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A Splash of Color: A Dual Dive into the Effects of EVO on Decision-Making with Goal Models: Supplemental Material

Alicia M. Grubb
Smith College, amgrubb@smith.edu

Yesugen Baatartogtokh
Smith College

Irene Foster
Smith College

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Authors: Yesugen Baatartogtokh, Irene Foster, and Alicia M. Grubb.

This repository contains the supplemental information for the above named paper. It consists of the study instrument and data. We also include the script required to complete our statistical analysis. Researchers may use this supplement for the purpose of study replication. Educators may also use the models for educational purposes.

With these materials, the user may:

- Review and reuse the study materials and data.
- Run scripts for statistical tests and data analysis.

Description of Artifact

Artifact-Repo
|___**README.md** — This file.
|___**LICENSE.md** — The license for this artifact.
|___**Supplement.pdf** — Open Science Supplement.
|___*models/* — Folder containing the raw .json files of the models that were shown in static form to the subjects in the survey. Running a simulation will result in a random path different to those shown to subjects.
| |___*bike.json* — Model shown to subjects in Experiment study in Parts 2–4.
| |___*course.json* — Model used to introduce all subjects to goal modeling and simulation syntax.
| |___*employee.json* — Model used to test goal modeling syntax and simulations over time for all subjects.
| |___*summer.son* — Model shown to subjects in Experiment study in Parts 2–4.

|___*pdfs/* — Folder containing the .pdf files used in the Experiment study.
| |___*BK-Model-CTL* — Bike Evolution Control
| |___*BK-Model-EVO* — Bike Evolution EVO
| |___*BK-Q11-CTL* — Bike Evolutions Comparison Control
| |___*BK-Q11-EVO* — Bike Evolutions Comparison EVO
| |___*SM-Model-CTL* — Summer Evolution Control
| |___*SM-Model-EVO* — Summer Evolution EVO
| |___*SM-Q11-CTL* — Summer Evolutions Comparison Control
| |___*SM-Q11-EVO* — Summer Evolutions Comparison EVO
| |___*TNE-Handout* — Evolving EVO training
| |___*TNG-Handout* — Initial Goal Modeling Training
| |___*TNS-Handout* — Function Types Training
| |___*TNS-Sim-Path* — Evolution of Training Model
| |___*Video-Slides* — Training Video Slides

|___*statistics/* — Folder containing the raw anonymized data for both the Experiment and User studies, as well as the RStudio scripts used in anonymizing the data for the studies.
| |___*data-scored-exp.csv* — Scored data for baseline comparison analysis of the Experiment study.
| |___*data-scored-user.csv* — Scored data for baseline comparison analysis of the User study.
| |___*final-exp.csv* — Final dataset for baseline comparison analysis of the Experiment study.
| |___*final-user.csv* — Final dataset for baseline comparison analysis of the User study.
| |___*final-reg.csv* — Final dataset for within-subjects analysis of the Experiment data.
| |___*initial-data-exp.csv* — Raw study data after anonymization used for quantitative analysis of Experiment study.
| |___*initial-data-user.csv* — Raw study data after anonymization used for quantitative analysis of User study.
| |___*initial-data-wQual-exp.csv* — `initial-data-exp.csv` with score qualitative data in `qualitative-data-scored-exp.csv` added manually.

| |___*initial-data-wQual-user.csv* — `initial-data-user.csv` with score qualitative data in `qualitative-data-scored-user.csv` added manually.
| |___*initial-qualitative-data-exp.csv* — Raw study data after anonymization used for qualitative analysis of Experiment study.
| |___*initial-qualitative-data-user.csv* — Raw study data after anonymization used for qualitative analysis of User study.
| |___*qualitative-data-scored-exp.csv* — Scored qualitative data for the Experiment. | |___*qualitative-data-scored-user.csv* — Scored qualitative data for the User study. | |___*script-statistics.R* — Statistical analysis in article for both Experiment and User study results.
| |___*script-anonymize-data.R* — Anonymizes survey data for further analysis.
| |___*script-finalize-data.R* — Finalizes data for analysis.
| |___*script-prep-regression-exp.py* — Prepares data for analysis within-subjects for the Experiment study.
| |___*script-scoring-data-exp.py* — Scores question data for statistical analysis for Experiment study.
| |___*script-scoring-data-user.py* — Scores question data for statistical analysis for User study.

|___*user-study-subject-models/* — Folder containing the raw anonymized data from the User study for each subject. Each subject's folder contains the transcripts from the in-person session, pictures and .json files of both the initial pre-study and completed post-study models.
| |___*Subject 1* — Folder also includes subject's custom EVO palette.
| |___*Subject 2*
| |___*Subject 3*
| |___*Subject 4*
| |___*Subject 5*
| |___*Subject 6*
| |___*Subject 7*
| |___*Subject 8*
| |___*Subject 9*
| |___*Subject 10*
| |___*Subject 11*

Steps to review study materials.

One of the goals of this supplement is to allow researchers to review and reuse our study materials. `Supplement.pdf` provides the exact wording of all instruments used in the study. It also references the files in the `pdfs/` folder.

BloomingLeaf (Release 2.5) was used to create the models shown in Supplement.pdf for the Experiment study, as well as the training models shown to subjects in both studies.

BloomingLeaf (Release 2.6) was used to create the pre-study models for the User study, and during the modeling session itself.

Steps to reproduce Experiment and User study analysis.

Preconditions: The R script used for the Experiment study was created using RStudio for MAC (Version: 2022.12.0+353 | Released: 2022-12-15), which required R 3.3.0 (but we used the R 4.2.2 binary).

Required Packages: Additionally, the R scripts require the installation of the follow packages directly in RStudio: `readr`, `tidyverse`, `ggplot2`, `reshape2`, `"dplyr"`.

Pre Processing:

1. Run `script-anonymize-data.R`. This script produces `initial-data-user.csv`, `initial-data-exp.csv`, `initial-qualitative-data-user.csv`, and `initial-qualitative-data-exp.csv`. *Note: The file `script-anonymize-data.R` will not run because the required source file is not included in this repository, as it contains personally identifying information. We include this script for reference and review.*
   The resulting `initial-data-exp.csv` and `initial-data-user.csv` files contains the raw data after

anonymization. We then scored the anonymous results manually from `initial-qualitative-data-exp.csv` and `initial-qualitative-data-user.csv` putting the answers in `qualitative-data-scored-exp.csv` and `qualitative-data-scored-user.csv`. For each question, responses were given a 0 or 1 score depending on whether they demonstrated reasoning that would follow from the model. During scoring, we did not have access to the subjects' grouping, to limit any researcher bias. After scoring the scored qualitative data responses and those scores were manually added to `initial-data-wQual-user.csv` and `initial-data-wQual-exp.csv`, for the next step.

2. Run `script-scoring-data-exp.py` and `script-scoring-data-user.py`, which takes as input `initial-data-wQual-exp.csv` and `initial-data-wQual-user.csv` to output `data-scored-exp.csv` and `data-scored-user.csv`.
3. Run `script-finalize-data.R`. This removes extra columns not required for analysis and then completes the analysis required for Section 4 of the paper. It also outputs `final-user.csv` and `final-exp.csv`, which is used in the next step.
4. Run `script-prep-regression-exp.py`. This script creates a new dataset to enable within-subjects analysis for the Experiment study and outputs `final_reg.csv`.

Article Statistics: Run `script-statistics.R`, which applies the statistics in the article. This requires `final-exp.csv`, `final-user.csv`, and `final_reg.csv`. –>

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