Plan Overview

A Data Management Plan created using DMPonline

Title: INFORMED REAL-TIME HUMAN-AGENT TEAMING THROUGH PATTERNS OF EYE GAZE ALLOCATION (iReaLHAT-PEGA)

Creator:FIRST NAME LAST NAME

Principal Investigator: Szonya Durant, Kostas Stathis

Data Manager: Szonya Durant

Project Administrator: Szonya Durant

Affiliation: Royal Holloway, University of London

Template: Royal Holloway - Institutional approval template

Project abstract:

It has been observed of human attention in multi-tasking conditions that often people may fail to notice important changes that require a response. However, the mechanisms underlying the balance between the need to pay attention to one task whilst allowing the distraction of an unexpected, but important task remain to be fully ascertained. At the same time, there have been many attempts over the years to build computer-based assistance for the human decision-making process, going back to long standing ideas for interfaces that reduce information overload. This proposal builds on an existing test-bed, the Integrated Cognitive User (ICU) assistance system, to tackle the problem of how attention with its limited resources operates when supported by software agents. In the ICU, agents are automated intelligent components that monitor eye-tracking information, in order to highlight parts of the interface, easing the attentional burden. In this context, we investigate how shifts in attention elicit unique eye gaze patterns that can be exploited as input metrics to a multi-agent network. Our models of gaze behavior built from data collected from the ICU will provide a dynamic representation of attentional limitations in complex environments. We will use this to extend current agent behavior to improve decision making and action in human-agent teaming (HAT). The efficacy of adjustments made will be tested behaviourally to evaluate the accuracy of our model. We ask: can agents be used to represent human attention, making use of gaze patterns to respond flexibly to the environment?

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Administrative Data

Please define an ID for your DMP.

108452

Which funder are you applying to?

US Air Force Office for Scientific Research

What is the title of your project?

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Briefly describe your project.

Humans are limited in their attentional capacity and thus sample parts of their environment sequentially over time (Carrasco, 2016). When humans 'fail to notice' it is because of suboptimal sampling. High information flow due to the number of displays, the rapid information change in displays and the dependence of information between displays challenges human attention limits (Matthews et al., 2004). At the same time, there have been many attempts over the years to build cognitive agents that give assistance to the human decision-making process, going back to the long-standing idea for interfaces that reduce overload (Maes, 1995). This proposal builds on an existing testbed to tackle the problem of how attention with its limited resources operates as a central part of a multi-agent system the Integrated Cognitive User (ICU) assistance system (Durant et al. 2021) under multitasking conditions. Agents in the testbed monitor on-line eye-tracking information using a teleo-reactive model of execution, e.g. (Nilson, 1994) and (Kowalski and Sadri, 2012), linking hierarchies of high-level agent goals to human interpretable behaviors, as opposed to low-level condition-action reactions that other agent models employ. Our objectives are as follows.

1. **To use data from the ICU eye movement based interactive agent system to characterize attention patterns under multitasking conditions and describe how these can be disrupted by highlighting and develop hypotheses on optimal attention patterns.** This will be achieved in the first phase by making use of previously collected, human-behavioral data, using the ICU system developed by this team, to characterize human-attention patterns under multi-tasking conditions. The postdoctoral researcher will work with Dr Durant to characterize occurrences of cognitive tunneling, misplaced salience, divided attention, and pre-response fixations to assess differences between low and high load and attention guidance to form results as part of an empirical journal article describing attention patterns under multi-tasking conditions and the effects of attention guidance, and also to use as input in Phase 2.

1. **To probe agent behavior in the minimal system above to develop hypotheses on optimal responses and describe how eye movements are reflected in agent behavior.** This will also be achieved in the first phase by analyzing recorded agent responses form previously collected data from the ICU system to categorize the effectiveness of agent responses and observe patterns that could be used to extend agent behavior and optimize the system, the output from this will be used as input in Phase 2.

1. **To use the above observations to incorporate more complex agent decision-making and multi-agent communication into the ICU system.** In the second phase we will study how to significantly extend the ICU system to contain the patterns observed from previous data as an instance of a more general system. This will involve the postdoctoral researcher working with Prof Stathis to revise the existing system to produce the updated ICU2. The design of this be to set ways of testing hypotheses of human attention with input from Dr Durant based on Phase 1, by incorporating them in ICU2.

2. **Test our hypotheses developed on multi-tasking attention and optimal agent responses in the updated ICU system and inform theories of real-time human-agent teaming.** In the third phase we will test human participants on the modified system. By evaluating the success of the modified system, we will be able to gauge whether we have successfully identified important patterns of attention and ways of using highlighting to affect them successfully. This will result in a further empirical journal article assessing the success of the changes made in terms of testing and how these confirm the hypotheses developed in Phase 1.

Who is the primary investigator on the project? Please also name any co-investigators on the project.

Szonya Durant (PI), Kostas Stathis (PI)

Who is the project data contact?

Szonya Durant
szonya.durant@rhul.ac.uk
01784 276522

Data Collection

What data will you collect or create?

Existing data from in the form of 120 text files containing eye tracking coordinates, keyboard and mouse responses and display outputs generated by the ICU software (https://dicelab-rhul.github.io/ICU/) will be analyzed along with data from a spreadsheet containing the time and date of experiment, ages, gender, self reported eye sight and subjective report of perceived difficulty of each task as well as notes with any issues.

This already collected data was collected for this purpose, has not been analysed yet and the participants consented to this use.

Further data from 50 new participants will be collected for this project. 200 text files will be generated using a newly created version of the ICU in similar format and a same overall spreadsheet. As before a randomly generated ID will be used across all data files in the naming.

These formats are chosen as easy to read by may different types of software and do not take up much storage space.

How will the data be collected or created?

The new experimental protocol will be piloted to ensure that data is collected as planned. The data will be collected using bespoke software and using a Tobii TX300 eye tracker and will be named according ppt ID that will be randomly generated. Quality of eye tracking will checked ensured through calibration and pre-processing checking for proportion of untracked samples. Final processed data will be peer reviewed.

Documentation and Metadata

What documentation and metadata will accompany the data?

The data will be made available on openscience framework (osf.io), which we will link to from any publication. Code for analysing the text files will be saved on github. Information including who created or contributed to the data, its title, date of creation and under what conditions it can be accessed will be available on osf.io.

Ethics and Legal Compliance

How will you manage any ethical issues?

The experimental protocol (including data storage plan and informed consent) will undergo review from the Royal Holloway University of London ethics committee. All data will be collected anonymously using a randomly allocated ID. There is no sensitive data collected.

Signed consent forms will be collected and stored securely, but these will no be linked to the data, instead participants are given a randomly generated ID so there is no chance of re-identification.

No personally indentifiable information will be available to anyone.

How will you manage copyright and Intellectual Property Rights (IPR) issues?

The code used to programme the ICU and data will be made publicly available under a GNU GENERAL PUBLIC LICENSE https://www.gnu.org/licenses

Storage and Backup

How will the data be stored and backed up during the research?

It will be stored on secure local computers, password protected hard drives and backed up daily on the secure storage offered by dropbox.com. There will be sufficient storage space. The research assistant on the project will be responsible for backup and recovery. Data up the last 24h will be able to be recovered from dopbox.com.

How will you manage access and security?

The data collected will be stored on password protected drives that only the research team will have access to. The U.S. Department of Defense personnel responsible for the protection of human subjects will have access to research records, including signed consent forms and the spreadsheet and text files described above.

Selection and Preservation

Which data should be retained, shared, and/or preserved?

All the original data collected will be stored indefinitely on a local hard drive and dropbox.com.

What is the long-term preservation plan for the dataset?

The data will be uploaded onto osf.io after preparing for sharing, which is costed for in the time of the PI. The original collected data will be stored for 5 years minimum.

Data Sharing

How will you share the data?

We will make the data available upon publication via the osf.io repository after it is prepared for sharing. Potential users will have a link to the data in the publication. The data will receive a DOI (Digital Object Identifier, is a string of numbers, letters and symbols used to uniquely identify an article or document, and to provide it with a permanent web address (URL)).

Are any restrictions on data sharing required?

No restrictions on data sharing will be required.

Responsibilities and Resources

Who will be responsible for data management?

The PIs are responsible or implementing the DMP, and ensuring it is reviewed and revised. The research assistant is responsible for collecting the data and daily back up. It is all on one site the PIs will make the data available archiving and for sharing and ensuring relevant policies will be respected.

What resources will you require to deliver your plan?

The PIs and research assistant will receive data management training and the hard drives and access to dropbox.com is provided through Royal Holloway, University of London.