Active and Passive Touch: A Research Methodology Project

Cynthia D. O'Dell
Departments of Women's Studies and Psychology
Indiana University Northwest

Mark Sudlow Hoyert
Indiana University Northwest

We describe a perceptual experiment that we have successfully used in Research Methods classes. Students attempt to identify a series of simple cookie cutter shapes using only the fingers and hands (haptic perception). Students read archival studies that have used this procedure, identify confounds, generate and test alternative hypotheses, and present the results. Students described the project as quite enjoyable. They also showed a deeper understanding of research design and were able to present their data clearly. This exercise is an effective project for exploring and practicing critical analysis of existing research, experimental design, and data analysis, as well as data and theory presentation.

People can accurately identify objects using only the information provided by their fingers and hands, a process known as *haptic perception.* Gibson (1962) argued that form perception becomes increasingly accurate as people move their fingers and hands over an object. He identified two varieties of haptic perception, active and passive touch. *Active touch* roughly corresponds to the pattern of activity that people colloquially call *touching.* That is, active touch occurs when people move their fingers and hands to explore properties of the object. In contrast, *passive touch* does not involve movement of the hands and fingers. The stimuli are simply impressed on the skin. Our classroom activity explores differences between active and passive touch. This project joins a set of research methods exercises that replicate classic studies (e.g., Suter & Frank, 1986; Ware & Johnson, 1996). We find this project to be appealing, because the basic findings are easy to produce in a classroom setting, data collection proceeds quickly, and the existing literature is small and highly accessible. These advantages enable our students to expend more of their effort toward learning about research design and presentation. This project is our most successful exercise for introducing and practicing concepts and techniques in research design including (a) reading and understanding archival literature, (b) designing experiments with special emphasis on identifying and correcting confounds, (c) developing and testing hypotheses, and (d) presenting data and theory.

Gibson (1962) provided the first examination of differences between active and passive touch. He visually presented adult participants with a set of six cookie cutters and a drawing of those cutters. In all trials, the participants placed their dominant hand out of sight behind a screen and the experimenter placed a form in that hand. In the active condition, the participants cupped their fingers and felt the edges. In the passive condition, the participants kept their hand flat while the experimenter pressed the form into the palm. The participants were very accurate during the active touch condition with a mean frequency of 95% correct. This percentage dropped dramatically to 49% in the passive touch condition. Although Gibson's original study contained several methodological flaws, subsequent research designed to correct some of the experimental confounds (e.g., Heller, 1980, 1984; Heller & Myers, 1983) has confirmed the general finding that active touch produces more accurate object recognition than passive touch. The research project we describe begins as a replication of the Gibson (1962) study, but moves beyond it as students redesign the study to eliminate confounds.

Preparation

Prior to the project, we ask our students to read the Gibson (1962) article. At this time, we assemble several sets of small (2.5 – 3.75 cm) metal cookie cutters for use as stimuli. We use five cookie cutters per set. Each set can serve as stimuli for four to five students. The particular shape is not an extremely important variable. However, the cookie cutters within any set should be approximately the same size and should be perceptually distinct from each other. For example, one of our sets contains the familiar shapes: moon, star, spade, flower, and heart. We constructed an object-matching page containing visual representations of the shapes. We trace each cookie cutter onto a sheet of blank paper and fill in the outline. We use a screen to obscure the vision of the participant. We constructed a wooden platform with a felt curtain that students can pass their hands through. However, a screen could be as simple as a piece of opaque fabric that two students stretch between them. Finally, we construct a data-coding sheet for each participant. Our sheets contain blanks for 20 active trials and 20 passive trials (five cookie cutters presented four times each) with places for order of presentation as well as for recording the actual response of the participant. At the top of each sheet, we record demographic information such as age, gender, and hand used in the study.

Basic Procedure

We ask students to work in groups of four or five. One person serves as the experimenter and presents the stimuli. We do not let this person serve as a participant because the experimenter manipulates the shapes extensively during presentation. Before the study begins, the experimenters fill out a coding sheet that specifies the order of stimulus presentation for each participant. Each experimenter generates a stimulus sequence in a semirandom order, with the limitations that a single stimulus does not appear more than twice in a row and that all stimuli are presented exactly four times. As a result, each participant experiences a different order of stimulus presentation. Furthermore, we ask the experimenters to group all 20 active and 20 passive trials together. Experimenters counterbalance the sequencing of active and passive trials across participants. The experimenters place the screen between themselves and the participants so that the participants cannot see their own hand or the stimuli. The participants place their hands through the screen with the palm up. The experimenters explain that the task is to try to identify the objects and then place the object-matching sheets in front of the participants. During active trials, the experimenters explain that the participants may move their palms and fingers around the objects. The experimenters place the objects in the participants' hands and remove them after 2 sec. During passive trials, the experimenters explain that the participants should hold their palms flat. The experimenters then press the objects gently into the palms for 2 sec. In all trials, the experimenters ask the participants to identify (from the object-matching sheet) the shape and then record their response. The data collection continues in this fashion until all trials are complete. Setting up and running the basic experiment takes about 15 to 20 min.

Replications

The basic experiment described is a fairly close replication of Gibson's (1962) original study. We have the students begin this project by collecting data using this procedure. The students compute the mean number correct and the standard deviation for the active and passive touch conditions. They also make a tally of the number of incorrect responses per stimulus to determine whether there is a pattern of mistakes.

After completing the first iteration of the study, the student groups discuss the study results, compare their results to Gibson's (1962) data, and identify any confounds they believe may have affected the data. The whole class then discusses the results and possible confounds and picks one of the generated suggestions for redoing the experiment. For example, our classes have proposed that the study should be repeated (a) using only the palms in both the active or passive touch conditions, (b) using only the fingers in both active and passive touch conditions, (c) making passive touch have movement without volition, (d) altering the time allotted for each trial, and (e) changing stimuli due to error patterns. These discussions provide an opportunity to introduce and explore many aspects of experimental design such as the importance of experimental control, the need to change only one independent variable at a time, order effects, and counterbalancing. Data collection proceeds quickly, as the testing of any one participant takes about 5 min. We devote two 75-min class meetings to this project and can run four or five permutations of the procedure in that time period.

Following each permutation, our students compute means and standard deviations. Following the final permutation, they compute means, standard deviations, and inferential statistics. We also then ask them to read a larger sample of the archival studies. The basic literature for the experiment includes the original Gibson (1962) study as well as a series of later studies that altered various aspects of the original procedure (Cronin, 1977; Heller, 1980, 1984; Heller & Myers, 1983; Schwartz, Perey & Azulay, 1975). These articles are all short and accessible, which greatly helps students understand the basic questions and procedures. The improved comprehension later helps students write clear and structured introduction and discussion sections for their American Psychological Association (APA) style experimental reports. Across different semesters, we have asked students to read the literature both before and after data collection. We find that reading the Gibson article before the study and the rest of the articles after they have worked through several permutations of the procedure allows them to discover the confounds on their own. This process demonstrates to our students that they are capable of producing insightful ideas much like those of published scientists.

Assessment

Of all the experiments that our research methods students conduct, this one has proved to be their favorite. They give the projects a high score on the general course evaluation ($M = 4.5$, $SD = 0.75$) based on a scale ranging from 5 (*outstanding*) to 1 (*poor*). We also have the students evaluate the projects separately at the end of the semester and this project always receives the highest average ratings ($M = 4.8$, $SD = 0.47$) with the other project score averages ranging from 3.5 to 4.5, $F(3, 147) = 18.32$, $p < .001$.

This project also led to better comprehension of the course material. We require the students to write APA-style laboratory reports for each of the projects in the class. The papers describing this experiment are noticeably clearer than the others. We asked three faculty members (the course instructor and two others) to read and evaluate the final laboratory paper written by 38 students. Eighteen papers described the active and passive touch experiment. Twenty papers described two other studies (the effect of imagery on memory and the effect of goal orientation on academic success). The evaluators independently rated the papers on eight different criteria: (a) overall quality, (b) use of APA style, (c) organization of information, (d) comprehension and presentation of archival literature and issues, (e) comprehension and presentation of methods, (f) comprehension and presentation of results, (g) integration of current data into a theoretical framework, and (h) discussion of future directions. They assigned a score for each criterion that ranged from 0 to 100 where higher scores

Table 1. Assessment of Laboratory Papers

	Touch		Other			
Criterion	*M*	SD	M	SD	*F*	*p*
Overall quality	83.4	7.6	80.8	9.9	0.65	.426
Use of APA style	87.8	7.4	83.9	10.5	1.91	.176
Organization	91.3	4.7	83.7	11.9	6.79	.014
Archival literature	89.4	6.5	78.6	15.5	6.75	.014
Methods	90.9	4.9	80.8	9.9	15.53	.001
Results	80.8	10.0	77.9	9.6	3.09	.088
Theoretical framework	80.0	10.4	77.4	11.1	1.99	.168
Future directions	75.7	11.8	71.3	16.1	0.90	.349

Note. APA = American Psychological Association.

indicated better performance. The faculty evaluations were quite consistent, $r(326) = .86$, for Readers 1 and 2; $r(62) = .83$, for Readers 1 and 3; and $r(62) = .82$, for Readers 2 and 3. We compared the scores using a MANOVA. As shown in Table 1, the overall quality of the two sets of papers was comparable, as was the use of APA style, the comprehension and presentation of results, integration of current data into a theoretical framework, and discussion of future directions. However, the evaluations for organization of information, comprehension and presentation of archival literature and issues, and comprehension and presentation of methods were significantly higher for the papers describing the active and passive touch study than for the other experiments. We suspect that the advantage is accrued because the literature and the theoretical issues are more accessible, thus enabling our students to write about a topic that they more fully comprehend. Working through confounds step-by-step also aids the understanding of methodology. We can see this effect by looking at course quiz performance. Students who had completed the active and passive touch experiment scored better on the quizzes testing methodological issues addressed within this project than students who had explored these same issues using other experiments ($M = 81.0$, $SD = 10.6$ vs. $M = 74.4$, $SD = 17.3$), $t(48) = 2.57$, $p = .013$.

Conclusions

We have used this experiment for several years in our Research Methods courses and have found the project to be quite valuable in introducing and practicing concepts and techniques in research design. We have also adapted this project for use in a Sensation and Perception course. When we do so, we integrate the project into the larger framework of Gibson's (1966) perception and action theory. We discuss possible neurophysiological evidence distinguishing active and passive touch (Sakata & Iwamura, 1978). In both Sensation and Perception and Research Methods courses, we have found that the project is successful in engaging students in developing and applying skills and knowledge. As such, it embodies the best characteristics of an active learning technique (Mathie et al., 1993; Ware & Johnson, 1996).

References

Cronin, V. (1977). Active and passive touch at four age levels. *Developmental Psychology, 13,* 253–256.

Gibson, J. J. (1962). Observations on active touch. *Psychological Review, 69,* 477–490.

Gibson, J. J. (1966). *The senses considered as perceptual systems.* Boston: Houghton Mifflin.

Heller, M. A. (1980). Reproduction of tactually perceived forms. *Perceptual and Motor Skills, 50,* 943–946.

Heller, M. A. (1984). Active and passive touch: The influence of exploration time on form recognition. *The Journal of General Psychology, 110,* 243–249.

Heller, M. A., & Myers, D. S. (1983). Active and passive tactual recognition of form. *The Journal of General Psychology, 108,* 225–229.

Mathie, V. A., Beins, B., Benjamin, L. T., Jr., Ewing, M. M., Hall, C. C. I., Henderson, B., McAdam, D. W., & Smith, R. A. (1993). Promoting active learning in psychology courses. In T. V. McGovern (Ed.), *Handbook for enhancing undergraduate education in psychology* (pp. 183–214). Washington, DC: American Psychological Association.

Sakata, H., & Iwamura, Y. (1978). Cortical processing of tactile information in the first somatosensory and parietal association areas in the monkey. In G. Gordon (Ed.), *Active touch* (pp. 55–72). New York: Pergamon.

Schwartz, A. S., Perey, A. J., & Azulay, A. (1975). Further analysis of active and passive touch in pattern discrimination. *Bulletin of the Psychonomic Society, 6,* 7–9.

Suter, W. N., & Frank, P. (1986). Using scholarly journals in undergraduate experimental methodology courses. *Teaching of Psychology, 13,* 219–221.

Ware, M. E., & Johnson, D. E. (1996). *Handbook of demonstrations and activities in the teaching of psychology: Vol. 1. Introductory, statistics, research methods, and history.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Note

Send correspondence to Cynthia O'Dell, Indiana University Northwest, Departments of Women's Studies and Psychology, 3400 Broadway, Gary, IN 46408; e-mail: codell@iun.edu.