A Brief History of Web Experimenting

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Abstract

In recent years, a small, but growing number of researchers has begun to use the world wide web as a medium for experimental research. To learn more about the circumstances and results of the first web experiments, we conducted a WWW-based online survey directed to researchers currently engaged in web experimenting. We hoped to get an impression of the experiences of the pioneering generation of web researchers. We summarize the results of this survey which showed that an increasing number of web experiments with promising results is now being conducted, and give a brief overview on the short history of web experiments.

The History of Web Experiments

The introduction of computerized experimenting in the 1970s (e.g., Connes, 1972; Hoggatt, 1977)

revolutionized traditional laboratory research. Among the attractive new features were a

standardized and controlled presentation of stimuli, item-branching capabilities, immediacy of

data entry, elimination of missing responses, elimination of transcription costs and errors, and

accurate measurements of response times. Adaptivity, interactivity, and ease of data storage and

analysis were additional advantages of the new technology. It has also been argued that the use of

computers reduces the tendency to respond in a socially desirable way (Booth-Kewley, Edwards

& Rosenfeld, 1992; Martin & Nagao, 1989), and helps to avoid experimenter biases and demand

characteristics (Hewson, Laurent & Vogel, 1996; Reips, this volume; Smith & Leigh, 1997).

Clearly, the computerized administration of experiments and questionnaires offered possibilities

unavailable in traditional paper-and-pencil research. With hindsight, it is hardly surprising

therefore that the computer revolution in experimental psychology in the 1970s was an

overwhelming success.

Twenty years later, most human experimental research in psychology is aided by computer

automation. Extending computerized experimenting beyond single PCs, local computer networks

have been used for the collection of data (Hoffman & MacDonald, 1993). Programs are written in

high-level languages such as C++, Pascal or Delphi, or with program packages such as SuperLab,

PsyScope, MEL (Micro Experiment Laboratory) and ERTS (Experimental Run Time System).

Although computerized experiments have become the method of choice in conducting

psychological research, there are many signs that another revolution is now beginning. It is

associated with the recent exponential growth of the Internet.

The Internet's early purpose in the 1960s was to link a U.S. Defense Department network called the Advanced Research Projects Agency Network (ARPAnet) with a variety of other radio and satellite networks (Abbate, 1994; Hardy, 1995). In the 1980s, Ethernet local area networks were developed to allow computers at a single site to connect to a time-sharing computer site (Salus, 1995). These capabilities were extended to include access to the ARPAnet. The latest and most influential part of the Internet, a global hypertext system called the World Wide Web, was born in the early 1990s at the European Laboratory for Particle Physics (CERN). Within a few years it became clear that it might become the basis of the next generation of computerized experiments in psychology.

While the term "hypertext" was coined by Theodor Nelson in 1960, the concept of hypertext dates back to the work of Vanevar Bush (1945). Around 1980, Tim Berners-Lee wrote a notebook program based on the hypertext concept and called it "Enquire-Within-Upon-Everything". The program created links between arbitrary nodes which were given a title and a list of bidirectional typed links. While working at CERN, Berners-Lee proposed a hypertext project in 1989 that extended his program to a more global level. It was created under the pretense that many people would be able to work collaboratively by putting information on a web of hypertext documents. The documents would be put on servers and client software, called a browser, would allow one to access the information stored on the server. The software calls up the information by searching for a link's URL (Uniform Resource Locator). It then uses HTTP (the HyperText Transfer Protocol) to get the document which is coded in HTML (HyperText Markup Language). The world's first web browser ran on a NeXt computer at CERN in 1990.

In 1991, Marc Andreesen and a group of students at NCSA (the National Center for Supercomputing Applications located on the campus of the University of Illinois at Urbana Champaign) began work on what would be the first publicly available browser called Mosaic. Mosaic, released in 1993, was the first point-and-click graphical user interface for the World Wide Web. The ability to combine words, pictures, and sounds on Web pages excited many computer programmers who saw the potential for publishing information on the Internet in a way that can be as easy as using a word processor.

When the people that previously constructed Mosaic started developing the Netscape Navigator in 1994, they decided to implement several new HTML features, and the Navigator soon became the dominant tool for browsing the web. A little later, Microsoft came along and created another browser also based on HTML, the Internet Explorer. HTML - the Hypertext Markup Language - became the lingua franca for publishing on the World Wide Web.

The World Wide Web Consortium (W3C), the most prominent members of which are Netscape and Microsoft, works on and publishes proposed recommendations of new HTML specifications. To date, the W3C released three versions of HTML. The first one in 1995 was HTML 2.0, which was a simple language that attempted to gather the various previous implementations and concatenate them into a concrete specification. (Whatever existed earlier is collectively called HTML 1.0, although there never was such a specification). Then came HTML 3.2, which aimed to gather all the most popular features Netscape had introduced into a concrete specification. HTML 3.2 still is the most reliable specification to refer to for simple applications and allows for the creation of simple Web pages. W3C's latest HTML specification is version 4.0, which was released in December 1997. It is supported by the latest version of both Netscape

(Version 4.0) and Internet Explorer (Version 4.0). Today, starting a browser and going online gives the user access to millions of web servers and hundreds of millions HTML pages. Having gone through several stages of evolution, HTML 4.0 has a wide range of features reflecting the needs of a very diverse and international community wishing to make information available on the Web. Among the most important of these features are forms.

Forms (or "fill-out forms") were first introduced in HTML 2.0. They are interactive, unlike the typical static web page, and they changed things in an important way. For the first time, the reader of a web document could communicate back to the server. Forms in HTML are the computer equivalant of paper forms, such as an application form. There is a button or link at the end of every WWW form, often labled "Submit". When this button is pushed, two things are sent to the server: the data that were typed into the form, and an ACTION, which basically tells the server the name of the program that knows how to process that form's data. The server simply invokes that program and passes the form's data to it (using CGI, the Common Gateway Interface), and arranges for the output of that program to be sent back to the browser (ordinarily another document that contains some form of feedback).

Common uses of forms are surveys, on-line order forms, or really any web page in which input is required from the user in order to accomplish a given task or provide a service to the user. Of course, for a psychologist, sending participant's experimental or questionnaire data back to the experimenter is the most interesting application of forms. Drawing on forms, the WWW first offered the possibility to conduct psychological surveys and experiments independent of any geographical constraints.

HTML was soon supplemented by Javascript, a compact, cross-platform, object-based scripting language that was first supported in version 2.0 of the Netscape Navigator and was also adopted by Microsoft in version 3.0 of its Internet Explorer (Flanagan, 1998). JavaScript code is embedded directly into the HTML page and can be used to create interactive web pages. The browser interprets the JavaScript statements embedded in an HTML page and executes them. JavaScript statements can respond to user events such as mouse-clicks, form input, and page navigation. For example, JavaScript functions can be used to verify that users enter valid information into a form requesting a fixed number format. Without any network transmission, the HTML page with embedded JavaScript can check the entered data and alert the user with a dialog box if the input is invalid.

Another important technology became available in 1995, when James Gosling and a team of programmers at Sun Microsystems released an Internet programming language, called Java. It again radically altered the way applications and information can be retrieved, displayed, and used over the Internet. Client-side Java applets are small programs that are transmitted over the web and run on the user's machine, offering a large variety of possibilities for sophisticated experiments. Java was first built into version 3.0 of the Navigator and version 3.0 of the Explorer. Owing to these technological developments and its exponential growth during the past few years, the World Wide Web presents researchers with an unprecedented opportunity to conduct experiments with participants from all over the world rather than with the usual student sample from their local universities. It thus has the potential to serve as an alternative or supplemental source of subjects and research environment for traditional psychological investigations (Buchanan & Smith, 1999; Reips, 1996a, 1996b, 1997b; Smith & Leigh, 1997). Using the Internet

to conduct research offers several advantages over traditional research practices (see Hewson et al., 1996, and Reips, 1995b, 1996a, 1996b, 1997b, this volume, for a summary). In a sense, using world-wide networks such as the Internet for experimental research therefore is the logical next step in what began with the first experiments on stand-alone computers (cf. Buchanan & Smith, 1999).

However, the use of the WWW as a medium for experimental research also poses a unique set of challenges (Reips, 1999a). To learn more about the circumstances and results of the recently growing number of web experiments, we conducted two online surveys directed to researchers currently engaged in web experimenting. We thus hoped to get an impression of the experiences of the pioneering generation of web researchers. In the present chapter we summarize the results of this survey and make an attempt to write the early history of web experiments.

As in writing a general history of the Internet (e.g., Musch, 1997), the frequency and ease by which WWW documents are changed, combined with the lack of an effort to comprehensively collect those documents during the first years of the WWW, make it a difficult task to determine what really happened when. This difficulty is even reflected in recommendations for references to online documents (e.g., Ott, Krüger & Funke, 1997), which advise to add the lookup date to the reference. On the other hand, the WWW is still very young, the number of web experiments is rather small, and so people's memory (including our own) should be still fresh.

In the fall of 1994, when one of us began planning what later became the *Web's Experimental Psychology Lab* (Reips, 1995a), an Internet scan for web experiments produced no results. However, before the Web's Experimental Psychology Lab went online with its first two

experiments in September 1995 there were already a few experiments online, as we later

discovered. Obviously, the time for web experimenting had come.

As it seems, the very first web experiments were Norma Welch's (1995) experiments on auditory

perception, which were simultaneously run at McGill University, Montreal, Canada and

Technical University, Darmstadt, Germany (Welch & Krantz, 1996). However, as Krantz and

Dalal (this volume) put it, these experiments "could not be really called studies carried out over

the web" as they were attached to tutorials in auditory perception. In May 1995, Andreas

Weigend and a class he taught at Colorado University put up three web experiments on music

recognition (Weigend, 1995). Unfortunately, the code of these web experiments was lost when

Weigend left Colorado University (A. Weigend, personal communication, November 6, 1998),

and we were not able to determine whether these studies were really experiments in the sense

that some variable was manipulated (as contrasted with an online questionnaire). A little later

John Krantz and colleagues started their web experiment on the determinants of female

attractiveness (Krantz, Ballard, & Scher, 1997). This might well have been the first true web

experiment that went online. It appears to be the first psychology web experiment that was

published in a scientific journal.

While Krantz, Ballard and Scher used a within-subjects design the first web experiment with a

between-subjects design appears to be the web experiment on cognitive consistency of causal

mechanisms (Reips, 1996a, 1996b, 1997b), with which the first virtual experimental psychology

laboratory (Reips, 1995a) opened its doors. Between-subject designs require random assignment

of participants to experimental conditions, which can be realized in web experiments through the

use of CGIs (Kieley, 1996, Reips, 1996b, 1997b, 1999a), Javascript or Java. Today, the Web's

Experimental Psychology Lab at Tübingen (Reips, 1995a), which is now at Zurich, is still a place

for methodological discussions on web experimenting and actively invites participation of

experiments from other researchers which can be hosted by the lab.

Since 1995, the following sites (with their opening dates) have gone online:

- Interactive CyberLab for Decision-Making Research (http://www.etl.go.jp/~e6930) [April, 1996];

- Laboratory of Social Psychology Jena (http://www.uni-jena.de/~ssw/labor.htm) [June, 1996];

- Experimental Server Trier (http://cogpsy.uni-trier.de:8000/TEServ-e.html) [June, 1997];

- Max-Planck Institute for Biological Cybernetics Tübingen (http://exp.kyb.tuebingen.mpg.de/web-experiment/index.html) [November, 1997];

- Online Psychology Lab Padua (http://www.psy.unipd.it/personal/laboratorio/surprise/htmltesi/index.html) [May, 1997];

- Decision Research Center (http://psych.fullerton.edu/mbirnbaum/dec.htm) [started online experiments in March, 1998];

- Psycholinguist Laboratory Scotland (http://surf.to/experiments) [September, 1998];

- PsychExps (http://www.olemiss.edu/PsychExps/) [Fall 1998; invites participation of web experiments from other researchers];

- Systems Analysis Lab at Helsinki University (http://www.hut.fi/Units/SAL);

- Jonathan Baron's questionnaires (http://www.psych.upenn.edu/~baron/qs.html).

Some additional WWW laboratories engage in teaching or demonstration of experiments, for

example the excellently designed Internet Psychology Lab (http://kahuna.psych.uiuc.edu/ipl/),

which went online in April, 1998. However, all of the laboratories in the list above are mainly used for experimental data collection. In addition to the above list of web laboratories and sites where web experiments are being conducted, a growing number of other sites has gone online to offer participation in psychological experiments.

The most comprehensive list of web experiments on the WWW can be found on the Psychological Research on the Net page (American Psychological Society, 1995), which was created and is maintained by John Krantz. John Krantz and many (probably more than half) of the other currently active web experimenters generously agreed to participate in our survey on the experiences of the first generation of web researchers.

Method

All respondents were recruited via the Internet. To promote its existence, we announced the web experimenter survey to the following mailing lists:

- PSYCGRAD (Psychology Graduate Student Internet Project)
- RESEARCH (Psychology of the Internet: Research and Theory)
- GIR-L (German Internet Research List)
- SCiP (Society for Computers in Psychology)

Additional invitations to participate were posted to the following Usenet newsgroups:

- sci.psychology.research
- sci.psychology.announce
- sci.psychology.misc
- alt.usenet.surveys

- bit.listserv.psycgrad

- de.alt.umfragen

- de.sci.psychologie

- de.sci.misc

- z-netz.wissenschaft.psychologie

Personal invitations were sent via e-mail to all researchers who announced a web experiment at one of the following places:

- the *Psychological Research on the Net* page of the American Psychological Society, maintained

  by John Krantz

http://psych.hanover.edu/APS/exponnet.html

- the list of *Online Social Psychology Studies* by Scott Plous

http://www.wesleyan.edu/spn/expts.htm

- Ulf-Dietrich Reips' *Web Experimental Psychology Lab* in Zürich and Tübingen

http://www.psych.unizh.ch/genpsy/Ulf/Lab/WebExpPsyLab.html

- the Psychology/Tests-and-Experiments pages at Yahoo International

http://www.yahoo.com/Social_Science/Psychology/Disciplines/Personality/Online_Tests/

- the Psychology/Tests-and-Experiments pages at Yahoo Germany

http://www.yahoo.de/Geisteswissenschaften/Psychologie/Online_Tests_und_Versuche/

Finally, we sent a call for participation to a number of researchers that we knew had conducted or planned to conduct a web experiment.

In a first wave of the survey, we received 21 submissions from web experimenters between October 17 and October 30, 1998. Additional submissions came from researchers who had conducted surveys. Conducting surveys on the web is a promising new way of online research (cf. Batinic, 1997; Batinic, Gräf, Werner, & Bandilla, 1999). However, because we were interested in web experiments rather than surveys, we did not include them in the analysis. The criterion used for classifying submissions as describing experiments was that at least one independent variable was manipulated.

In this first wave of the survey, we told the respondents that if they conducted more than one web experiment, they should answer all questions with regard to their first web experiment. A second wave was online from April 16 - April 28, 1999. In this second wave, we asked participants who had already participated in the first wave to answer some questions with respect to the last web experiment they had conducted. First time participants were asked to describe the first experiment they had conducted. The number of questions was reduced for the second wave of the survey which was announced to the same mailing lists and to the same newsgroups to which the first wave had been announced. In addition, it was announced to SJDM, the mailing list of the Society for Judgment and Decision making. There were 14 submissions from researchers who conducted a web experiment in the second wave of the survey. Additional submissions from researchers who conducted are survey rather than an experiment were not included into the analysis. Thus, the final sample consisted of 35 submissions from 29 different researchers currently engaged in web experimenting. The regional distribution of the 29 researchers was as follows: Germany (8), United States (7), United Kingdom (6), Canada (1), Austria (1), Switzerland (1), Australia (1), Soviet Union (1), Finland (1), New Zealand (1),

Unknown (1). After the data were collected and analyzed, all respondents were provided with a summary of the results. An additional WWW scan and notes from the Web Experimental Psychology Lab's archives (Reips, 1995a) showed that at least eight more people have conducted web experiments, but did not respond to either wave of our survey.

Procedure

The survey consisted of three WWW pages and was written in HTML, the computer programming language most often used to display pages on the WWW. On the first page survey participants were greeted and informed about the rationale for conducting the survey. Also, participants were told that only online data collection was considered a *web experiment* that met the definition of "any undertaking in which some variable is manipulated; thus, in contrast with a survey, at least two conditions must be involved in an experiment". Then, participants were asked to indicate the number of web experiments they had conducted, and to provide us with their e-mail address for feedback and possibly additional questions. Most researchers had conducted one (N=15) or two (N=6) web experiments at the time of the survey. Eight experimenters already had conducted a higher number of studies (ranging from 3 to 20 experiments).

Submission of the first page of the survey sent the form data (i.e. the data that were filled in by the respondent) to a server-side plugin (Mailagent 1.1, Netdrams Software, 1998), which wrote the data to a tab-delimited file. Also, it triggered the display of the second survey page in the respondent's web browser window. This second page contained almost all of the questions asked.

A variety of WWW specific answering formats was used. For example, to answer the question on announcement media respondents had to use their mouse arrow to click on *checkboxes*. Checkboxes allow for multiple non-exclusive selections. To limit responses to one out of several possible answers both possibilities offered by HTML were used: a question about the area of research, for example, was presented as a *pop-up menu*, while a question about the use of counterbalancing had to be answered by clicking on *radio buttons*. Such electronic answering formats, which allow for only one answer have been shown to reduce the frequency of response errors (Kiesler & Sproull, 1986). Certain answers, especially open-ended questions such as the question on the experimental factors used, required *text fields*. Text fields can be limited to a maximum number of characters. When a survey respondent sent off the second page by clicking on its submit button again the data were sent to the web server (WebSTAR by StarNine Technologies) and processed by the Mailagent plugin. In addition to writing the data to a file the plugin sent an e-mail to the respondent and the experimenters to report the processing of the data.

Results

When did you start the experiment? When did you end the experiment?

John Krantz and colleagues from Hanover College started their first web experiment in April 1995. We are not aware of any psychology web experiment with at least two conditions (i.e., two levels of an independent variable) that appeared on the WWW before this date. The number of web experiments has been constantly rising since, with the majority of web studies starting during 1997 and 1998.

In the first wave of our survey, we told the respondents that if they conducted more than one web experiment, they should answer the following questions for their first web experiment for which they had reported the starting date.

How important were the following factors for your decision to conduct the web experiment?(1 - not important at all, 7 - very important)

	Mean	SD	*N*
large number of participants	5.5	1.9	20
high statistical power	4.5	2.2	20
high speed	3.6	2.4	20
reach participants from other countries	3.6	2.2	20
high external/ecological validity	3.4	2.1	20
low cost	3.2	2.2	21
replicate a lab experiment with more power	2.9	2.5	20
chance to better reach a special subpopulation on the web	2.6	2.5	20

(e.g., handicapped, rape victims, chess players)

The factor that experimenters rated as most important was reaching a large number of participants. The high statistical power associated with a large sample size, the high speed with which web experimenting is possible, and the chance to reach participants from other countries were also considered important by most of the respondents.

How problematic do you think were the following potential problems in your web experiment? (1 - not problematic at all, 7 - very problematic)

	Mean	SD	*N*
no control of participant's behavior during participation	3.6	2.0	21
no control of participant's motivation	3.4	1.7	21
participants cannot ask questions	3.3	1.7	21
no control of participant's hardware and equipment	2.9	2.1	21
non-representative samples	2.8	1.8	21
manipulation and fraud	2.4	1.4	21
ethical problems	1.5	1.0	21

The biggest concern of the web experimenters participating in the first wave of our survey was the lack of control of participant's behavior during participation. However, a numeric value of 3.6 translates to not more than an assessment of this lack of control as "somewhat problematic". Ethical problems were not considered a problem by most web experimenters.Obviously, it is important to note that all these ratings came from researchers who themselves are conducting web experiments, and the results may well have been different if another sample of researchers had been asked.

In which media did you announce your experiment?

Naturally, the WWW was used most often to promote web experiments (22 out of 35 experiments were promoted on the web). Many researchers also relied on newsgroups (18), e-mails (15), and search engines (14) to advertise their experiment. Few experiments were also announced in print media (2) and radio programs (1).

How many design factors did you include in your experiment? For each of these factors, please specify the number of levels on which it was varied.

The mean number of factors participants of the first wave of the survey indicated they had manipulated was 2.1 (with a median and a mode of 2.0). There were six experiments in which as many as three or more factors were varied. The following designs were reported in the first wave of the survey:

levels per factor	N
5 x 5 x 2 x n	1
5 x 5 x 4	1
5 x 3 x 2	1
3 x 3 x n	2
3 x 2 x 2	1
5 x 2	2
3 x 3	1
3 x 2	1
2 x 2	5
n x 2	1
3	1
2	4
not specified	1

60% of the designs involved between subjects factor manipulations, another 20% of the designs involved within subjects factor manipulations, and 20% of the designs involved both kinds of experimental manipulation.

In what area of research did you conduct the experiment?

To aid the respondents' decision, we offered a list of 54 subject areas used for classifying poster contributions to the 10th Annual Convention of the American Psychological Society (1998).

Just as one would expect from a theoretical perspective (Reips, 1997b), the web experimental method obviously seems best suited for cognitively oriented areas of research (see, for example, Klauer, Musch & Naumer, 1999). The areas in which most experiments were conducted are Cognition (4), Thinking and Reasoning (3), Psycholinguistics (2), Sensation/Perception (1), Memory (1), Judgment/Decision Making (1), Attention/Performance (1), Personality (1), Social / Groups (1), Social / Cognition (1), Social / Attitudes (1), and Computers in Psychology (1).

What was the main hypothesis? What were other hypotheses? Please name the factors you varied, and their levels.

The following selective list gives an impression of the theories and hypotheses that were tested in web experiments, and the independent variables that were manipulated. Hypotheses that are difficult to understand without sufficient knowledge of the subject domain, or that were not explained by the survey respondents are not included in the list.

- Judges violate stochastic dominance in coalesced gambles, but satisfy stochastic dominance when gambles are presented in split form (high versus low variance of gambles; .01, .50, .99 probability to win higher price; value of prizes; combined versus split consequences of gamble; stochastic dominance between gambles). Lower degree of violation among people with more training and education in judgment and decision-making

- Comparison of Bayes Theorem, Subjective Bayesian Model, and Averaging Model of Inference. Participants use the base rate in the taxi cab problem contrary to the idea of base rate fallacy (base rate, witness credibility, witness report)

- Persons relying on schema-based interpretation of incoming text information are less likely to have accurate recall than aschematic readers (schematic versus aschematic text, temporal delay between reading and recall)

- Pronominal case-ambiguous objects elicit a preference towards accusative case assignment, whereas non-pronominal, case-ambiguous objects elicit no preference (object noun phrase type: ambiguous non-pronominal, ambiguous pronominal, unambiguous pronominal; object case: accusative, dative)

- Answers to questions in online surveys are potentially subject to biases, depending on the number of questions per page (one, two), scale type (pop-up, radio buttons), reading directionality (from left/top, from right/bottom), cursor entry position (top, bottom), question order (donation question first, expense question first), and numerical labeling (-5 to +5, 0 to 10)

- Experts use their specific and their general knowledge for data evaluation (expertise: high versus low; data are in accordance with versus contradict expert knowledge)

- Subjects perceive feminine male and female faces as more attractive (masculinity of male face: more feminine to more masculine)

- Background color influences response to emotionally-laden statements (different shades of background color, print color white versus red)

- Web questionnaires produce response effects that are similar to paper and pencil questionnaire response effects (questionnaire length: short, long)

- People with low context constraint encode individual words deeper (context constraint: low, high)

- Syllogisms with believable conclusions are accepted more often than unbelievable ones, irrespective of their validity („belief bias"). The suggested base rate of valid conclusions influences the willingness to accept a given conclusion if the participant cannot determine its validity (suggested base rate of valid conclusions: low, medium, high; validity of conclusion: valid, invalid; believability of conclusion: believable, unbelievable)

- What kind of errors are being made when reconstructing 2D information from a 3D model? (object colors, object shape, map orientation)

- Is syntactic priming (in German verb-final constructions) sensitive to subcategorization information, or linear precedence, or both? What is the baseline proportion of ditransitive vs. simple transitive responses, given different target types? (prime type: accusative < dative, dative < accusative, accusative, dative, control; target type: accusative object, dative object)

- Previously acquired knowledge about causal mechanisms influences later acquisition and use of causal knowledge involving those mechanisms (acquired type of causal mechanism: consistent, inconsistent, none)

- Syntactic primes affect completions of targets; possible interaction with case, especially dative (prime type: neutral, ditransitive-accusative-dative, ditransitive-dative-accusative, transitive-accusative, transitive-dativ; target type: accusative, dative)

- Participants recruited from newsgroups likely to be read by High Self-Monitors score higher on a WWW mediated version of the Self-Monitoring Scale than participants recruited through newsgroups likely to be read by Low Self-Monitors (likely self-monitoring: low, high)

- Does bimodal presentation (hearing, seeing) of objects increase memory performance? Does contradictory bimodal presentation decrease memory performance? (Acoustic naming of pictures showed: no acoustic, true naming, wrong naming)

- Content of sites visited before answering a survey systematically influences answer behavior; time of watching instructions influences strength of context effects (content of simulated WWW site: pictured or not; social desirability via instruction: high, low).

- Important computer-specific concepts are explained in more detail if addressee is a beginner (concept importance: important, less important; adressees knowledge level: beginner, advanced)

Did you assign participants to the experimental conditions randomly? If yes, what did you use to obtain random assignment?

Of the 34 experimenters who answered this question, 29 assigned participants to the experimental conditions in a random order. (Four of the remaining experiments varied conditions within subjects, and one study was a quasi-experiment). The techniques that were used most often to obtain random assignment were CGI, Java, and Javascript. Few respondents indicated they used yet another (unspecified) technique to obtain random assignment. (Birth month, birthday, social security number, etc. are alternative criteria that can be used to obtain random assignment, for

example by offering different hyperlinks to participants born in odd vs. even months of the year; cf. Birnbaum, in press-a, in press-b).

Did you apply counterbalancing of any sort?

Although the use of a counterbalancing is certainly an important aspect of internal control in many experimental designs, only a little more than half of the experiments (20 out of 35) applied counterbalancing of some kind. This may in part be attributable to the technical and programming difficulties associated with the use of counterbalancing. Five of the fourteen experiments that did not make use of counterbalancing measures were one-factor experiments, however, which may have been simple enough not to require this technique.

What did you do to guard against multiple submissions?

Entry errors, the intent to foil the experiment, and curiosity are just some of the possible reasons respondents may have for submitting their answers more than once. Because all WWW browsers have a "back button" built in, it is not easy to prevent users from reexamining their Web form page and submitting it again, possibly after altering their data (Schmidt, 1997; cf. Schmidt, this volume). However, several techniques exist that can be used to deal with the problem (Buchanan & Smith, 1999; Reips, 1996b, 1997b, 1999a; Schmidt, 1997; Smith & Leigh, 1997). Most of them try to uniquely identify each participant, and to filter out all suspicious submissions. This can be done by examining a variety of aspects of the data provided by the participants. We wanted to know what data web experimenters used to tackle the problem of multiple submissions.

In many of the 35 experiments, researchers relied on checking the e-mail (24) and IP addresses (18). Both variables help to uniquely identify the participants. However, e-mail addresses can be faked, repeated participation may take place from a different computer address, and proxy

servers can make the submissions of different users falsely appear to have been sent from one and the same person. Perhaps because of these problems, passwords were used in addition to control of e-mail and IP addresses in three experiments. In two experiments, no special precautionary measures against multiple submissions were taken.

Several researchers also used the following procedures to secure data integrity:

- Cookies (3)

- Date/Time (2)

- Bank account (2)

- Asking not to participate more than once (2)

- Asking for seriousness of submit (1)

- Check for identical records arriving in close temporal interval (1)

One researcher told us that he felt any attempts to cheat by multiple submissions would have been very unattractive regarding the low reward participants received in his experiment.

On what technical HTML level was your web experiment programmed?

Advanced HTML levels offer a number of sophisticated layout features such as tables, frames, and style sheets. However, the lower the HTML level used, the wider the population of potential respondents will be. This is because not all users have installed the latest version of their web browser, and older versions do not support the latest HTML features.

Only three researchers made use of features of the latest HTML 4 version. The vast majority of researchers preferred a conservative approach and restricted themselves to the more established HTML versions 2 and 3.

Which of the following techniques / programming languages / tools did you use?

A large variety of techniques and programming languages is being used to implement web experiments. CGI was used by 19 respondents; other popular tools that were named are Perl (13), Javascript (11), Java client-side (10), Java server-side (7), and Cookies (4). A few experiments were also conducted using VRML (2), C/C++ (2), DHTML (1), XML (1), and ActiveX (1).

What operating system was your Web server running on?

In order to conduct a web experiment, one requires access to a WWW server (Kieley, 1996). This can be practically any machine connected to the Internet: an account on a multi-user UNIX system or a networked PC or Macintosh is all the hardware that is required (Reips, 1996b, 1997b; Schmidt, Hoffmann, & MacDonald, 1997). Because the software available for implementing web experiments largely depends on the type of operating system that is installed on the WWW server, we asked participants of the first wave of the survey which operating systems they used. Answers indicated a clear preference for Unix and Unix derivatives such as Solaris, Linux etc., followed in this order by MacOS and Windows 95/98/NT.

In which language(s) did you offer your experiment?

There were 17 experiments that were offered in English and 10 experiments that were offered in German. Offering experiments in parallel versions for different languages reliably increases the number of participants and allows for cross-cultural comparisons. This possibility was used by seven researchers.

What was the total number of participants included for final data analysis (after deletion of multiple submissions etc.)?

Respondents indicated the final sample size for 26 of the 27 experiments that were already

finished at the time of the survey. The mean number of participants in these experiments was

427, with a standard deviation of 650. The median number of participants was 158. The smallest

number of participants was 13 and the largest was 2649.

Can you tell (in %) how many of those who looked at the very first access page to your

experiment decided to start the experiment?

Several experiments recorded how many of the visitors of the first access page proceeded to start

the experiment. However, it is important to note that the definitions of "the first access page" to

a web experiment may vary quite extensively, as indicated by the responses. This first access

page could be the main page of an online laboratory, an informed consent page, the first

instructions page, or the last page of a "warm-up phase" (a technique used to reduce drop out

during web experiments, see Reips, 1996b, 1997b, 1999a). On average, 68% (median: 80%) of all

visitors of the very first access page proceeded to start the experiment ($N = 10$). The minimum

click-through rate was 7%, the maximum was 100%. The chance to obtain this information is a

unique advantage of web experiments if one considers the number of visitors of the first access

page of a web experiment as equivalent to the number of people who consider or are asked to

take part in a standard laboratory experiment. In the case of a laboratory experiment, the

researcher usually does not know how many students decide *not* to sign up for an experiment (or

would have decided to do so if given the right to choose among studies).

Can you tell (in %) how many of those who started the experiment by looking at the first page

after the instructions page did complete it?

On average, 66% (median: 65%) of the participants who started an experiment did also complete it ($N = 20$). The respective figures ranged from 13% to 99%. In 15 experiments, the drop-out rate was not (yet) determined; four of these experiments were still running at the time of the survey.

Did your participants have to download a plugin or an applet first to be able to participate?

The only plugins used were VRML (Virtual Reality Modeling Language), offering the opportunity to display three-dimensional objects, and Macromedia Flash. With these two exceptions, all participating researchers indicated that their experiments did not require the (somewhat time-consuming and troublesome) download of a plugin. [Note, however, that the PsychExps group (McGraw, Tew & Williams, this volume) at the University of Mississippi uses the Shockwave plugin to deliver its experiments; http://www.olemiss.edu/PsychExps/]. Eight experiments required the download of an applet prior to participation.

Did you ever have a problem with a hacker trying to intrude your experiment? If yes, please give a description of what happened.

On the WWW, nothing prevents anybody from downloading and examining the HTML source code of web experiments. Hackers can attempt to foil the experimental results, and they may even try to gain control over the web server (Schmidt, 1997). One possibility to do so is to send manipulative data to the CGI program for processing.[1] We wanted to know whether web experimenters had faced such problems.

No respondent indicated to have observed a hacker attack. Of course, this does not mean that there were no such attacks. Although one may assume that successful attempts to damage the

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[1] To prevent this, experimenters can set up their CGI program to restrict acceptance to data from only certain referers.

experiment would have been noticed, the possibility that a hidden hacker went undetected cannot be excluded.

Which demographic questions did you ask your participants?

To know which denizens of the web chose to participate in their on-line experiments, investigators have asked a variety of demographic questions. The variables web experimenters gathered most often from their participants were age (32 out of 35), sex (32), occupation (16), language (11), nationality (9), insider knowledge concerning the field of research (7), and education (6).

Several researchers asked respondents to provide additional data regarding

- their handedness (3)

- their marital status (2)

- their dialect (2)

- their circumstances of housing, job

- their religion

- their socio-economic status

- their status as student or non-student

- their college major

- their class (for credit assignment)

- their name

- the web-browser they used

- the size and color (yes/no) of their monitor display

- the speed of their internet connection

Did you provide the participants with the possibility to contact you via e-mail?

The vast majority of researchers (94 %) offered an e-mail link, thus allowing participants to ask

questions, to make comments, and to point out errors. The chance to obtain this kind of feedback

is a notable advantage of web experiments (Welch & Krantz, 1996).

Did your experimental material contain any graphics or sounds?

Advanced facilities for viewing graphics are available in the HTML language and 16 out of 35

experiments contained graphics in some form.

A modality less frequently used than graphics in a typical experiment is sound. Only two

experiments were based on acoustical stimuli. This might well be the result of the technical diffi-

culties associated with the large differences in the hardware and software used to interpret and

play sound files, and in the audio formats they can handle (cf. Welch & Krantz, 1996).

Did you measure any reaction times (below 1 sec)?

In spite of the technical difficulties associated with reaction time measurement on the World-

Wide Web, eight experiments made use of such measurements. This surprisingly high number

might be due to the fact that many web servers automatically log access time in fractions of a

second.

Did you measure any time intervals (above 1 sec)?

The measurement of time intervals provides valuable information about the participant's behavior

during the experiment, and 14 out of the 34 experiments recorded time intervals.

Monetary rewards can be expected to increase both the motivation and the number of

participants.

Did you offer a monetary reward to each participant?

Three out of 34 experiments offered a monetary reward to each participant. In these experiments, the amount every respondent received was $ 15.- (on average), $ 13.-, and DM 10.- (approximately $6.-).

Did you offer monetary or other prizes in a lottery? If yes, what was the total amount of money (the value of your prizes) in $?

Ten experiments offered a lottery. The total value of the prizes was $1224, $750, $500, $192, $150, $100, $100, $100, $85, and $11, respectively. One experiment offered a 1% chance to actually play (with real money) one of the attractive gambles that were part of the experiment. To investigate whether financial incentives have a beneficial effect, we conducted some additional analyses. We found that if some kind of monetary compensation (individual payments or lottery prizes) was offered, the percentage of participants who completed the experiment was significantly higher (86%, $N = 13$) than if no rewards were at stake (55%, $N = 7$; $t = 2.61$, $df = 18$, $p < .05$). Although the sample sizes are very small, this observation might indicate that financial incentives can help to reduce the number of drop-outs. There was a similar (though nonsignificant) trend for a higher number of participants per week when a financial incentive was offered (49 versus 37 participants per week).

On average, how much time did it take to participate in your experiment (minutes)?

The average duration of the experiments was 22 minutes ($N = 33$), with a median of 15 minutes. The minimum duration that was reported was 5 minutes, the maximum was 90 minutes.

Did you inform your participants in advance about the duration of the experiment?

The 29 experiments which informed potential participants in advance about how much time they would need to complete it attracted a higher number of participants (mean $N = 496$) than the five experiments that did not provide this information (mean $N = 230$). However, because of the small sample sizes and the large variance in participation rates, this difference was not significant.

Did you offer an individual feedback to each participant?

Web experiments, as other computer-based forms of experimenting, offer the opportunity to provide dynamic and interactive forms of feedback to the participants (Schmidt, 1997). This feedback can be specifically tailored to the responses given, and it can provide summary statistics about the results of other respondents. It is thus possible to give respondents interesting pieces of information in return for their efforts, probably a powerful motivation to participate in an experiment. Schmidt (1997) conjectured that if respondents know that the feedback they receive is about themselves, and based on the data they provide, they are likely to supply accurate and thoughtful responses. However, apparently because much effort is needed to implement an individualized feedback, only 9 out of 34 experiments included this feature. Of these 9 experiments, six provided feedback immediately after participation, and three provided feedback with some temporal delay.

Did you offer feedback concerning the goals and hypotheses of the experiment to the participants?

Most experiments offered feedback about what was being investigated, either immediately after participation (10) or with some temporal delay (16). In eight experiments, participants were not offered feedback about the goals of the study.

Did you offer feedback concerning the design of the experiment?

About half of the experiments conveyed the experimental design to the participants, either immediately after participation (4) or with some temporal delay (12). Participants were not informed about the design of the study in which they participated in 18 experiments.

Did you also run the experiment with non-internet participants (for comparison)? If yes, how would you rate the convergence of Web and Lab data? If there was less than complete agreement, please describe the differences.

To assess the validity of their findings, 18 experimenters conducted a replication study in a traditional setting. (The results of another 5 replication studies were not yet available at the time of the survey).

Almost all experimenters observed complete or good agreement between their web and lab data. There were no experiments for which a lack of agreement between lab and web data was observed. Low agreement between data collected in a traditional versus internet-based setting was found in one case where an effect of stimulus material was found in the lab but not in the web data. The author of this experiment conjectures that the stimulus images were too small to be seen properly in the web version of his experiment. Higher variances in the web were observed in one experiment for which the experimenter otherwise observed good agreement between lab and web data. Another experimenter also described the agreement between lab and web data as good but observed slightly more outliers (in the form of extreme or illogical judgements) in the web version of his experiment. The author of an experiment that showed only partial agreement between the web and the lab data assumed that this difference might be due to the small sample size in his lab experiment. Another researcher observed that internet participants were more

highly educated than the participants in his lab sample and showed lower rates of violation of stochastic dominance in their choices.

Overall, how much time (person hours) did you put into the web experiment, compared to a similar laboratory experiment? If you plan to conduct another web experiment: How much time do you expect to need, compared to your first web experiment? And how much money did you put into the web experiment, compared to a similar laboratory experiment?

There was no clear pattern with regard to the question whether first time web experiments need less working time than more traditional approaches; about one third of participants indicated they needed more time for the web experiment than they would have needed for a similar laboratory experiment, another third needed about the same amount of time, and another third indicated that they needed less time for the web experiment. A majority of researchers stated that in their opinion, much time can be saved when more than one web experiment is conducted. This seems consequential regarding the effort one has to put into learning and implementing a whole new research method. Naturally, the difficulties to get the first web experiment running will be reduced in subsequent web experiments, and the computer setup as well as other materials can be recycled (although rapid changes in technology may create obsolescence quickly). Experimenters also indicated that web experimenting is a quite inexpensive undertaking. The vast majority of respondents estimated the costs of web experiments to be smaller or much smaller than the costs of a traditional laboratory experiment.

Overall, how much space/rooms did you need for the web experiment, compared to a similar laboratory experiment?

Another benefit of using the web for experiments stems from savings of space and rooms needed for laboratory experiments (Reips, 1995b, 1996a, 1996b, 1997b, this volume). All researchers indicated that they needed less or much less space for their web experiment than they would have needed for a laboratory experiment.

Are you planning to conduct another Web experiment?

The experiences web experimenters reported seem overwhelmingly positive. With only one exception, all researchers said they would certainly, or at least perhaps, conduct another web experiment.

Did you present your experiment to a scientific conference or is your presentation accepted for an upcoming conference? If yes, which conference?

More than two thirds of the data of already finished web experiments have been presented to a scientific conference, or accepted for presentaton at an upcoming conference. On the following occasions web experiments were (or will be) reported:

- Virtual Reality Modeling Language Conference, 1998

- European Conference on Visual Perception, 1998

- Annual Workshop on Object Perception and Memory, 1998

- Society for Computers in Psychology, 1996, 1998

- British Psychological Society, 1998

- German Online Research, 1998

- Economic Science Association, 1998

- Conference of the Society for Research in Experimental Economics [Tagung der Gesellschaft für Experimentelle Wirtschaftsforschung], 1998

- Annual Convention of the Canadian Psychological Association

- Congress of the German Psychological Society, 1998

- Experimental Psychologists' Conference [Tagung Experimentell Arbeitender Psychologen], 1998, 1999

- Annual Conference of the Text and Discourse Society

- Annual Conference of the Cognitive Science Society, 1999

- Annual Conference of the German Linguistic Society [Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft], 1999

- International Society for Research in Emotion Conference, 1998

Did you already write a paper on your experiment? If yes: Did you report comparison data from non-web participants? Which journal did you submit it to? What is the current status of the first submission of your paper? If the paper was not accepted when you first submitted it, what were the stated reasons? If the paper was not accepted, did you submit it to another journal afterwards?

The respondents had written twelve papers on their web experiments by the time of the survey, five of which reported comparison data from a traditional lab sample. Several manuscripts were not yet completed. The journals to which the completed manuscripts were submitted to are:

- Behavior Research Methods, Instruments, and Computers [3 submissions. 2 manuscripts were accepted, 1 was rejected but not because web data were reported; the manuscript has not yet been resubmitted]

- Journal of Economic Behavior and Organization [under review]

- Journal of Behavioral Decision Making [not accepted for reasons other than the web data]

- British Journal of Psychology [accepted but wanted it as a short report; the authors elected to resubmit elsewhere rather than rewrite]

- Psychological Review [under review]

- Psychology and Marketing [not accepted for reasons other than the web data]

Four articles and a book by survey participants are already in press or published (Birnbaum, in press-a; in press-b; in press-c; Morrow & McKee, 1998; Schmalhofer, Elst, Aschoff, Bärenfänger, & Bourne, in press). However, the number of web experiments that already found their way into scientific journals is still very low (but see Hänze, Hildebrandt & Meyer, 1998; Krantz, Ballard, & Scher, 1997; Welch & Krantz, 1996). Of course, one reason for this is that the first web experiments were started only in recent years. It remains to be seen whether the editors and reviewers of traditional journals will accept the growing number of papers reporting data from web experiments.

Web experiments offer a number of advantages compared to traditional laboratory experiments. This has mostly been explored theoretically or concluded from experience with very few web experiments (Krantz & Dalal, this volume; Reips, 1995b, 1996a, 1996b, 1997b, this volume), and, of course, a number of traditional experiments. Our survey shows for the first time on an

empirical basis that many of those advantages hold true in the impressions of those who used web experiments as a method for doing research.

Although online data collection efforts are undertaken in many areas of research (American Psychological Society, 1995), it seems that the core areas for web experiments are those that deal with cognition. Combined with the practical advantages and the ease with which web experiments can be conducted this might lead to an increase in cognitive research, especially in light of the integration of online research and online publication (Reips, 1997a, 1998a).

Taken together, we feel that the results of this survey give a number of interesting insights into the experiences of the first generation of web experimenters. At the moment, the number of web experiments is still small, but a rapid growth can be predicted on the basis of the present results. We would not be surprised if within the next few years, a fair proportion of psychological experiments will be conducted on the web. It will be interesting to see how the experiences of the early researchers shape this new direction in psychological research.

References

Abbate, J.E. (1994). *From Arpanet to Internet: A history of ARPA-sponsored computer networks, 1966-1988.* Unpublished PhD thesis, University of Pennsylvania.

American Psychological Society (1995). Psychology Experiments on the Net. [WWW document]. URL http://psych.hanover.edu/APS/exponnet.html

American Psychological Society (1998). [WWW document]. URL http://www.psychologicalscience.org

Batinic, B. (1997). How to make an internet based survey? In W. Bandilla & F. Faulbaum (Eds.), *SoftStat '97 - Advances in Statistical Software 6* (pp. 125-132). Stuttgart: Lucius & Lucius.

Batinic, B., Gräf, L., Werner, A., & Bandilla, W. (1999): *Online Research*. Göttingen, Germany: Hogrefe.

Birnbaum, M.H. (in press-a). How to show that 9 > 221: Collect judgments in a between-subjects design. *Psychological Methods.*

Birnbaum, M.H. (in press-b). *Introduction to Behavioral Research on the Internet.* Upper Saddle River, NJ: Prentice-Hall.

Birnbaum, M.H. (in press-c). Testing critical properties of decision making on the Internet. *Psychological Science.*

Booth-Kewley, S., Edwards, J., & Rosenfeld, P. (1992). Impression management, social desirability, and computer administration of attitude questionnaires: Does the computer make a difference? *Journal of Applied Psychology, 77,* 562-566.

Buchanan, T., & Smith, J. L. (1999). Using the Internet for psychological research: Personality testing on the World Wide Web. *British Journal of Psychology, 90,* 125-144.

Bush, V. (1945). As we may think. *Atlantic Monthly, 1,* 101-103.

Connes, B. (1972). The use of electronic desk computers in psychological experiments. *Journal of Structural Learning, 3,* 51-72.

Flanagan, D. (1998). *Javascript: The definitive guide* (3rd Edition). Cambridge: O'Reilly.

Hänze, M., Hildebrandt, M., & Meyer, H.A. (1998). Feldexperimente im World Wide Web: Zur Verhaltenswirksamkeit des "mere-exposure"-Effekts bei der Informationssuche [Field experiments in the World Wide Web: Effectiveness of the "mere exposure" effect on information seeking]. *Psychologische Beiträge, 40,* 363-372.

Hardy, H.E. (1995). A short history of the net [WWW document]. URL http://www.ocean.ic.net/ftp/doc/snethistnew.html

Hewson, C. M., Laurent, D., & Vogel, C. M. (1996). Proper methodologies for psychological and sociological studies conducted via the internet. *Behavioral Research Methods, Instruments, & Computers, 28*, 186-191.

Hoffman, R. & MacDonald, J. (1993). Using HyperCard and Apple events in a network environment: Collecting data from simultaneous experimental sessions. *Behavior Research Methods, Instruments, & Computers, 25,* 114-126.

Hoggatt, A. C. (1977). On the uses of computers for experimental control and data acquisition. *American Behavioral Scientist, 20,* 347-365.

Kieley, J.M. (1996). CGI scripts: Gateways to World-Wide Web power. *Behavior Research Methods, Instruments, & Computers, 28*, 165-169.

Kiesler, S. & Sproull, L. S. (1986). Response effects in the electronic survey. *Public Opinion Quarterly, 50*, 402-413.

Klauer, K.C., Musch, J., & Naumer, B. (1999). On belief bias in syllogistic reasoning. *Manuscript submitted for publication.*

Krantz, J. H., Ballard, J. & Scher, J. (1997). Comparing the results of laboratory and world-wide web samples on the determinants of female attractiveness. *Behavioral Research Methods, Instruments, & Computers, 29,* 264-269.

Martin, C.L., & Nagao, D.H. (1989). Some effects of computerized interviewing on job applicant responses. *Journal of Applied Psychology, 74,* 72-80.

Morrow, R., & McKee, J. (1998). CGI scripts: a strategy for between-subjects Web designs. *Behavior Research Methods, Instruments, & Computers, 30,* 306-308.

Musch, J. (1997). Die Geschichte des Netzes: ein historischer Abriß [The net's history: a synopsis]. In B. Batinic (Ed.): *Internet für Psychologen* [Internet for psychologists] (pp. 27-48). Göttingen, Germany: Hogrefe.

Mailagent 1.1 [Computer software]. (1998). Rohnert Park, CA: Netdrams Software.

Ott, R., Krüger, T., & Funke, J. (1997). Wissenschaftliches Publizieren im Internet [Scientific Publishing on the Internet]. In B. Batinic (Ed.): *Internet für Psychologen* [Internet for psychologists] (pp. 199-220). Göttingen, Germany: Hogrefe.

Reips, U.-D. (1995a). The Web's Experimental Psychology Lab [WWW document]. URL http://www.psych.unizh.ch/genpsy/Ulf/Lab/WebExpPsyLab.html

Reips, U.-D. (1995b). The web experiment method [WWW document]. URL http://www.psych.unizh.ch/genpsy/Ulf/Lab/WWWExpMethod.html

Reips, U.-D. (1996a, April). Experimentieren im World Wide Web [Experimenting in the World Wide Web] [Abstract]. Experimentelle Psychologie: Tagung experimentell arbeitender

Psychologen [Proceedings of the Experimental Psychologist's Conference], Germany, 38, 256-257.

Reips, U.-D. (1996b, October). Experimenting in the World Wide Web. Paper presented at the 1996 Society for Computers in Psychology conference, Chicago.

Reips, U.-D. (1997a). Forschen im Jahr 2007: Integration von Web-Experimentieren, Online-Publizieren und Multimedia-Kommunikation [Science in the year 2007: Integration of web experimenting, online publishing, and multimedia communication]. In D. Janetzko, B. Batinic, D. Schoder, M. Mattingley-Scott und G. Strube (Eds.), *CAW-97. Beiträge zum Workshop "Cognition & Web"* [Articles presented at the workshop "Cognition & Web"]. Freiburg: IIG-Berichte 1/97.

Reips, U.-D. (1997b). Das psychologische Experimentieren im Internet [Psychological experimenting on the internet]. In B. Batinic (Ed.): *Internet für Psychologen* [Internet for psychologists] (pp. 245-265). Göttingen, Germany: Hogrefe.

Reips, U.-D. (1998a). Forschung in der Zukunft [Future Science]. In T. Krüger & J. Funke (Eds.), *Psychologie im Internet: Ein Wegweiser für psychologisch interessierte User [Psychology in the internet: a pathfinder for psychologically interested users]* (pp. 115-123). Weinheim: Beltz.

Reips, U.-D. (1999a). Theorie und Techniken des Web-Experimentierens [Theory and techniques of web experimenting]. In B. Batinic, L. Gräf, A. Werner, & W. Bandilla (Eds.): *Online Research*. Göttingen, Germany: Hogrefe.

Reips, U.-D. (1999b). Online answering biases. *Manuscript submitted for publication.*

Salus, P.H. (1995). *Casting the net: from ARPANET to Internet and beyond.* Reading: Addison-Wesley.

Schmalhofer, F., Elst, L., Aschoff, R., Bärenfänger, O., Bourne, L. (in press). Mentale

Modelle sozialer Interaktionen: Wie Texte über Sozialbetrügereien verstanden werden [Mental

models of social interactions: How readers comprehend texts about cheating behaviors].

Zeitschrift für Experimentelle Psychologie.

Schmidt, W. (1997). World-wide web survey research: Benefits, potential problems, and

solutions. *Behavior Research Methods, Instruments, & Computers, 29,* 274-279.

Schmidt, W. (1997). Operate your own World-Wide Web server. *Behavior Research Methods,*

Instruments, & Computers, 29, 189-193.

Smith, M., & Leigh, B. (1997). Virtual subjects: Using the internet as an alternative source of

subjects and research environment. *Behavior Research Methods, Instruments, and Computers,*

29, 496-505.

Weigend, A. (1994). *Music recognition experiments.* [WWW document]. URL

http://www.cs.colorado.edu/~andreas/Teaching/Music/Experiments.html

Welch, N. (1995). *Demonstrations in Auditory Perception.* [WWW document]. URLs

http://www.music.mcgill.ca/auditory/Auditory.html and http://gl15.bio.tu-

darmstadt.de/auditory/auditory.html

Welch, N., & Krantz, J. (1996). The World-Wide Web as a medium for psychoacoustical

demonstrations and experiments: Experience and results. *Behavior Research Methods,*

Instruments, & Computers, 28, 192-196.