

Data overview, RQ2, and RQ3

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This file is meant to guide you through reproducing the information we provide on our collected data as well as our analyses for RQ2 and RQ3.

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Types of analyses

Data overview and participant characteristics

Refer to the file "dataoverview_participantcharacteristics.ipynb" to reproduce:

- The mean effort per preparatory activity (Supplementary Table 1),
- Mean effort per action and combination of selected state feature values (Supplementary Figure 5),
- Number of samples per action and combination of selected state feature values (Supplementary Figure 6),
- Mean return likelihood rating per session ("Results"-section), and
- The participant characteristics (Supplementary Table 5).

Refer to the file "human_feedback_overview.ipynb" to reproduce the following numbers reported in the "Results"-section:

- The number of people noticing human feedback according to the post-questionnaire,
- The number of people reading human feedback messages according to the post-questionnaire,
- The number of people clicking on the reading confirmation links in the feedback messages, and
- The number of people with data from the next session after receiving vs. not receiving human feedback.

Refer to the file "user_weights_for_allocation_principles.ipynb" to reproduce the following:

- The weights participants assigned to the allocation principles, grouped based on the auxiliary rewards we have, from Table 4,
- The weights participants assigned to the allocation principles from Supplementary Table 4, and
- The relative weights for allocation principles corresponding to our auxiliary rewards compared to prognosis, used for our analysis for RQ3.

The files "dataoverview_participantcharacteristics.html," "human_feedback_overview.html," and "user_weights_for_allocation_principles.html" show the corresponding results as computed by us.

Feature selection for RL model

Refer to the file "feature_selection_from_nonabstracted_states.ipynb" to reproduce our selection of three base state features. The file "feature_selection_from_nonabstracted_states.html" shows the results as computed by us.

Analysis for RQ2

Refer to the file "rq2_longterm_effect_unlimited_feedback.ipynb" to reproduce our analysis on the long-term effect of unlimited human feedback. This includes:

- Figure 2, and
- The transition functions for giving and not giving human feedback shown in Supplementary Figure 1.

Refer to the file "rq2_longterm_effect_limited_feedback.ipynb" to reproduce our analysis on the long-term effect of limited human feedback. This includes:

- Policies for different human feedback costs from Table 2,
- Figure 3,
- The distribution of people across the 12 base states we observed in the first session of our longitudinal study from Supplementary Figure 7, and
- The mean reward and percentage of people receiving human feedback when repeating the analysis for our hypothetical live application described for RQ3, shown in Supplementary Figure 8.

The corresponding .html-files again show the results as computed by us.

To re-compute the dynamics and Q-values underlying the computations, refer to the file "compute_policies.py."

Analysis for RQ3

Refer to the file "rq3.ipynb" to reproduce our analysis for RQ3. This includes:

- The average percentage of people with negative return likelihood ratings in our study, used as basis for the dropout in our hypothetical live application, and
- Figure 4.

The corresponding .html-file again shows the results as computed by us.

Policies for return likelihood as reward

Refer to the file "policies_return_likelihood.ipynb" to reproduce:

- The optimal policies for different human feedback costs when using the return likelihood as basis for the reward (Supplementary Table 2).

The corresponding .html-file again shows the results as computed by us.

To re-compute the dynamics and Q-values underlying the computations, refer to the file "compute_policies_returnlikelihood_effortfeatures.py."

Steps to reproduce analyses

The reproduction of our code is based on Docker and Jupyter Notebook. Take the following steps:

1. Make sure that you have Docker installed. You can check whether you do by running `docker -v`.
2. Now choose from the following two options:
 - In the directory of this README-file, build the Docker image via `docker build . -t gbna4/humaninv2024_python`.
 - Pull the Docker image from Dockerhub via `docker pull gbna4/humaninv2024_python`.

3. Run the Docker container via `docker run -p 8888:8888 -e JUPYTER_ENABLE_LAB=yes -v <this_working_directory>:/home/jovyan/work gbna4/humaninv2024_python`, where `<this_working_directory>` is the path to the directory that this README-file is in.
4. Go to one of the links presented in the terminal upon running the Docker container to access Jupyter Notebook.
5. Open the "work"-folder in Jupyter Notebook.
6. Open one of the notebooks to reproduce the corresponding analyses.

Explanation of files and folders

This directory contains the following files and folders:

- Data: Data needed for our analyses
 - `all_abstract_states_with_session.csv`: All abstract states, including those of people with no state data in session 2, with corresponding session.
 - `all_states`: All non-abstracted states, including those of people with no state data in session 2.
 - `data_rl_samples.csv`: Non-abstracted transition samples.
 - `data_rl_samples_abstracted[0, 1, 2][3, 2, 2].csv`: Abstracted transition samples.
 - `ethical_principle_relative_weights_with_prognosis`: Weights for the allocation principles corresponding to our auxiliary rewards relative to prognosis.
 - `ethical_principle_weights`: Weights for the allocation principles corresponding to our auxiliary rewards.
 - `feedback_reading_confirmation_anonym`: Anonymized human feedback reading data.
 - `postquestionnaire_anonym`: Anonymized post-questionnaire data.
 - `sessionsdata_anonym`: Anonymized data from the conversational sessions.
- Figures: Figures created during our analyses.
- `Intermediate_Results`: Dynamics and Q-values for our different human feedback costs when using the effort as basis for the reward. Computed in `"compute_policies.py"`.
- `Intermediate_Results_Return_Efforfeatures`: Dynamics and Q-values for our different human feedback costs when using the return likelihood as basis for the reward. Computed in `"compute_policies_returnlikelihood_effortfeatures.py"`.
- `compute_dynamics_feat_sel.py`: Functions for computing dynamics and performing the feature selection.
- `compute_policies.py`: To compute dynamics and Q-values for our analyses for RQ2 and RQ3.
- `compute_policies_returnlikelihood_effortfeatures`: To compute dynamics and Q-values to compute the policies from Supplementary Table 2.
- `dataoverview_participantcharacteristics.html`: Our results for the data overview and participant characteristics.
- `dataoverview_participantcharacteristics.ipynb`: File to reproduce the results above.

- `Dockerfile`: File to build the Docker image yourself.
- `feature_selection_from_nonabstracted_states.html`: Our results for the selection of state features.
- `feature_selection_from_nonabstracted_states.ipynb`: File to reproduce the results above.
- `human_feedback_overview.html`: Our results on people noticing and reading human feedback messages.
- `human_feedback_overview.ipynb`: File to reproduce the results above.
- `optimal_policy_computations.py`: Functions for computing optimal policies.
- `policies_return_likelihood.html`: Our results on the policies for different human feedback costs when using the return likelihood as basis for the reward (Supplementary Table 2).
- `policies_return_likelihood.ipynb`: File to reproduce the results above.
- `README.md/README.pdf`: This Readme-file.
- `rq2_longterm_effect_limited_feedback.html`: Our results of the analysis of long-term effects of limited human feedback.
- `rq2_longterm_effect_limited_feedback.ipynb`: File to reproduce the results above.
- `rq2_longterm_effect_unlimited_feedback.html`: Our results of the analysis of long-term effects of unlimited human feedback.
- `rq2_longterm_effect_unlimited_feedback.ipynb`: File to reproduce the results above.
- `rq3.html`: Our results of the analysis for RQ3.
- `rq3.ipynb`: File to reproduce the results above.
- `user_weights_for_allocation_principles.html`: Our results on the weights participants of our post-questionnaire assigned to the allocation principles.
- `user_weights_for_allocation_principles.ipynb`: File to reproduce the results above.