Supervised Advanced Experimental Psychology

PSY 594

By

Dr: Adebayo O Adejumo
Dept of Psychology
University of Ibadan

General Introduction and Course Objective

PSY 594 is designed to afford the advanced student an opportunity to put into practice theoretical skills acquired in previous statistics and research methods. The Distance Learning Centre Bachelor of Science Psychology curriculum offers carefully planned series of instructions cutting across a five-year period of academic activities on the open and distance learning platform. This includes lectures on research methodologies, and statistics among others.

Considering that a major deficiency of this approach is the lack of emphasis on practical skills, PSY 594 is therefore an effort to fill the gap by providing practice-based instructions which if rightly applied equips the learner with skills required for evidenced based experimental psychological researches.

I therefore recommend this reading material not only to students of the Distance Learner Centre, but other researchers willing to establish cause and effect relationship in their basic and applied researches.

Therefore, every lecture must be effectively handled with total commitment and renewed dedication.

LECTURE ONE

The meaning and brief history of experimental psychology

Introduction

In this lecture, I intend to succinctly define the concept of experimental psychology and to also remind you of the major highlights in the history of experimental psychology.

The field of experimental psychology employs the scientific method in the quest for establishing cause and effect relationship. Compared to other techniques of research, there is greater emphasis on precision; nothing is left to guess-work. This Chapter highlights the contributions of early scientists who, through their efforts in experimentation brought fame to the field of experimental psychology.

Objectives

At the end of this lecture, you should be able to:

1. explore the meaning of psychology
2. explain the features / characteristics of experiments
3. highlight the main features of the history experimental psychology

Pre-Test

1. Define psychology
2. Highlight the features of experiments
3. Discuss the features of experimental psychology

CONTENT

Introduction

According to Pastorino and Portillo (2012), psychology is the scientific study of behaviour and mental processes. Ciccarelli and Meyer (2006) further explain that behaviour incorporates all our overt actions and reactions. Our mental processes also constitute a type of behavior, i.e.

the covert activity of our minds (cited in Barker, 2007). Psychology is the study of the mind, occurring partly via the study of behavior. Grounded in scientific method, psychology has the immediate goal of understanding individuals and groups by both establishing general principles and researching specific cases. To achieve these, psychologists assess, describe, explain, predict and control the mental processes and behaviours of humans and animals.

Psychology originated from philosophy. However, with the passage of time its nature has undergone a change from sheer speculation to the scientific procedure. Defined first as the study of soul in its history of evolution, it has been known gradually as the study of mind, study of consciousness and finally study of behaviour. Today it is considered as the science of behaviour (when behaviour is taken in its comprehensive meaning involving all types of behaviour of all living organisms,humans and animals inclusive).

Psychology by nature is quite scientific and not philosophical or mysterious as supposed to be considered in days gone by. Like sciences, it believes in cause and effect relationship, utilizes observation, experimentation, and other scientific methods for its study, possesses a universally accepted body of facts and believes in the modification and alterations in its principles through future researches and findings. However, it is not so perfect and developed a science as the other natural and physical sciences. In fact, it is a developing behavioural science that is trying hard to become as much objective, exact, and accurate as possible to be on a par with the developed sciences. Therefore, it is termed as a developing positive science (and not as a science) of behaviour.

However, the scope of psychology is so wide. It studies, describes and explains the behaviour of all the living organisms, including animals. No limit can be imposed upon the scope of the subject psychology. It has many branches and fields of studies. For convenience, it can broadly be divided as pure and applied psychology.

An experiment is an orderly procedure carried out with the goal of verifying, refuting, or establishing the validity of a hypothesis. Controlled experiments provide insight into cause and-effect by demonstrating what outcome occurs when a particular factor is manipulated. Controlled experiments vary greatly in their goal and scale, but always rely on repeatable procedure and logical analysis of the results. There also exist natural experimental studies.

Experimental psychology is a branch of pure psychology. This branch of psychology describes and explains the ways and means of carrying out psychological experiments following scientific methods in controlled or laboratory situations for the study of mental processes and behaviour. It picks up animals, birds and human beings as subjects for these experiments. This not-withstanding, experimental psychology often involves human participants.

Features of good experiments

Snee and Hare, (1992) highlighted that a good experiment has the following features:

1. Provides unbiased estimates of the factor effects and associated uncertainties
2. Enables the experimenter to detect important differences
3. Includes the plan for analysis and reporting of the results
4. Gives results that are easy to interpret
5. Permits conclusions that have wide validity
6. Shows the direction of better results
7. Is as simple as possible

It is also required that good experiments possess these characteristics.

1. Time order of variable: Time order means putting one's ideas in the order in which they happened. When planning and reporting a psychological research activity, there is the need to use time order. Events have to be sequenced, such that it begins with the first event or activity, then the second, and further still, in that sequence. The concept of time order is needed to help the reader of the report understand what and when something happened. If an experiment is conducted without recourse to time order, it will become difficult to replicate or understand the experiment.

2. Manipulation of the independent variable(s): The investigator consciously introduces an independent variable or known stimulus or substance into a dependent or outcome variable to discover whether it will lead to a change, and also what level of impact it would make on the dependent variable.

3. Relationship between variable: A good experiment should clarify significant connection or similarity between two or more variables, or the state of being related to another variable.

4. Use of a control group: The control group is composed of participants who do not receive the experimental treatment. When conducting an experiment, these people are randomly selected to

be in this group. They also closely resemble the participants who are in the experimental group, or the individuals who receive the treatment.

While they do not receive the treatment, they do play a vital role in the research process. Experimenters compare the experimental group to the control group to determine if the treatment had an effect. By serving as a comparison group, researchers are able to isolate the independent variable and look at the impact it had.

5. Random sampling and random assignment: Random sampling is a sampling technique where we select a group of subjects (a sample) for study from a larger group (a population). Each individual is chosen entirely by chance and each member of the population has a known, but possibly non-equal, chance of being included in the sample.

By using random sampling, the likelihood of bias is reduced.

6. Variables are held constant

This involves the keeping or handling of participants involved in an experiment under the same conditions within the course of the research. Doing this requires a precise and testable definition of what the variables are and how they are measured within the context of the investigation. The main purpose is control. By the researcher's understanding of what he is measuring, he can control for it by holding the variables constant between all of the groups or manipulating it as appropriate. This provides the rationale for excluding extraneous variables.

History of Experimental Psychology

Wilhelm Wundt, German doctor and psychologist, was responsible for creating the world's first experimental psychology lab. This lab was established in 1879 at the University of Leipzig in Germany. By creating an academic laboratory devoted to the study of experimental psychology, Wundt officially took psychology from a sub-discipline of philosophy and biology to a unique scientific discipline. Wundt had a significant influence on early psychology and left his mark on some of his most famous students who included James McKeen Catell and G. Stanley Hall. In 1883, Wundt's student G. Stanley Hall created the first experimental psychology lab in the United States at John Hopkins University. However, there are other accounts attributing the establishment of the first psychology laboratory to William James at Harvard University; in 1875, a full four years before Wundt established his lab and eight years before Hall established his.

Universities created independent chairs in psychology shortly thereafter; and William James published the landmark work *Principles of Psychology* in 1890. In *A History of Modern Experimental Psychology,* George Mandler traces the evolution of modern experimental and theoretical psychology from these beginnings to the "cognitive revolution" of the late twentieth century. Throughout, he emphasizes the social and cultural context, showing how different theoretical developments reflect the characteristics and values of the society in which they occurred. Thus, Gestalt psychology can be seen to mirror the changes in visual and intellectual culture at the turn of the century, behaviorism to embody the parochial and puritanical concerns of early twentieth-century America, and contemporary cognitive psychology as a product of the postwar revolution in information and communication.

Early experimental psychologists

Charles Bell

Charles Bell was a British physiologist. His main contribution was research involving nerves. He wrote a pamphlet summarizing his research on rabbits. His research concluded that sensory nerves enter at the posterior (dorsal) roots of the spinal cord and motor nerves emerge from the anterior (ventral) roots of the spinal cord. Eleven years later, a French physiologist Francois Magendie published the same findings without being aware of Bell's research. Due to Bell not publishing his research, the discovery was called the Bell-Magendie law. Bell's discovery disproved the belief that nerves transmitted either vibrations or spirits.

Ernst Heinrich Weber

Weber was a German physician who is credited with being one of the founders of experimental psychology. His main interests were the sense of touch and kinesthesis. His most memorable contribution is the suggestion that judgments of sensory differences are relative and not absolute. This relativity is expressed in "Weber's Law," which suggests that the just noticeable difference, or jnd is a constant proportion of the ongoing stimulus level. Weber's law is considered the first quantitative law in the history of psychology(Hergenhahn, 2009).

Gustav Fechner

Fechner published in 1860 what is considered to be the first work of experimental psychology, "Elemente der Psychophysik (Fraisse, Piaget, Reuchlin,1963). Some historians date the beginning of experimental psychology from the publication of "Elemente." Weber was not a

psychologist, and it was Fechner who realized the importance of Webers research to psychology. Fechner was profoundly interested establishing a scientific study of the mind-body relationship, which became known as psychophysics. Much of Fechner's research focused on the measurement of psychophysical thresholds and just noticeable differences, and he invented the psychophysical method of limits, the method of constant stimuli, and the method of adjustment, which are still in use.

Oswald Klpe

He was a pupil of Wilhelm Wundt for about twelve years. Unlike Wundt, Klpe believed experiments were possible to test higher mental processes. In 1883 he wrote Grundriss der Psychologie, which had strictly scientific facts and no mention of thought (Fraisse, Piaget, Reuchlin,1963). The lack of thought in his book is odd because the Wrzburg School put a lot of emphasis on mental set and imageless thought.

Wrzburg School

The work of the Wrzburg School was a milestone in the development of experimental psychology.

The School was founded by a group of psychologists led by Oswald Klpe, and it provided an alternative to the structuralism of Edward Titchener and Wilhelm Wundt. Those in the School focussed mainly on mental operations such as mental set (*Einstellung*) and imageless thought. Mental set affects perception and problem solving without the awareness of the individual; it can be triggered by instructions or by experience Similarly, according to Klpe, imageless thought consists of pure mental acts that do not involve mental images. An example of mental set was provided by William Bryan, an American student working in Klpe's laboratory. Bryan presented subjects with cards that had nonsense syllables written on them in various colors. The subjects were told to attend to the syllables, and in consequence they did not remember the colors of the nonsense syllables. Such results made people question the validity of introspection as a research tool, and let to a decline of voluntarism and structuralism. The work of the Wrzburg School later influenced many Gestalt psychologist, including Max Wertheimer.

George Trumbull Ladd

Experimental psychology was introduced into the United States by George Trumbull Ladd, who founded Yale University's psychological laboratory in 1879. In 1887, Ladd published *Elements of Physiological Psychology*, the first American textbook that extensively discussed experimental psychology. Between Ladd's founding of the Yale Laboratory and his textbook, the center of experimental psychology in the US shifted to Johns Hopkins University, where George Hall and Charles Saunders were extending and qualifying Wundt's work.

Charles Sanders Peirce

With his student Joseph Jastrow, Charles S. Peirce randomly assigned volunteers to a blinded, repeated-measures design to evaluate their ability to discriminate weights (Peirce & Jastrow, 1885). Peirce's experiment inspired other researchers in psychology and education, which developed a research tradition of randomized experiments in laboratories and specialized textbooks in the 1800s (Peirce & Jastrow, 1885). The Peirce Jastrow experiments were conducted as part of Peirce's pragmatic program to understand human perception; other studies considered perception of light, etc. While Peirce was making advances in experimental psychology and psychophysics, he was also developing a theory of statistical inference, which was published in Illustrations of the Logic of Science (187778) and A Theory of Probable Inference (1883); both publications that emphasized the importance of randomization-based inference in statistics. To Peirce and to experimental psychology belongs the honor of having invented randomized experiments, decades before the innovations of Neyman and Fisher in agriculture (Peirce & Jastrow, 1885).

Peirce's pragmaticist philosophy also included an extensive theory of mental representations and cognition, which he studied under the name of semiotics (Liszka, 1996). Peirce's student Joseph Jastrow, continued to conduct randomized experiments throughout his distinguished career in experimental psychology, much of which would later be recognized as cognitive psychology. There has been a resurgence of interest in Peirce's work in cognitive psychology (Sowa, 1984), Another student of Peirce, John Dewey, conducted experiments on human cognition, particularly in schools, as part of his "experimental logic" and "public philosophy."

20th century

In the middle of the 20th century, behaviorism became a dominant paradigm within psychology, especially in the United States. This led to some neglect of mental phenomena

within experimental psychology.

In the latter half of the 20th century, the phrase "experimental psychology" had shifted in meaning due to the expansion of psychology as a discipline and the growth in the size and number of its sub-disciplines. Experimental psychologists use a range of methods and do not confine themselves to a strictly experimental approach, partly because developments in the philosophy of science have had an impact on the exclusive prestige of experimentation. In contrast, an experimental method is now widely used in fields such as developmental and social psychology which were not previously part of experimental psychology. The phrase continues in use, however, in the titles of a number of well-established, high prestige learned societies and scientific journals, as well as some university courses of study in psychology.

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Summary

An experiment is an orderly procedure carried out with the goal of verifying, refuting, or establishing the validity of a hypothesis. Controlled experiments provide insight into cause and-effect by demonstrating what outcome occurs when a particular factor is manipulated.

Experimental psychology is a branch of pure psychology.

Features of good experiments

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1. Time order of variable
2. Manipulation of the independent variable(s)
3. Relationship between variable
4. Use of a control group
5. Random sampling and random assignment
6. Variables are held constant

Wilhelm Wundt, German doctor and psychologist, was responsible for creating the world's first experimental psychology lab.

William James published the landmark work *Principles of Psychology* in 1890.

Early experimental psychologists include:

Charles Bell, Ernst Heinrich Weber, Gustav Fechner, Oswald Klpe, Wrzburg School, George Trumbull Ladd, Charles Sanders Peirce,

Post Test

1. Discuss the meaning of psychology
2. Explore the features and characteristics of good experiemnts
3. Mention five early scientist, highlighting their specific contributions to the field of experimental psychology

LECTURE TWO

The scientific method and psychology

Introduction

The scientific method is a systematic, step-by-step procedure psychologists use when conducting research. By following these specific steps, psychologists seek cause and effect relationships which means that they can be certain (at least have a high level of confidence) that one variable causes an effect on another variable and that the results of the study are caused by the variable being studied and not some other, outside (extraneous) variables. The scientific method is a systematic process that allows people to hypothesize about the world around them and draw relevant conclusions. The steps to the scientific method include describing the topic of study, making predictions (hypotheses), select a method for the study, controlling external variables, collecting data (running the study), analyzing & explaining the findings, and reporting & sharing the findings (usually via publication or lecturing). There are variations but these are the basic steps in the scientific method.

Objectives

At the end of this lecture, you should be able to:

1. highlight the overview of the research process
2. describe the characteristics of scientific explanationsal psychology

Pre-Test

1. Enumerate the steps in the research process
2. Highlight the characteristics of scientific experiments

CONTENT

Overview of the research process

All sciences follow a set of guidelines for conducting research, even though the methods and procedures vary widely. For example, looking at the fossil record in the Precambrian era to determine what kinds of organisms existed 500 million years ago is obviously different from measuring one's perceptions of their body image. However, despite these radically different topics, there are commonalities in the research process. The basic steps in the process are: formulation of a research hypothesis based on theory, testing the question, and making inferences based on the hypothesis test that relate to theory. Importantly, a vital component of this last step is making the research findings public. (Within each step there are a number of other steps so you might see the same sort of process in a more complicated/thorough format.).

1. Stating the problem: This is the first step in conducting a psychological experiment. The problem could be presented in the form of a research question. It has to be solvable, and empirically testable. The idea could originate from challenges encountered in practice, problems identified in literatures, it could also arise as a result of a hunch. It is required that there should be a clear definition of variables to be investigated, even from mere looking at the research question or problem.

2. Formulating hypothesis: An hypothesis is a tentative explanation for phenomenon, used as basis for further investigation. It may be a reasoned potential solution of or a mere guess. The statement of hypothesis is what the researcher tests to determine whether it is true or not. Experimental data provides the most reliable means of testing an hypothesis.

Hypothesis Formation

A hypothesis is a testable explanation for a phenomenon. It is often described in terms of a relationship between variables or a predicted difference between variables. It is important to understand that an hypothesis needs to be testable to be a scientific hypothesis. For example, something like "I think dreams are an indication of what's in the unconscious mind" is not a valid hypothesis because it's not testable, nor are the definitions (e.g., unconscious mind) specific (or, in the terms of research methods, the definitions are not 'operational').

i. Generating a Hypothesis

How do hypotheses come about? Are they just off the top of your head? Are they simply using intuition? The answer is that most good hypotheses are built on previous research and theory. For example, if previous theory has shown that the fossil record demonstrates a record of changing organisms throughout the earth's history, you'd predict certain organisms in certain fossil records, depending on the age of the rock housing those fossils. In fact, that's exactly what geologists, biologists, and geologists have confirmed. If previous research has shown that we remember things that are different, or stand out from other things, a hypothesis is that most people would remember the word "beer" better than the other words in the list "oak, pine, maple, redwood, beer, ash, poplar, mulberry, elm, sequoia, fir." That's exactly what you find. (This is called the von Restorff effect).

So remember, hypotheses are built on previous research and theory, not just off the top of your head. Conducting research begins with an understanding of past research. Then, unique predictions can be made in an attempt to a) confirm the theory, b) disconfirm the theory (which is much more powerful than a confirmation), or c) extend and refine the theory.

ii. Hypothesis Testing

Once you have a working hypothesis, it then needs to be tested. Testing methods vary widely across sciences depending on the types of measurements and the tools used for those

measurements. Instruments can vary from questionnaires (e.g., depression or personality inventories) to electron microscopes to magnetic resonance imaging (MRI) machines. It is generally very good advice to use methods that others have used. The reason people do not want to "reinvent the wheel" is that it gives one another interpretation of your data. Specifically, let's say you have a good hypothesis based on previous research. You then develop a unique way of testing that hypothesis. Because there are two unique aspects of your research (the research question and the method), the results could be due to either your unique question *or* your unique method. Generally speaking, it is better to follow the footsteps of those before you and use pre-established methods of testing a hypothesis. Once you've decided on your method of testing the hypothesis, you then collect data. Every scientific study uses data; the data can come from many sources, including previously-collected data (called archival data) or data you and your colleagues collect.

Much of this methods course is dedicated to the various ways of testing hypotheses in psychology. There are two general categories of ways of conducting research: experiments and correlational designs.

3. **Selecting participants**. The nature of the research problem and the population being considered determine the potential participants in an experimental study.

4. Assigning participants to groups: In order to provide a basis for determining the impact of an intervention proposed or an independent variable, the participants recruited in to the study should be divided into groups, so that members of each group are equivalent at the beginning of the experiment, and similar in all respects. This achieved through randomization. This is followed by the introduction of the treatment being investigated to the treatment or intervention group. The other group, i.e. control is offered the standard or known treatment; or given a placebo. The use of a control group provides a basis for comparing the treatment. This is important so that the observation of the dependent variable recorded in each group would attributable to the effect of the independent variable, not chance or other characteristics of the group differences.

5. Controlling extraneous variables: One of the most critical responsibilities of an investigator is to assure that no variables other than the independent variable may affect the dependent variable in an experiment. If possible extraneous variables are not controlled, the experiment is likely to

be contaminated, and the post test measures or outcomes would no longer be attributable exclusively to the independent variable, destroying the fundamental purpose of the study.

6a. Determining the influence of the independent variables: This is the hallmark of experimental psychology. Following the process highlighted above, a baseline measure of the dependent variable is determined among both the treatment and control groups; extraneous variables are controlled, followed with the exposure of the treatment group to the treatment being investigated. Thereafter, both the treatment and control groups are tested again to determine their score on the dependent variable. If there is a significant change or improvement among the treatment and control groups in their score on the dependent variable, it is assumed that the degree of variation is attributable to the effect or influence of the independent variable.

6b. Stimulus-response laws: Psychologists are interested in comparing the relationship between a stimulus and the response to the effect of the known stimulus. This is based on knowledge that if a pattern/characteristic of an environment is changed, it is expected that there would a relative change in the behavior of an organism/person sensitive to the stimulus environment change. The event or stimulus that is introduced into an environment, which is expected to lead to specific changes in some features of the participants exposed to the stimulus is called an independent variable. The behavior or organismic characteristic that is expected to change as a result of exposure to the independent variable is called the dependent variable. In a scientific study, the concept that the researcher is interested in studying are called variables. A variable is anything that could attain different values, e.g., memory, intelligence; they vary in measurement. If a factor does not change, it is called a constant. If we are studying the effects of a new drug on memory, the drug is the independent variable, and the measure s of memory are called the dependent variable. A discrete number describes statistical elements or variables that are distinct, unrelated, and have a finite number of values, or countable number of elements. A discrete variable is one that has finite number of values between any two points. For example number of children in a family, or number of times a patient visits a dentist. A continuous variable is one that, at least in theory can assume an infinite number of values between any two points. For example, an individual s height could take values such as 1.63 meters, 1.75 meters etc.

7. Interpreting & Publishing Results

There are three main components here. First, you need to analyze your data. Second, you need to write up your research. Third, you need to make your research public (which then adds back to theory).

a. Data Analysis

Once you have your data, you need to analyze them. This means first putting into a form that is usable (usually in tables with codes/numbers and such) and then summarizing them. Looking at your data for what they are is called using descriptive statistics; using the descriptive statistics to make an inference about them. In psychology, the inference is usually made about a group of people that have something in common (i.e., a population). Since you did not measure everyone in the population during your data collection, you have to *infer* something about them from the data you have. This type of analysis is done through the use inferential statistics.

b. Writing the Research Paper

Writing up the research is an important part of conducting research. It is not always necessary if

a) there were problems in your methodology

b) the number of observations (i.e., sample size) was too small, or

c) your results can't be interpreted.

If your research does not suffer from any of these problems and you want to contribute to science, you must write up your results. In psychology, we have a very specific format for the research paper using APA (American Psychological Association) style writing.

8. Publishing the Paper

This is one of the most critical components in science. Once the paper is written (and revised, and revised), it is then sent to a scientific journal. Journals come in many flavors--some requiring extensive analyses of previous theory and current research (e.g., Psychological Review), others with strict criteria and extremely high standards for research quality, and still others with somewhat lower and relaxed criteria for publication. Often, journals have a certain focus such as human memory, cognitive neuroscience, clinical psychology, applied social psychology, etc. Once you send your paper to a chosen journal, it is then sent out to a number of experts in the field who review and critique the research. This is the process of peer-review and ensures that your research does not suffer from theoretical, methodological, or statistical problems. Once the reviewers have given their critiques, they make a judgment as to whether the research is

acceptable for publication. The author(s) of the research then receive the reviews and the decision by the journal editor about whether the paper will be published. Usually, the research is not acceptable and the research paper (called a manuscript) is rejected. Sometimes, the editor will conditionally accept the paper if certain changes are made. Generally speaking, manuscripts are never accepted "as is" for publication when they are first submitted. If a manuscript makes it way through the review process and is accepted, it is then published in the journal, thereby adding to the body of knowledge and improving our understanding of that subject.

Characteristics of scientific explanations

As diverse as sciences are, all scientific explanations have a lot in common. Psychological research, just like all other scientific research, adheres to these principles.

i. Scientific Explanations are Empirical

"Empirical" means "based on the senses." All scientific explanations must be based on empirical observations or experiments (or at the very least, be directly inferred when direct observation cannot be achieved).

ii. Scientific Explanations are Tentative

This means that all findings are subject to change should there be enough evidence to necessitate a change. There is always a chance that the scientific theory is wrong, no matter how much supporting evidence there is for the theory. In other words, *nothing is ever proven in science.*

iii. Scientific Explanations are Probabilistic

Nothing can be measured precisely; there is always a degree of uncertainty in one's measurement. This is especially true in psychology because humans are amazingly complex. In psychology, keep in mind that any finding is what's *likely* to be true but because of the impreciseness and variability in human observation, human behavior, and measures we say there's only probability of a finding being true.

iv. Scientific Explanations are Testable

There must exist an outcome that does not support the theory. An example of a non-testable theory is Freud's theory of personality. You can't test the id, the ego, or the superego. Thus, Freud's theory is not scientific. (The same applies to dream interpretation -- certainly not scientific.)

v. Scientific Explanations are Parsimonious

If there are multiple theories that explain the data, the simplest one is usually correct. This is sometimes called the principle of simplicity. Here's a silly example that shows the principle: If I put on a blindfold and tell you how many fingers you're holding up, you can either explain this by a) telepathy (i.e., mind-reading), or b) that I cheated and saw your fingers. Which is the most parsimonious explanation? Clearly, the 'cheating' explanation is much simpler and requires the fewest assumptions.

vi. Scientific Explanations Assume Cause & Effect

For every effect, there is a cause. If we assume no cause, the explanation is not scientific. In fact, much of psychological research is about finding the *causes* of human behavior.

vii. Scientific Explanations are General

Scientific findings must be applicable to other situations, to other people, to other scenarios, in other locations, at other times, etc. This is called "external validity." If the finding only happens once and does not apply to anyone or anything else, it's not scientific.

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LECTURE THREE

Meaning of and general methods of research in psychology: A review

Introduction

Before we concentrate fully on experimental designs in psychology research, it is needful to review other research methods in the field of psychology. It is my intention to provide a broad base of knowledge in this area to assist learners maintain a grasp of general research designs, in an effort to assure capacity for relating this with experimental research techniques. Occasionally, a few experimental procedures may be preceded by other research designs, e.g. broad based surveys. A review of non-experimental research methods in this Chapter offers a double

advantage of not only reminding students in the distance learning mode of education through reinforcement of learning, it also offers them an opportunity to apply the knowledge towards developing the competence required in practical application of research skills, which is the bedrock of Supervised Advanced Experimental Psychology.

Content

Research comprises "creative work undertaken on a systematic basis in order to increase the stock of
knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to
devise new applications (OECD, 2002). It is used to establish or confirm facts, reaffirm the results of
previous work, solve new or existing problems, support theorems, or develop new theories . A research
project may also be an expansion on past work in the field. To test the validity of instruments, procedures, or experiments, research may replicate elements of prior projects, or the project as a whole. The primary purposes of basic research (as opposed to applied research are
dicumentation, discovery, interpretation, or the research and development (R&D) of methods and systems for the advancement of human knowledge.

Research has been defined in a number of different ways. A broad definition of research is given by Martyn Shuttleworth - "In the broadest sense of the word, the definition of research includes any gathering of data, information and facts for the advancement of knowledge (Shuttleworth, 2008).

Research is also a studious inquiry or examination; especially: investigation or experimentation aimed at
the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws. The goal of the research process is to
produce new knowledge or deepen understanding of a topic or issue. This process takes three main forms (although, as previously discussed, the boundaries between them may be obscure):

-Exploratory research: Helps to identify and define a problem or question.

-Constructive research- Tests theories and proposes solutions to a problem or question.

-Empirical research- Tests the feasibility of a solution using empirical evidence.

Forms of research

Scientific research relies on the application of the scientific method, a harnessing of curiosity . This research provides scienmtific information and theories for the explanation of the nature and the properties of the world. It makes practical applications possible. Scientific research is funded by public authorities, by charitable organizations and by private groups, including many companies. Scientific research can be subdivided into different classifications according to their academic and application disciplines. Scientific research is a widely used criterion for judging the standing of an academic institution, such as business schools, but some argue that such is an inaccurate assessment of the institution, because the quality of research does not tell about the quality of teaching (these do not necessarily correlate totally) (Armstrong & Sperry, 1994).

Types of Research

Qualitative research -This invlves the understanding of human behavior and the reasons that govern such behavior. Asking a broad question and collecting data in the form of words, images, video etc that is analyzed and searching for themes. This type of research aims to investigate a question without attempting to quantifiably measure variables or look to potential relationships between variables. It is viewed as more restrictive in testing hypotheses because it can be expensive and time consuming, and typically limited to a single set of research subjects. Qualitative research is often used as a method of exploratory research as a basis for later quantitative research hypotheses. Qualitative research is linked with the philosophical and theoretical stance of social constructionism and grounded theory.

***Quantitative research*:** Systematic empirical investigation of quantitative properties and phenomena and their relationships. Asking a narrow question and collecting numerical data to analyze utilizing statistical methods. The quantitative research designs are experimental, correlational, and survey (or descriptive).

Statistics derived from quantitative research can be used to establish the existence of associative or causal relationships between variables. Quantitative research is linked with the philosophical and theoretical stance of positivism.

The Quantitative data collection methods rely on random sampling and structured data collection instruments that fit diverse experiences into predetermined response categories. These methods produce results that are easy to summarize, compare, and generalize. Quantitative research is concerned with testing hypotheses derived from theory and/or being able to estimate the size of a phenomenon of interest. Depending on the research question, participants may be randomly assigned to different treatments (this is the only way that a quantitative study can be considered a true experiment). If this is not feasible, the researcher may collect data on participant and situational characteristics in order to statistically control fortheir influence on the dependent, or outcome, variable. If the intent is to generalize from the research participants to a larger population, the researcher will employ probability sampling to select participants (Creswell, 2008).

In either qualitative or quantitative research, the researcher(s) may collect primary or secondary data. Primary data is data collected specifically for the research, such as through interviews or questionnaires.

Secondary data is data that already exists, such as census data, which can be re-used for the research. It is good ethical research practice to use secondary data wherever possible (Kara, 2012). Mixed-method research, i.e. research that includes qualitative and quantitative elements, using both primary and secondary data, is becoming more common.

Types of psychological research

Psychology research can usually be classified as one of three major types:

1. Causal Research

When most people think of scientific experimentation, research on cause-and-effect is most often brought to mind. Experiments on causal relationships investigate the effect of one or more variables on one or more outcome variables. This type of research also determines if one variable causes another variable to occur or change. An example of this type of research would be altering the amount of a treatment and measuring the effect on study participants.

When researchers are trying to determine if changes in one variable lead to changes in another variable, they must perform experiments in order to establish a causal relationship. Other research methods (such as correlational studies) can be used to establish that a relationship between to variables exists, but an actual experiment is necessary to establish that it is a *cause-and-effect* type of relationship.

Experiments can be extremely complex and included a multitude of variables. However, one of the most basic methods is to use what is known as a simple experiment.

What is a Simple Experiment?

A simple experiment can establish cause-and-effect, so this type of study is often used to determine the effect of a treatment. For examples, researchers might want to determine if administering a certain type ofmedicine leads to an improvement of symptoms. In a simple experiment, study participants are randomly assigned to one of two groups. Generally, one group is the control group and receives no treatment, while the other group is the experimental group and receives the treatment.

Parts of a Simple Experiment

The simple experiment is composed of a few key elements:

i.The experimental hypothesis: A statement that predicts that the treatment will cause an effect. The experimentall hypothersis will always be phrased as a cause-and-effect statement. For example, researchers might propose a hypothesis that: "Administration of Medicine A will result in a reduction of symptoms of Disease B."

ii. The null hypothesis: A hypothesis that the experimental treatment will have no effect on the participants or dependent variables. It is important to note that failing to find an effect of the treatment does not mean that there is no effect. The treatment might impact another variable that the researchers are not measuring in the current experiment.

iii. The independent variable:The treatment variable that is manipulated by the experimenter. The dependent variable: The response that the experimenter is measuring.

iv. The control group:This group is made up of individuals who are randomly assigned to a group but do not receive the treatment. The measures takes from the control group are then compared to those in the experimental group to determine if the treatment had an effect.

v. The experimental group: This group is made up of individuals who are randomly assigned to the group and then receive the treatment. The scores of these participants are compared to those in the control group to determine if the treatment had an effect.

Determining the Results of a Simple Experiment

Once the data from the simple experiment has been gathered, researchers then compare the results of the experimental group to those of the control group to determine if the treatment had an effect. How do researchers determine this effect? Due to the always present possibility of errors, we can never be 100% sure of the relationship between two variables. After all, there might always exist some unknown variables that we are unaware of or unable to measure that might nevertheless have an influence over the outcomes.

Despite this ever-present problem, there are ways to determine if there *most likely* is a meaningful relationship. Experimenters use inferential statistics to determine if the results of an experiment are meaningful. Inferential statistics is a branch of science that deals with drawing inferences about a population based upon measures taken from a representative sample of that population. The key to determining if a treatment had an effect is to measure the statistical significance**.** Statistical significance shows that the relationship between the variables is probably not due to mere chance and that a real relationship most likely exists between the two variables.Statistical significance is often represented likethis: $p < 0.05$

A p-value of less than .05 indicates if the particular results are due merely to chance, the probability of obtaining these results would be less than 5%. Occasionally, smaller p-values are seen such as $p < 0.01$.

There are a number of different means of measuring statistical significance. The type of statistical test used depends largely upon the type of research design that was used.

2. Descriptive Research

Descriptive research seeks to depict what already exists in a group or population. An example of this type of research would be an opinion poll to determine which Presidential candidate people plan to vote for in the next election. Descriptive studies do not seek to measure the effect of a variable; they seek only to describe.

3. Relational Research

Relational Research is a study that investigates the connection between two or more variables is considered relationship The variables that are compared are generally already present in the group or population. For example, a study that looked at the proportion of males and females that would purchase either a classical CD or a jazz CD would be studying the relationship between gender and music preference.

Correlational studies are one of the two major types of psychology research. Correlational studies are frequently used in psychology research to look for relationships between variables. While correlational studies can suggest that there is a relationship between two variables, finding a correlation does not prove that one variable causes a change in another variable. In other words, correlation does not equal causation.

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LECTURE FOUR

Review of Non-Experimental Research Methods

Introduction

In this lecture, I intend to revise some of the issues discussed during earlier lectures on research methodology. However, the approach of McLeod (2012) is adopted because of its simplicity and adaptability to socio-behavioural and experimental psychology researches.

We are going to consider correlation technique, cross sectional as well as longitudinal research; looking at the strengths and weaknesses, as well common types of each. It is my hope that knowledge of this would provide the foundation necessary for identifying the similarities, differences, and relationship between these techniques and experimental research methods.

Objectives

At the end of this lecture, you should be able to:

1. discuss the types of correlational research techniques
2. explain the methods of conducting cross sectional researches; and
3. highlight the method and examples of longitudinal researches

Pre-Test

1. Describe the geographical features of Nigeria
2. List the impact of colonialism on the government and politics of Nigeria
3. List the major ethnic groups in Nigeria
4. What do you understand by Politics, Government and The State?

CONTENT

A. Correlational Studies

Correlational studies are used to look for relationships between variables. There are three possible results of a correlational study: a positive correlation, a negative correlation, and no correlation. The correlation coefficient is a measure of correlation strength and can range from –1.00 to +1.00.

Positive Correlation: Both variables increase or decrease at the same time. A correlation coefficient close to +1.00 indicates a strong positive correlation.

Negative Correlation: Indicates that as the amount of one variable increases, the other decreases (and vice versa). A correlation coefficient close to -1.00 indicates a strong negative correlation.

No Correlation: Indicates no relationship between the two variables. A correlation coefficient of 0 indicates no correlation.

Limitations of Correlational Studies: While correlational studies can suggest that there is a relationship between two variables, they cannot prove that one variable causes a change in another variable. In other words, correlation does not equal causation. For example, a correlational study might suggest that there is a relationship between academic success and self-esteem, but it cannot show if academic success increases or decreases self-esteem. Other variables might play a role, including social relationships, cognitive abilities, personality, socio-economic status, and myriad other factors.

Types of Correlational Studies:

1. Naturalistic Observation

Naturalistic observation involves observing and recording the variables of interest in the natural environment without interference or manipulation by the experimenter.

Advantages of Naturalistic Observation:

i. Gives the experimenter the opportunity to view the variable of interest in a natural setting.

ii. Can offer ideas for further research.

iii. May be the only option if lab experimentation is not possible.

Disadvantages of Naturalistic Observation:

i. Can be time consuming and expensive.

ii. Does not allow for scientific control of variables.

iii. Experimenters cannot control extraneous variables.

iv. Subjects may be aware of the observer and may act differently as a result.

2. The Survey Method

Survey and questionnaires are one of the most common methods used in psychological research. In this method, a random sample of participants completes a survey, test, or questionnaire that relates to the variables of interest. Random sampling is a vital part of ensuring the generalizability of the survey results.

Advantages of the Survey Method:

i. It's fast, cheap, and easy. Researchers can collect large amount of data in a relatively short amount of time.

ii. More flexible than some other methods.

Disadvantages of the Survey Method:

i. Can be affected by an unrepresentative sample or poor survey questions.

ii. Participants can affect the outcome. Some participants try to please the researcher, lie to make themselves look better, or have mistaken memories.

3. Archival Research

Archival research is performed by analyzing studies conducted by other researchers or by looking at historical patient records. For example, researchers recently analyzed the records of soldiers who served in the Civil War to learn more about PTSD.

Advantages of Archival Research:

i. The experimenter cannot introduce changes in participant behavior.

ii. Enormous amounts of data provide a better view of trends, relationships, and outcomes.

iii. Often less expensive than other study methods. Researchers can often access data through free archives or records databases.

Disadvantages of Archival Research:

i. The researchers have not control over how data was collected.

Ii, Important date may be missing from the records.

iii. Previous research may be unreliable.

B. Cross sectional study

Cross-sectional research is a research method often used in developmental psychology, but also utilized in many other areas including social science and education. This type of study utilizes different groups of people who differ in the variable of interest, but share other characteristics such as socioeconomic status, educational background, and ethnicity.

For example, researchers studying developmental psychology might select groups of people who are remarkably similar in most areas, but differ only in age. By doing this, any differences between groups can presumably be attributed to age differences rather than to other variables.

Cross-sectional studies are observational in nature and are known as descriptive research not causal or relational. Researchers record the information that is present in a population, but they do not manipulate variables. This type of research can be used to describe characteristics that exist in a population, but not to determine cause-and-effect relationships between different variables. These methods are often used to make inferences about possible relationships or to gather preliminary data to support further research and experimentation.

Defining Characteristics of Cross sectional studies

i. Takes place at a single point in time

ii. Does not involve manipulating variables

iii. Allows researchers to look at numerous things at once (age, income, gender)

iv. Often used to look at the prevalence of something in a given population

Potential Challenges

While the design sounds relatively simple, finding participants who are very similar except in one specific variable can be difficult. Also, groups can be affected by cohort differences that arise from the particular experiences of a unique group of people. Individuals born in the same time period may share important historical experiences, while people born in a specific geographic region may share experiences limited solely to their physical location.

Cross-Sectional Vs. Longitudinal Studies

This type of research differs from longitudinal research in that cross-sectional studies are designed to look at a variable at a particular point in time. Longitudinal studies involve taking multiple measures over an extended period of time, while cross-sectional research is focused on looking at variables at a specific point in time.

C. Longitudinal research

Longitudinal research is a type of research method used to discover relationships between variables that are not related to various background variables. This observational research technique involves studying the same group of individuals over an extended period of time.

Data is first collected at the outset of the study, and may then be gathered repeatedly throughout the length of the study. In some cases, longitudinal studies can last several decades.

Benefits of Longitudinal Research

The benefit of this type of research is that it allows researchers to look at changes over time. Because of this, longitudinal methods are particularly useful when studying development and lifespan issues.

Drawbacks of Longitudinal Research

However, longitudinal studies require enormous amounts of time and are often quite expensive. Because of this, these studies often have only a small group of subjects, which makes it difficult

to apply the results to a larger population. Another problem is that participants sometimes drop out of the study, shrinking the sample size and decreasing the amount of data collected.

Types of Longitudinal Research

There are three major types of longitudinal studies:

***i. Panel Study*:** Involves sampling a cross-section of individuals.

***ii. Cohort Study*:** Involves selecting a group based on a specific event such as birth, geographic location or historical experience.

***iii. Retrospective Study*:** Involves looking to the past by looking at historical information such as medical records.

LECTURE FIVE

Experimental Research Methods: Types

Introduction

Having learnt about other types of research methods in the previous Chapters, it is necessary for us to learn about the major types of experimental research methods. The field of experimental psychology adopts any of these methods depending on the research problem, participants, and design, among others. While the various methods highlighted in this Chapter have capacity for the establishment of cause and effects, they differ in their strengths and weaknesses. This Chapter therefore succinctly explains various techniques of experimental which if understood and applied by students of experimental psychology, would enhance students' ability to conduct small scale scientific research, with precision, high reliability, and other attributes of experimental researches. As seen in the preceding Chapter, the viewpoint of McLeod (2012) was adopted.

Objectives

At the end of this lecture, you should be able to:

1. discuss three types of experimental research
2. explain the strengths and weaknesses of each of the types of experimental research mentioned above

Pre-Test

1. Mention three types of experimental research
2. Enumerate the strengths and weaknesses of each of the examples mentioned above

Content

The prime method of enquiry in science is the experiment. The key features are control over variables, careful measurement, and establishing cause and effect relationships.

An experiment is an investigation in which the independent variable is manipulated (or changed) in order to cause a change in the dependent variable.

Types of experimental researches

There are three types of experiments you need to know:

1. Laboratory / Controlled Experiments

This type of experiment is conducted in a well-controlled environment – not necessarily a laboratory – and therefore accurate measurements are possible.

The researcher decides where the experiment will take place, at what time, with which participants, in what circumstances and using a standardised procedure. Participants are randomly allocated to each independent variable group.

An example is Milgram's Obedience Experiment

The major strengths of laboratory experiments include:

i. It is easier to replicate (i.e. copy) a laboratory experiment. This is because a standardised procedure is used.

ii. They allow for precise control of extraneous and independent variables. This allows a cause and effect relationship to be established.

The limitations of laboratory experiments include:

i.The artificiality of the setting may produce unnatural behavior that does not reflect real life, i.e. low ecological validity. This means it would not be possible to generalize the findings to a real life setting.

ii. Demand characteristics or experimenter effects may bias the results and become confounding variables.

2. Field Experiments

Field Experiments are done in the everyday (i.e. real life) environment of the participants. The experimenter still manipulates the independent variable, but in a real-life setting (so cannot really control extraneous variables) e.g. Holfing's Study on Obedience.

The strengths of field experiments include:

i. Behavior in a field experiment is more likely to reflect life real because of its natural setting, i.e. higher ecological validity than a lab experiment.

ii. There is less likelihood of demand characteristics affecting the results, as participants may not know they are being studied. This occurs when the study is covert.

iii. There is less control over extraneous variables that might bias the results. This makes it difficult for another researcher to replicate the study in exactly the same way.

3. Natural Experiments

Natural Experiments are conducted in the everyday (i.e. real life) environment of the participants but here the experimenter has no control over the IV as it occurs naturally in real life.

For example; Hodges and Tizard's attachment research (1989) compared the long term development of children who have been adopted, fostered or returned to their mothers with a control group of children who had spent all their lives in their biological families. The advantages of natural experiments include:

i. Behavior in a natural experiment is more likely to reflect life real because of it natural setting, i.e. very high ecological validity.

ii. There is less likelihood of demand characteristics affecting the results, as participants may not know they are being studied.

iii. Can be used in situations in which it would be ethically unacceptable to nipulate the independent variable, e.g. researching stress. The major weaknesses of natural experiments include:

i. They may be more expensive and time consuming than lab experiments.

ii. There is no control over extraneous variables that might bias the results. This makes it difficult for another researcher to replicate the study in exactly the same way.

Terminologies related to experimental research

i. Ecological validity: The degree to which an investigation represents real-life experiences.

ii. Experimenter effects: These are the ways that the experimenter can accidentally influence the participant through their appearance or behavior.

iii. These are the clues in an experiment that lead the participants to think they know what the researcher is looking for (e.g. experimenter's body language).

iv. Independent variable (IV): Variable the experimenter manipulates (i.e. changes) – assumed to have a direct effect on the dependent variable.

v. Dependent variable (DV): Variable the experimenter measures.

vi. Extraneous variables (EV) are all variables, which are not the independent variable, but could affect the results (DV) of the experiment. EVs should be controlled were possible.

vii. Confounding variables: Variable(s) that have effected the results (DV), apart from the IV. A confounding variable could be an extraneous variable that has not been controlled.

Summary

Post–Test

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LECTURE SIX

Quasi-Experimental Designs

Introduction

A quasi-experimental study is a type of evaluation which aims to determine whether a program or intervention has the intended effect on a study's participants. Quasi-experimental studies take on many forms, but may best be defined as lacking key components of a true experiment.

If you recall, for an experimental design to be classified as a True Experimental Design, it must meet two criteria; 1) random assignment of participants to groups, and 2) manipulation of an internal variable (IV). A Quasi- Experimental Design is exactly the same except that there is no random assignment of participants to groups. That is the only difference between the two types of designs, but it is a very important difference. Without both random assignment and manipulation of an IV, a researcher cannot make cause and effect conclusions.

Objectives

At the end of this lecture, you should be able to:

1. explain the meaning of quasi-experiments
2. mention the advantages and disadvantages of quasi-experiments
3. highlight types of quasi-experimental designs

Pre-Test

1. Mention the main features of quasi-experiments
2. Highlight the features of experiments
3. identify 5 types of quasi-experimental designs

CONTENT

Sometimes it is just not possible to randomly assign participants to groups. An example of a quasi-experimental design would be a study in which you examine the effects of smoking on

respiratory functioning. You might have people who smoke 1 pack a day and 2 packs a day smokers, but you cannot really assign them into these groups (is it ethical to make people who smoke 1 pack a day now smoke 2?) You would then run your study, but when you make conclusions, you cannot make any cause and effect conclusions.

Since the most common form of a quasi-experimental study includes a pre-post test design with both a treatment group and a control group, quasi-experimental studies are often an impact evaluation that assigns members to the treatment group and control group by a method other than random assignment. Because of the danger that the treatment and control group may differ at the outset, researchers conducting quasi-experimental studies attempt to address this in a number of other ways (e.g., by matching treatment groups to be like control groups or by controlling for these differences in analyses).

This section focuses on two forms of quasi-experimental studies: a pre-post test design study without a control group and a pre-post test design with a control group.

The first part of creating a quasi-experimental design is to identify the variables. The quasi-independent variable will be the x-variable, the variable that is manipulated in order to affect a dependent variable. X is generally a grouping variable with different levels. Grouping means two or more groups such as a treatment group and a placebo or control group (placebos are more frequently used in medical or physiological experiments). The predicted outcome is the dependent variable, which is the y-variable. In a time series analysis, the dependent variable is observed over time for any changes that may take place. Once the variables have been identified and defined, a procedure should then be implemented and group differences should be examined.

Advantages

Since quasi-experimental designs are used when randomization is impractical and/or unethical, they are typically easier to set up than true experimental designs, which require random assignment of subjects. Additionally, utilizing quasi-experimental designs minimizes threats to external validity as natural environments do not suffer the same problems of artificiality as compared to a well-controlled laboratory setting. Since quasi-experiments are natural experiments, findings in one may be applied to other subjects and settings, allowing for some generalizations to be made about population. Also, this experimentation method is efficient in

longitudinal research that involves longer time periods which can be followed up in different environments.

Disadvantages

The control allowed through the manipulation of the quasi-independent variable can lead to unnatural circumstances; although the dangers of artificiality are considerably less relative to true experiments (quasi-experimental designs are often chosen for field studies where the random assignment of experimental subjects is impractical, unethical, or impossible). Also, the lack of random assignment in the quasi-experimental design method may allow studies to be more feasible, but this also poses many challenges for the investigator in terms of internal validity. This deficiency in randomization makes it harder to rule out confounding variables and introduces new threats to internal validity. Because randomization is absent, some knowledge about the data can be approximated, but conclusions of causal relationships are difficult to determine due to a variety of extraneous and confounding variables that exist in a social environment. Moreover, even if these threats to internal validity are assessed, causation still cannot be fully established because the experimenter does not have total control over extraneous variables

There are several types of quasi-experimental designs ranging from the simple to the complex, each having different strengths, weaknesses and applications. These designs include (but are not limited to):

i. The one-group posttest only
ii. The one-group pretest posttest
iii. The removed-treatment design
iv. The case-control design
v. The non-equivalent control groups design
vi. The interrupted time-series design
vii. The regression discontinuity design

Of all of these designs, the regression discontinuity design comes the closest to the experimental design, as the experimenter maintains control of the treatment application and it is known to yield an unbiased estimate of the treatment effects. It does, however, require more participants

and proper modeling of the functional form between the assignment and outcome variable to yield the same power as a traditional experimental design

I shall discuss a few such designs here.

Pretest-Posttest Nonequivalent Groups Design

This design looks a lot like the randomized pretest-posttest design, but in this case the two groups have not been equated prior to treatment. Since one has not randomly assigned subjects to groups, one cannot assume that the populations being compared are equivalent on all things prior to the treatment, and accordingly internal validity is threatened.

Double –Pretest Nonequivalent Groups Design.

This modification of the pretest-posttest nonequivalent groups design helps to control for a Selection x Maturation interaction by including a second pretest. If the groups are maturing at different rates, that difference may appear in the comparison between the first pretest and the second pretest

Regression-Discontinuity Design

This design looks a lot like the pretest-posttest. nonequivalent groups design, but the groups are nonequivalent by choice. The subjects are assigned to groups based on their score on the covariate (the pretest).

One usually starts by deciding what the treatment and criterion variables will be. For example, I may decide that my treatment variable will involve an online tutorial program in basic statistics and my criterion variable will be students' performance in an undergraduate statistics class. I shall offer the program to some students (and entice them to use it) but not to other students. At the end of the semester I shall use scores on the comprehensive final examination as the criterion variable.

One usually starts by deciding what the treatment and criterion variables will be. For example, I may decide that my treatment variable will involve an online tutorial program in basic statistics and my criterion variable will be students' performance in an undergraduate statistics class. I shall offer the program to some students (and entice them to use it) but not to other students. At the end of the semester I shall use scores on the comprehensive final examination as the criterion variable.

Pretest-Post test Non-Equivalent Groups Design

This design looks a lot like the randomized pretest-posttest design that I discussed earlier, but in this case the two groups have not been equated prior to treatment. Since one has not randomly assigned subjects to groups, one cannot assume that the populations being compared are equivalent on all things prior to the treatment, and accordingly internal validity is threatened

Double-Pretest Nonequivalent Groups Design

This modification of the pretest-posttest nonequivalent groups design helps to control for a Selection x Maturation interaction by including a second pretest. If the groups are maturing at different rates, that difference may appear in the comparison between the first pretest and the second pretest

Non-Equivalent Dependent Variables design

In this design you have only one group of subjects but you have two or more dependent variables. In the simplest variation you have one dependent variable that you expect to be affected by the experimental treatment and a second dependent variable that you do not expect to be affected by the experimental treatment. The second dependent variable serves as a control variable. You want your control variable to be one that is similar enough to the primary variable that it should be affected in the same way by history, maturation, and other threats to a single group pretest-posttest design, but different enough from the primary variable that it will not also be affected by the experimental treatment.

Time Series Design

Time series designs refer to the pretesting and post-testing of one group of subjects at different intervals. The purpose might be to determine long term effect of treatment and therefore the number of pre- and posttests can vary from one each to many. Sometimes there is an interruption between tests in order to assess the strength of treatment over an extended time period. When such a design is employed, the posttest is referred to as follow-up

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Summary

A Quasi- Experimental design is similar to true experimental design except that there is no random assignment of participants to groups. Without both random assignment and manipulation of an IV, a researcher cannot make cause and effect conclusions.

Advantages

1. Easier to set up than true experimental designs.

2. Minimizes threats to external validity as natural environments do not suffer the same problems of artificiality as compared to a well-controlled laboratory setting.

3. Efficient in longitudinal research that involves longer time periods which can be followed up in different environments.

Disadvantages

1. The control allowed through the manipulation of the quasi-independent variable can lead to unnatural circumstances.

2. The lack of random assignment poses many challenges for the investigator in terms of internal validity.

3. This deficiency in randomization makes it harder to rule out confounding variables and introduces new threats to internal validity.

4. Causal relationships are difficult to determine due to a variety of extraneous and confounding variables

Types of quasi-experimental designs

i. The one-group posttest only

ii. The one-group pretest posttest

iii. The removed-treatment design

iv. The case-control design

v. The non-equivalent control groups design

vi. The interrupted time-series design

vii. The regression discontinuity design

Post Test

1. Distinguish between quasi and true experiments
2. Mention the main features of quasi-experiments
3. Highlight of 6 types of quasi-experimental designs

LECTUR SEVEN

Control of Extraneous/Confounding Variables

Introduction

Extraneous Variables are undesirable variables that influence the relationship between the variables that an experimenter is examining. Another way to think of this, is that these are variables the influence the outcome of an experiment, though they are not the variables that are actually of interest. These variables are undesirable because they add error to an experiment. A major goal in research design is to decrease or control the influence of extraneous variables as much as possible. Say you wanted to work out how clever a fish species were in finding food depending on how long since they had eaten. But if their ability to find food also depended on the temperature of the water and you were not able to either control or measure accurately the temperature of the water. Then the temperature could be described as an extraneous variable.

Objectives

At the end of this lecture, you should be able to:

1. explain the meaning of confounding variables
2. discuss techniques of controlling for confounding variables

Pre-Test

1. Explain the meaning of the term confounding variables
2. Mention 6 techniques of controlling for extraneous variables

Content

Extraneous or confounding variables can be controlled for by using of one or more of a variety of techniques that eliminate the differential influence an extraneous variable may have for the comparison groups in a research study.

Differential influence occurs when the influence of an extraneous variable is different for the various comparison groups. For example, if one group is mostly females and the other group is mostly males, then the gender may have a differential effect on the outcome. As a result, you will not know whether the outcome is due to the treatment or due to the effect of gender.

If the comparison groups are the same on all extraneous variables at the start of the experiment, then differential influence is unlikely to occur. In experiments, we want our groups to be the same (or "equivalent" on all potentially confounding extraneous variables). The control techniques are essentially attempts to make the groups similar or equivalent. It is required the comparison groups are similar to each other (on all characteristics or variables) at the start of an experiment. Then, after manipulating the independent variable you will be better able to attribute the difference observed at the posttest to the independent variable because one group got a treatment and the other group did not. It is expected that the only systematic difference between the groups in an experiment to be the variation of the independent variable. You want the groups to be the same on all other variables (i.e., the same on extraneous or confounding variables). In this Chapter, we will briefly discuss these six techniques that are used to control for confounding extraneous variables: random assignment, matching, holding the extraneous variable constant, building the extraneous variable into the research design, counterbalancing, and analysis of covariance.

1. **Random Assignment**

Random assignment is the most important technique used to control for confounding variables because it has the ability to control for both known and unknown confounding extraneous variables. Because of this characteristic, you should randomly assign whenever and wherever possible. Random assignment makes the groups similar on all variables at the start of the

experiment. If random assignment is successful, the groups will be mirror images of each other. Random assignment is the mark of an excellent experimental design.

You must be careful not to confuse random assignment with random selection! The two techniques differ in purpose. The purpose of random selection is to generate a sample that represents a larger population. The purpose of random assignment is to take a sample (usually a convenience sample) and use the process of randomization to divide it into two or more groups that represent each other. That is, you use random assignment to create probabilistically "equivalent" groups. Note that random *selection* (randomly selecting a sample from a population) helps ensure external validity, and random *assignment* (randomly dividing a set of people into multiple groups) helps ensure internal validity. Because the primary goal in experimental research is to establish firm evidence of cause and effect, *random assignment is more important than random selection in experimental research*.

Random assignment controls for the problem of differential influence. It does this by ensuring that each participant has an equal chance of being assigned to each comparison group. In other words, random assignment eliminates the problem of differential influence by making the groups similar on all extraneous variables. The equal probability of assignment means that not only are participants equally likely to be assigned to each comparison group but that the characteristics they bring with them are also equally likely to be assigned to each comparison group. This means that the research participants and their characteristics should be distributed approximately equally in all comparison groups! Again, random assignment is the best way to create equivalent groups for use in experimental research.

Here is one way to carry out random assignment that we included in the first edition of our textbook:

EXHIBIT 8.1 Procedure for Randomly Assigning Participants to Comparison Groups

The most popular procedure for randomly assigning participants to comparison groups is to use a list of random numbers, such as the following list of 200 numbers. (Larger lists are contained in the appendixes of most statistics books.)

	1	2	3	4	5	6	7	8	9	10
1	8	1	4	5	5	6	9	8	7	3
2	2	7	9	6	5	4	6	4	8	3
3	0	0	0	5	5	8	9	7	6	9
4	7	8	3	4	7	0	7	7	5	2
5	8	5	8	6	3	5	4	2	2	2
6	7	3	5	3	6	8	0	7	3	3
7	1	8	6	0	1	0	7	4	4	7
8	7	9	5	3	0	1	5	5	5	1
9	5	6	6	7	8	5	8	1	1	9
10	3	0	3	3	9	1	9	9	1	9
11	9	7	4	7	8	4	7	1	0	9
12	5	6	4	5	1	4	5	4	1	1
13	5	7	4	0	4	2	5	9	6	7
14	8	6	0	5	6	9	4	4	3	2
15	6	7	6	7	3	3	7	1	8	9
16	2	6	0	6	7	3	3	0	6	9
17	6	7	5	5	1	4	7	4	1	2
18	6	3	0	9	9	9	5	3	8	0
19	0	3	7	3	0	3	0	6	8	6
20	7	1	6	8	2	0	5	3	2	1

This list consists of a series of twenty rows and ten columns. The number in each position is random because each of the numbers from 0 to 9 had an equal chance of occupying that position, and the selection of one number for a given position had no influence in the selection of another number for another position. Therefore, since each individual number is random, any combination of the numbers must be random.

Assume that you have fifteen participants in your sample and you want to randomly assign them to three comparison groups. First, you give each participant a number from 0 to 14. You then block the list of random numbers into columns of two to provide five pairs of columns since two columns are necessary to represent the total sample of participants.

Now you are ready to randomly assign the five participants to each of the three comparison groups. The procedure usually followed is to randomly select the first five participants from the sample of fifteen and assign them to one comparison group. Then randomly select a second group of five participants from the sample of fifteen and assign them to another comparison group. Once these ten participants have been randomly selected and assigned, only five participants remain; these five participants are assigned to the third comparison group.

To randomly select the first participant for the first group, read down the first two columns until you encounter a number less than 15. From the list, we find that the first such number is 00. Consequently, the first randomly selected participant is the participant with the number 0. Proceed down the columns until you encounter the second number less than 15, which is 03. Participant number 3 represents the second randomly selected participant. Once you have reached the bottom of the first two columns, start at the top of the next two columns. With this procedure, the participant numbers 05, 06, and 09 are selected, which represent the remaining three of the first five randomly selected participants. Note that if you encounter a number that has already been selected (as we did with the number 05), you must disregard it.

To randomly select the second group of five participants, proceed down the columns and identify numbers less than 15 that have not already been chosen. Using this procedure, we find the numbers 10, 01, 14, 07, and 11. These numbers correspond to the second group of randomly selected participants. The third group represents the remaining participants.

We now have the following three randomly selected groups of participants.

00	01	02
03	07	04
05	10	08
06	11	12
09	14	13

Once each of the three groups has been randomly selected, they must be randomly assigned to one of the three experimental comparison groups.

This is accomplished by using only one column of the table of random numbers, since there are only three groups of participants. The three groups are numbered from 0 to 2. Proceed down the first column until you reach the first of these three numbers. In looking at column 1, you can see that the first number is 2. Consequently, group 2 (the third group of participants) is assigned to the first treatment condition and represents the first comparison group. The second number encountered is 0, so group 0 (the first group of participants) is assigned to the second treatment condition and represents the second comparison group. This means that group 1 (the second group of participants) is assigned to the third treatment condition and is the third comparison group. Now we have randomly assigned the sample of participants to three groups and have randomly assigned them to the three treatment or comparison conditions.

Treatment or Comparison Condition		
A_1	A_2	A_3
Group 2	Group 0	Group 1

Another way to conduct random assignment is to assign each person in your sample a number and then use a random assignment computer program. Here is one:
http://www.graphpad.com/quickcalcs/randomize1.cfm

2. Matching

Matching controls for confounding extraneous variables by equating the comparison groups on one or more variables that are correlated with the dependent variable. What you have to do is to decide what extraneous variables you want to match on (i.e.., decide what specific variables you want to make your groups similar on). These variables that you decide to use are called the matching variables.

Matching controls for the matching variables. That is, it eliminates any differential influence of the matching variables. You can match your groups on one or more extraneous variables. For example, let's say that you decide to equate your two groups (treatment and control groups) on IQ. That is, IQ is going to be your only matching variable. What you would do is to rank order all of the participants on IQ. Then select the first two (i.e., the two people with the two highest IQs) and put one in the experimental treatment group and the other in the control group (The best way to do this is to use random assignment to make these assignments. If you do this then you have actually merged two control techniques: matching and random assignment). Then take the

next two highest IQ participants and assign one to the experimental group and one to the control group. Then just continue this process until you assign one of the lowest IQ participants to one group and the other lowest IQ participant to the other group. Once you have completed this, your two groups will be matched on IQ! If you use matching without random assignment, you run into the problem that although you know that your groups are matched on IQ you have not matched them on other potentially important variables. A weakness of matching when it is used alone (i.e., without also using random assignment) is that you will know that the groups are equated on the matching variable(s) but you will not know whether the groups are similar on other potentially confounding variables.

3. Holding the Extraneous Variable Constant

This technique controls for confounding extraneous variables by ensuring that the participants in the different treatment groups have the same amount or type on a variable. For example, you might use only people who have an IQ of 120-125 in your research study if you are worried about IQ as being a confounding variable. If you are worried about gender, this if you used this technique you would either study females only or males only, but not both. A problem with this technique it that it can seriously limit your ability to generalize your study results (because you have limited your participants to only one type).

4. Building the Extraneous Variable into the Research Design

This technique takes a confounding extraneous variable and makes it an additional independent variable in your research study. For example, you might decide to include females and males in your research study. This technique is especially useful when you want to study any effect that the potentially confounding extraneous variable might have (i.e., you will be able to study the effect of your original independent variable as well as the additional variable(s) that you built into your design.

5. Counterbalancing

Counterbalancing is a technique used to control for sequencing effects (the two sequencing effects are order effects and carry-over effects). Note that this technique is only relevant for a design in which the participants receive more than one treatment condition. Sequencing effects

are biasing effects that can occur when each participant must participate in each experimental treatment condition.

Order effects are sequencing effects that arise from the order in which the treatments are administered. For example, as people complete their participation in their first treatment condition they will become more familiar with the setting and testing process. When these people participate, later, in their second treatment condition, they may perform better simply because are now familiar with the setting and testing that they acquired earlier. This is how the order can have an effect on the outcome..

Carry-over effects are sequencing effects that occur when the effect of one treatment condition carries over to a second treatment condition. That is, participants' performance in a later treatment is different because of the treatment that occurred prior to it. When this occurs the responses in subsequent treatment conditions are a function of the present treatment condition as well as any lingering effect of the prior treatment condition. Learning from the earlier treatment might carry-over to later treatments. Physical conditions caused by the earlier treatment might also carry-over if the time elapsing between the treatments is not long enough for the earlier effect to dissipate. Counterbalancing is a control technique that can be used to control for order effects and carry-over effects. You counterbalance by administering each experimental treatment condition to all groups of participants, but you do it in different orders for different groups of people. For example if you just had two groups making up your independent variable you could counterbalance by dividing you sample into two groups and giving this order to the first group (treatment one followed by treatment two) and giving this order to the second group (treatment two followed by treatment one).

6. Analysis of Covariance

Analysis of covariance (ANCOVA) is a statistical control technique that is used to statistically equate groups that differ on a pretest or some other variable. For example, in multi-group designs that have a pretest, ANCOVA is used to equate the groups on the pretest. As another example, in a learning research study you might want to control for intelligence because if there are more of brighter students in one of two comparison groups (and these students are expected to learn faster) then the difference between the groups might be because the groups differ on IQ rather

than the treatment variable; therefore, you would want to control for intelligence. Analysis of covariance statistically adjusts the dependent variable scores for the differences that exist on an extraneous variable (your control variable). When selecting variables to control for, note that the only relevant extraneous variables are those that also affect participants' responses to the dependent variable.

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Summary

Extraneous Variables are undesirable variables that influence the outcome of an experiment, though they are not the variables that are actually of interest.

Techniques of controlling for extraneous/confounding variables

Random assignment is the most important technique used to control for confounding variables because it has the ability to control for both known and unknown confounding extraneous variables.

Matching controls for confounding extraneous variables by equating the comparison groups on one or more variables that are correlated with the dependent variable.

Holding the Extraneous Variable Constant: This technique controls for confounding extraneous variables by ensuring that the participants in the different treatment groups have the same amount or type on a variable.

Building the Extraneous Variable into the Research Design: This technique takes a confounding extraneous variable and makes it an additional independent variable in your research study. For example, you might decide to include females and males in your research study. This technique is especially useful when you want to study any effect that the potentially confounding extraneous variable might have (i.e., you will be able to study the effect of your original independent variable as well as the additional variable(s) that you built into your design.

Counterbalancing: Counterbalancing is a technique used to control for sequencing effects (the two sequencing effects are order effects and carry-over effects). Note that this technique is only relevant for a design in which the participants receive more than one treatment condition.

Sequencing effects are biasing effects that can occur when each participant must participate in each experimental treatment condition.

Order effects are sequencing effects that arise from the order in which the treatments are administered.

Carry-over effects are sequencing effects that occur when the effect of one treatment condition carries over to a second treatment condition.

Analysis of Covariance : Analysis of covariance (ANCOVA) is a statistical control technique that is used to statistically equate groups that differ on a pretest or some other variable. For example, in multi-group designs that have a pretest, ANCOVA is used to equate the groups on the pretest

Post Test

1. Explain Discuss the meaning of confounding variables
2. Explore the main features of six techniques of controlling for confounding variables in an experimental study.

LECTURE EIGHT

Common Instruments Used in Experimental Psychology

Introduction

Instruments used in experimental psychology have been changing over time. In fact, the original instruments used by experimenters were not originally designed for the specific use of psychologists. This was partly due to the lack of psychological laboratories in the 19th century when experimental psychology began to develop. The modern history of physiological psychology has been written by psychologists who have combined the experimental methods of psychology with those of physiology and have applied them to the issues that concern all psychologists. In recent years investigators have studied many aspects of physiology, using the multi-disciplinary approach. This has become an avenue by which tools originally developed for other clinical and health related sciences became applicable in the discipline of experimental psychology. However, we should remember that there are other instruments that were developed for the exclusive use of psychologists, such as the lie detector etc., we should remember that many of such instruments were already discussed during our PSY 209 lectures. This chapter will therefore focus on other equipment often used in diagnostic procedures, which are also often used in the field of experimental researches involving psychologists.

Objectives

At the end of this lecture, you should be able to:

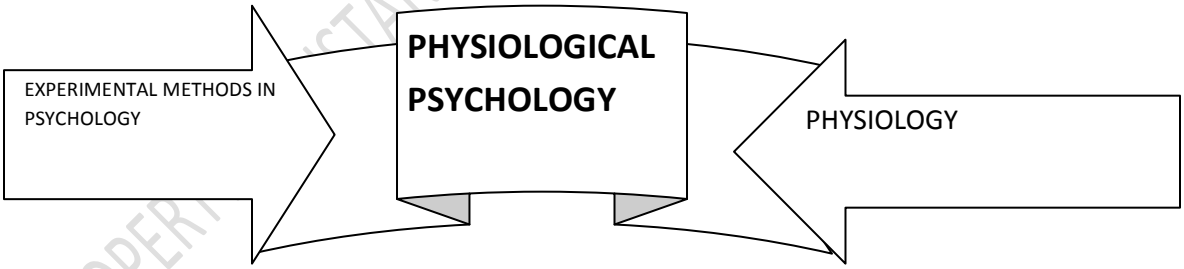
1. explain the meaning of instruments
2. mention ten experimental psychology equipment
3. explain the purpose of ten experimental psychology and allied equipment

Pre-Test

1. Explain the meaning of experimental psychology equipment
2. Identify ten equipment used in experimental psychology

Content

Instruments are precision tools or equipment used in safe performance of a procedure or task. Instruments used in experimental psychology have been changing over time. In fact, the original instruments used by experimenters were not originally designed for the specific use of psychologists. This was partly due to the lack of psychological laboratories in the 19th century when experimental psychology began to develop. The modern history of physiological psychology has been written by psychologists who have combined the experimental methods of psychology with those of physiology and have applied them to the issues that concern all psychologists. In recent years investigators have studied many aspects of physiology, using the multi-disciplinary approach. This has become an avenue by which tools originally developed for other clinical and health related sciences became applicable in the discipline of experimental psychology. However, we should remember that there are other instruments that were developed for the exclusive use of psychologists, such as the lie detector etc., we should remember that many of such instruments were already discussed during our PSY 209 lectures. This chapter will therefore focus on other equipment often used in diagnostic procedures, which are also often used in the field of experimental researches involving psychologists.



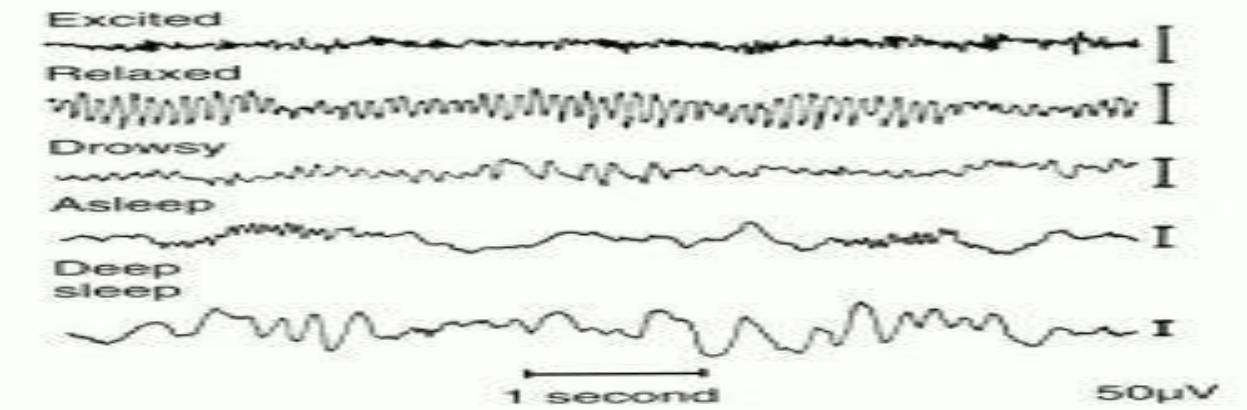
AN INTERACTION BETWEEN PHYSIOLOGY AND PSYCHOLOGY

The instruments used by researchers vary from simple to complex. Experimenters develop new instruments and tools for their varying experiments. Listed below are some of the different types of instruments used in physiological psychology.

Common instruments used in experimenting/testing various disorders in humans

1. Electroencephalography (EEG)

An electroencephalogram (EEG) is a test used to detect abnormalities related to electrical activity of the brain. This procedure tracks and records brain wave patterns. Small metal discs with thin wires (electrodes) are placed on the scalp, and then send signals to a computer to record the results on the screen or on paper as wavy lines. Normal electrical activity in the brain makes a recognizable pattern. Through an EEG, doctors can look for abnormal patterns that indicate certain conditions, such as seizures, can be seen by the changes in the normal pattern of the brain's electrical activity. The EEG record is read by a doctor (neurologist) who is specially trained to diagnose and treat disorders affecting the nervous system. The most common reason an EEG is performed is to diagnose and monitor seizure disorders. EEGs can also help to identify causes of other problems such as sleep disorders and changes in behavior. EEGs are sometimes used to evaluate brain activity after a severe head injury or before heart or liver transplantation. An electroencephalogram (EEG) may be done in a hospital or in a doctor's office by an EEG technologist.



Electroencephalogram: Recordings made while the subject was excited, relaxed, and in various stages of sleep. During excitement the brain waves are rapid and of small amplitude, whereas in sleep they are much slower and of greater amplitude.

Uses of the EEG

i. Diagnose epilepsy and see what types of seizures are occurring. EEG is the most useful and important test in confirming a diagnosis of epilepsy.

ii. Check for problems with loss of consciousness or dementia.

iii. Help find out a person's chance of recovery after a change in consciousness.

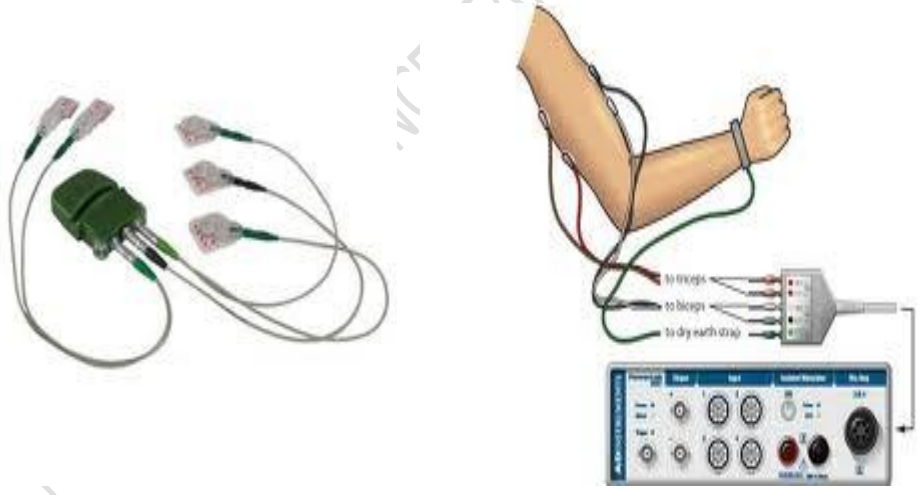
iv. Find out if a person who is in coma is brain-dead.

v. Study sleep disorders, such as narcolepsy.

vi. Watch brain activity while a person is receiving general anesthesia during brain surgery.
vii. Help find out if a person has a physical problem (problems in the brain, spinal cord, or nervous system or a mental health problem.

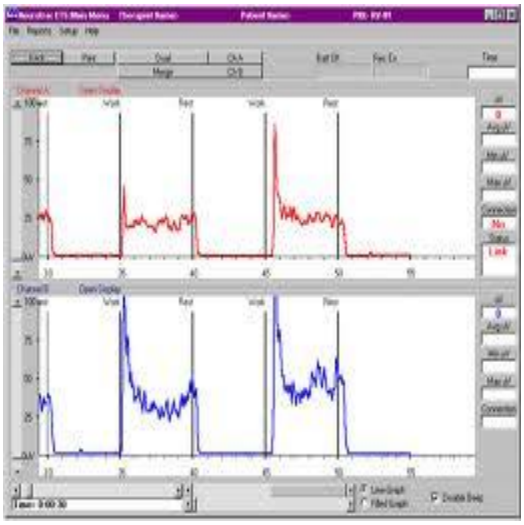
2. Electromyography (EMG)

Electromyography, (EMG) is a test that measures the response of muscles and nerves to electrical activity. It is used to help determine muscle conditions that might be causing muscle weakness, including muscular dystrophy and nerve disorders. It involves testing the electrical activity of muscles. Often, EMG testing is performed with another test that measures the conducting function of nerves. In some medical conditions the electrical activity of the muscles or nerves is not normal. Finding and describing these electrical properties in the muscle or nerve may help your doctor diagnose your condition. EMG is most often used when people have symptoms of weakness, and examination shows impaired muscle strength. It can help to tell the difference between muscle weakness caused by injury of a nerve attached to a muscle and weakness due to neurologic disorders. The Muscles are stimulated by signals from nerve cells called motor neurons.



This stimulation causes electrical activity in the muscle, which in turn causes the muscle to contract or tighten. The contraction muscle produces electrical signals when a needle electrode is inserted into the muscle (the insertion of the needle might feel similar to an injection). The signal

from the muscle is then transmitted from the needle electrode through a wire (or more recently, wirelessly) to a receiver/amplifier, which is connected to a device that displays a readout. The results are either printed on a paper strip or, more commonly, on a computer screen. The EMG may aid with the diagnosis of nerve compression or injury (such as Carpal Tunnel Syndrome), nerve root injury (such as sciatica), and with other problems of the muscles or nerves.



Uses of the Electromyography

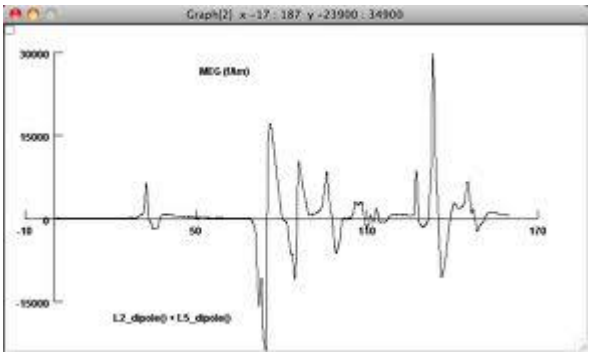
EMGs help diagnose three kinds of diseases that interfere with normal muscle contraction:

diseases of the muscle itself (most commonly, muscular dystrophy in children)

i. diseases of the neuromuscular junction, which is the connection between a nerve fiber and the muscle it supplies

ii. diseases "upstream" in nerves and nerve roots (which can be due to either nerve damage or ongoing nerve injury).

3. Magneto-encephalography



Magneto-encephalography is an Objective Test for PTSD (Post-traumatic stress disorder)

PTSD can be a difficult condition to diagnose in patients that have difficulty "opening up" to a psychiatrist. Moreover, because symptoms of PTSD are often used as evidence in court cases, an Objective test can be a welcome tool in helping to convict violent criminals.

Magneto-encephalography can provide an accurate analysis of the existence of PTSD in the brains of its victims. Magneto-encephalography (MEG) is a technique for mapping brain activity by recording magnetic fields produced by electrical currents occurring naturally in the brain, using very sensitive magnetometers. Arrays of SQUIDS (superconducting quantum interference devices) are currently the most common magnetometer, and SERF being investigated for future machines. Applications of MEG include basic research into perceptual and cognitive brain processes, localizing regions affected by pathology before surgical removal, determining the challenge posed by MEG is to determine the location of electric activity within the brain from

the induced magnetic fields outside the head. Problems such as this, where model parameters (the location of the activity) have to be estimated from measured data (the SQUID signals) are referred to as *inverse problems* (in contrast to *forward problems.* where the model parameters (e.g. source location) are known and the data (e.g. the field at a given distance) is to be estimated.) The primary difficulty is that the inverse problem does not have a unique solution (i.e., there are infinite possible "correct" answers), and the problem of defining the "best" solution is itself the subject of intensive research, Possible solutions can be derived using models involving prior knowledge of brain activity.

The source models can be either over-determined or under-determined. An over-determined model may consist of a few point-like sources ("equivalent dipoles"), whose locations are then estimated from the data. Under-determined models may be used in cases where many different distributed areas are activated ("distributed source solutions"): there are infinitely many possible current distributions explaining the measurement results, but the most likely is selected.

4. Electronystagmography (ENG)

Electronystagmography (ENG) is a diagnostic test to record involuntary movements of the eye caused by a condition known as nystagmus. During ENG, electrodes are attached to the face near the eyes to record eye movements. The movements are recorded on graph paper or the computer screen. A series of recordings is done.

i. Baseline recordings are taken with your head at rest.

ii. More recordings are done:

iii. While you move your head up and down, left and right

iv. While you look at a moving object.

v. After warm or cold water (or air) is placed inside your ears.

ENG is done to help see whether there is damage or a problem in how the inner ear, brain, or nerves connecting them work. These problems may cause dizziness, vertigo, or loss of balance. The ENG provides an objective assessment of the oculomotor and vestibular systems. The vestibular system monitors the position and movements of the head to stabilize retinal images. This information is integrated with the visual system and spinal afferents in the brain stem to produce the vestibuloocular reflex.

Essentially, the standard ENG test battery consists of the following 3 parts:

- Oculomotor evaluation
- Positioning/positional testing
- Caloric stimulation of the vestibular system

Although ENG testing cannot be used to determine the specific site of lesion, the information acquired can be integrated with history, symptoms, and other test results to aid in diagnosis. Comparing results obtained from various subtests of an ENG evaluation assists in determining whether a disorder is central or peripheral. In peripheral vestibular disorders, the side of lesion can be inferred from the results of caloric stimulation and, to some degree, from positional findings. An ENG evaluation can also be useful in ruling out potential causes of dizziness.

The electronystagmograpy (ENG) is used to:

i.Find where the problem is in the inner ear, brain, or nerves connecting them that is causing dizziness, vertigo, or a loss of balance.

ii. Find any damage to structures or nerves in the inner ear, brain, or nerves connecting them.

For 2 to 5 days before the test, you will be asked to stop taking:

Your doctor may ask you to eat a light meal or not eat for 3 to 4 hours before the test, because the test can cause nausea and vomiting. It is proper not to wear facial makeup during the test so

the electrodes can attach to the skin. Five electrodes will be attached with a special paste to your face. You will be in a dark room for the test. The test may have six parts.

i. To find the right settings for the measuring tool, you will follow a moving point of light with only your eyes. You should not move your head during this part of the test.

ii. Readings will be taken with your eyes closed. You may be given a mental task to do, such as an arithmetic problem, during this part of the test. Readings will be taken while you look straight ahead and to each side.

iii. Readings will be taken while your eyes follow the back-and-forth movement of a pendulum.

iv. Readings will be taken while you follow a series of moving objects out of your line of vision. As each object leaves your line of vision, you will be asked to look immediately at the next moving object.

v. Readings will be taken while you move your head from side to side and up and down. You may be asked to move your body (as well as your head) into different positions.

vi. Near the end of the test, your eye movements may be recorded while cool and warm water is placed inside your ears. In some cases, warm and cool air may be blown gently into your ears instead of using water. This part of the test is called the caloric test and may be done without using electrodes near your eyes. The caloric test is not done if you have a perforated eardrum, because water used in the caloric test can get into the middle ear and lead to infection. The caloric test can be done with air instead of water, but if the eardrum is perforated, the caloric test may not be done at all. The test may take 60 to 90 minutes.

Risks

An electronystagmograpy may cause vomiting. There is a small chance of causing a neck or back problem to get worse during the test because of the quick body movements that are done.

5. **Hipp Chronoscope**

The Hipp chronoscope is one of the most important scientific instruments of late 19th and early 20th century psychology. Following similar devices constructed by the English physicist Charles Wheatstone (1802 - 1875), the German clockmaker and mechanic Matthäus Hipp (1813 - 1893) presented his version of this electromagnetic precision timer in 1848. After Wilhelm Wundt (1832 - 1920) recommended the application of Hipp's chronoscope in the first edition of his path-

breaking text book *Grundzüge der physiologischen Psychologie* in 1874, the "time viewer" was widely used in the emerging community of experimental psychologists.

This instrument was originally designed to be used in physics to verify the laws of falling bodies. It was then introduced to ballistics research in the 1850s to measure the speed of bullets. After then being introduced to physiology, it was finally introduced to psychology. Researchers used the Hipp Chronoscope to measure reaction time and the duration of mental processes.

6. **Audiometer**

This is an instrument used to measure hearing threshold. The purpose of audiometry is to establish an individual's range of hearing. It is most often performed when hearing loss is suspected. Audiometry can establish the extent as well as the type of a hearing loss. Audiometric techniques are also used when an individual has vertigo or dizziness, since many hearing and vestibular or balance problems are related. Since those with facial paralysis may also have hearing loss, audiologic testing may be performed on these individuals as well.

Use of Audiometer

The most common method of assessing hearing ability is with the audiometer. Audiometric testing with the audiometer is performed while the patient sits in a soundproof booth and the examiner outside the booth communicates to the patient with a microphone. The patient wears headphones when air conduction is tested and a vibrating earpiece behind the ear next to the mastoid bone or along the forehead when bone conduction is tested. One ear is tested at a time, and a technique called masking, in which noise is presented to the ear not being tested, assures the examiner that only one ear is tested at a time. Through the headphones or earpiece pure sounds in both frequency and intensity are transmitted to the patient and the threshold at which the patient can hear for each frequency is established. The patient signals an ability to hear a sound by raising a hand or finger. The threshold for each frequency, for each ear is plotted on a graph. The right ear is usually plotted in RED, and as an 'x', and the left in Blue as a circle. There are special symbols for the conditions under which the hearing test is done

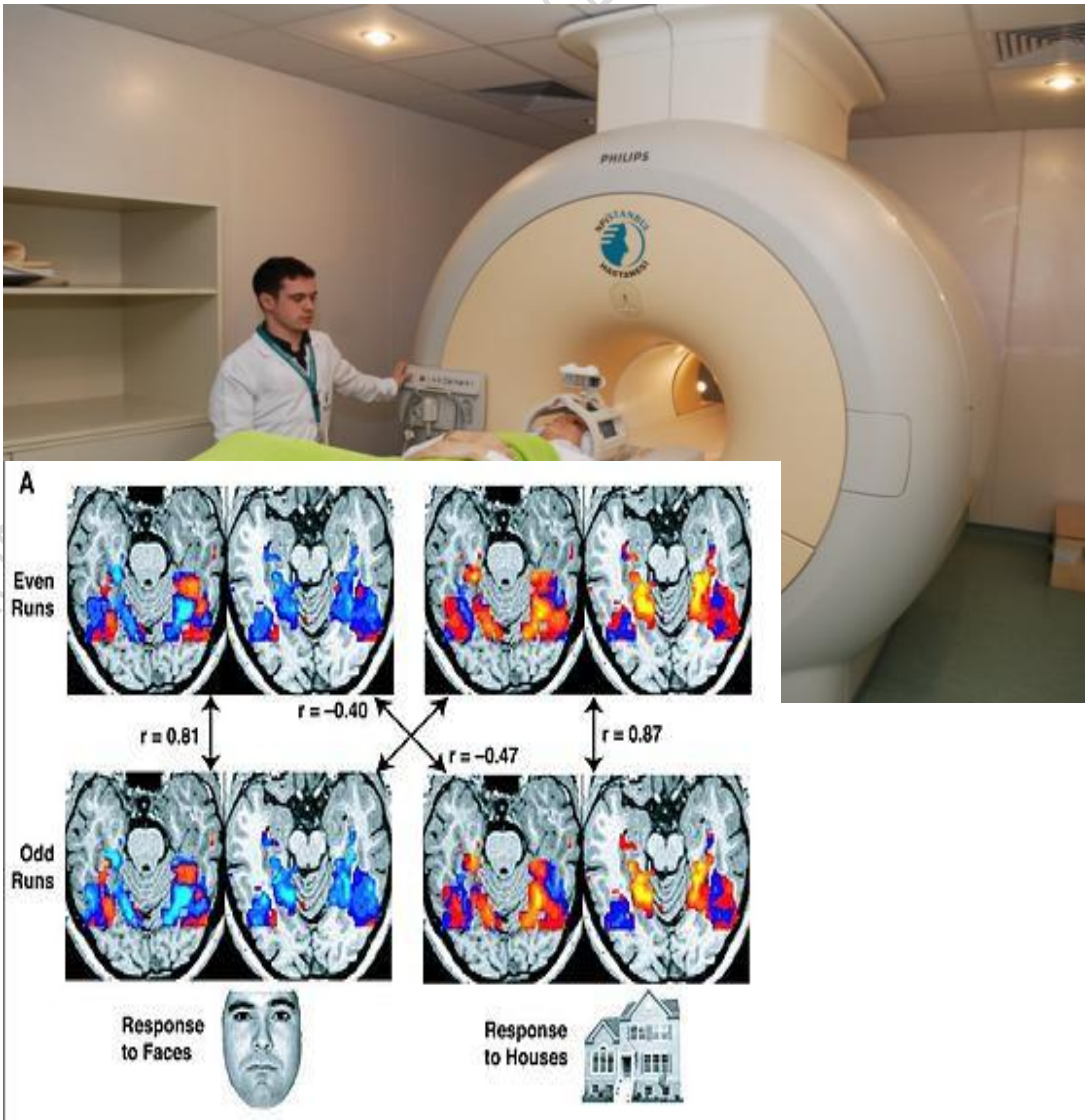
Risk in Using Audiometer

If the ABR is used under sedation then the side effects of sedatives must be considered. Otherwise there are no risks associated with audiometry.

7. Functional Magnetic Resonance Imaging (Fmri)

The Functional magnetic resonance imaging, or fMRI, is a technique for measuring brain activity. It works by detecting the changes in blood oxygenation and flow that occur in response to neural activity – when a brain area is more active it consumes more oxygen and to meet this increased demand blood flow increases to the active area. fMRI can be used to produce activation maps showing which parts of the brain are involved in a particular mental process.

The development of FMRI in the 1990s, generally credited to Seiji Ogawa and Ken Kwong, is the latest in long line of innovations, including positron emission tomography (PET) and near infrared spectroscopy (NIRS), which use blood flow and oxygen metabolism to infer brain activity.



These fMRI images are from a study showing parts of the brain lighting up on seeing houses and other parts on seeing faces. The 'r' values are correlations, with higher positive or negative values indicating a better match.

The attractions of FMRI have made it a popular tool for imaging normal brain function – especially for psychologists. Over the last decade it has provided new insight to the investigation of how memories are formed, language, pain, learning and emotion to name but a few areas of research. FMRI is also being applied in clinical and commercial settings.

As a brain imaging technique FMRI has several significant advantages:

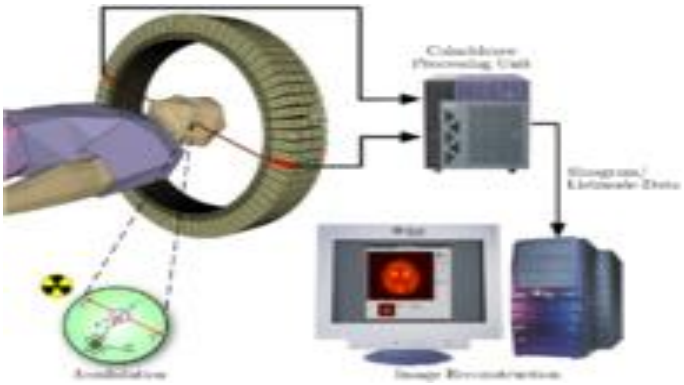
1. It is non-invasive and doesn't involve radiation, making it safe for the subject.
2. It has excellent spatial and good temporal resolution.
3. It is easy for the experimenter to use.

8. Positron Emission Tomography

The PET is a scanner that has a large machine with a round, doughnut shaped hole in the middle, similar to a CT or MRI unit. Within this machine are multiple rings of detectors that record the emission of energy from the radiotracer in your body. To conduct the scan, a short-lived radioactive and tracer isotope is injected into the living subject (usually into blood circulation). The tracer is chemically incorporated into a biologically active molecule. There is a waiting period while the active molecule becomes concentrated in tissues of interest; then the subject is placed fluorodeoxyglucose (FDG), a sugar, for which the waiting period is typically an hour. During the scan a record of tissue concentration is made as the tracer decays.

As the radioisotope undergoes positron emission decay (also known as positive beta decay), it emits a positron, an antiparticle of the electron with opposite charge. The emitted positron travels in tissue for a short distance (typically less than 1 mm, but dependent on the isotope), during which time it loses kinetic energy, until it decelerates to a point where it can

interact with an electron. The encounter annihilates both electron and positron, producing a pair of annihilation (gamma) photons moving in approximately opposite directions. These are detected when they reach a scintillator in the scanning device, creating a burst of light which is detected by photomultiplier tubes or silicon avalanche photodiodes (Si APD).



PET is also used in pre-clinical studies using animals, where it allows repeated investigations into the same subjects. This is particularly valuable in cancer research, as it results in an increase in the statistical quality of the data (subjects can act as their own control) and substantially reduces the numbers of animals required for a given study.

Alternative methods of scanning include x-ray computed tomography (CT), magnetic resonance imaging (MRI), ultrasound, and single-photon emission computed tomography (SPECT).

9. Polygraph

A polygraph (popularly referred to as a lie detector) measures and records several physiological indices such as blood pressure, pulse, respiration, and skin conductivity while the subject is asked and answers a series of questions. The belief is that deceptive answers will produce physiological responses that can be differentiated from those associated with non-deceptive answers.

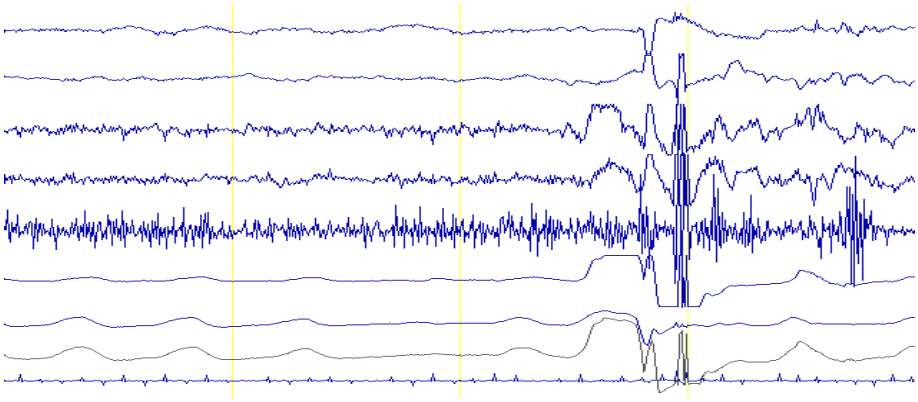
A polygraph is an instrument that simultaneously records changes in physiological processes such as heartbeat, blood pressure, respiration and electrical resistance (galvanic skin response or GSR). The polygraph is used as a lie detector by police departments, the FBI, the CIA, federal and state governments, and numerous private agencies. The underlying theory of the polygraph is that when people lie they also get measurably nervous about lying. The heartbeat increases,

blood pressure goes up, breathing rhythms change, perspiration increases, etc. A baseline for these physiological characteristics is established by asking the subject questions whose answers the investigator knows. Deviation from the baseline for truthfulness is taken as sign of lying.
There are three basic approaches to the polygraph test:

i. The Control Question Test (CQT). This test compares the physiological response to relevant questions about the crime with the response to questions relating to possible prior misdeeds. "This test is often used to determine whether certain criminal suspects should be prosecuted or classified as uninvolved in the crime" (American Psychological Association).

ii. The Directed Lie Test (DLT). This test tries to detect lying by comparing physiological responses when the subject is told to deliberately lie to responses when they tell the truth.

iii. The Guilty Knowledge Test (GKT). This test compares physiological responses to multiple-choice type questions about the crime, one choice of which contains information only the crime investigators and the criminal would know about.



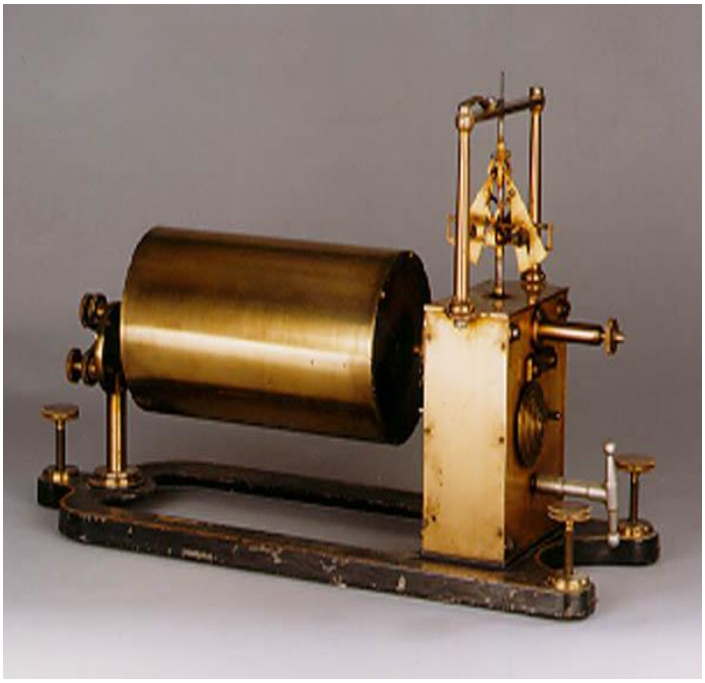
A Polygram showing physiological responses

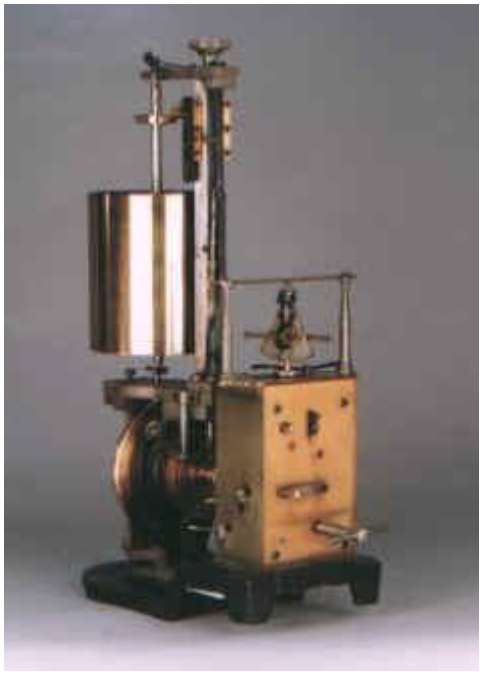
Psychologists do not think either the CQT or the DLT is scientifically sound, but a majority surveyed by the American Psychological Association think that the Guilty Knowledge Test is based on sound scientific theory and consider it "a promising forensic tool." However, they "would not advocate its admissibility [in court] in the absence of additional research with real-life criminal cases." One major problem with this test is that it has no controls. Also, unless the investigators have several pieces of insider information to use in their questioning, they run the risk of making a hasty conclusion based on just one or two "deviant" responses. There may be many reasons why a subject would select the "insider" choice to a question. Furthermore, not responding differently to the "insider" choices for several questions should not be taken as proof the subject is innocent. He or she may be a sociopath, a psychopath, or simply a good liar.

Is there any evidence that the polygraph is really able to detect lies? The machine measures changes in blood pressure, pulse, and respiration rate. When a person lies it is assumed that these physiological changes occur in such a way that a trained expert can detect whether the person is lying. Is there a scientific formula or law which establishes a regular correlation between such physiological changes and lying? No. Is there any scientific evidence that polygraph experts can detect lies using their machine at a significantly better rate than non-experts using other methods? No. There are no machines and no experts that can detect with a high degree of accuracy when people, selected randomly, are lying and when they are telling the truth.

The reason the polygraph is not a lie detector is that what it measures--changes in heartbeat, blood pressure, and respiration--can be caused by many things. Nervousness, anger, sadness, embarrassment, and fear can all be causal factors in altering one's heart rate, blood pressure, or respiration rate. Having to go to the bathroom can also be causative. There are also a number of medical conditions such as colds, headaches, constipation, or neurological and muscular problems which can cause the physiological changes measured by the polygraph.

10. Kymograph





A kymograph is a device that graphically records changes in position over time, and is most commonly used to record changes in pressure or motion. The kymograph consists of a drum to which a stylus is attached. The stylus records the changes on a paper wrapped around the drum as the drum revolves. Since its invention in the 1800s, the kymograph has been used most commonly in the field of medicine to study various physiological and muscular processes, for example blood pressure, respiration and muscle contractions. It has also been used to analyze other phenomena like atmospheric pressure, speech sounds, and turning fork vibrations.

The term kymograph comes from Latin and translates as "wave writer," referring to the graphical record produced by the instrument, where the stylus traces a pattern of the changes as they occur. This record provides a representation of changes over time, with time intervals usually marked on the paper. The graphic record generated by the kymograph instrument is commonly translated into a graph, showing changes in pressure or motion on the horizontal x-axis, and time elapsed on the vertical y-axis.

This instrument was invented in the 1840s by German physiologist Carl Ludwig, who primarily used it to study changes in blood pressure. Ludwig also used it to study speech sounds. As a person read words out loud, the vibrations of the sound waves would be recorded by the kymograph, making it possible to study sound duration, intensity and pitch. In the 1800s, kymographs were also used for a variety of other purposes, like studying the influence of drugs on various organs and the function of steam engines.

Today kymographs have been replaced by more recently invented instruments for many purposes, but kymograph analysis is still used for certain phenomena. For example, kymographs can be used to study moving organelles and to describe their motion in detail. This instrument is also commonly used in physiological and biological experiments, and in some pharmacological testing, to record mechanical activities of animal tissues and to study how muscular tissue reacts to drugs and other stimuli.

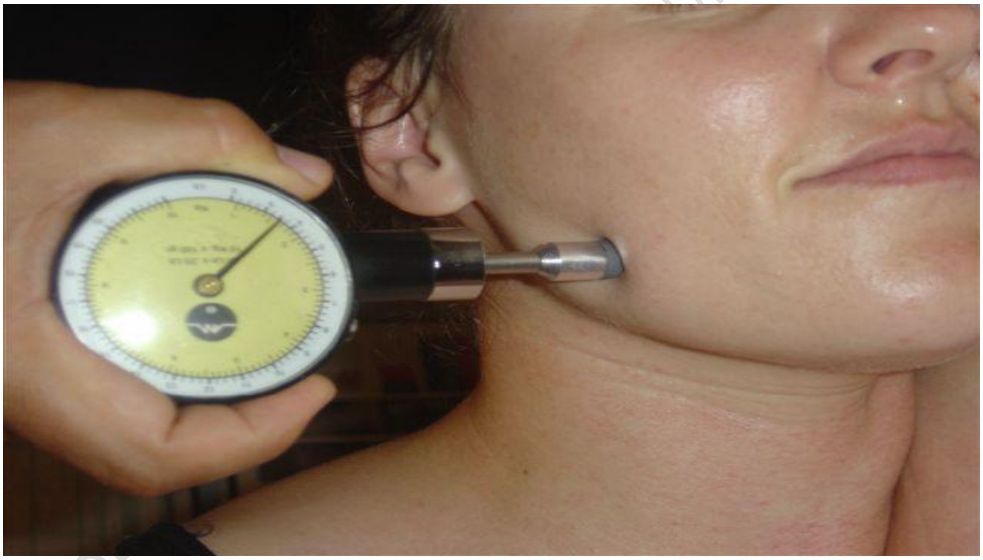
A kymograph can be either horizontal or vertical, depending on the orientation of the drum. A clockwork or electric motor drives the drum, rotating it slowly while the stylus traces a graphic record on a piece of paper wrapped around the drum. Today, plain paper is commonly used for this purpose, but in the past, smoked paper that had been treated by holding it over the fumes from a petroleum lantern, was often used.

This kymograph is designed for recording mechanical activities of animal tissues in the physiological, pharmacological and biological experiments conducted by medical and pharmaceutical colleges or research institutes. It is cabinet, portable, solid, and durable, and runs noiselessly, steadily, reliably and reassuring. It can also shift rotational speed in a large range.

The instrument is simply assembled and convenient to servicing. It can be assembled with a passive drum for being used as a two-drum kymograph.

It was a revolving drum that had a moving stylus to record the data. The kymograph is similar to the polygraph. The main difference is the recording surface of a polygraph is driven along a rack instead of a drum.

11. **Algesiometer and Algometer**



It is an instrument for measuring the degree of sensitivity to a painful stimulus. It has a piston rod with a blunted tip which is pressed against the skin. They have a sharp needle-like stimulus point so it does not give the sensation of pressure.

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Summary

The instruments used by researchers vary from simple to complex. Experimenters develop new instruments and tools for their varying experiments. Listed below are some of the different types of instruments used in physiological psychology.

Common instruments used in experimenting/testing various disorders in humans include

1. Electroencephalography (EEG): An electroencephalogram (EEG) is a test used to detect abnormalities related to electrical activity of the brain. This procedure tracks and records brain wave patterns.

2. Electromyography (EMG)

Electromyography, (EMG) is a test that measures the response of muscles and nerves to electrical activity. It is used to help determine muscle conditions that might be causing muscle weakness, including muscular dystrophy and nerve disorders.

This stimulation causes electrical activity in the muscle, which in turn causes the muscle to contract or tighten

3. Magneto-encephalography: Magneto-encephalography is an Objective Test for PTSD (Post-traumatic stress disorder). PTSD can be a difficult condition to diagnose in patients that have difficulty “opening up” to a psychiatrist. Moreover, because symptoms of PTSD are often used as evidence in court cases, an objective test can be a welcome tool in helping to convict violent criminals.

4. Electronystagmography (ENG): Electronystagmography (ENG) is a diagnostic test to record involuntary movements of the eye caused by a condition known as nystagmus. The movements are recorded on graph paper or the computer screen. An electronystagmograpy may cause vomiting. There is a small chance of causing a neck or back problem to get worse during the test because of the quick body movements that are done.

5. Hipp Chronoscope: The Hipp chronoscope is one of the most important scientific instruments of late 19th and early 20th century psychology. Following similar devices constructed by the English physicist Charles Wheatstone (1802 - 1875), the German clockmaker and mechanic Matthäus Hipp (1813 - 1893) presented his version of this electromagnetic precision timer in 1848. After Wilhelm Wundt (1832 - 1920) recommended the application of Hipp's chronoscope in the first edition of his path-breaking text book *Grundzüge der physiologischen Psychologie* in 1874. Researchers used the Hipp Chronoscope to measure reaction time and the duration of mental processes.

6. Audiometer: This is an instrument used to measure hearing threshold. The purpose of audiometry is to establish an individual's range of hearing. It is most often performed when hearing loss is suspected.

7. Functional Magnetic Resonance Imaging (Fmri): The Functional magnetic resonance imaging, or fMRI, is a technique for measuring brain activity. The development of FMRI in the 1990s, generally credited to Seiji Ogawa and Ken Kwong.

8. Positron Emission Tomography: The PET is a scanner that has a large machine with a round, doughnut shaped hole in the middle, similar to a CT or MRI unit.

9. Polygraph: A polygraph (popularly referred to as a lie detector) measures and records several physiological indices such as blood pressure, pulse, respiration, and skin conductivity while the

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Post Test

1. explain the meaning of experimental equipment
2. describe ten experimental psychology equipment
3. explain the purpose of ten experimental psychology and allied equipment