Eye-tracking Programming in E-Prime 3 Software for Insight Problem Solving Validity and Reliability Testing

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May 14th 2019

Project Description

Old Dominion University's psychology department contains a specialty in creative cognitive psychology. In this concentration area, Dr. Ash studies creative cognition. Creativity in cognitive psychology is the focus of the creation of new ideas, for instance, solving a math problem or trivia answer.

In the study of creativity in cognition, there are two ways to go about a problem: incrementally and utilizing insight. Incremental problem solving is best seen in situations such as algebraic problems where prior knowledge, strategies and algorithms further help a person figure out a problem, and they can systematically work through it to find a solution.

Insightful problem solving might be related to responding to trivia or completing a Rubix cubes. In these cases, a person's prior knowledge is of little use, and (s)he cannot solve a problem by a series of logical steps. (S)He will most likely reach a period of *impasse*. A period of impasse can be characterized as the moment when a person is considering them self to be stuck and the solution seems unattainable. After the period of impasse, a person must restructure the problem space, which simply means they change the way they view the problem and how they are currently attempting to solve it. If a person restructures the problem correctly, a person will then be able to find a solution, which may include an Aha – moment. An Aha – moment is one in which a person feels high levels of suddenness, high levels of confidence in their answer, and low levels of effort in attaining the solution.

Identifying the process of restructuring in cognitive psychology has proven to be difficult for researchers. The way a person goes about a problem uses either incremental or insight problem solving, depending on the person and their experiences as well as the problem given to them. Researchers first need to identify if a solution is insightful or non-insightful to be able to study restructuring. To identify insight, researchers have come up with three main approaches; comparing Aha – moments in terms of self-ratings to compare scores (Aha! ratings), using a Think Aloud protocol in which people voice their thoughts as they solve a given problem, and examining eye fixation patterns through an eye-tracking system.

The current project will compare Aha! ratings, Think Aloud protocols, and Eye-tracking techniques for identifying solutions that use insight. The techniques will be examined in terms of validity and reliability, in hopes of contributing to a standardized technique for measuring impasse.

Few studies have used eye tracking as a measure of impasse, but studies that used this technique showed higher validity and reliability than the common technique for measuring impasse; Think Aloud protocol. Think Aloud protocols often do not have reliable results and have varying techniques in analyzing the data. Since difficulties in the current Think Aloud protocol include the inability to read minds and the lack of agreement among researchers in multiple experiments, the lab proposes this technique to be less likely to yield proper results than the Eye-tracking techniques. The research being done in this project will investigate how the techniques can become more valid and reliable, as well as a better understanding of the technique of Eye-tracking, which has not been explored in depth in the field.

Methodology

Measuring insight requires the presence of a problem. For this study, the researcher will be using Knoblich's matchstick problems (Knoblich, Ohisson, Haider, Rhenius, 1999). These are problems in which a specific construct is challenged in order to create an impasse for most people.

Such constructs consist of things such as changing a plus sign made out of matchsticks, to an equal sign (see Appendix A.1).

When looking at these problems, people will be tested with Aha! ratings in each of the three techniques (Eye-tracking, Think Aloud, and self-reported Aha! ratings). Self-reported Aha! ratings will be reported using three questions after every solution provided. The questions will ask how confident the person is on their answer, how much effort they feel was required for the answer, and how suddenly the answer came to them, each on a 5-point scale. The answers rated high in confidence and suddenness as well as low in effort will be considered insight problem solving.

Think Aloud protocol will gather Aha! ratings by using a coding system. This system will turn impasse into binary, meaning that if a person displays a period of silence, body language including fidgeting or exasperation, or repetition of the given question mindlessly, then the person will be considered to have experienced an impasse in their problem solving.

Eye-tracking will measure Aha! ratings by using the departmental software, E-Prime 3. E-Prime 3 is the most common programming platform for eye-tracking in experimental psychology and is the most current version of the available software. This eye-tracking software will measure fixations on the screen in terms of specified sections. Each section will be examined when looking for possible trends between the impasse and solution portion of the experiment. In order to use the eye-tracker, a researcher must program the entire experiment in E-Prime 3 and turn the data recorded from the eye-tracker into usable data, which can then be put into statistical programming software that will be used (in SPSS).

Over the summer of 2019, the researcher will be trained to operate E-Prime 3, program in E-Prime 3, and fully utilize eye-tracking hardware. After completing a literary analysis of eye-tracking in cognitive psychology for preparation of an honors thesis proposal, the researcher will finalize their research design for the comparison between insight testing techniques. They will then program research variables into E-Prime for data collection. Final steps for the summer experimentation will be pilot testing the data collection from the program built.

Outcomes

Anticipated outcomes will include a program that is ready for full use by the end of the summer and thorough understanding of eye tracking software. After the summer of 2019, a fully running program will be built for measuring insight problems and will record Aha! ratings through solution ratings in terms of time, documented through the eye-tracking hardware. This program will have been tested and will be available to run for the 2019 fall semester in the Psychology Department's SONA Research Participation System. The researcher will also complete the internal review board (IRB) application for testing with Human Subjects to ensure the ability to experiment in the 2019 fall semester. A final goal is for the researcher to have a completed draft of their Honors Thesis Proposal to the department by the beginning of fall 2019.

Budget

The proposed budget includes a direct stipend to the student that will cover the expenses of a laptop, with a cost of $1,800 and protective and adaptive equipment with a cost of $200. Proposed hours of work will include 20 hours a week, for 8 weeks, with compensation around $60/wk. This will mean a total proposed amount of compensation for work at $500. The remaining $500 will go towards the faculty mentor that will be transferred directly towards the department. This will be used to purchase needed lab materials and software.

A laptop is required so the researcher is able to continue to work off campus and during all hours the researcher is available regardless of the availability of the lab. The laptop will be used to transport documents, continue research outside of lab hours, and will give the researcher the ability to efficiently compare literature on eye-tracking software while simultaneously programming on the computer in the lab. The laptop will also allow for the researcher to take notes and compile information during lab meetings, organize information into electronic sharable folders, and enable a mobile learning environment.

Independence of the Project

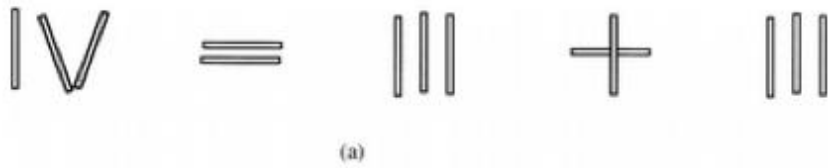
The researcher in this project will be the one to independently learn and program software. The faculty mentor will be providing guidance in general research protocol and procedures, but is not programming the proposed experiment. This project will be the beginning to an experiment that will hopefully be extended into the fall semester that will study and compare three different protocols to measure insight: Eye-tracking, Think Aloud, and self-reported Aha! ratings. The importance of the research in this study is to provide a solidified foundation that provides the researcher the ability to run participants and conduct a full experiment for an honors thesis in the fall. Rather than conducting research through a survey, this study is going to provide enough time to allow for an experiment comparing two techniques still commonly used in the field of cognitive psychology.

Citation

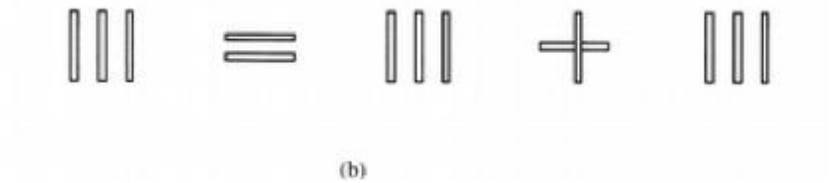
Knoblich, G., Ohlsson, S., Haider, H., & Rhenius, D. (1999). Constraint relaxation and chunk decomposition in insight problem solving. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 25*(6), 1534-1555. doi:10.1037/0278-7393.25.6.1534

Appendix

A.1



(a)



(b)