PsychExperiments: A Web-based Resource for Enhancing Science Training Through Simulation

Kenneth O. McGraw
University of Mississippi

PsychExperiments (http://psychexps.olemiss.edu) is an on-line psychology laboratory that offers interactive experiments, data collection, and data analysis. Like any laboratory, the site is an instructional resource; it does not offer instructions or lessons, just tools. That is, instructors can use it in their classes to add a laboratory component to their instruction, but it is not built as a stand-alone with tutorials.

The experiments at the site are of two types: research experiments and laboratory experiments. Research experiments are ones posted by individuals, including undergraduate students, who want to collect their own data using a project of their own design. Undergraduates who have used our site in this way were typically collecting data for a class or thesis project. We have assisted students in developing their projects in the form of experiments or surveys and then we have posted them at our site where they benefit from a secure, reliable server, a pre-configured database, and pre-existing generic scripts for writing and retrieving data from the database. Laboratory experiments are experiments that have been designed by us and other faculty to address questions that are of special interest in undergraduate psychology instruction. Table 1 gives a list of the laboratory experiments available Fall 2002 along with a brief description.

What's New and What's Not

Before providing a more extensive description of PsychExperiments, it is important to note that although the site is functionally and technologically novel, what it offers faculty and students is in many senses conventional. Long before PsychExperiments, psychology faculty provided students with resources for doing research. Laboratory courses, for example, are a near universal requirement for a psychology major. In these courses, students routinely complete one or more empirical investigations and report their results in a style acceptable for scientific communications. In addition to required laboratory courses, there are often opportunities for semester-long research in the form of capstone courses and undergraduate thesis programs. These research opportunities are often facilitated by pre-built software that presents stimulus materials on a computer screen and then records users responses. Students can select one of these tools and adapt it to the needs of their specific project. In one sense, therefore, PsychExperiments offers via the Web what was already offered locally. It offers pre-built software and a means of recording responses made to the stimuli the software presents. The most direct analog to PsychExperiments from conventional technology are the experiment packages that were sold for laboratory use by commercial vendors such as CONDUIT in the early 1980's. Current products include Psychology Software Tools (http://www.pstnet.com) package for PCs called MEL and Cedrus Corpopration's (http://www.cedrus.com) cross-platform product known as SuperLab LT. These packages offer stock programs that provide similar research opportunities to the experiments in Table 1.

What then is new in PsychExperiments? To begin answering the question requires identifying the holes in the traditional means for offering research opportunities to students. One is that local resources and time demands have restricted the opportunities actually offered undergraduates. That is, even where faculty believe passionately in the important role that would be played by having students perform research projects, they are not able to offer the experience, or do so to a lesser degree than they would like, because they are blocked by inadequate resources and/or time. These result in students' inability to address questions that might be meaningful to them and in data sets that are too small to answer questions definitively.

The Local Resource Constraint

Inadequate resources in the form of equipment and space characterize smaller, less well-funded schools. Such schools may have a class of 15-20 students prep all semester for a single semester-ending project on which all the students participate using equipment of their own manufacture. "Does ESP work?" might be the assigned question and the class builds up to the data collection that will lead to their answer by readings in research methodology and parapsychology. Other times, students are asked to work in small teams on a question of their choosing or in some cases, to work alone on a unique question. Laboratory package software might not be used because of the expense, which typically runs about $35 per student.

The Time Constraint

In addition to the limitations on equipment and space that prevent poorly funded schools from offering more extensive opportunities for their students to play the role of behavioral scientist, all schools experience the time constraint. The length of a semester or a quarter is the same at all schools, no matter their size or financial status. Laboratory courses, independent research classes, capstone classes, or other classes (e.g., honor's thesis) all must fit within the 10- to 15-week limit set by academic terms. This time constraint seriously limits the questions that can be addressed meaningfully with data, because collecting data typically takes time. When one adds to data collection the time required to prepare the apparatus or other materials to be used in the research, many research endeavors are simply not feasible. The small data sets that result when there is inadequate time is compounded at small schools where there are relatively few participants available for use in the research.

In light of these problems with the conventional approaches to providing opportunities for students to play the role of scientist, the value of PsychExperiments begins to emerge. Even small, underfunded schools have Internet-connected computers students can use. These can be anywhere and certainly do not have to be in a classroom. This means that offering a laboratory course or research experience is feasible without local resources, so long as one is willing to restrict the research questions to those that can be addressed with current Web technology. This means research is limited to questions that can be addressed using human subjects through the delivery of multi-media stimulus materials to elicit user interactions measurable via a mouse or keypress. Familiar applications are having users make ratings, enter text responses, or move objects and then having the software record the speed or accuracy of these activities.

The time problem that confronts all undergraduate researchers is not eliminated by PsychExperiments but it is greatly reduced. Traditional investigations require making measurements one subject at a time. This can be tedious work and it seldom adds anything substantial to the learning experience. Web-based experiments can be run on computers in parallel. Because data can be collected in parallel without the physical oversight of an experimenter, the data collection phase of an experiment can take just a day or two, depending on the recruitment method for participants. A number of the classes that use PsychExperiments are held in computer laboratories. Here, all the students in a class can participate in an experiment simultaneously, submit, and then download their data. This means that it is easy to have students participate in an experiment, then view and discuss their results as an in-class exercise.

The Small Research Pool Constraint

The speedy data collection that characterizes web-based experiments makes it possible to achieve datasets quickly, but when the available subject pool is small, the dataset will be too, despite the speedy collection. This observation points to a major advantage of web technology for research over conventional lab-based research—the subject pool is vast. One may argue over whether it is

representative and how to achieve representative samples via the web (O'Neil & Penrod, 2001; Reips, 2000), but there is no denying the size of the subject pool. In that access to Internet computers will only grow, one could say the subject pool is infinite. And unlike the relatively homogeneous subject pools on campuses, it is multi-lingual, multi-cultural, multi-aged, and pluralistic in every other way one can imagine. It even includes the special populations that are frequently of interest to psychologists. A University of Mississippi undergraduate was able to complete an honor's research project concerning the cognitive performance of Prader-Willli clients in a local retardation facility by having them participate via the Web in the Stroop experiment at PsychExperiments. Mike Marcell at the College of Charleston has published a paper on individuals with Down's syndrome using the same approach. . Since individuals from these special populations are often not concentrated in one geographical location, the Web offers an ideal method for reaching them.

Although the potential subject pool for any Web-based experiment is infinite, practical considerations of recruitment greatly restrict the number of people who will actually initiate and then complete a data session at a website. So the actual pool and potential pool are different. The actual pool consists just of those who visit the website and learn of the opportunity to participate or those who are recruited through traditional means by the researcher. At PsychExperiments the actual pool consists primarily of the students currently taking psychology classes from instructors who have signed up to use the site. These instructors can be contacted via a listserv to which they are automatically added when they enroll at the site. In this way, a student at Mississippi College in tiny Clinton, Mississippi, was able to get 138 volunteers for a research project just 2 weeks before she presented the results at a regional psychology convention.

In addition to having a large pool of subjects potentially available for any new project, the cumulative database at PsychExperiments offers access to the data of everyone who has ever participated in one of the experiments. For some of the more popular experiments, the database holds in excess of 4000 entries (see Table 2). These will only grow. Datasets of this size offer totally novel research opportunities. Among them are the possibilities of investigating phenomena that have small but reliable effects, effects that are represented in between subject differences (e.g., gender, cultural, or experiential effects), and effects that are found in multi-way interactions of variables. Another novel opportunity is the chance to work with datasets large enough to permit more complex statistical analysis than small datasets.

In conclusion to the question of what's new and what's not, PsychExperiments in part is just old wine in a new bottle. On the laboratory side, there are a number of experiments that can be conducted using pre-built software that interfaces with a database from which students can extract data. This much is old in that students at many campuses have had laboratory experiment packages to use since the early 1980's. Using these packages did depend on students or departments being able and willing to buy the software, and it depended too on having sufficient local resources to buy and house computers for students to use. These requirements excluded students at many small campuses. Nonetheless, if PsychExperiments' only innovation were web-delivery of free software, it would not be offering substantially new opportunities for students to have the experiences that best enable them to discover the distinction between science and non-science. The real innovations, therefore, come in the speed of data collection, which helps overcome the time constraint on undergraduate research projects, and in the size of datasets, which overcomes the problem of inadequate subject pools.

Table 1
Laboratory Experiments at PsychExperiments, Fall 2002

Experiment	Description	Developer
Covert Attention	A study of the effects of attentional priming on response time.	Ric Topolski, Augustana State University
Dichotic Listening	A study of hemispheric specialization that measures whether sounds heard in the right or left ear are identified most accurately	PyschExperiments Team
Facial Recognition	A study of false memory that has implications for the validity of eye-witness testimony	PyschExperiments Team
Implicit Association Test	Measures the subtle effects of racial stereotypes on speed of categorization	PyschExperiments Team
Infant Communication	Measures individual differences in the ability to classify infant cries into pain, hunger, and pleasure categories	Martha Arterberry, Gettysburg College
Learning and Memory	A study of a learning paradigm known as transverse patterning	Debra Titone, McClear Hospital & Harvard Medical School
Lexical Decision	A study of the "spreading activation" theory of memory	Dawn Blasko, Pennsylvania State University - Erie
Line Motion	A study to determine the time and speed parameters that determine when line motion will be misperceived as proceeding from an attentional focus rather than from the actual origin	PyschExperiments Team
Maze	Trial and error learning experiment	Shawna Regan, University of Alaska
Mental Rotation	Measures the effect of angle rotation and type of decision on the speed of the decision	PyschExperiments Team

Mirror Drawing	A motor learning task in which the effects of cursor movements are reversed to simulate the task of copying a figure while observing one's hand in a mirror	Zhe Chen, University of Mississippi
Mueller-Lyer	The effects of fin angle on the magnitude of a simple line illusion	PyschExperiments Team
Numerical Memory	Compares auditory and visual memory on digit-span task	Will Sharp, University of Mississippi
Object Location Memory	Compares males and females in their ability to recall the location of objects	Kathy Flannery, St. Anselm College
Perception of Gender	Determines participants' ability to use facial information to discriminate males and females	Bill Wilson, Gettysburg College
Phonemic Transformation	Shows that pure vowel sounds are perceived to have verbal forms that are stable over time	Magdalene Chalikia, Moorhead State University
Pitch Memory	Measures the accuracy of auditory memory of tones differing in pitch	PyschExperiments Team
Poggendorff	A study of the effects of line separation and length of line segments on the misperception of collinearity	PyschExperiments Team
Ponzo Illusion	Measures the magnitude of the Ponzo line illusions.	PyschExperiments Team
Reaction Time Color	Measures the reaction time to a visual stimulus	PyschExperiments Team
Reaction Time Sound	Measures the reaction time to an auditory stimulus	PyschExperiments Team
Self Reference	Compares memory for words that are evaluated using questions that elicit semantic or orthographic analysis	Gary Levin, Edinboro University

Social Balance	Permits the test of a strong theory of social balance theory, one that makes quantitative predictions about the degree of liking between to people in a triadic relationship where the degree of liking in two of the three diads are specified	Michael Birnbaum, California State University - Fullerton
Lateralized Stroop Experiment	Measures response time on a task that requires identifying the font color used in displays of color words (blue, red, green, yellow)	PyschExperiments Team
Word Recognition	Measures the ability to recognize words presented briefly in the right and left visual fields	PyschExperiments Team

Table 2
Number of Data Sessions Completed at PsychExperiments Since Fall 1999 by Experiment

Experiments	Spring 2002	Fall 2001	Spring 2001	Fall 2000	Spring 2000	Fall 1999	Totals
Covert Attention	389	390	328	172	71	25	**1375**
Dichotic Listening	111	103	168	70	7	0	**459**
Facial Recognition	68	97	103	123	176	123	**690**
Lateralized Stroop	413	329	371	650	305	158	**2226**
Learning and Memory	250	117	118	142	0	0	**627**
Lexical Decision	458	175	83	123	1	0	**867**
Line Motion	53	223	100	391	227	95	**1089**
Maze	177	129	152	170	2	0	**630**
Mental Rotation	682	583	713	518	555	458	**3509**
Mirror Drawing	449	95	41	0	0	0	**585**
Mueller-Lyer	224	106	171	296	317	110	**1224**
Numerical Memory	132	208	65	45	0	0	**450**
Object Location Memory	138	58	131	179	118	1	**625**
Perception of Gender	835	1200	1069	497	14	1	**3616**
Phonemic Transformation	40	38	0	0	0	0	**78**
Pitch Memory	133	55	32	48	48	7	**323**
Poggendorff	455	163	141	259	244	90	**1352**
Ponzo Illusion	360	193	235	84	66	0	**938**
Reaction Time Color	405	667	486	453	401	77	**2489**
Reaction Time Sound	26	70	17	136	175	7	**431**
Self Reference	886	1444	1039	356	302	266	**4293**
Word Recognition	350	307	209	435	120	391	**1812**
Totals	**7061**	**6750**	**5772**	**5147**	**3149**	**1809**	**29,688**