Advantages and Disadvantages of Conducting Experiments Over the Internet

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Abstract

There are both advantages and disadvantages to advertising and conducting psychological experiments over the Internet. Experiments can be advertised through dedicated study-advertisement webpages, through links on regular webpages, and through newsgroups and email lists. Some advantages of advertising over the Internet include the ability to reach large numbers of interested people, usually for free, over a large geographical area, or to reach relatively large numbers of people from special target groups. Disadvantages include the fact that participants are self-selected and are not entirely representative of the general population of the United States. However, Internet samples do tend to be more representative than Subject Pool samples. Whether or not the study was advertised over the Internet, there are several advantages to conducting the data collection itself using webpages. These include the fact that participants can complete the study at a wider range of times and locations than the usual experiment, and online experiments are less expensive, allow research to be conducted without lab space or a Subject Pool, reduce experimenter effects and demand characteristics, and increase generalizability and external validity. On the other hand, some experimental procedures simply cannot be conducted over the Internet (such as PET scans, drug administration, and food tasting), and other activities cannot be conducted over the Internet yet (such as interacting with confederates). As well, drop-out rates are often high, and if drop-outs vary across experimental conditions, this can confound the experiment; thus, researchers need to examine and control for differential drop-outs. For many experiments, however, the advantages of on-line data collection will outweigh the disadvantages.

Introduction

What is an Experiment?

First, let me begin by saying what an experiment is. What makes something an experiment is random assignment to groups. In the ideal experiment, this assignment is double-blind: neither the researcher nor the participant knows which group the participant is in. So, in this symposium, we're going to teach you a few different ways of conducting true double-blind experiments over the Internet.

What is On-Line Research?

What is on-line research? On-line research is research that is conducted over the computer, often at great distances. The information can be collected and sent either through emails or webpages. Webpages are more flexible and powerful than emails, though, and so in this presentation, we will focus on the use of webpages to conduct experiments.

Webpages can be created in a variety of ways, such as html, programming languages, Dream weaver, FrontPage, Flash, Authorware, and other specialized webpage development programs. In this symposium, we'll introduce you to several of these different methods. The stimuli can be written questions, pictures, audio clips, or even videos. Most studies use written questionnaires, like your typical personality questionnaire, but other types of stimuli are also possible. Responses can be made in a variety of ways, including checkboxes, radio buttons, text boxes, and open-ended questions, but also including other variables, like reaction time.

What is On-Line Advertising?

Now, I'd like to distinguish between running a study on-line and advertising a study on-line. You can do one or the other or both, but doing one does not necessarily mean you are doing the other.

There are several ways to advertise a study on-line. You can send advertisements though emails, or send notices to newsgroups. You can put a link on a regular webpage, and or on a webpages that is dedicated specifically to advertising on-line studies.

On-line experiments can also be advertised in any of the usual methods: flyers, newspaper ads, radio ads, the department subject pool. I have even seen studies advertised on the back of receipts, when I purchased something. So there's lots of different ways of advertising.

But just because you advertise a study on-line does not mean that you have to run the study on-line. For example, the Subject Pool at UNLV now uses an Internet-based sign-up system, so that students use the Internet to see what studies are available. But most studies are still done by appointment in the lab.

When people talk about doing studies over the Internet, though, they usually mean advertising a study on the Internet and then running the study on the Internet. So, before I talk about the advantages and disadvantages of running a study on the Internet, I first want to talk about the advantages and disadvantages of advertising a study on the Internet.

Advertising On-line

Open-Advertising

There are two different types of on-line advertising. open advertising and targeted advertising. In open advertising, anyone is allowed to participate. People see that you are running a study, and they decide to participate. How do they find out about your

study? There are websites devoted to providing free advertisement for on-line studies. These webpages provide direct links to the webpages where the studies are being conducted.

Here are two examples:

American Psychological Society: Psychological Research on the Net. Website located at
http://psych.hanover.edu/research/exponnet.html

PsychExperiments: Psychology Experiments on the Internet. [Focused on Authorware experiments] Website located at
http://psychexps.olemiss.edu/

Advantages

There are several advantages to open advertising on the Internet. First, you can reach a large number of people, usually for free. This provides large sample sizes and lots of power. Second, you can advertise across a wide geographical area. Because webpages can be accessed from anywhere with an Internet connection, you are not limited to participants who live or work in the same city or state as you. Third, you can get a wider variety of participants than the typical Subject Pool study. Participants are more varied in terms of their ages, wealth, education, and background than a typical Psy 101 class. This contributes to our ability to generalize to a wider variety of people than we usually can, and allows us to compare the results for different types of people, to make sure that our findings apply to various subgroups.

Disadvantages

There are several disadvantages to open advertising, however. First, samples obtained through open on-line advertising are mostly Americans. Open advertising in English is likely to get most responses from the United States, Canada, and England, but the vast majority of responses are from Americans. If you want to get a large sample of people from other countries, open advertising may not be your best choice.

Second, the Americans who do respond to open advertising are not entirely representative of the American population. They are more representative than most of the usual alternatives. They are more representative that the samples you would get from using a subject pool in a psychology department, or giving a radio ad in one city, or by sampling people who visit one particular hospital, but they are still not entirely representative. If getting a representative sample is very important (such as political polls), then none of these methods should be used. Very carefully stratified samples will be required.

Third, if you are not paying your participants or offering other incentives, you need to keep the study short. Most on-line studies conducted with open advertising do not pay participants at all, and so most of these studies are quite short (5 – 10 minutes).

Fourth, participants are self-selected, based upon the source and content of the advertisement (Reips, 2000). They decide if they want to participate. This results in a non-representative sample (as is true of most psychological research), making it difficult to generalize to people who did not participate in your study. Reips (2000) suggests a method for determining if self-selection had a big effect on your results. First, advertise your study in multiple locations, using several different types of ads. Then analyze your results to see if they change based upon the advertising site.

Fifth, if participants are recruited from all over the world, some of your participants may not read the language very well. This can lead to people who do not understand the instructions or the questions, and reduce the validity of the experiment.

Targeted Advertising

An alternative to open advertising is targeted advertising. With targeted advertising, the researcher determines in advance the general type of participant wanted.

Advantages

There are several advantages to targeted advertising on the Internet. First, it is easy to target special populations, since there are websites and newsgroups for special interest groups. So, for example, if you want to do research on relatives of people with schizophrenia, on owners of small independent companies, or of mothers of triplets, it may be easy to find websites and newsgroups devoted to these issues, which make it easy for you to locate these people, and advertise your study to them.

Second, with targeted on-line advertising, it may be easier to get a sufficient number of participants from a special population. This can be difficult when a researcher is limited to a particular geographical area.

Finally, there are some groups of people who are difficult to study in the university lab, because they are unable to travel, or unwilling to identify themselves, or geographically very spread out. For example, people with some medical conditions may be unable to travel. Drug dealers may be unwilling to identify themselves. Twins of people with Multiple Sclerosis are likely to be geographically very spread out. Research with these groups is possible if recruiting and then testing are both done over the Internet.

Disadvantages

Sometimes targeted advertising can be difficult. It may be difficult to find adequate ways of targeting the group of people you are interested in, to ensure that most people reading your advertisement meet your criteria. If you are unable to find ways of advertising so that most people reading your ad belong to your target group, then you should specify in your advertisement exactly the type of people you want to participate in your study, and you should include screening questions in the study itself, so that you can remove data from people who are not in the target group.

Second, you should avoid sending unwanted emails to newsgroups, or otherwise spamming potential participants. Doing this will give on-line research a bad reputation. So, before sending emails to a newsgroup, get permission from the administrator of the group.

Subject Pool

One type of targeted advertising is the use of the local psychology Subject Pool. Special software has now been developed to assist in the on-line advertisement of Subject Pool studies. Some of these Subject Pool studies might be on-line studies, but most of these studies are regular in-person appointments.

Three of these programs are Experimetrix (2004), ExperimenTrak (2004), and Sona Systems (2003). These programs allows researchers to advertise their studies over the Internet, and list available sign-up times. Students can view the available studies

and sign-up times, and sign-up for the experiments directly through the Internet. In addition, researchers themselves can give research credit to the students who participated, and students can check the on-line system to see how many credits they have earned.

Advantages

There are several advantages to advertising Subject Pool studies on-line, rather than having paper sign-up sheets in hallways, the way we all used to. First, the advertisements are available whenever students want to look at them. Students can view available experiments any time and anywhere they want, as long as they have an Internet connection.

Second, researchers can view and print a list of students who have signed up, whenever they want. If they are running the experiment in a research lab that has an Internet connection, they can print the sign-up sheet just before the experiment begins. Or if they are trying to judge how many sessions to run, they can view the sign-up sheets any time they want, and easily create new appointments on the spot.

Third, on-line advertising and sign-ups protect the privacy of our participants. When sign-up sheets are in hallways, everyone can see who signed up for each experiment. Sometimes, experiments have restrictions upon who can participate, and so the mere fact that someone signed up for an experiment reveals potentially private information about a person.

Finally, these programs also typically allow the experimenters to give credit to the students who participated, allow students to check the number of credits earned, send email reminders to students before their appointments, and generate reports of credits earned for each instructor. Therefore, on-line advertising and credit assignment can save Subject Pool Coordinators a substantial amount of time, in terms of keeping track of students, teachers, and credits.

Disadvantages

The one disadvantage of using on-line advertising for a Subject Pool is that it may be more expensive that paper sign-up sheets. Use of these systems costs roughly $900 per year. If all the people who were running your Subject Pool were doing this work without being paid, then this will be more expensive. On the other hand, if you are providing release time to a faculty member to do this work, or if you pay a graduate student to oversee the Subject Pool, then the time-savings will probably more than compensate for the cost of the system. In our own case at UNLV, we have halved the amount of time that is spent administering the Subject Pool.

Conducting Experiments Using the Internet

All Internet Experiments

What do I mean when I say the Experiment is conducted using the Internet? I mean that experimental materials are available on the Internet, and participants complete them while being connected to the Internet. Usually Internet studies are conducted without any appointments, so that the researcher and participant never meet, but there are some advantages and disadvantages of Internet studies that are also shared by studies that do have appointments: participants meet the researcher at a specified time and location, and then sit down at a computer to complete the materials. So, first, I'm going to start by talking about the general advantages and disadvantages, and then I'll compare the two types of Internet studies, the ones with and without appointments.

Advantages

Administering your tests and questionnaires over the computer means that the participant enters their data directly into the computer. This means that you don't have to do data entry. This saves time, and also prevents data entry errors. By removing a step in the process, you've eliminated the errors that can result during that step.

Second, computerized administration saves paper. The questionnaires and tests for my dissertation research filled seven boxes. By administering a study on the computer, we do not need to print out the questionnaires and tests for our participants.

Third, if you design the study yourself, it is much cheaper than paper-based delivery. You don't have to pay for paper, copying, or mailing. Some people pay to have professionals design their on-line studies, but today we're going to teach you how to design your own on-line experiments.

Fourth, administering the study over the computer allows you to collect time-related data. You can get precise measurement of reaction time, and time for completion, and your participant doesn't even have to know you are collecting that data, if you don't want them to.

Fifth, by minimizing or eliminating contact between research participants and the experimenters, and by automatizing everything, we minimize or eliminate experimenter effects and demand characteristics (Reips, 2000). One of the challenges in conducting a true double-blind experiment is to prevent the session administrator from knowing which condition the participant is in. Sometimes this is possible. For example, if a real drug and a placebo drug are made to look the same, and the person administering the drug does not know which drug is being given. However, even in that situation, the researcher who interacts with participants may soon know which condition the participant is in, based upon side-effects of the active drug. In many experiments, it is impossible to prevent the administrator from knowing what condition the participant is in, because the administrator has to ensure that the correct treatment is given. The best that can be done in those circumstances is to refrain from telling the administrator what the hypotheses of the study are. However, where there is little or no contact between the participants and the researchers, as is the case in an on-line experiment conducted without appointments, it is easy to create a true double-blind experiment, eliminating demand characteristics. And even if you do have an appointment, you could have the participant come in, and sign the consent form, and then leave them alone with the computer while they are completing the measures – in which case it's easy to make the experiment double-blind.

Finally, commercial tests often come in both paper-based forms and Internet-based forms. The Internet-based forms are often much cheaper. If you can set up your study to connect to Internet-based forms of commercial tests, you can save a lot of money.

Disadvantages

Some people are not very familiar with the on-line environment. Because of this, they might decide not to participate in you tell them that the study needs to be completed on the Internet. If they do participate, they might get confused, not understand the instructions, or make mistakes in completing the measures. If the experimenter is not physically present, the participants may not obtain clarification before completing the study. This can lead to a lack of validity. This is less of a problem in an experiment that has appointments, because the researcher is right there to answer any questions that participants have. However, if you are working with a population that has little computer experience, it may be too disruptive to teach participants the necessary skills, even if you do have appointments.

Second, some studies do not lend themselves to being completed on computers. Maybe you need to use an Interview, so you can change the questions you ask, based upon the information you've received so far, to probe until you understand the situation being described. Maybe you need the participants to interact in groups.

Third, creating on-line studies requires technical skills. If you want to use random assignment to groups, or have stimuli presented in random order, or have time limits, there are several different ways to do this, and you can pick your favorite. But most of us don't even know a single one of these methods, and so we have to learn these new skills before we can put our experiments on the Internet.

Finally, putting a study on the Internet requires a reconsideration of ethical issues. The ethical issues that face on-line research are the same *issues* as are faced by studies conducted in the lab, but the *methods* of dealing with these issues are sometimes different. For example, how do you assure confidentiality, when the data is being sent over hundreds of miles of wires? How do you assure informed consent, when you are not sure how well the participant understands English? I've written a paper on this (Barchard & Williams, 2005), which will help you get started.

Without Appointments

The most common way of conducting experiments using the Internet is that the study is advertised and run on-line, without the researcher ever meeting the participants. The researcher advertises the study through some on-line media, telling participants the on-line location of the study. Participants then complete the study over the Internet, at whatever time and location they choose, without ever meeting the researcher.

Advantages

There are many advantages to conducting experiments over the Internet, without appointments.

First, participants can complete the study any time they want. This may make it much easier for people to participate in your study, especially if they are very busy, or have unusual schedules or schedules that are not fixed, so that it is hard for them to make appointments.

Second, participants can complete the study from virtually any location. All they need is an Internet connection. This makes it more convenient, less time consuming, and perhaps less expensive for participants to complete our studies, than if we required them to come to a specific location. We are bringing the experiment to the participant, rather than requiring the participant to come to us (Reips, 2000).

Third, researchers can collect data from people in distant locations or spread across a wide geographical area, for no more money than it costs to collect data from people who are all nearby. For example, if you wanted to do research on participants in San Francisco, or on participants who are spread across the country, you would usually either have to pay travel costs to get to where the participants are, or postage to send materials to participants.

Fourth, on-line administration typically results in much larger sample sizes than traditional administration methods, resulting in higher power (Reips, 2000). A large portion of current research is conducted with inadequate power, which results in non-significant results and conflicting results across multiple studies. By increasing our sample sizes, we can increase our power, resulting in faster accumulation of knowledge.

Fifth, when data is collected without appointments, researchers do not have to spend time administering testing sessions. This means that research assistants are not needed to administer sessions and do data entry, and therefore research can usually be conducted without the assistance of research assistants.

Sixth, because of all the advantages already listed, the use of on-line administration allows experiments to be conducted by people who do not have access to a Subject Pool, who do not have lab space, who do not have research assistants, and who do not have money for postage. Therefore, it allows researchers to do research, even if they are at an institution that does not provide a lot of support for research.

Seventh, in any experiment with no direct contact with participants, drop-out rates are high. Many people start the experiment, such as by reading the introduction or cover letter, but then do not complete it. Unlike mailed surveys, researchers can examine drop-outs in on-line studies, because some information about these participants will be known – such as which webpages they looked at, and which experimental conditions they were in.

Eighth, lab environments are strange and unfamiliar places for most people. Web experiments allow the participants to complete the experiment in a familiar environment, increasing the external validity of the experiments (Reips, 2000). This makes it more likely that an effect found in our research study will generalize to real life.

Ninth, with on-line administration, it is possible to provide participants with complete anonymity. With in-person studies, we can refrain from asking someone their name, but we still see their face. With telephone surveys, we can refrain from asking someone their name, but we still know their phone number and hear their voice. Whereas with on-line administration, the study can be set up so as to ensure complete anonymity.

Disadvantages

The most serious problem with on-line experiments without appointments are their high drop-out rates (Reips, 2000). A lot of people will start an on-line experiment and not finish it. This limits our ability to generalize to the entire group of people that we were advertising to. The most serious problem is differential drop-out. If people drop out of experimental conditions at different

rates or for different reasons, this confounds the experimental condition with the drop-out rate. This can lead to serious errors. Researchers might even make the wrong conclusion about the direction of the experimental effect (Reips, 2000). Therefore, if experimental conditions are different enough that there might plausibly be differential drop out (or drop out for different reasons), the researcher needs to examine drop outs. Reips (2000) provides several suggestions for reducing the overall drop out rate and to prevent differential drop-outs. One of these suggestions is to use a High Entrance Barrier Technique. The idea here is to make most people drop-out BEFORE the random assignment to groups, so that drop-out within the experimental conditions is the same. Before even giving your first measure, you can ask participants to download players and plus-ins, to set screen resolution, and to check the speakers. Furthermore, you can administer several questionnaires and tests, before doing the random assignment to groups. This way, people are likely to drop out of your experiment before they have been assigned to groups, so that drop-out within your groups is very low and is the same across experimental conditions.

Second, some studies require the participant to be physically present in the research setting. Think about PET scans and MRI scans, EEGs, administering drugs, doing a taste test, and touching another person (Reips, 2000). There are other types of studies that can't be done over the Internet yet, but it might be possible to collect that type of data in the future. For example, videoing participants, and interactions of participants and accomplices.

Third, when participants are completing a study anywhere they want, you have lost control over the experimental environment. There is no standardization. There might be background noises and interruptions. This lack of standardization will result in more random error.

Fourth, there is a second way that the study will be non-standardized: webpages do not look them same on all computers. Different screens and different browsers will display the same webpage differently. Because of this, an experiment can look different to different people (Reips, 2000). This can actually be an advantage, because it randomizes miscellaneous factors that are probably not central to one's research question, and therefore improves generalizability. This reduces power by increasing random error, but most online studies have lots of power. Therefore, the increase in the ability to generalize one's results is probably worth the small loss in power (Reips, 2000). To ensure that the essential features of your experiment remain intact, you should pre-test your experiment on different screens, using different browsers, to make sure that the critical aspects are preserved. For example, if you need one line to be twice as long as another line, you should check several different browsers to see that their relative length has been preserved.

Fifth, when you do not have appointments, participants who are confused may have difficulty obtaining clarification. It is therefore essential that the instructions are extremely clear. In general, the solution is careful pre-testing (Reips, 2000). Get many people to complete your study before it starts, to try to make it clear and unambiguous, even to people with minimal computer experience.

Finally, for a variety of reasons, you might get multiple submissions. The same people might send you data multiple times. This can happen intentionally or unintentionally. Intentionally, people might participate in your study several times if the experiment is fun and interesting (Reips, 2000). Therefore, experimenters need to take steps to catch or prevent this. For example, you can ask that people only complete the study once. Or you can give them a separate link to use if they want to do the study again, and the second time they complete the study no data is submitted. For most of us, though, our studies are not that interesting. So intentional re-submissions are probably very rare.

On the other hand, accidental re-submissions are common. People might unintentionally submit multiple entries, by hitting the submit button multiple times. If the browser is slow to respond, the participant can hit the submit button several times before the computer responds, which results in several sets of data being sent to the server. It's pretty easy to spot this kind of resubmission, because you get two or more lines of data in a row where absolutely every entry is identical. So, this happens fairly often, but is easy to catch.

With Appointments

It is also possible to conduct on-line experiments in basically the same way as other laboratory experiments. Set an appointment for the participant to meet you, and then administer the study. However, rather than handing the participant some pieces of paper to fill out, they could complete the measures over the computer, and the tests and questionnaires could be on the Internet.

If you've put your study on the Internet, you might wonder why you would want to have appointments. Well, there are several things you can do in a study that does have appointments that you can't do in a study that doesn't have appointments.

Advantages

First, having appointments also allows the researcher to interact with the participant more, and in particular, provides more opportunities to answer participant questions. So, if participants are not very familiar with computers or the Internet, by running the experiments with appointments, the researcher can help the participant whenever they get stuck. Or if the experiment involves deception, then the researcher needs to ensure that participants are adequately debriefed, and this can be done with appointments.

Second, having appointments allows control of timing of completion of measures. One of the advantages of running studies without appointments is that participants can do the study any time they want, but one of the disadvantages is that the researcher has little control over when participants complete the study. If you need control over when participants do the study, appointments are an easy and effective way of doing this. For example, if you need a participant to do something exactly one week after the first testing session, you can do this with an appointment. Or if you need them to do something at 9am, noon, 3pm, and 6pm, you can do this with appointments. Personally, I've sometimes run Internet experiments with appointments, because I was collecting test-retest data.

Third, having appointments provides more control over the presentation of materials, because the researcher gets to decide which computers, screens, and browsers are used to complete the experiment. If you want, you can run all participants on a single computer. This way, you know that the browser and screen are the same for all participants.

Fourth, if you expect a high drop-out rate, or if you expect differential drop-out rates, using appointments is an easy way to deal with this problem. Generally, participants are relatively unlikely to drop-out of in-person experiments, probably because it

would be considered somewhat rude to get up and leave – even though we tell them they can do this. So, if you are worried about drop-outs, administering the materials during appointments will alleviate that problem.

Fifth, you might need appointments because part of your experiment involves doing something that can't be done over the Internet, like meeting a confederate, or taking a blood sample, or doing a taste test.

Sixth, many test publishers are unwilling to let you use their tests on the Internet. They want to make sure that the test materials – the test items – are kept secure. By using appointments, the researcher can make sure that the participant is never left alone with testing materials, doesn't print them or copy them out, and is unable to access the test content after the study is over. For example, you can set up the testing materials on the Internet, but put password protection on the website, and never tell the participant what the password is. When the participant shows up for the experiment, you have already typed in the password, and the study is ready to go. But the participant cannot access the website when you are not there. These procedures may be sufficient to allow you to gain permission from the test publishers to use the tests you want.

Disadvantages

Of course, by having appointments, you loose all those advantages of not having appointments: convenience for the participants, large sample sizes, being able to conduct research over wide areas, etc.

However, given that you've decided you need to have appointments for your study, there are a couple of more disadvantages, because of running the study on the Internet.

First, in most cases, administering the study on computers will limit the number of participants you can run at one time. Most computer labs are relatively small, seating only 10 to 25 people, meaning that you can't run more than 25 people at once. If you administer your study on paper, however, you can collect a lot more data at once. Classrooms usually hold 30, 50, or even 100 people. Furthermore, it may be difficult to book time in a computer lab, but it is relatively easy to book time in a classroom.

Second, by administering your study on computers, you are relying on technology. You need access to computers for administration. If computers are not working, the participant will be unable to complete study.

Subject Pool (Without Appointments)

Finally, I want to briefly discuss a particular type of experiment, or a particular subject population: Subject Pools. There are several advantages to running on-line experiments in Subject Pools, especially if you are able to run the experiments without appointments.

Advantages

First, the study can be done any time, from any location. Students really appreciate this, given that their schedules often conflict with the appointment times offered by the researchers.

Second, there is no practical limit on the number of people who can complete the study at once. There could be five people doing the study at one time, or fifty, or a hundred. This makes it a lot easier to collect a lot of data in a short period of time, such as the last two weeks of the Subject Pool – which seems to be when everyone wants to participate.

Third, each participant can complete the study entirely alone, so that no one except the experimenter knows who participated in a particular study. This may be important if participation in a particular study reveals confidential information about a student, such as medical information, sexual orientation, criminal history, etc). In your typical lab experiment, participants can see other participants in the studies. Even if they don't know each others' names, they can still recognize each other.

Finally, if there aren't enough studies at a particular university, students can participate in on-line studies that are being conducted elsewhere. This eliminates the problem of students complaining that there aren't enough studies.

Disadvantages

Running an on-line experiment in the Subject Pool without appointments has the same disadvantages as running an on-line experiment without appointments elsewhere. However, there is one further disadvantage. Because students do not need appointments, the researcher does not have direct control over the number of students who participate. In Subject Pools where there are not enough students compared to the number of studies, the department may want to control the number of students who can participate in any one study. In that situation, the researcher needs to keep careful track of the number of students who have participated, and close the experiment down when their quota has been reached.

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