



Research Methods for Simple and Complex Systems
By David Alderoty © 2015

Chapter 5) Observational Research for Simple and Complex Systems, with Related Concepts
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Important Notes

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The material in this chapter is focused on [observational research](#), which does not involve experimental manipulation of the systems that are studied. However, all experimental research involves observations. Thus, many of the techniques and concepts presented in this section also apply to studies that involve experimentation.

Often, the [term observational research](#) is used in the social and psychological sciences, including marketing. In this e-book, the term observational research applies to any type of non-experimental research, including studies that involve astronomy, biology, chemistry, ecology, medicine, and physics.

Observational Research (Non-Experimental Research)

The Definitions, and Descriptions of Observational Research, Varies from One Source to Another

[Observational research is defined a number of ways](#), depending on the source, and its focus. The focus is often [on the social sciences, and the concept is defined and described for human studies](#).

In this e-book, OBSERVATIONAL RESEARCH is defined very broadly, so that it will apply to **ALL NON-EXPERIMENTAL**

STUDIES of simple and complex systems. This includes the systems of the physical, biological, and social sciences, and can involve study of subatomic particles, atoms, molecules, plants, animals, people, machines, and celestial objects. (Some sources Page 3 / 19 called the above **Non-Experimental Research**, because it excludes experimental manipulation.)

Some sources might define observational research, in a narrow sense, which involves just watching and/or listening, and excludes all interventions. This would **exclude** interviews, questionnaires, and laboratory evaluation of samples. In this e-book, I am calling this **purser observational research**.

Precisely, What is Observational Research?

Based on the way am using the terminology, observational research is a strategy to obtain information about a **system** by **observing** it, and/or by **examining samples** that relate to the system. This is done **WITHOUT experimentally modifying or manipulating** the system. Some sources call the above non-experimental research.

Note: The red underlined words and related concepts are explained in the following six paragraphs.

The **system** can be anything that a researcher wants to study with observational research. A few examples are presented below:

- In chemistry, the systems can be molecules, chemicals, or a beaker of reacting chemicals.
- In physics, mechanics, or electronics, the systems can be subatomic particles, electrons, atoms, gravitational field of a planet, a magnet, a nuclear reactor, an electronic circuit, a computer, or any type of mechanical or electrical device.
- In the natural sciences, systems can be plants, microorganisms, insects, fish, snakes, a flock of birds, fossils, or any entity that is alive, or was alive at one time.
- In geology or earth science, the systems can be mineral deposits, rocks, caves, mountains, volcanoes, earthquake faults, tectonic plates, rivers, lakes, streams, geologic structures, or any natural formation composed of rock or minerals.
- In astronomy and astrophysics, the systems can be the moon, planets, asteroids, the sun, a cluster of stars, galaxies, black holes, or any other celestial body.
- In psychology, the systems can be animals, individuals with specific psychological disorders, people with unique abilities, personalities, or behavior patterns, as well as individuals with typical psychological profiles.
- In the social sciences, the systems can be a political party, a social club, a street gang, a social organization, a cultural group, a group of individuals comprising a subculture, the population of a city, state, or nation

- In marketing, and product development, the systems can be customers, potential consumers of a product, people using a new product, sales clerks, and service providers.

Observing is used in a very general sense in this e-book, and it means taking in information through our senses, and/or with photographic or electrical devices. Thus, the term is not limited to vision, and it includes, hearing, smelling, and touching.

Observing can sometimes involve special equipment to circumvent the limitations of our senses. This equipment may display the observed data in the form of images, numbers, graphs, and other formats. A few examples are microscopes, telescopes, thermometers, galvanometers, oscilloscopes, seismographs, and cameras that can display images, with x-rays, infrared, or ultraviolet.

Examining samples, can involve laboratory evaluations for chemical composition, mass, density, and age, such as to evaluate rocks, mineral deposits, or fossils. Living samples might be dissected to examine internal structures, and DNA evaluations of the genetic makeup might be performed. Very small objects may be prepared for examination with electron or light microscopes. In the social sciences, samples of a social group or population are frequently evaluated with surveys, and/or interviews.

The data from the **observations,** and/or from the **examination of samples** are **recorded,** which can be done

manually, photographically, and/or electronically. Manually recording the data usually involves simple note taking, which generally requires a special effort to be objective. This includes avoiding interpretations or inferences in the verbal descriptions that might distort the data.

However, after the data is collected, the researcher evaluates it, and might make inferences, interpretations, and explain the data in terms of a set of related sequences, or in terms of a theoretical framework. Mathematical evaluation of the data might be carried out, which can involve calculations with various types of formulas, as well as statistical computations. The researcher may devise a new hypothesis based on the data, and/or explain how the data supports or refutes a specific hypothesis. All of this might represent a general discussion that leads to a conclusion in a scientific paper.

Summarizing Observational Research in Three Steps

An observational research project may be complex, and it may involve dozens of steps. However, it can be summarized in a simplified way with the following three steps:

- 1) **OBSERVING, AND/OR EXAMINING SAMPLES:** Observational research involves observing the system, and/or examining one or more samples that relate to the system. This can include evaluating the functionality, behavior, and/or structure of a system.

2) **RECORDING THE DATA:** The data obtained from step one is recorded. This can be done manually, such as by taking notes, or more scientifically with equipment, such as with video cameras, and tape recorders.

3) **EVALUATING THE DATA, AND DEVISING A CONCLUSION:**

This can involve, organizing the data, and in some cases evaluating it mathematically, as well as devising inferences and hypotheses from the data. The data may be explained in terms of a theory, a problem, a set of related behavior patterns, or cause-and-effect sequences. The researcher may use the data to explain how it supports or refutes a hypothesis. All of the above may represent a discussion that leads to the conclusion, in a scientific paper.

**A Practical form of Observational Research,
That is Used in Everyday life, consists of Observational
Learning, and Devising Inferences and Conclusions**

The three steps that comprise observational research, described above, are not only used in scientific studies. That is observational research is used by all of us, throughout life, in an informal and simplified way. This can also be called observational learning, and devising related inferences and conclusions. This is explained in the following paragraphs.

We learn about people, and other systems we encounter in everyday life, by **observations**. With some occupations, a type of observational research is commonly carried out, such as to evaluate problems, to assess progress towards a goal, and to evaluate equipment and personnel.

Usually, we **record** our day-to-day observations with memory, which can take place unconsciously. Some people also record their observations in written language, such as describing their experiences in a diary. On-the-job, especially with professional occupations, observations are often recorded by taking notes, and/or writing reports.

The data we obtain from our observations are usually **evaluated** in our minds, which may take place on a conscious or unconscious level. This involves deriving various types of conclusions about the systems we encounter, such as **personal:** beliefs, hypotheses, and theories. These conclusions might not be scientifically correct, but they may work well for the individual that created them. This is because they may represent the reactions the individual obtains from the people he or she encounters frequently. For example, an individual that habitually violates traffic regulations, and gets many summonses, may conclude that traffic cops are mean. Thus, he would try to avoid cops, especially while driving, because of his conclusion.

In the following four paragraphs, there are some examples of **the informal and simplified observational research that takes place in everyday life, consisting of learning by observations, and devising inferences, and related conclusions.**

We initially learn about the world we live in, from infancy to adulthood, primarily by the process of observation. This involves

observing the systems in our environment, such as people, pets, toys, appliances, tools, and utensils, and devising related inferences and conclusions. This includes the development of expectations and an understanding of the people, and other systems we encounter in daily life.

We get to know people, and build relationships, with observational learning. This involves learning about the behavior patterns, and emotional and verbal responses of the people we are getting to know. With the information obtained from our observations, we develop conclusions about the people we are interacting with, throughout life.

When we seek the services of a physician, he or she evaluates our medical problem, and current state of health through a process of observation. This may include use of instruments to circumvent the limitations of his or her senses, such as stethoscopes, blood pressure monitors, x-rays, CAT scans, and cardiograms. Physicians, commonly evaluate samples, with laboratory evaluations. This involves chemically evaluating blood, and urine.

For Additional Information, or Alternative Points of View, On Observational Research, and Related Concepts, see the following Websites from other Authors

- 1) [Google search page: "Observational Research"](#),
- 2) [Observation](#), 3) [Key features in qualitative observation](#),
- 4) [How is observational learning used in everyday life?](#),

5) [Pragmatic and Observational Research](#), 6) [Observational Research](#), 7) [Observational Techniques in Marketing Research](#), 8) [What is observation?](#), 9) [Seven rules for observational research: how to watch people do stuff](#), 10) [Non-Experimental and Experimental Research: Differences, Advantages & Disadvantages](#), 11) [What is Observational Research](#), 12) [LEARNING BY PURE OBSERVATION](#), 13) [How to Use Observations in a Research Project, by NICK FOX](#), 14) [Google video search page "Observational research"](#), 15) [Video: Ethnography or observational research](#), 15) [Video: Non-experimental Research Design](#)

Observational Research, and Experimentation

What is the Difference Between Observational Research, And Experimental Research

With ***experimental research***, a system is **manipulated or modified in some way**, by the researcher. This is done with the goal of **obtaining data about the manipulated or modified system**.

With ***observational research***, the system is **NOT modified, NOT manipulated, or changed in any way**. This is done with the **goal of obtaining information about a system in its current state, or under normal conditions**.

It is interesting to note that both **experimental research**, and **observational research**, involves an effort to obtain information about a system, by observing it, and/or by examining samples that relate to the system. However, experimental research involves systems that have been experimentally manipulated, and observational research involves the study of systems that have not been manipulated.

In general, **observational research** is useful for discovering unknown phenomena, especially when equipment is used to circumvent the limitations of our senses. **Experimental research** is useful for testing hypotheses, and for creating new methods, drugs, and technologies.

From a practical perspective, observational research is useful for identifying problems, including the causes and contributing factors to problems. **Experimental research** can be useful for devising techniques, equipment, and chemicals that can solve the problems. This is illustrated with the following hypothetical research projects:

Example 1)

OBSERVATIONAL RESEARCH: A research project is created to determine the chemicals that are polluting a river. This study will not indicate how to reduce or neutralize the pollutants, but the following experimental research would provide this information.

EXPERIMENTAL RESEARCH: An experimental study is created to devise techniques of reducing or neutralizing the various

chemicals that are polluting the river. This study cannot be carried out without the observational study presented above, which determines the specific chemicals that are polluting the river.

Example 2)

OBSERVATIONAL RESEARCH: A study is device to evaluate the productivity and efficiency of a workgroup, with the equipment they have been using for several years. This study would not provide any information about new equipment that might increase the efficiency of the workgroup, but the experimental research below would provide this information.

EXPERIMENTAL RESEARCH: A research study is created to experiment with newly developed equipment, to determine if any of this equipment increases the productivity and efficiency of the workgroup. These experiments could **not** be carried out without the observational study presented above, which establishes a benchmark for productivity and efficiency, based on the old equipment.

Example 3)

OBSERVATIONAL RESEARCH: An observational study is created to determine the social and psychological factors that interfere with academic achievement. This research would not abolish the problematic factors. However, the experimental research presented below, might provide the information needed to reduce or eliminate these factors.

EXPERIMENTAL RESEARCH: A research project is created, consisting of a series of experiments, to devise strategies to eliminate or circumvent the social and psychological factors that interfere with academic achievement. These experiments can only be carried out if the observational research, presented above, identified the factors that were interfering with academic achievement.

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The most important concepts of this subsection can be summarized as follows: Observational research can provide a picture of the current state of affairs of a system. This may include the dynamics, structure, and/or malfunctions of a system. Experimental research can be used to devise methods, devices, or chemicals to change or improve the current state of affairs of a system.

For additional information, and alternative points of view on observational research versus experimentation, see the following websites from other authors. **1)** [Experiments vs. Observational Studies](#), **2)** [Observational Studies and Experiments](#), **3)** [Observational Versus Experimental Studies: What's the Evidence for a Hierarchy?](#), **4)** [Non-Experimental and Experimental Research: Differences, Advantages & Disadvantages](#), **5)** [Video: Observational Study vs Experiment](#), **6)** [Video: Observational vs Experimental study designs](#), **7)** [Video: Experimental Design - Observational Studies](#)

Observational Research to Study the Results of Spontaneously Occurring Experiments

As was explained above, with observational research, the system that is studied is **not** experimentally manipulated or modified, by the researcher. However, sometimes systems are spontaneously manipulated or modified by nature, or intentionally or inadvertently by the collective action of human beings. I am defining the spontaneous manipulation or modification of a system as a ***spontaneously occurring experiment, which can be studied with observational research.*** All of the above will be clarified, with the examples presented in the following paragraphs.

Some examples of factors that can spontaneously modify system include all of the following: earthquakes, volcanoes, floods, storms, snow, erosion, invasive species, pollution, farmers, fishermen, miners, loggers, hunters, automobile drivers, manufacturing facilities, waste disposal, construction projects, and proliferation of cities.

Systems comprised of human beings, such as cultural groups, and society in general, are often spontaneously manipulated or modified by one or more of the following: social trends, technological developments, mass epidemics, natural disasters, economics, political dynamics, and war.

Some examples of potential observational research projects, that involve spontaneously occurring experiments, are presented below:

- Studies on how people respond to major disasters, such as earthquakes, electrical blackouts, military or terrorists attacks on the city or village. This can involve studying the initial responses to the disaster, or the long-term impact of the disaster that may continue for many years.
- Studies on how wild animals adjust to pollution, automobile traffic, people, the development of cities
- Studies on how marriages are affected by one or more of the following: economic recessions, loss of employment by the husband, loss of employment by the wife, a wife that earns more than her husband, a husband that develops a serious medical condition, a wife that develop a serious medical condition

There is a major advantage of spontaneously occurring experiments, over conventional experimentation. Specifically, the researcher cannot expose people to destructive or potentially hazardous factors to obtain data and device a conclusion. For example, if you wanted to study the impact of long-term heroin use on health, you obviously could not expose human subjects to heroin for a few years. However, you can carry out this study by looking for spontaneous occurring experiments. With this example, you would search for volunteers that have been heroin addicts for three years or longer, and evaluate their health. Then you would compare the health of the addicts, with people of the same age and sex, who never used heroin, to obtain the results.

Presented below, there are three additional examples of spontaneously occurring experiments, which were studied with observational research. These studies are **NOT** hypothetical. However, they do not appear to be formal scientific studies, but they are very good examples, and quite interesting.

With the following examples, the *red italicized underlined words represent the system that was spontaneously modified*. The *black italicized, underlined words represent the results of the spontaneous modification*.

EXAMPLE 1, OF A SPONTANEOUSLY OCCURRING

EXPERIMENT: *When crows were spontaneously exposed to an urban environment, the result was the development of new behavior patterns, in relation to food consumption. The birds use moving automobiles to crack open nuts, which are too hard to open with their beaks.* The above is based on a YouTube video, which can be accessed from the following link: [Wild crows inhabiting Japanese city, BBC wildlife, David Attenborough](#)

EXAMPLE 2, OF A SPONTANEOUSLY OCCURRING

EXPERIMENT: *When swallows were spontaneously exposed to an environment with automobile traffic, the initial results were collisions with moving vehicles, resulting in the death of many birds. However, the long-term results were the evolvment of shorter wings that are suitable for dodging moving vehicles.* The above, is based on a web-based article, which can be accessed by clicking on the following link. [Swallows may be evolving to dodge traffic, by Beth Marie Mole](#)

EXAMPLE 3, OF A SPONTANEOUSLY OCCURRING

EXPERIMENT: 300 years ago, Monkeys were introduced into a Caribbean island, by the **rum industry**. *These monkeys and their present day descendants are living in an environment abundant with alcoholic beverages.* *As a result, some of these monkeys developed the habit of stealing and consuming alcoholic beverages.* All of the above is based on a YouTube video, which can be accessed by left clicking on the following link. [Alcoholic Monkeys! - Weird Nature - BBC animals.](#)

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Interestingly, the video attributes the monkey's behavior to genetics. This is consistent with the current trend, where almost every behavior pattern, habits, and psychological disorder is erroneously attributed to genetics. There is no evidence that monkeys naturally crave alcohol. Monkeys of course naturally crave food and water, which is genetically based. It is obvious that the monkeys learned the habit of consuming alcohol, as a result of environmental conditions. This learning was passed down from one generation to another, over the last 300 years.

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