

Quantitative Methodology: Appropriate use in Research for Blind Baseball Ergonomics and Safety Design

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ABSTRACT

This paper outlines the appropriateness of using a quantitative research methodology that will examine several aspects of beep baseball as a way for the visually-impaired to lead more enjoyable leisure lives. Several experiments are mentioned in connection with this thesis, included are as follows: (1) a determination of the process problems for the visually impaired versus normally sighted people with blindfolds who participate in beep baseball (2) the differences of hearing acuity between the visually impaired people who play beep baseball and those who do not; and (3) a determination of the effectiveness of present day aids and the tools in beep baseball playing versus new and as yet untested technologies.

Keywords: *Blind Baseball, Visually Impaired, Ergonomics*

INTRODUCTION

Quantitative research is appropriate when variables to be used and/or examined are clearly defined and numerical data is present. That seems to be the case here in a dissertation having to do with the study of the effects that beep baseball technologies have now and will have in the future in the improvement of the ability of the visually impaired to lead more enjoyable lives. As well, this research thesis also conducts research to determine whether the visually impaired are able to perform with this kind of technology better than those with normal vision while wearing blindfolds. This type of research methodology is strictly positivistic, objective, scientific, and experimental. Such a research methodology should be used when: (1) a highly structured research design is needed and can be naturally imposed on the experiment being conducted, (2) the researcher needs to be totally objective; is not part of what he or she observes, and does not bring his or her own interests, values, or biases to the research, (3) although the phenomena being captured may be complex, they can be broken down and assigned some type of numerical or at least probabilistic value.

There is no doubt that the research methodology described above is the most appropriate one for use in this study—as this study fits all of three criteria: the research design needs to be structured and experimented in nature (using participants from the National Taichung School for The Visually Impaired in Taiwan); the researcher in this case is definitely and completely objective and unbiased. The only interest brought to the table is the fact that he wishes to conduct this study in order to help improve the lives of those who are visually impaired. This phenomenon can definitely be broken down into smaller components and assigned numeral values. This only comes when determining the difference in hearing acuity between visually impaired beep baseball players and the visually impaired, specifically ones who does not play beep baseball. Therefore, determining whether visually impaired beep baseball players can play the game better than normally sighted people with blindfolds or not, and in determining which of the present-day and potential future tools and aids for playing beep baseball are most useful. This is also known as

the positivistic research philosophy, one of two, with the other being phenomenology (Saunders *et al.*, 2003; Remenyi *et al.*, 1998; Hussey and Hussey, 1997). Table I below provides a breakdown of the differences between the two paradigms as they are often called.

Table 1: Positivism Versus Phenomenology

<i>Positivistic Paradigm</i>	<i>Phenomenological Paradigm</i>
Quantitative	Qualitative
Objective	Subjective
Scientific	Humanistic
Experimentalist	Interpretivist
Traditionalist	Constructivist

(adapted from Hussey and Hussey, 1997, p. 47).

Remenyi *et al.* (1998) state that "being a positivist, or perhaps more correctly a logical positivist, implies that the researcher is working with an observable ... reality and that the end product of such research can be the derivation of laws or law-like generalizations similar to those produced by the physical and natural scientists" (p. 3).

The present study is definitely positive in nature that the researcher will be working with specific physical laws with the assumption and that such laws will remain stable: (1) how to measure hearing acuity; (2) how to determine the differences in reaction times between various participants in the tests; (3) how to examine and test the various tools and aids in terms of specific uses (what they do versus what they are supposed to do). Quantitative methods of research means that a deductive approach is used, as such an approach allows for the setting up of a conceptual and/or theoretical structure before that structure is tested through the use of scientific instruments or other form of empirical observation (Gill and Johnson, 1997). Variables that are set up are to be tested through various propositions or operational hypotheses. As well, there is a set and standard procedure to be followed in order to achieve results with that procedure which is dependent on the type of quantitative method the researcher chooses. Also, this hypotheses can either be proved or disproved. There is no in between level of complexity or doubt. The theory is then either confirmed, modified or abandoned. If a quantitative experiment is conducted properly, a given variable is either one responsible for a series of causes and effects or it is not-and a new one otherwise is tested.

Thus, a highly structured research methodology is to be followed without deviation from start to finish with known limitations placed on the type of information that is going to be acquired through the experiment or study. The information sought is the only one that should be obtained. This, according to Saunders *et al.* (2003), ensures reliability of research findings and allows generalization. Otherwise, the experiment is deemed a failure.

Finally, the experiment must be replicable so that the same information (within measurable parameters) is obtained each time when it is carried out. Deviation from those numbers must be within a set standard as indicated by statistical methods and the researcher must be able to attribute them to "residue." One of the things that the quantitative research methods are not good for is when it is in studying and/or analyzing causal relations among social phenomena. According to Little (1998), when it is among the conditions that rule out a strictly quantitative method, it would be:

1. Such causal relations or connections among classes and kinds of social events/phenomena are not made up of the same kinds of laws or regularities that we have found in the natural world.

2. Rather, these causal relations that link or bind social events/phenomena are made up of the causal powers found in the events, social structures, hierarchies, etc.; which are combined with the type of causal mechanisms that are time-driven, moving from antecedents to outcomes.
3. To make matters even more complicated, there can be no such creature as "pure social causation," which we can use to make deductions from one macro-state to another. We must always break everything back down to the micro-state and start over again because no two conditions/phenomena/situations/events are ever the same on the macro-level.
4. Unlike a mathematical equation, explanations for one or other social causation can be multiple and myriad. This causative diversity cannot be handled by quantitative methods which would need to return the same responses each time.

As seen here, none of the conditions above can be used to disqualify a quantitative research methodology for this study of ergonomics and safety design in blind baseball. In fact, exactly the opposite is true. The quantitative research design is very appropriate in this case-as it is exactly the measurement of the efficacy of such designs and devices. Also an attempt to uncover which will be the best for use in future iterations of blind baseball that forms the core of this study.

TYPES OF QUANTITATIVE METHODOLOGIES

Quantitative research methods can all be listed under the natural or hard science grouping. Among the methods are: experimental, quasi-experimental, evaluation research, surveys, existing data, causal-comparative, and meta-analysis. Each of these has its own approach, but with similar underlying assumptions: a positivistic philosophy with results are quantified so they can be converted for statistical analysis. Quantitative methods work under a "normative" approach, with two key ideas: "first, that ... behavior is essentially rule-governed; and second, that it should be investigated by the methods of natural science" (Cohen *et al.*, 2000, p. 22). The focus is on the experiment, control, objectivity, precise measurement, quantification of data, and description of results in statistical terms.

Experiments

Central to experimental research is the deliberate control and manipulation of the conditions to see which, if any, of the variables causes the events that occur. Experiments consist of making an observable and quantifiable change in one variable, the independent variable; and then observing how that affects other variables, the dependent variables. Cohen *et al.* (2000) give as an example an experiment to test the efficacy of a fertilizer on wheat growth:

Scientists would take the bag of wheat seed and randomly split it into two equal parts. One part would be grown under normal existing conditions, controlled and measured amounts of soil, warmth, water and light and no other factors. This would be called the control group. The other part would be grown under the same conditions, the same controlled and measured amounts of soil, warmth, water and light as the control group with the new wonder-fertilizer added additionally. Finally, four months later, the two groups are examined and their growth measured (p. 211).

Quasi-Experiments

True experiments and quasi-experiments differ in the selection process. A true experiment needs the selection process for the control group versus the group to be tested to be random. In a quasi-experiment,

that is not possible for one reason or another. In this case, the groups are already existing-students in a classroom, for example, or executives within a set of corporations.

Evaluation Research

When researchers speak of evaluation research within a quantitative paradigm, they are speaking of systematic evaluation, conducted under the same conditions and circumstances as any other approach to gathering evidence and information. These conditions are: (1) the ability to duplicate results through the same instruments; (2) the ability to conduct further tests on the evidence to see if any findings could have taken place without the intervention. According to Fischer (1980):

Emphasizing experimental design, evaluation research focuses on the identification of the aspects of the situation or target populations that are to be changed, the measurement of their state before introduction of the program, and measurement again after completion of the program. To assure that the effectiveness of the evaluatum (rather than other extraneous variables) being measured, a control situation that does not receive the program is ideally introduced for the purpose of comparison (p. 117).

Surveys

There are two sampling methods for testing a subset of the general population for any particular research problem: probability and non-probability methods. In probability methods, theoretically every person within the subset being studied has the opportunity to partake in the sample (random sampling); in non-probability methods, randomness is not used. Normally, the idea in probability sampling is to achieve as close a representative subset of the general population under study as possible, given constraints on time, feasibility and costs (Thomas, 2004, p. 103-104). Among the ways surveys gather information is through one or a combination of the following methods: structured or semi-structured interviews, attitude scales, self-completion questionnaires, and standardized tests of achievement or performance: "The attractions of a survey lie in its appeal to generalizability or universality within given parameters, its ability to make statements which are supported by large data banks and its ability to establish the degree of confidence which can be placed in a set of findings" (Cohen *et al.*, 2000, p. 171).

Existing Data

In existing data research, the researcher uses data, documents, records, etc. that was in existence prior to any data collection on the part of the researcher. In other words, the data was not created specifically by the researcher for the particular project in which it will be used. These existing data sets are subject to a variety of limitations including: potential errors in selection and sampling; changes in recording methods and techniques; a lack of fit between one database and another or one set of data and another; outdated information.

Causal-Comparative

Causal-Comparative research resembles experimental research in some ways in that two groups are examined to determine the variables that are causing the differences between them. However, while in experimental research, one of the groups that has its variables manipulated by the researcher, this is not the case in causal-comparative research. According to Fraenkel and Wallen (2001): "Causal-comparative researchers attempt to determine the cause or consequences of differences that already exist among groups of individuals ... This is in contrast to an experimental study, in which a researcher creates a dif-

ference between groups, and then compares their performance (on one or more dependent variables) to determine the effects of the created difference" (p. 330).

Meta-Analysis

Meta-Analytic research arose out of the concern that traditional analysis and systematic review of studies dealing with a particular subject matter were too dependent on the judgment of a specific reviewer. Thus meta-analysis arises (Smith, Glass and Miller, 1981). According to Fraenkel and Wallen (2001): "Put simply, when a researcher does a meta-analysis, he or she averages the results of selected studies to get an overall index of outcome or relationship. This is done statistically" (p.76). A meta-analysis quantifies, integrates and analyzes empirical study findings with respect to a particular hypothesis or subject. The way it does this is through what is called the effect size, a statistical quantification defined as the difference between the means of the experimental and control conditions divided by the standard deviation (Glass, 1976; Wolf, 1986).

APPROPRIATE QUANTITATIVE RESEARCH METHOD

As stated in the original paper on The Ergonomics and Safety Design For Participation in Blind Baseball in Taiwan for The Visually Impaired, this particular thesis was to examine the effects of beep baseball and the technological aids and tools used. With the help of the National Taichung School for The Visually Impaired in Taiwan and the members of its blind baseball team, research will be conducted to determine:

(a) The process problems in the participation of the visually impaired versus those who have normal vision (but are blindfolded). The preliminary hypothesis will be that the visually impaired will find it less difficult to adapt to the game of beep baseball than normally sighted people with blindfolds; (b) The difference in hearing acuity between the visually impaired who participate in blind baseball and the visually impaired who do not. The preliminary hypothesis will be that the visually impaired who play blind baseball will have higher levels of hearing acuity compared to those who do not play. (c) A third set of experiments will be conducted to determine the usefulness of the various aids and tools presently used by blind baseball versus newer and updated technologies that are already in existence and could possibly be used in the future.

Again, the hypothesis will be that visually impaired beep baseball players will find present-day technologies more utile because they are used to those versus having to adapt to new ones-even if the new ones are better and will eventually allow them to play better. From this, it would seem that the most appropriate quantitative research designs from those listed above could be narrowed down to the experimental, quasi-experimental, and causal-comparative.

Because the sample being selected for the hypothesis is not random, but rather consists of already selected students from the National Taichung School for The Visually Impaired, the true experiment may be ruled out. A quasi-experimental approach would be appropriate for any experiment among the blind baseball players that makes use of new technology for playing the game versus the present-day technology. In this case, the researcher would use the same players-only the equipment they use would be altered to determine which technologies better enhance the performance during the game.

On the other hand, a causal-comparative research approach would be more appropriate in experiments that require different sets of visually-impaired students. For example, an experiment that would try to determine whether visually-impaired students who play blind baseball develop better hearing acuity

than those who do not play blind baseball. In this case, there is no manipulation of variables (such as updated beeping baseballs or electronic methods of sensing a ball coming at a player). Rather, one group has one set of variables and the other another set. The object is to determine the difference between them.

As for the part of the study that compares the play of visually impaired beep baseball players versus normally-sighted people wearing blindfolds, a causal-comparative approach would again seem to be the most appropriate. Here, again, the variables are already present within the two groups and do not need to be introduced in order to be manipulated. The one variable that is of importance is the fact that one group is visually impaired while the other is not. As a side note, if a fourth experiment could be carried out, it would be to determine whether visually-impaired students who have never played beep baseball before would be better at it than normally-sighted students who also have never played the game before. The hypothesis here would be that visually impaired students would be better because of the training they have received with picking up aural cues, training that the majority of normally sighted people have not.

CONCLUDING REMARKS

A quantitative research methodology seems appropriate for use in this study. The research contains all the parameters needed for a quantitative design, including the fact that it is highly structured, and the results will be determined numerically or statistically. Also, the variables are clearly defined; the researcher is working within objective parameters; and the phenomena to be captured, no matter how complex, can be deconstructed into smaller pieces, all of which are measurable. As well, all the experiments described will result in conclusions that will either prove or disprove the hypothesis accompanying it. As for the specific research designs for the experiments recommended for the thesis, two appear most appropriate for the particular experiments: the quasi-experimental and the causal-comparative.

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