found that this strategy systematically asks the most reliable experts (e_2 and e_6) to evaluate projects on the criterion with the highest decision weight (c_5). It starts by asking expert e_2 to rate criterion c_5 for a randomly selected project. If that rating is below the maximum score, the same expert is immediately asked to rate the same criterion for a different project. If expert e_2 gives project p_i the highest possible score on criterion c_5 ($max_{obs} = 5$), the strategy requests a second opinion about it from expert e_6 . If expert e_6 also evaluates the criterion's value as 5, the decision process ends and project p_i is selected. If expert e_6 provides a rating below 5, expert e_2 is asked about a different project. This process is repeated until a project in which both experts e_2 and e_6 estimate $c_5 = 5$ is found, or the maximum number of decision operations (5) is reached. It is important to note that while this decision strategy is relatively easy to understand, describe, and execute, the task of discovering this specific strategy as more resource-rational than the vast number of possible other strategies is considerably more difficult.

2 Code

The Git repository containing the source code for the project selection environment, MGPS, and the data analysis can be found at [removed] and is additionally supplied as an anonymized zip file.

3 Experiment instructions

The remainder of this document contains all instructions given to participants of the online experiment. All instructions are provided unedited as seen by the participants.

Participants viewed the pages in the order they are listed. Not shown here are: a comprehension quiz after the initial instructions, the 10 training trials, the 10 test trials, and a final questionnaire asking participants general information. The full experiment structure was:

1. General instruction (see pages 3-8)
2. Comprehension quiz
3. Training instruction (see page 9 for the No tutor condition and page 10 for the MPGS tutor and the Dummy tutor conditions)
4. Training trials
5. Test instruction (see page 11)
6. Test trials
7. Final survey

Structure of the experiment

In this HIT, you will participate in a psychology experiment. This experiment has three phases:

Instructions: In this phase, you will be introduced to the experiment and will be given instructions about it.

Training: In this phase, you will learn how to play the game.

Test: In this phase, you will be tested on what you learnt in the training phase. You can earn a bonus payment by achieving a high score in the test phase.

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Project selection

In this HIT, you will be playing a game called **Project Selection**.

During the game, you are in charge of a company. Your task is to select between a number of projects and ultimately choose a project with a high score.

The score of a project is determined by multiple criteria, such as the project's potential profit or sustainability.

Some criteria are more important than others. The measure of importance is called the scaling factor. It describes how much impact on the overall score each criteria has.

To compute a project's final score, each criteria's score (e.g. sustainability) is first multiplied with the criteria's scaling factor.

The scaled criteria scores are then added together, resulting in the project's final score. Don't worry, we will do the math for you!

As you see below, project 1 has a final score of 3.14, which is calculated by scaling and adding the criteria: $0.2 * 3.2 + 0.3 * 4 + 0.5 * 2.6 = 3.14$

Your goal in this game is to find a project with a high final score.

	Project 1	Project 2	Project 3
Profit Scale: 0.2	3.2	4.1	2.4
Success probability Scale: 0.3	4	3.5	4.2
Sustainability Scale: 0.5	2.6	3.1	3.7
Overall Score	3.14	3.42	3.59

The profit criteria has a scale of 0.2

Overall score of project 1

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Certainty display

Unfortunately, you don't know the true criteria scores and have to make your decision with uncertain information.

To display how certain information in the game is, we will display a number of stars.

The more stars are displayed under some piece of information, the more likely it is that the true score will be close to the displayed score.

The number of stars denotes how close the displayed criterion score is likely to be to the true criterion score.

Specifically:

- 1 star: there is a 90% chance that the true score is less than 3 points away from the displayed score.
- 2 stars: there is a 90% chance that the true score is less than 2 points away from the displayed score.
- 3 stars: there is a 90% chance that the true score is less than 1 point away from the displayed score.
- 4 stars: the true value is likely to be very close to the estimation.

A certainty of one star means that the true value is likely to be between 1.1 and 7.1

	Project 1	Project 2	Project 3
Profit Scale: 0.2	3.2 ★☆☆☆	4.1 ★☆☆☆	2.4 ★☆☆☆
Success probability Scale: 0.3	4 ★☆☆☆	3.5 ★☆☆☆	4.2 ★☆☆☆
Sustainability Scale: 0.5	2.6 ★☆☆☆	3.1 ★☆☆☆	3.7 ★☆☆☆
Overall Score	3.14 ★★★☆☆	3.42 ★☆☆☆	3.59 ★☆☆☆

A certainty of three stars means that the true value is likely to be between 2.14 and 4.14

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Asking for help

To gather additional information about each project's scores, you can ask a number of experts for **their** estimate of a specific project value.

Hiring experts isn't free, asking an expert for advice has a fee of 0.002 points, which will be deducted from your score.

Additionally, in each round of the selection game you can only ask for advice up to 5 times.

Requesting information from an expert reveals his estimate and automatically updates your current estimate about the project.

However, experts aren't perfect and can make mistakes. You can ask multiple experts for their estimates to get a closer estimate of the project's value.

The numbers of stars under each expert's name indicates how certain that expert is.

	Project 1			Project 2		
	Expert 1 ★☆☆	Expert 2 ★★★★	Current Estimate	Expert 1 ★☆☆	Expert 2 ★★★★	Current Estimate
Profit Scale: 0.2			3.2 ★★★★	4.8	3.9	4.1 ★★★★
Success probability Scale: 0.3	4.2		4 ★★★★		4.2	3.5 ★★★★
Sustainability Scale: 0.5			2.6 ★★★★			3.1 ★★★★
Overall Score			3.14 ★★★★			3.42 ★★★★

Expert 1's accuracy is one star, which means his estimates are usually within 3 units of the true estimate

Expert 1's estimate for the success probability of project 1

This column displays your current best guess of the true values when taking the revealed expert opinions into account

Asking experts makes you more certain of the criteria's score and the overall estimate

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How to play

The game consists of two stages:

First, hire experts until you are satisfied with the available information and want to make a choice.

To request information, click on the field in the table you want to reveal.

In the second stage, click on the project you want to select. You will not be able to request additional information anymore after selecting a project.

To select a project, click on the project name at the top of the table columns.

To choose a project, click on the project name

	Project 1			Project 2		
	Expert 1 ★☆☆	Expert 2 ★☆☆	Current Estimate	Expert 1 ★☆☆	Expert 2 ★☆☆	Current Estimate
Profit Scale: 0.2			3.2 ★☆☆	4.8	3.9	4.1 ★★★★
Success probability Scale: 0.3	4.2		4 ★★★★		4.2	3.5 ★★★★
Sustainability Scale: 0.5			2.6 ★★☆☆			3.1 ★★☆☆
Overall Score			3.14 ★★★★			3.42 ★★★★

To ask an expert for his estimate of a specific value, click the field you want to reveal

Your estimates update automatically, you don't have to click them

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Additional Information

You will play multiple rounds of the game.

In each round, the scores and expert opinions of all projects are **randomized**.

The real environment is much larger than the environment in the previous examples: there are 5 projects, 6 criteria, and 6 experts.

As you can see in the example below, certainty is not always given as an exact number of stars. For example, a certainty of 3.5 stars means your certainty level is inbetween 3 stars and 4 stars.

Since the real environment is so large, you might need to scroll both horizontally and vertically to see all the values.

Please do not close the window or reload the page during the experiment.

	Project 1							Project 2							Project 3		
	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Current Estimate	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Current Estimate	Expert 1	Expert 2	Exp
Economic effects scale: 0.02	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Social effects scale: 0.07	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17
Environmental effects scale: 0.22	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Strategic alliance scale: 0.11	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13
Organizational readiness scale: 0.47	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
Risk of investment scale: 0.12	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Estimated performance	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4

Use the scrollbar to see all projects

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Training section

Next, you will perform the project evaluation and selection for 10 different problems.

These trials are part of the training section of the experiment.

In the training section, you can ask for expert advice as often as you want. Keep in mind that in the later test section you can only ask for expert advice 5 times per problem.

The size of the training environment will increase during training, make sure to use the scroll bar to see all the projects you can choose from.

Your score in the training trials does not affect your pay or bonus payments.

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Training section

Next, you will train with an interactive tutor for 10 different problems.

In the tutor session, your task is to learn to select the best option out of multiple highlighted expert opinions. You might need to scroll within the table to see all highlighted fields.

The tutor will provide you with feedback on your choice.

In addition to asking for advice, you also always have the option to stop the planning process by selecting a project.

The size of the training environment will increase during training, make sure to use the scroll bar to see all the projects you can choose from.

These trials are part of the training section of the experiment.

Your score in the training trials does not affect your pay or bonus payments.

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Test section

Next, you will perform the project evaluation and selection for 10 different problem cases on your own.

Remember, in this section you can only ask for expert advice 5 times per problem.

You can earn a **bonus payment** in this section.

Successfully completing all test trials will earn you a bonus payment of £0.25.

If your score is in the top 50% of all participants who completed the experiment, you will get an additional bonus payment of £0.5.

As before, you can hire experts to evaluate specific aspects of the projects and ultimately choose the project you want to select.

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