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PSY 105
History of Experimental Psychology

Course Manual

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COURSE MANUAL

History of Experimental Psychology

PSY105

University of Ibadan Distance Learning Centre
Ibadan Open and Distance Learning Course Series Development
Version 1.0 ev1

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ISBN: 978-021-279-5

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Page layout, instructional design and development by EDUTECHportal, www.edutechportal.org

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Vice-Chancellor's Message

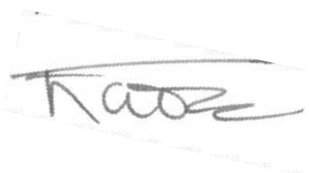
The Distance Learning Centre is building on a solid tradition of over two decades of service in the provision of External Studies Programme and now Distance Learning Education in Nigeria and beyond. The Distance Learning mode to which we are committed is providing access to many deserving Nigerians in having access to higher education especially those who by the nature of their engagement do not have the luxury of full time education. Recently, it is contributing in no small measure to providing places for teeming Nigerian youths who for one reason or the other could not get admission into the conventional universities.

These course materials have been written by writers specially trained in ODL course delivery. The writers have made great efforts to provide up to date information, knowledge and skills in the different disciplines and ensure that the materials are user-friendly.

In addition to provision of course materials in print and e-format, a lot of Information Technology input has also gone into the deployment of course materials. Most of them can be downloaded from the DLC website and are available in audio format which you can also download into your mobile phones, IPod, MP3 among other devices to allow you listen to the audio study sessions. Some of the study session materials have been scripted and are being broadcast on the university's Diamond Radio FM 101.1, while others have been delivered and captured in audio-visual format in a classroom environment for use by our students. Detailed information on availability and access is available on the website. We will continue in our efforts to provide and review course materials for our courses.

However, for you to take advantage of these formats, you will need to improve on your I.T. skills and develop requisite distance learning Culture. It is well known that, for efficient and effective provision of Distance learning education, availability of appropriate and relevant course materials is a *sine qua non*. So also, is the availability of multiple plat form for the convenience of our students. It is in fulfillment of this, that series of course materials are being written to enable our students study at their own pace and convenience.

It is our hope that you will put these course materials to the best use.



Prof. Isaac Adewole

Vice-Chancellor

Foreword

As part of its vision of providing education for "Liberty and Development" for Nigerians and the International Community, the University of Ibadan, Distance Learning Centre has recently embarked on a vigorous repositioning agenda which aimed at embracing a holistic and all encompassing approach to the delivery of its Open Distance Learning (ODL) programmes. Thus we are committed to global best practices in distance learning provision. Apart from providing an efficient administrative and academic support for our students, we are committed to providing educational resource materials for the use of our students. We are convinced that, without an up-to-date, learner-friendly and distance learning compliant course materials, there cannot be any basis to lay claim to being a provider of distance learning education. Indeed, availability of appropriate course materials in multiple formats is the hub of any distance learning provision worldwide.

In view of the above, we are vigorously pursuing as a matter of priority, the provision of credible, learner-friendly and interactive course materials for all our courses. We commissioned the authoring of, and review of course materials to teams of experts and their outputs were subjected to rigorous peer review to ensure standard. The approach not only emphasizes cognitive knowledge, but also skills and humane values which are at the core of education, even in an ICT age.

The development of the materials which is on-going also had input from experienced editors and illustrators who have ensured that they are accurate, current and learner-friendly. They are specially written with distance learners in mind. This is very important because, distance learning involves non-residential students who can often feel isolated from the community of learners.

It is important to note that, for a distance learner to excel there is the need to source and read relevant materials apart from this course material. Therefore, adequate supplementary reading materials as well as other information sources are suggested in the course materials.

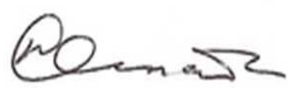
Apart from the responsibility for you to read this course material with others, you are also advised to seek assistance from your course facilitators especially academic advisors during your study even before the interactive session which is by design for revision. Your academic advisors will assist you using convenient technology including Google Hang Out, You Tube, Talk Fusion, etc. but you have to take advantage of these. It is also going to be of immense advantage if you complete assignments as at when due so as to have necessary feedbacks as a guide.

The implication of the above is that, a distance learner has a responsibility to develop requisite distance learning culture which includes diligent and disciplined self-study, seeking available administrative and academic support and acquisition of basic information technology skills. This is why you are encouraged to develop your computer skills by availing yourself the opportunity of training that the Centre's provide and put these into use.

In conclusion, it is envisaged that the course materials would also be useful for the regular students of tertiary institutions in Nigeria who are faced with a dearth of high quality textbooks. We are therefore, delighted to present these titles to both our distance learning students and the university's regular students. We are confident that the materials will be an invaluable resource to all.

We would like to thank all our authors, reviewers and production staff for the high quality of work.

Best wishes.



Professor Bayo Okunade

Director

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Contents

About this course manual

History of Experimental Psychology PSY105 has been produced by University of Ibadan Distance Learning Centre. It is structured in the same way, as other psychology course.

How this course manual is structured

The course overview

The course overview gives you a general introduction to the course. Information contained in the course overview will help you determine:

- If the course is suitable for you.
- What you will already need to know.
- What you can expect from the course.
- How much time you will need to invest to complete the course.

The overview also provides guidance on:

- Study skills.
- Where to get help.
- Course assessments and assignments.
- Activity icons.
- Study sessions.

The course content

The course is broken down into study sessions. Each study session comprises:

- An introduction to the study session content.
- Learning outcomes.
- Content of study sessions.
- A study session summary.
- Assessments and/or assignment, as applicable.

Your comments

After completing this course, History of Experimental Psychology, we would appreciate it if you would take a few moments to give us your feedback on any aspect of this course. Your feedback might include comments on:

- Course content and structure.
- Course reading materials and resources.
- Course assessments.
- Course assignments.
- Course duration.
- Course support (assigned tutors, technical help, etc).
- Your general experience with the course provision as a distance learning student.

Your constructive feedback will help us to improve and enhance this course.

Course overview

Welcome to History of Experimental Psychology PSY105

The overall aim of this course is to enable learners become aware of how experimental psychology has evolved over the years. The course will also provide insight on basic experimental research techniques and ethics.

This course manual supplements and complements PSY105 UI Mobile Class Activities as an online course. The UI Mobile Class is a virtual platform that facilitates classroom interaction at a distance where you can discuss / interact with your tutor and peers while you are at home or office from your internet-enabled computer. You will also use this platform to submit your assignments, receive tutor feedback and course news with updates.

History of Experimental Psychology PSY105—is this course for you?

PSY105 is a three unit *required* course for psychology students. The course exposes learners to a survey of the origin of modern psychology within science and philosophy. Later trends in experimental psychology, including design and performance evaluation in psychology, are examined.

Course outcomes

Outcomes

Upon a successful completion of History of Experimental Psychology PSY105, you will be able to:

- *outline* the history of experimental psychology.
- *ethically* engaged in research that involves human and animal participants.

Timeframe

How long?

This is a 15 week course. It requires a formal study time of 45 hours. The formal study times are scheduled around online discussions / chats with your course facilitator / academic advisor to facilitate your learning. Kindly see course calendar on your course website for scheduled dates. You will still require independent/personal study time particularly in studying your course materials.

How to be successful in this course

As an open and distance learner your approach to learning will be different to that from your school days, where you had onsite education. You will now choose what you want to study, you will have professional and/or personal motivation for doing so and you will most likely be fitting your study activities around other professional or domestic responsibilities.

Essentially you will be taking control of your learning environment. As a consequence, you will need to consider performance issues related to time management, goal setting, stress management, etc. Perhaps you will also need to reacquaint yourself in areas such as essay planning, coping with exams and using the web as a learning resource.

We recommend that you take time now—before starting your self-study—to familiarize yourself with these issues. There are a number of excellent resources on the web. A few suggested links are:

- http://www.dlc.ui.edu.ng/resources/studyskill.pdf

  This is a resource of the UIDLC pilot course module. You will find sections on building study skills, time scheduling, basic concentration techniques, control of the study environment, note taking, how to read essays for analysis and memory skills ("remembering").

- http://www.ivywise.com/newsletter_march13_how_to_self_study.html

  This site provides how to master self-studying, with bias to emerging technologies.

- http://www.howtostudy.org/resources.php

  Another "How to study" web site with useful links to time management, efficient reading, questioning/listening/observing skills, getting the most out of doing ("hands-on" learning), memory building, tips for staying motivated, developing a learning plan.

The above links are our suggestions to start you on your way. At the time of writing these web links were active. If you want to look for more, go to www.google.com and type "self-study basics", "self-study tips", "self-study skills" or similar phrases.

Need help?

Help

As earlier noted, this course manual complements and supplements PSY105at UI Mobile Class as an online course.

You may contact any of the following units for information, learning resources and library services.

Distance Learning Centre (DLC)
University of Ibadan, Nigeria
Tel: (+234) 08077593551 – 55
(Student Support Officers)
Email: ssu@dlc.ui.edu.ng

Head Office
Morohundiya Complex, Ibadan-Ilorin Expressway, Idi-Ose, Ibadan.

Information Centre
20 Awolowo Road, Bodija, Ibadan.

Lagos Office
Speedwriting House, No. 16 Ajanaku Street, Off Salvation Bus Stop, Awuse Estate, Opebi, Ikeja, Lagos.

For technical issues (computer problems, web access, and etcetera), please send mail to webmaster@dlc.ui.edu.ng.

Academic Support

Help

A course facilitator is commissioned for this course. You have also been assigned an academic advisor to provide learning support. The contacts of your course facilitator and academic advisor for this course are available at onlineacademicsupport@dlc.ui.edu.ng

Activities

Activities

This manual features "Activities," which may present material that is NOT extensively covered in the Study Sessions. When completing these activities, you will demonstrate your understanding of basic material (by answering questions) before you learn more advanced concepts. You will be provided with answers to every activity question. Therefore, your emphasis when working the activities should be on understanding your answers. It is more important that you understand why every answer is correct.

Assessments

Assessments

There are three basic forms of assessment in this course: in-text questions (ITQs) and self assessment questions (SAQs), and tutor marked assessment (TMAs). This manual is essentially filled with ITQs and SAQs. Feedbacks to the ITQs are placed immediately after the questions, while the feedbacks to SAQs are at the back of manual. You will receive your TMAs as part of online class activities at the UI Mobile Class. Feedbacks to TMAs will be provided by your tutor in not more than 2 weeks expected duration.
Schedule dates for submitting assignments and engaging in course / class activities is available on the course website. Kindly visit your course website often for updates.

Bibliography

Readings

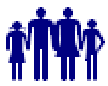
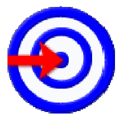
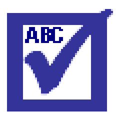
For those interested in learning more on this subject, we provide you with a list of additional resources at the end of this course manual; these may be books, articles or websites.

Getting around this course manual

Margin icons

While working through this course manual you will notice the frequent use of margin icons. These icons serve to “signpost” a particular piece of text, a new task or change in activity; they have been included to help you to find your way around this course manual.

A complete icon set is shown below. We suggest that you familiarize yourself with the icons and their meaning before starting your study.

 Activity	 Assessment	 Assignment	 Case study
 Discussion	 Group Activity	 Help	 Outcomes
 Note	 Reflection	 Reading	 Study skills
 Summary	 Terminology	 Time	 Tip

Study Session 1

The Epistemology of the Mind in the 17th and 18th Centuries

Introduction

In the development of sciences, experimental psychology emerged from the fusion of two streams of thought: the philosopher's concern with the mind of man (rather than his soul) and the psychologist's application of the techniques of experimentation and measurement. In this Study Session, you will therefore be exposed to the history of psychology as a science and its' development on the knowledge of the mind.

Learning Outcomes

When you have studied this session, you should be able to:

1.1 *discuss* experimental psychology history as it relates to the epistemology of the mind.
1.2 *identify* and *discuss* the contributions of specific people to experimental study of the mind.

1.1 Perspectives on Development of Psychology

Boring (1950) believes that an experimental psychologist should combine historical sophistication with his/her experiences in technical procedures. Otherwise, he/she will be unable to see present research in a proper perspective and evaluate the full significance of new concepts and techniques. Therefore, the gift of professional maturity comes only to a psychologist who knows the history of his/her science.

Curiosity and wonder are the prime motivators of science. Thus, the workings of the mind have been of interest to man over the ages. However, the methods of science were not applied to the study of the human mind and behaviour until three or four hundred years after they found a solid place in physics. Epistemology of the Mind as a science was greatly retarded by the Cartesian Dualism, which states that though the mind and the body are separate entities, operating according to different principles, they still interact. In dualism, it is believed that the body is governed by physical laws like inanimate objects, while the mind is not governed by such laws because it possesses free will. As such, scientific methods cannot be applied to discover mental laws. However, Descartes (1596-1650) advanced the position that the body could affect the mind, and the mind could affect the body. The application of scientific methods, which include physics and astronomy, starts with using animals because they were believed not to have souls and were treated as inanimate objects. Other philosophers, such as Locke, Berkeley, Hartley and Kant built on this foundation.

1.2 Contributions to the Development of Experimental Study of the Mind

1.2.1 Contributions of John Locke to Development of Psychology

John Locke (1632-1704) was born in Wrington, Somerset, England. He was brought up in a liberal Puritan environment, and was educated at Christ's Church, Oxford. His *Essay Concerning Human Understanding*, dated 1690, but actually published in 1689, like much of the rest of 17th century philosophy, was a reaction to Cartesian mind – body interactionism briefly examined above. Locke moved the discussion into the purely psychological realm of experience, contrasting the inner sense (the mind's reflective experience of its own experience of things) with the outer sense (the mind's experience of things). Locke, from his empiricist perspective, was the first to propose the epistemological question of the limits of knowledge. Employing a very general notion of "idea" that incorporated a disparate set of entities among which modern psychologists would distinguish perceptions, mental images, and concepts, Locke concerned himself with both the certainty of our ideas experientially attained through reflection or the inner sense and the truth of our ideas insofar as they depend on the outer sense. After Locke, it would be possible to emphasize either the vivid character of the ideas transmitted by the outer sense or the intuitive certainty of the inner sense.

1.2.2 Contributions of George Berkeley to Development of Psychology

George Berkeley (1685-1753) also made use of notions contained in Locke's *Essay*. In the *Essay on Human Understanding*, Locke had distinguished between **primary** and **secondary qualities**. Primary qualities, such as solidity or extension are completely inseparable from the bodies in which they inhere and are simply perceived by the senses. Secondary qualities are the powers inherent in objects to produce sensations in the perceiver such as color, odor, or sound. The colors, odors, and sounds, however, do not themselves inhere in the objects. Berkeley's "immaterialism" was simply the notion of secondary qualities expanded to include primary qualities and taken out of objects and placed in God.

George Berkeley (1685-1753) was born at Kilkenny, Ireland, and educated at the Trinity College, Dublin. In 1709, he published his first book, *Essay towards a New Theory of Vision*. Although Berkeley did not explicitly discuss his immaterialism in the *New Theory*, it was everywhere implicit in his views and combined with a proto-associational view of the importance of connections between ideas. It provided him with the basis for a theory of the perception of distance, which became a prototype for later associationist accounts. For Berkeley, distance is not immediately perceived by vision. Rather, when "the mind has, by constant experience, found the different sensations corresponding to the different dispositions of the eyes to be attended each with a different degree of distance in the object...(and), there has grown an habitual or customary connection between those two sorts of ideas."

1.2.3 Contributions of David Hartley to Development of Psychology

David Hartley (1705-1757) was born at Luddenden, Halifax, England and educated at Jesus College, Cambridge. In 1749, he published his two-volume *Observations on Man.* Hartley was the first to apply the association principle as a fundamental and exhaustive explanation of all experience and activity. Moreover, he joined his psychological theory with postulates about how the nervous system functions. According to Hartley, man's sensations were paralleled by vibrations ... or 'elemental' particles in the nerves and brain ... In relating the phenomena of sensation, ideation, and motion to the nervous system; he laid down the principles of physiological psychology, which Ferrier would later combine with the concept of cerebral localization. Hartley therefore made use of notions contained in Locke's *Essay.*

1.2.4 Contributions of Étienne Bonnot de Condillac to Development of Psychology

Condillac (1715-1780) was born in Grenoble, educated in theology at Saint-Sulpice and at Sorbonne; he was ordained to the priesthood in 1740. Of the two sources of knowledge in Locke, sensations transmitted through the outer sense and reflection through the inner sense, Condillac focused exclusively on the former. His *Traité des sensations*, published in 1754, was designed to show that external impressions through the outer senses, taken by themselves, can account for all the ideas and mental operations of man. Using the famous example of a statue, endowed with no other property than a single sense of smell, he attempted to derive attention, memory, judgment, imagination, the whole of mental life. Condillac's views are, clearly, the most extreme form of the *tabula rasa* perspective. Like all *tabula rasa* views, no matter how powerful the correlative principle of association, Condillac's extreme sensationalism runs afoul of the obvious fact of variation (species differences, individual differences) in biological constitution.

1.2.5 Contributions of Thomas Reid to Epistemology of the Mind

In direct contrast to Condillac, Thomas Reid (1710-1796) chose to emphasize Locke's inner sense, building on the simple notion of reflection to develop an elaborate theory of the intuitions and faculties of the human mind given by its fundamental constitution. Reid was born near Aberdeen and educated at the Marischal College. His major work, *An Inquiry into the Human Mind on the Principles of Common Sense,* was published in 1764, the year in which he accepted appointment as Professor of Moral Philosophy at the University of Glasgow.

In the *Inquiry,* Reid articulated the basic intuitional postulate of the "common sense" philosophy on which the Scottish faculty of psychology was to be built. Intuitions are native tendencies to mental action. They are aspects of the fundamental constitution of the human mind, which regulate the conscious experience of all human beings from birth. Because intuitions require the presentation of appropriate objects in order to be called forth in mental action, the Scottish philosophy is Realism. Intuitions do not project the mind into reality; they allow the mind access to it. Intuitionalism is a native of psychological process. It is also the methodological inquiry into the nature and existence of natively given principles of mind, which takes place by induction from observed facts in self-consciousness. It was this view, coupled with Reid's (1785, 1788) later analyses of specific faculties that dominated the 19th century academic mental philosophy in America. It was also indirectly from Reid that Gall obtained the original list of 27 powers of the mind that guided his attempt to map the localization of function in the brain.

1.2.6 Contributions of Immanuel Kant to Epistemology of the Mind

Kant (1724-1804) was born, lived, and died at Königsberg, in East Prussia. It is said that in the entire course of his life, he never travelled more than forty miles from the place of his birth. The suggestion from Ribot that 18th century philosophy culminated in the work of Kant was probably not an unreasonable one; although, it might be fairer appraisal of Kant's influence to say that the philosophy of both 19th and 20th centuries followed Kant much as the earlier philosophy had followed Descartes.

Kant's indirect influence on scientific psychology was, therefore, enormous. His direct contributions, although admittedly more circumscribed, were also of considerable importance. One such contribution was Kant's defining the prerequisites that should be met for psychology to become an empirical science. Another contribution of Kant to psychology consisted of a treatise, *Anthropologie in pragmatischer Hinsicht*, published in 1798. Long ignored, probably in part because of its pronounced sympathy for a soon to be discredited physiognomy, the *Anthropologie* is, nonetheless, a fascinating little book. In this work, Kant analyzes the nature of the cognitive powers, feelings of pleasure and displeasure, affects, passions, and character in the context of a denial of the possibility of an empirical science of conscious process. The *Anthropologie* went through two editions during Kant's lifetime and several later printings had helped to define the context within which not only Herbart and Fechner, but phenomenologically oriented physiologists, such as Purkyne, Weber, and Müller, worked to establish the science of conscious phenomena that Kant was unable to envision.

Study Session Summary

Summary

In this Study Session, we focused on the historical background and contributions of difference scholars in relation to Epistemology of the Mind. We noted that Locke moved the mind – body dichotomy into purely psychological realm of experience by contrasting the inner sense (the mind's reflective experience of its own experience of things) with the outer sense (the mind's experience of things).

And, George Berkeley built on Locke's findings and proposed that there are connections between ideas from the mind, object and distance. This provided him with the basis for a theory of the perception of distance, which became a prototype for later associationist accounts. You also learned that Hartley was the first to apply the association principle as a fundamental and exhaustive explanation of all experience and activity. Condillac who was born in Grenoble focused on Locke's sensations transmitted through reflection through the inner sense the former.

Assessment

Assessment

SAQ 1.1 (tests Learning Outcome 1.1)

1. Boring believed experience in technical procedures are crucial for an experimental psychologist. Discuss this.
2. Explain how "curiosity" and "wonder" eventually fostered the development of the field of psychology..

SAQ 1.2 (tests Learning Outcome 1.2)

1. Discuss in two sentences each what contemporary experimental psychology might be missing without the contribution of John Locke, George Berkeley, David Hartley, Etienne Bonne de Cadillac, Thomas Reid and Immanuel Kant.

Bibliography

Readings

http://en.wikiversity.org/wiki/Historical_Introduction_to_Philosophy/Epistemology retrieved July, 2013

http://pespmc1.vub.ac.be/EPISTEMI.html retrieved July, 2013

Study Session 2

Epistemology of the Nervous System in 19th Century

Introduction

Between 1800 and 1850, discoveries in physiology helped lay the foundation for the eventual rise of experimental psychology. The events of particular interest to us in this Study Session are:

a) the first elaboration of a distinction between sensory and motor nerves;

b) the emergence of a sensory phenomenology of vision and of touch; and

c) the articulation of the doctrine of specific nerve energies, including the related view that the nervous system mediates between the mind and the empirical world.

Learning Outcomes

When you have studied this session, you should be able to:

2.1 *present* relevant contributions of at least five nineteenth century authors to the development of experimental psychology.

2.2 *point out* how the study of physiology is associated with experimental psychology

2.1 Contributions of Charles Bell (1774-1842)

The first of the relevant physiological discoveries (that of the distinction between sensory and motor nerves), is credited to Charles Bell (1774-1842). Bell was born in Edinburgh and educated informally. Although he attended lectures at the University of Edinburgh, most of Bell's anatomical and surgical instructions were received from his older brother, John, a noted physician. By the time Bell was in his twenties, he was already a well-respected surgeon and, by 1799, he had been admitted to the Royal College of Surgeons in Edinburgh. In 1806, he moved to London and five years later, he became affiliated with the Hunterian School of Anatomy. It was in the same year, 1811, that Bell printed one hundred copies of his 36 page *Idea of a New Anatomy of the Brain* for private circulation among his friends and colleagues. In the *New Anatomy*, Bell employed anatomical evidence to support the assertion that the ventral roots of the spinal cord contain only motor and the dorsal roots, only sensory fibres. In so doing, he overturned centuries of tradition in which it was implicitly assumed that nerve fibres were indiscriminate with respect to sensory or motor function and established the fundamental distinction between these two types of nervous processes. When, as we have already seen, this distinction was combined with a parallel sensory-motor associationism, it led, in the hands of Bain and Spencer, to the first proper psycho-physiological psychology and, through Jackson and Ferrier, to the establishment of the sensory-motor paradigm as the basis of functional localization in the cortex.

2.2 Contributions of Thomas Brown (1778-1820)

The first of the relevant philosophical advances was provided by Thomas Brown (1778-1820). Brown was born at Kirkmabreck, Scotland, and educated in philosophy and medicine at the University of Edinburgh where he took courses with Dugald Stewart, a disciple of Reid. In 1810, he was appointed to share the professorship of moral philosophy with Stewart and within a short time he had become renowned for the brilliance of his Study Sessions. In 1820, after his premature death, these Study Sessions were published in four volumes as *Study Sessions on the Philosophy of the Human Mind*. Their impact was immediate, undoubtedly, because Brown managed to unite elements of two disparate traditions, the Scottish intuitionalism of Reid and the empiricism of Condillac. In so doing, he helped redirect both traditions.

Among a number of novel contributions of Brown was an important critique of introspection. This was based on Brown's belief in the absurdity of the idea that one and the same indivisible mind could be both the subject and the object of the same observation, Brown made two conceptual advances of fundamental importance in the history of experimental psychology. The first was to emphasize the "muscle sense." Before Bain, as we have earlier suggested, the associationist had neglected movement and action in favor of the analysis of sensation. Brown was the first philosopher in that tradition to move toward a more balanced sensory-motor view by including the sensory side of movement in his conceptualization of the problem of objective reference in perception. Brown's second contribution involved his detailed elaboration of the secondary laws of association, which he termed "suggestion." Brown's formulation of these laws, which involved the relative duration, strength (liveliness), frequency, and recency of the original sensations as wells as the reinforcement of one idea by others, provided later learning theorists with a basis for explaining not only the facts but the quantitative parameters of association.

2.3 Contributions of Friedrich Herbart (1776-1841)

During almost the same period, in Germany, another philosopher of mind, Johann Friedrich Herbart (1776-1841) was also getting engaged in quantitative relationships among ideas. Herbart was born in Oldenburg and studied at the University of Jena, under Johann Gottlieb Fichte, with whom he found himself in some disagreement. Provoked by Fichte's ideas, Herbart decided to work toward his own systematic philosophy. Upon completion of his study at Jena, Herbart went to Göttingen where he took his doctorate in 1802. He remained there until 1809 when he moved to Königsberg to assume the chair formerly occupied by Kant. At Königsberg, Herbart began working on his psychology, publishing his *Lehrbuch* in 1816 and *Psychologie als Wissenschaft* in 1824/1825. As is evident from this later title, Herbart believed that psychology could be both empirical (although he denied the possibility of experiment) and mathematical. Arguing that ideas ("presentations") are arrayed in time and vary in intensity, he attempted to create both a static and a dynamics of mind and employed complex mathematical equations to describe an hypothesized system of principles of interaction among ideas. Specifically, Herbart assumed that ideas of the same sort oppose one another while ideas of different sorts do not. Opposition progressively weakens the original idea in consciousness and, as a result, it eventually sinks below the threshold of awareness where it remains until the appearance of a similar idea in experience causes the original to rise at a speed proportional to the degree of similarity between the two ideas. Furthermore, as the original is pulled up by the new idea, similar ideas cling to it. Thus, no idea can rise except to take its place in the unitary mass of ideas already present in consciousness. This is Herbart's famous concept of "apperception" in which an idea is not only made conscious but assimilated to the whole complex of conscious ideas, the *apperceptive mass*. In these views, Herbart took several giant strides along the path that the new scientific psychology would eventually follow toward a complex, carefully worked out, quantitative recognition of the critical distinction between ideas above and below the threshold of consciousness. As the received history suggests, he was a transitional figure between Kant and Fechner.

However, because of his rejection of the possibility of experimental verification and his inability to link his philosophy of mind to the physiology of the brain, he moved only partially toward the "new" psychology. Before psychology could be taken into the laboratory, it needed methods; and the primary source of the early methods lay not in the philosophy of mind, but in the works of physiologists such as Purkyne and Weber, who made fundamental contributions to the experimental phenomenology of sensation; and Müller, who elaborated the doctrine of specific nerve energies that systematized the epistemological role of the nervous system as intermediary between the mind and the empirical world.

2.4 Contributions of Jan Evangelista Purkyne (1787-1869)

Purkyne was born in Libochovice, in Northern Bohemia and received his first formal education at a Piarist monastery. After completing the novitiate, he spent a year in study at the Piarist Philosophical Institute. In 1807, under the influence of the writings of Fichte, he left the order and traveled to Prague. Two years of work at the University of Prague and an additional three years as a private tutor preceded his decision to return to the university to study medicine. In 1819, on the completion of his medical studies, he published his doctoral dissertation, *Beiträge zur Kenntnis des Sehens in subjectiver Hinsicht*. This led in 1823 to his appointment as Professor of Physiology at the University of Breslau. In the same year, he reprinted his dissertation as the first volume of *Beobachtungen und Versuche zur Physiologie der Sinne*. The second volume, which followed in 1825, was sub-titled *Neue Beiträge zur Kenntnis des Sehens in subjectiver Hinsicht*. The two volumes of the *Beobachtungen* were among the great intellectual achievements of the period and constituted a major point of transition in the emergence of experimental psychology. With extraordinarily acute ability to observe phenomenological details, Purkyne explored the psychological consequences in visual experience of a series of experimental manipulations of the conditions of stimulation, including application to the eyeball of pressure and electrical current, alteration in point of light exposure relative to the fovea, degree of eye movement, and variation in the intensity of light.

Tip

While Purkyne is best known to psychologists for his classic descriptions of phenomena, such as the change in apparent luminosity of colors in dim as opposed to bright daylight (the so-called "Purkyne effect"), it was the breadth and systematicity of his use of the experimental method to explore the parameters of sensory experience that helped lay the foundation for future laboratory work.

2.5 Contributions of Ernst Heinrich Weber (1795-1878)

Weber was born in Wittenberg and educated at Leipzig, where he remained to serve as Professor of Anatomy from 1818 and of Physiology, after 1840. In 1834, he published *De pulsu, resorptione, auditu et tactu*. In that portion of the work devoted to the sense of touch, Weber presented an extensive experimental exploration of the sensory phenomenology of tactile experience. Whereas Purkyne had shown the value of applying the experimental method to the phenomenology of sensation, Weber extended the approach beyond experimentation to quantification.

Coining the phrase, *just noticeable difference* (JND) to refer to the smallest perceptible difference between two sensations, Weber amassed data in support of the general principle that a JND in the intensity of a sensation is a function of the change in the magnitude of a stimulus by a constant factor of its original magnitude (ÆR/R). Although it has since been shown that there are significant limitations in the generality of this relationship not only across other sensory systems, but even within the sense of touch itself, it would be hard to overestimate the importance of Weber's discovery for the emerging science of psychology. In articulating the relationship which Fechner later termed "Weber's Law," Weber provided an existence proof for the possibility of establishing quantitative relationships between variations in physical and mental events. By linking these relationships to the nervous system, he helped, with Müller, to establish the epistemological function of the nervous system, in mediating the relationship between the mind and the physical environment.

2.6 Contributions of Johannes Müller (1801-1858)

Müller was born in Coblenz and educated at the University of Bonn. He received his medical degree in 1822 and, after a year in Berlin, was habilitated as *privatdozent* at Bonn, where he rose eventually to the professorate. In 1833, he left Bonn to assume the prestigious Chair of Anatomy and Physiology at the University of Berlin. His most important contributions to the history of experimental psychology were the personal influence that he exerted upon younger colleagues and students, including

Hermann von Helmholtz, Ernst Brücke, Carl Ludwig, and Emil DuBois-Reymond, and the systematic form he gave to the doctrine of the specific energies of nerves in the *Handbuch der Physiologie des Menschen für Vorlesungen*], published between 1834 and 1840. Although Müller had enunciated the doctrine of specific nerve energies as early as 1826, his presentation in the *Handbuch* was more extensive and systematic. Fundamentally, the doctrine involved two cardinal principles. The first of these principles was that the mind is directly aware not of objects in the physical world but of states of the nervous system. The nervous system, in other words, serves as an intermediary between the empirical world and the mind and, thus, imposes its own nature on mental processes. The second principle was that the qualities of the sensory nerves of which the mind receives knowledge in sensation are specific to the various senses; the nerve of vision being normally not sensible to sound, as the nerve of audition is to light. As Boring (1950) pointed out, there was nothing in this view that was completely original with Müller. Not only was much of the doctrine contained in the work of Charles Bell, the first of Müller's two most fundamental principles was implicit in Locke's idea of "secondary qualities" and the second incorporated an idea concerning the senses that had long been generally accepted. What was important in Müller was his systematization of these principles in a handbook of physiology that served a generation of students as the standard reference on the subject and the legitimacy he lent the overall doctrine through the weight of his personal prestige. After Müller, the mind – body problem, the relationship of the mind to the brain and nervous system and the relationship of the mind to the empirical world were inextricably linked. Although Müller did not himself explore the implications of his doctrine for the possibility that the ultimate correlates of sensory qualities might lie in specialized centers of the cerebral cortex or develop a sensory psycho-physics, his principle of specificity lay the groundwork for the eventual localization of cortical function. Furthermore, his view of the epistemological function of the nervous system helped define the context within which techniques for the quantitative measurement of the mind/world relationship emerged in Fechner's psychophysics.

Study Session Summary

Summary

In this Study Session we analyze the relevant statements of authors and their contributions to the development of experimental psychology and how physiology is associated to the study. In the words of Charles Bell (1774-1842), there is a distinction between sensory and motor nerves. This discovery laid the foundation of the discipline of psycho-physiological psychology.

- Thomas Brown (1778-1820) made two conceptual advances of fundamental importance in the history of experimental psychology. The first was to emphasize the "muscle sense." The second contribution is involved in his detailed elaboration of the secondary laws of association, which he termed "suggestion."

- Johann Friedrich Herbart (1776-1841) was a philosopher of the mind who concerned himself with quantitative relationships among ideas, he propounded the famous concept of "apperception" in which an idea is not only made conscious but assimilated to the whole complex of conscious ideas, the *apperceptive mass*.
- Jan Evangelista Purkyne (1787-1869) is best known for the change in apparent luminosity of colours in dim as opposed to bright daylight concept (the so-called "Purkyne effect"). It was the systematic use of the experimental method to explore the parameters of sensory experience that helped laid the foundation for future laboratory work in psychology.
- Ernst Heinrich Weber (1795-1878) presented the sensory phenomenology of tactile experience experiment. He was able to establish the epistemological function of the nervous system in mediating the relationship between the mind and the physical environment, through experiment.
- Johannes Müller (1801-1858) explained the relationship between the mind and the body, the relationship of mind to brain and nervous system, and the relationship of the mind to the empirical world.

Assessment

Assessment

SAQ 2.1

1. Explain the major theme of Charles Bell's "Idea of a New Anatomy of the Brain."
2. Discuss the result of Thomas Brown's combination of Reid's Scottish Intuitionalism and Cadillac's empiricism.
3. Describe Herbart's attitude to experiments and give possible reasons why he felt this way.
4. Discuss Purkyne's "breadth and systemacity" in his approach to experimental psychology.
5. Discuss the expression "just noticeable differences" depicting its relevance to Weber's contribution to psychology.

SAQ 2.2

1. Show how the study of physiology is associated with experimental psychology using an example.

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Study Session 3

Mind, Brain, and Experimental Psychology

Introduction

So far, we have examined the authors whose works laid the foundation of what we now know as experimental psychology. As you can see, most of our discussions have been on philosophical psychology and psychological physiology. In this Study Session, we shall examine how the study of the mind and the brain finally led to the formal birth of experimental psychology.

Learning Outcomes

When you have studied this session, you should be able to:

3.1 *highlight* the contributions of Fechner, Helmoholtz, Wundt and Herbart to the development of experimental psychology.

3.2 *outline* the development of experimental psychology from physiological psychology.

Hint

- Scientific psychology began in Germany as a physiological psychology, born of a marriage between the philosophy of mind, on the one hand, and the experimental phenomenology that arose within sensory physiology, on the other.
- Philosophical psychology, concerned with the epistemological problem of the nature of the knowing mind in relationship to the world as known, contributed fundamental questions and explanatory constructs.
- Sensory physiology contributed immensely to the development of experimental methods and a growing body of phenomenological facts.

- Boring (1950).

3.1 Contributions of Gustav Theodor Fechner (1801-1887)

Fechner was born in Gross-Sächen, Prussia. At the age of 16, he enrolled for the study of medicine at the University of Leipzig where he studied anatomy under Weber. By 1824, he was lecturing in physics and in 1834, he had over 40 publications to his credit. He was appointed Professor of Physics at the University of Leipzig.

Fechner's psychological interests began to manifest themselves toward the end of the 1830s in papers on the perception of complementary and subjective colors. It is in the work that we find the formal beginning of experimental psychology. Before Fechner, as Boring (1950) tells us, there was only psychological physiology and philosophical psychology. It was Fechner who performed with scientific rigor those first experiments, which laid the foundations for the new psychology and the basis of its methodology. Between 1851 and 1860, Fechner worked out the rationale for measuring sensation indirectly in terms of the unit of just noticeable difference between two sensations, developed his three basic psycho-physical methods (just noticeable differences, right and wrong cases, and average error), and carried out the classical experiments on tactual and visual distance, visual brightness, and lifting weights. He had impact on scientists such as Helmholtz, Ernst Mach, A.W. Volkmann, Delboeuf, and others. By combining methodological innovation in measurement with careful experimentation, Fechner moved beyond Herbart to answer Kant's second objection, regarding the possibility of scientific psychology. Mental events could, Fechner showed, not only be measured, but measured in terms of their relationship to physical events. In achieving this milestone, Fechner demonstrated the potential for quantitative, experimental exploration of the phenomenology of sensory experience and established psycho-physics as one of the core methods of the newly emerging scientific psychology.

3.2 Contributions of Wilhelm Wundt (1832-1920)

Wundt was born at Neckarau and received his early education at the hands of a private tutor and at the Bruchsal Gymnasium. At age 19, he set off to study medicine at Tübingen, where his uncle, Friedrich Arnold, held the Chair in Anatomy and Physiology. During his first summer semester, he worked intensively on the study of cerebral anatomy under Arnold's guidance and, by the end of the summer; he had decided to make physiology his career. When his uncle moved to Heidelberg to direct the Institute of Anatomy, Wundt followed, completing his medical studies in 1855. After a year of hospital work and a journey to Berlin for a semester of study under Müller and Du Bois-Reymond, Wundt returned to Heidelberg in 1857 as *Dozent* in Physiology, becoming assistant to Helmholtz in the following year.

Wundt began the study of sense perception that led to a series of publications collected, in 1862, as his *Beiträge zur Theorie der Sinneswahrnehmung*. The *Beiträge* consisted of six previously published articles on sense perception, preceded by a methodological introduction. In these articles, Wundt provided the basics of a psychological theory of the perception of space (including some discussion of the need for unconscious inference, apparently arrived at in independently of Helmholtz); reviewed the history of theories of vision and analyzed the psychological function of sensations, arising from visual accommodation and eye movement; presented the results of experiments on binocular contrast effects and stereoscopic fusion. He also argued, contra Herbart, that the content of consciousness at a given instant always consists of a single, unconsciously integrated, percept. Rejecting a metaphysical foundation for psychology, Wundt argued for the need to transcend the limitations of the direct study of consciousness through the use of genetic, comparative, statistical, historical, and, particularly, experimental methods. Only in this way, he suggested, would it be possible to come to a needed understanding of conscious phenomena as "complex products of the unconscious mind" (p. xvi).

Hint

Wundt, still at Heidelberg, began to work toward the conception of physiological psychology that was to serve as the basis for his systematic approach to experimentation. In 1867, in a new quarterly journal of psychiatry founded by Max Leidesdorf and Theodor Meynert, Wundt published an invited article, wherein under the banner of physiological psychology, he reviewed recent literature on visual space perception and the measurement of the time taken by mental operations. As an outgrowth of this review, Wundt offered a series of lectures on physiological psychology in the winter of 1867/1868 and 1872/1873. Around the same time, he was preparing the texts, which Boring (1950) later regarded as “the most important book in the history of modern psychology" (p. 322). Issued in two parts, in 1873 and 1874, the *Grundzüge der physiologischen Psychologie* was the first comprehensive handbook of modern experimental psychology published by Wundt. It was, as Boring tells us, "on the one hand, the concrete result of Wundt's intellectual development at Heidelberg and the symbol of his metamorphosis from physiologist to psychologist, and, on the other hand, ... the beginning of the new 'independent' science"

Although the theories elaborated in the *Grundzüge* changed over the five major revisions, the essential structure of Wundt's system, "his great argument for an experimental psychology" (Boring, p. 323), had been reasonably well worked out by 1874. In that year, Wundt accepted a call to the University of Zurich, where he worked for a year, moving in 1875 to Leipzig to assume the chair in philosophy. Wundt seemed, as early as the winter of 1879/1880, to have nonetheless allowed two students, G. Stanley Hall and Max Friedrich, to occupy themselves with research investigations. This research took place in a small classroom in the Konvict Building that had earlier been assigned to Wundt for use as a storage area. Humble, though it may have been, this small space constituted the first laboratory in the world devoted to original psychological research. Experimental psychology, born with Fechner, nurtured by Helmholtz and Donders, was to be raised by Wundt. Over the years until his retirement in 1917, Wundt served as the *de facto* parent of the "new" psychology. Students from all over the world, especially from the United States, journeyed to Leipzig to learn experimental technique and to return to their home institutions imbued with the spirit of scientific psychology.

Wilhelm Wundt, the founder of structuralism school of psychology, is considered as the father of experimental psychology. He established the first psychology laboratory in Leipzig and, thus, he was the first researcher, experimental psychologist. Wundt was the first to call himself a "psychologist". In the first half of the twentieth century, experimental psychology became closely allied with behaviourism, especially in the United States, and this led to some neglect of mental phenomena. In Europe, including the United Kingdom, this was less so, and under the influence of psychologists such as Sir Frederic Bartlett, Kenneth Craik, W. E. Hick and Donald Broadbent, experimental psychologists focused on topics such as thinking, memory and attention, laying the foundations for the subsequent development of cognitive psychology

3.3 Contributions of Hermann Ludwig Ferdinand von Helmholtz (1821-1894)

Hermann Ludwig Ferdinand von Helmholtz (1821-1894) was born in Potsdam and educated at the Potsdam Gymnasium and at the Friedrich Wilhelm Medical Institute in Berlin. In Berlin, he came under the influence of Müller and in 1842, at 21 years of age; he graduated with a degree in medicine and entered the service of the Prussian Army, as a physician. In reaction to Müller's vitalism, which he rejected, Helmholtz became interested in clarifying the physiological basis of animal heat, a phenomenon that was sometimes used to help justify vitalism. This led in 1847 to a famous paper on the conservation of energy, which in turn brought Helmholtz the offer of a Professorship of Physiology at Königsberg, where he remained from 1848 to 1855. In 1855, he moved to Bonn and from Bonn, in 1858, to Heidelberg to serve as Director of the Institute of Physiology. It was during the Bonn and Heidelberg periods that Helmholtz made his most fundamental contributions to the newly emerging experimental psychology.

3.4 Contributions of Franciscus Cornelis Donders (1818-1889)

Between 1865 and 1868, another great physiologist, Franciscus Cornelis Donders (1818-1889) assimilated the reaction-time procedure to psychology, employing it to study the time taken up by mental operations. Donders was born in the town of Tilburg, in the Netherlands, and entered the University of Utrecht as a medical student at the age of 17. Having received the degree, he joined the military as a surgeon and, at the age of 24, was invited to teach at the Military Medical School at Utrecht. Five years later, Donders was offered a position as *extraordinarius* at the University of Utrecht, which he accepted, remaining there for the remainder of his career. In 1865, Donders published a preliminary communication in which he reported work carried out with a student, Johan Jacob de Jaager, and summarized more fully in de Jaager's doctoral dissertation, *De physiologische tijd bij psychische processen* (1865). Reasoning that reaction time was additive, Donders separately assessed the time taken to respond to a stimulus under conditions of choice and simple non-choice. Subtracting simple non-choice from choice reaction-time, Donders computed the interval taken by the decision process. In 1868, in a classic paper appearing in German, "Die schnelligkeit psychischer Processe", Donders provided the definitive report of the results of this work and its extension to discrimination times. Although the specifics of Donder's findings are of little interest today, his use of the reaction technique to measure the time taken by mental processes, exerted a major impact on his contemporaries and reaction-time was installed, along with psychophysics, as a method of choice in the early experimental laboratory.

Study Session Summary

Summary

In this Study Session, we focused on contributions of philosophers in the study of the Mind, Brain, and the Experimental Psychology of Consciousness.

- Gustav Theodor Fechner (1801-1887) performed the first experiments which laid the foundations for the new psychology and still lie at the basis of its methodology. He demonstrated the potential for quantitative, experimental exploration of the phenomenology of sensory experience and established psychophysics.
- Hermann Ludwig Ferdinand von Helmholtz (1821-1894) propounded a comprehensive theory of colour vision and a famous unconscious inference theory of perception.
- Franciscus Cornelis Donders (1818-1889) assimilated the reaction-time procedure to psychology, employing it to study the time taken up by mental operations.
- Wilhelm Wundt (1832-1920) rejected a metaphysical foundation for psychology, and argued for the need to transcend the limitations of the direct study of consciousness through the use of genetic, comparative, statistical, historical, and, particularly, experimental methods. He is the founder of structuralism school of psychology, and considered as the father of experimental psychology.

Assessment

Assessment

SAQ 3.1

Enumerate the individual contributions of Gustav Theodor Fechner, Wilhelm Wundt, Hermann Ludwig Helmholtz, and Franciscus Cornelis Donders.

SAQ 3.2

Outline the steps through which experimental psychology evolved from physiological psychology.

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Study Session 4

Carrying out Experiments in Psychology

Introduction

No one believes a hypothesis except its originator, but everyone believes an experiment. In this Study Session, you will learn what experiments are, and also explore how experiments are carried out in psychology.

Learning Outcomes

When you have studied this session, you should be able to:

4.1 *illustrate* the two features of an experiment.
4.2 *highlight* the advantages of experiments.
4.3 *point out* reasons why experiments are carried out.

Imagine you are a student in a class in environmental psychology and have received the following assignment: go to the library and "defend" a table by preventing any other person else from sitting down on it for as long as you can. You must use only nonverbal and nonviolent means to accomplish this. To carry out this task, you might wait in the library until a table was vacant, quickly sit down, and proceed to spread your books clothing, and other belongings all over the table in the hope that this disarray might keep others away. After some time, say, fifteen minutes or so, someone finally does sit down at your table, ending your assignment. Have you performed an experiment?

Before answering this question, let us sketch out the major criteria for an experiment. An experiment occurs when the environment is systematically manipulated so that the causal effect of this manipulation on some behaviour can be observed. Aspects of the environment that are not of interest, and hence not manipulated, are held constant, so as not to influence the outcome of the experiment. We can then explain that the behaviour resulted from the manipulation; and also explain two special terms briefly independent and dependent variables to describe how the environment is manipulated and how behaviour is observed.

4.1 The Basic Features of an Experiment

Many students, and probably you too, are surprised to discover that the actions described in our library table-exercise do not constitute an experiment. *All experiments require at least these two special features: the independent and the dependent variables just mentioned.* The dependent variable is the response measure of an experiment that is dependent on the subject. In this case, the time that elapsed until someone else sits down at the table is the dependent variable or response measure. The independent variable, however, is a manipulation of the environment controlled by the experimenter: In this case, it is the strewing of articles on the table.

But an experiment must have at least two values, or levels, of the environment. These levels may differ in a quantitative sense (items strewn across only a portion of the table versus items strewn across the entire table), or the levels may reflect a quantitative difference (the person defending the table assumes a friendly, inviting expression as opposed to a stern, forbidding expression). The point is that at least two conditions must be compared with each other to determine if the independent variable (portion of the table covered or facial expression) produces a change in a behaviour or outcome. Sometimes, these two levels might simply be the presence or absence of a manipulation. The library example fails to meet this criterion, since it involves only one level of the independent variable.

Tip

All experiments require at least these two special features: the independent and the dependent variables. An experiment must have at least two values, or levels, of the environment. The point is that at least two conditions must be compared with each other to determine if the independent variable produces a change in a behaviour or outcome. Sometimes, these two levels might simply be the presence or absence of a manipulation.

How might we change the procedure to obtain an experiment? The simplest way would be to sit down again, this time without scattering anything. Then our independent variable would have the necessary two levels: The table with items strewn about and the bare table with no items strewn about. Now we have something to compare with the first condition.

This experiment has three possible outcomes:

1. strewing articles on the table results in a longer time before the table is invaded by another person;
2. the times until invasion is the same, whether or not articles are strewn about; and
3. scattering articles results in a shorter time until.

Without the second level of the independent variable (the table with no articles strew about), these three outcomes cannot be formulated. Indeed, it is impossible to say anything about how effective articles are in defending library tables until two levels of the independent variable are tested.

> *When this library experiment is performed properly, the first possible outcome is obtained. A table can be better protected by a person plus assorted articles than by a person alone. We can see, then that experiments must have at least independent and dependent variables. Before an experiment can be established, independent variables with at least two levels are necessary.*

4.2 Advantages of Experiments

The main advantage of experiments is better control of extraneous variation. In the ideal experiment, no factors (variables) except the one being studied are permitted to influence the outcome; in the jargon of experimental psychological, we say that these other factors are controlled. If as in the ideal experiment, all factors but one (that under investigation) are held constant, we can logically conclude that any difference in outcome must be caused by manipulation of that one independent variable. As the levels of the independent variable are changed, the resulting differences in the dependent variable can occur only because the independent variable cause has changed. In other words, changes in the independent variable cause the observed changes in the dependent variable. In the library example, we might want to manipulate the facial expression of the person defending the table.

1. To control for extraneous variation, we would need to give careful consideration to other factors that might compromise our ability to make statements about causation. In this case, we might want to hire one assistant to defend the table during the duration of the experiment or establish objectively that our assistants are, for example, equally attractive. We might also decide to control for gender by either incorporating it as an additional independent variable or by using only female (or male) researcher assistants. Designing experiments so that there can be only one explanation of the result is at the heart of the experimental method. Whereas nonexperimental research techniques are limited to statements about description and correlation, experimental permit statements about causation-that is, independent variable A (facial expression) causes variable B (time elapsed until someone else sits down) to change. In this experiment, we would expect the time elapsed to be shorter when the assistant assumes a friendly rather than a forbidding posture.
   Thus, in principle, experiments lead to statement about causation. In practice, these statements are not always true. No experiment is 100 percent successful in eliminating or holding constant all other sources of variation than do other research techniques.
2. Another advantage of experiments is economy. Using the technique of naturalistic observation requires that the scientists wait patiently until the conditions of interest occur. If you lived in Trondheim, Norway – near the Arctic Circle and wanted to study how heat affects aggression, relying on the sun to produce high temperatures would require great patience and a lot of time. The experimenter controls the situation by creating the conditions of interest (various levels of heat in a laboratory setting), thus obtaining data quickly and efficiently.

4.3 Rationale for Conducting Experiments

The same general reasons that apply to the conduct of any research also explain why psychologists perform experiments. In basic research, experiments are performed to test theories and to provide the database for explanations of behaviour. These kinds of experiments are typically well planned, with the investigator having a clear idea of the anticipated outcome. So-called critical experiments try to pit against each other two theories that make different predictions. One outcome favors theory A; the other, theory B. Thus, in principle, the experiment will determine which theory to reject and which to keep. In practice, these critical experiments do not work out so well, because supporters of the rejected theory are ingenious in thinking up explanations to discredit the unfavorable interpretation of the experiment. One example of such an explanation is found in a study of how people forget. Two major explanations of forgetting are that (1) items decay or fade out over time, just the way an incandescent light bulb fades when the electricity is turned off(this explanation is called trace decay) or (2) items snever fade, but because of this, they interfere with each other, causing confusion. For example, Waugh and Norman (1965) carried out a simple critical experiment in which they varied the time between introduction into memory of successive items, holding the number of items constant. Memory should be worse with longer times, according to trace-decay theorists, because there is more time for items to fade out. But because the number of items remains, the theory predicts no difference in forgetting. When this experiment is performed, there is no difference in memory this would seem to nullify the trace-decay explanation. The rejoinder by trace-decay theorists, however, is that the extra time given between items allows people to rehearse –repeat the items to themselves-which prevent forgetting. Less often, researchers perform an experiment in the absence of a compelling theory just to see what happens; we can call this a what –if-experiment. Students often come up with what-if experiments, since these experiments require no knowledge of theory or the existing database and can be formulated on the basis of personal experience and observations. Some scientists frown at what-if experiments; the main objection to them is their inefficiency. If, as is often the case, nothing significant happens in a what-if experiment – say, the independent variable has no effect – nothing is gained from the experiment. By contrast, if nothing significant happens in a careful experiment for which a theory predicts something will happen, the finding of no difference can be useful. We must admit-to having tried what-if experiments at one time or another. Most of them did not work, but they were fun. Our advice is to check with your instructor before trying a what-if experiment. He or she probably can give you an estimate of the odds of your coming up with anything or may even know the results of a similar experiment that has already been performed.

This brings us to the last major reason for doing experiments in basic research, which is to repeat or replicate a previous find. A single experiment by itself is far less convincing than a series of related experiments. The simplest replication is the direct repetition of an existing experiment, with no change in procedures. Direct replications are especially useful when the original experiment was quite novel. Generally, however, a better way to replicate is to extend the previous procedure by adding something new while retaining something old. Thus, part of the replication is a literal repetition, but the novel part adds to scientific knowledge. This kind of repetition demonstrates the generality of a result by showing how it is (or is not) maintained over different independent variables.

Study Session Summary

In this Study Session, we have discussed that experiments are performed to test theories, to replicate and expand previous findings, or to show that prior research cannot be confirmed. Only rarely are experiments performed just to see what might happen. Dependent variable is the response measure of an experiment that is dependent on the subject. The independent variable is a manipulation of the environment controlled by the experimenter: Designing experiments ensure that there can be only one explanation of the result which is at the heart of the experimental method. Experiments are carried out for many reasons one of which may be for replication purposes.

Assessment

Assessment

SAQ 4.1

Explain what independent and dependent variables are

SAQ 4.2

Enumerate major advantages of experimental method

SAQ 4.3

Discuss the rationale for conducting experiments

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Study Session 5

Variables

Introduction

Variables are the gears and cogs that make experiments run. Effective selection and manipulation of variables make the difference between a good experiment and a poor one. This Study Session will expose you to the three kinds of variables that must be carefully considered, before starting an experiment: independent, dependent, and control variables.

Learning Outcomes

When you have studied this session, you should be able to:

5.1 *select* an independent variable for experimentation.
5.2 *select* a dependent variable for experimentation.
5.3 *control* variables.
5.4 *discuss* the relevance of using multiple independent variables in an experiment.

5.1 Independent Variables

In true experiments, independent variables are those manipulated by the experimenter. The brightness of a light, the loudness of a tone, the temperature of a room, the number of food pellets given to a rat – all are independent variables, since the experimenter determines their quality and quantity. Independent variables are selected because an experimenter believes they will cause changes in behaviour. Increasing the intensity of a tone should increase the speed with which people respond to the tone. Increasing the number of pellets given to a rat for pressing a bar should increase the number of times the bar is pressed. When change in the level (amount) of an independent variable causes a change in behaviour, we say that the behaviour is under control of the independent variable.

Failure of an independent variable to control behaviour, often called null results, can have more than one interpretation. First, the experimenter may have guessed incorrectly that the independent variable was important: the null results may be correct. Most scientists will accept this interpretation only reluctantly, and so the following alternate explanations of null results are common. The experimenter may not have created a valid manipulation of the independent variable. Let us say, you are conducting an experiment on children in Primary two, and your independent variable is the number of small pieces of puff-puff they get after each correct response. Some children get only one whereas others get two. You find no difference in behaviour. However, if your independent variable had involved a greater range – that is, from one piece of puff-puff to ten pieces of puff-puff – perhaps you would have obtained a difference. Your manipulation might not have been sufficient to reveal an effect of the independent variable or perhaps, unknown to you, the class had a birthday party just before the experiment started and their little tummies were filled with ice cream and cake. In this case, maybe even ten pieces of puff-puff would not show any effect. This is why, in studies of animal learning with food as a reward, the animals are deprived of food before the experiment starts.

We can see that experimenters must be careful to produce a strong manipulation of the independent variable. Failure to do so is a common cause of null results. Because there is no way to determine if the manipulation has failed or the null results are correct, experimenters cannot reach any conclusions regarding the effect of the independent variable on the dependent variable. Other common causes of null results are related to dependent and control variables, to which we now turn.

5.2 Dependent Variables

The dependent variable is the response measure of an experiment that is dependent on the participants' responses to our manipulation of the environment. In other words, the participant's behaviour is observed and recorded by the experimenter and is dependent on the independent variable. Time elapsed before a participant sits down at a table defended by a research assistant, the speed of a worm crawling through a maze, the number of times a rat presses a bar – all are dependent variables, because they are dependent on the way in which the experimenter manipulates the environment. In the library example, we might predict that a participant would be more reluctant to sit down at a table that is defended by an assistant who displays a forbidding expression than if the assistant assumes a congenial expression. In this instance, the participant's behaviour is dependent on the expression that we instruct the assistant to adopt. The time that elapses until the participant sits down at the table is the dependent variable of interest.

5.2.1 Criteria for Selecting Dependent Variable

One criterion for a good dependent variable is stability. When an experiment is repeated exactly – same participant, same levels of independent variable, and so on – the dependent variable should yield the same score as it did previously. Instability can occur because of some deficit in the way we measure some dependent variable. Assume that we wish to measure in grams the weight of an object, say a candle, before and after it is lit for fifteen minutes, we use a scale that works by having a spring move a pointer. The spring contracts when it is cold and expands when it is hot. As long as our weight measurements are taken at constant temperatures, they will be reliable. But if temperature varies while objects are being weighed, the same object will yield different readings. This is because our dependent variable lacks stability.

Null results can also be caused by inadequacies in the dependent variable, even if it is stable. The most common cause is a restricted or limited range of the dependent variable so that it gets "stuck" at the top or bottom of its scale. Imagine that you are teaching a rather uncoordinated friend how to bowl for the first time. Since you know from introductory psychology that reward improves performance, you offer to buy your friend a drink every time he or she gets a strike. However, your friend got all gutter balls, so you took all the drinks yourself. Thus, you can no longer offer a reward. Therefore, you expect a decrement in performance. But since it is impossible to do any worse than all gutter balls, you cannot observe any decrement. Your friend is already at the bottom of the scale. This is called a floor effect. The opposite problem, getting 100 percent correct, is called a ceiling effect. Ceiling and floor effects prevent the influence of an independent variable from being accurately reflected in a dependent variable.

5.3 Control Variables

A control variable is a potential independent variable that is held constant during an experiment, because it is controlled by the experimenter. For any one experiment, the list of relevant control variables is quite large, far larger than can ever be accomplished in practice. In even a relatively simple experiment, for example, requiring people to memorize three-letter syllables, there are many control variables involved. Time of day changes your efficiency; ideally, this should be controlled. Temperature could be important because it might also affect memory performance; intelligence is also related. The list could be extended. In practice, an experimenter tries to control as many salient variables as possible, hoping that the effect of uncontrolled factors will be small relative to the effect of the independent variable. Although, it is always important to exercise strict control over extraneous factors, it is even more critical when the independent variable produces a small effect on the dependent variable. Holding a variable constant is not the only way to remove extraneous variation. Statistical techniques also control extraneous variables. Holding a variable constant is the most direct experimental technique for controlling extraneous factors, so we limit our definition of control variables to only this technique. Null results often occur in an experiment because there is insufficient control of these other factors, that is, they have been left to vary systematically with the independent variable. Depending on the relationship between an extraneous variable and an independent variable, this uncontrolled variation can either obscure or inflate the effect of the independent variable on the dependent variable of interest. The problem of extraneous variation occurs more often in studies that are conducted outside of laboratories, where the ability to hold control variables constant is greatly limited.

Activity

Allow 20 minutes

Name the Variables

Understanding independent, dependent, and control variable is so important, we have included some examples for your use in checking your understanding. For each situation, name the three kinds of variables.

The answers follow at the feedback section in this page.

1. An automobile manufacturer wants to know how bright brake lights should be to minimize the time required for the driver of a following car to realize that the car in front is stopping. An experiment is conducted to answer this. Name the variables involved.
2. A pigeon is trained to peck a key if a green light is illuminated but not if a red light is on. Correct pecks are regarded by giving it access to grain. Name the variables involved.
3. A social psychologist does an experiment to discover whether men crowded into a telephone booth. Name the variables involved.
4. A therapist tries to improve a patient's image of himself. Every time the patient says something positive about himself, the therapist rewards this by nodding, smiling, and being extra-attentive. Name the variables involved.

Feedback Section

1	Independent variables (manipulated)	Intensity (brightness) of break light
	Dependent (observed) variable	Time from the outset of the brake light until the depression of brake pedal by following driver.
	Control (constant) variables	Colour of brake lights, shape of brake pedal, external illumination, etc
2	Independent variables	Colour of light (red or green)
	Dependent variable	Number of key pecks
	Control variables	Hours of food deprivation, size of key, intensity of red and green lights, etc
3	Independent variables	Gender of participant
	Dependent variable	rating of discomfort
	Control variables	size of telephone booth, number of persons (6) crowded into booth, size of individuals, etc

4	Independent variables	Actually, this is not an experiment because there is only one level of the independent variable. To make this an experiment, we need another level---say, rewarding positive statements about the patient's mother-in-law and ignoring negative ones. Then the independent variable would be kind of statement rewarded.
	Dependent variable	Number (or frequency) of statement
	Control variables	office setting, therapist, etc.

5.4 Multiplicity of Variables in an Experiment

This section discusses the importance of using multiple independent variables in an experiment. The possibility of using multiple dependent variables in an experiment is also discussed. Examples are given for illustration.

5.4.1 Multiple Independent Variables

It is unusual to find an experiment reported in a psychological journal in which only one independent (manipulated) variable is used; the typical experiment manipulates from two to four independent variables simultaneously. This procedure has several advantages. First, it is often more efficient to conduct one experiment with, say, three independent variables than to conduct three separate experiments. Second, experimental control is often done better, since with a single experiment, some control variable –time of day, temperature, humidity, and so on-are more likely to be held constant than with three separate experiments. Third, and most important, the result generalized-that is, shown to be valid in several situations-across several independent variables are more valuable than data that are yet to be generalized. Just as it is important to establish generality of results across different types of experimental subjects, experiments also need to discover if some result is valid across levels of independent variables. Fourth, this allows us to study interactions, the relationships among independent variables. We illustrate these advantages with some examples. Let us say, we wish to find out which of two kinds of rewards facilitates the learning of geometry by high school students. The first reward is an outright cash payment for problems correctly solved; the second reward is early dismissal from class-that is, each correct solution entitles the students to leave class five minutes early. Assume that the results of this (hypothetical) experiment show early dismissal to be the better reward. Before we make early dismissal a universal rule in high school, we should first establish its generality by comparing the two kinds of reward in other classes, such as history or biology. Here, subject matter of the class would be a second independent variable. It would be better to put these two variables into a single experiment than to conduct two successive experiments. This would avoid problems of control, such as one class being tested the week of the big football game (when no reward would improve learning) and the other class being tested the week after the game is won (when student felt better about learning). When the effects produced by one independent variable are different at each level of a second independent variable, we have an interaction. The search for interaction is a major reason for using multiple independent variables per experiment.

This can better be demonstrated by example of Martell and Willis (1993) were interested in discovering how feedback about a group's performance would influence what subjects remembered about the group's behaviour. Prior to observing the same work group, subjects were given either positive or negative feedback, concerning the group's performance. Subjects who received positive feedback were told that a panel of experts had ranked the group among the top 20 percent of all work groups. Subjects in the negative feedback condition were told that the group ranked in the bottom 20 percent.

There were two independent variables. The subjects were first given either the positive or negative feedback. All subjects watched the same videotape of a work group. Work group members displayed both effective and ineffective behaviours in their attempt to build a bridge of planks and ropes across a pool of water. So all subjects observed the same videotape in which the group engaged in both effective and ineffective behaviours. Thus, the two independent variables were performance feedback (positive or negative) and type of behaviour observed (effective). After subjects watched the videotape, they were shown a list of behaviours and then asked to decide which ones they had actually observed. The dependent variable then was the proportion of effective and ineffective behaviours that subjects attributed to the work group. When subjects observed effective behaviours, a lower proportion of behaviours attributed to the group were checked than when they observed ineffective behaviours. When subjects were given a positive feedback, a higher proportion of behaviours attributed to the group were found. However, this simple interpretation of the results can be misleading. Effective behaviour does not always produce a lower proportion of behaviours attributed to the group as might be concluded. Instead, the direction of the effect of behaviour depends on the kind of feedback given. Only for negative feedback does effective behaviour produce a lower proportion of behaviours attributed to the group. For positive feedback, this is not true.

Remember, an interaction between two variables indicates that the effects produced by one independent variable (performance feedback) are not the same at each level of a second independent variable (effective versus ineffective work behaviour). This is exactly what was found. Subjects, who received a positive feedback, regarding the work group, recognized a greater proportion of effective than ineffective behaviours. In contrast, subjects who received a negative feedback responded in the opposite manner, recognizing a greater proportion of ineffective as opposed to effective behaviours in the work group. This judgment represents an illusion of memory created by exposure to positive or negative feedback.

Despite the fact that subjects in the two conditions actually saw the same videotape, their memories for the group's behaviours were biased by their prior expectations.

The effects produced by the manipulation of performance feedback depend on whether the behaviours are effective or ineffective, with subjects recognizing a greater proportion of behaviours that are consistent with their feedback condition (e.g., a greater proportion of effective behaviours when given a positive feedback). If performance feedback produced similar results for both effective and ineffective behaviours, then both feedback groups would recognize either more effective behaviours or more ineffective behaviours of the work group. Now let us imagine that this experiment was performed with the two feedback conditions but that the experimenters decided to ignore (or failed to consider) the distinction between effective and ineffective work behaviours. In other words, the experimenters investigated the effect of performance feedback on work group behaviour in general. The experimenters would have been forced to conclude that performance feedback produces little or no effect on the proportion of behaviours attributed to the work group. You can see that by designing the experiment this way, the experimenters would have ended up with null results and, as a consequence, missed discovering an important finding, regarding the effects of performance feedback on work behaviour ratings. Thus there are dangers in overlooking important variable when designing experiments. From the results in this example, the actual result shows an interaction. The effects of one independent variable depend on the level of the other independent variable. Subjects were more likely to endorse or "remember" work behaviours that were consistent with the feedback they were given about the work group.

Many experiments include two or more independent variables so that the results may contain an interaction. Because of the frequency with which you are likely to encounter interactions, we present another example of a two-variable experiment to help you practice interpreting the results of complex experiments.

In the experiment on social loafing by Brickner, Harkins, and Ostrom (1986), the authors wanted to determine the effect of personal involvement in a task on the amount of social loafing shown on that task. Bricker and her associates noted that low-involvement tasks, such as clapping and generating uses for a knife, had been used in earlier research on social loafing. The authors reasoned that the effort devoted to a task should be related to the intrinsic importance or personal significance that the task has for the individual. High personal involvement in a task should reduce social loafing because individuals should put forth a substantial amount of effort on such tasks, regardless of whether their individual performance is monitored. So, the researchers varied the subjects' involvement in the task and also varied the amount that individual effort could be assessed. If their reasoning was correct, there should be an interaction: Low involvement should lead to social loafing (reduced effort when the individual's effort cannot be assessed) but high involvement should lead to about the same amount of effort, whether or not individual effort could be identified.

Brickner and his associates had college students generate as many thoughts as they could in a twelve-minute period about a proposal to implement senior comprehensive exams, which a student would have to pass in order to graduate. In the high-involvement condition, the students were led to believe that the proposal would be instituted at their college prior to their graduation. Thus, the addition of comprehensive exams as one prerequisite to graduation should have high personal relevance. In the low personal-involvement condition, the students were led to believe that the exams would be instituted later, at another college. The possible identifiability of individual effort was also manipulated by instructions. Subjects wrote each of their thoughts about comprehensives on an individual slip of paper. In the low identifiability condition, the subjects were told that their thoughts would be collected together with those of other subjects, because the committee evaluating the thoughts wanted to assess the range of opinions for the group as a whole. In the high-identifiability condition, the subjects were told that their opinions would be considered separately from those of others, because the committee in charge wanted to assess individual responses. To summarize, the dependent variable was the number of thoughts generated in the four conditions: low identifiability and low involvement; low identifiability and high involvement; high identifiability and low involvement, high identifiability and high involvement. A number of thoughts were generated against identifiability for the two involvement conditions. The result showed that earlier social loafing research is replicated in the low-involvement condition: Fewer thoughts were generated when the subjects believed that their individual performance was not being assessed. When there was high involvement, the variables interacted, and the effects of identifiability depended on the level of task involvement. In other words, social loafing, and therefore diffusion of responsibility, is less likely to occur when a person is confronted with a personally, involving task than when the task does not have much intrinsic interest.

5.4.2 Multiple Dependent Variables

The dependent (observed) variable is used as an index of behaviour. It indicates how well or poorly the subject is performing. It permits the experimenter to score behaviour. The experimenter must decide which aspects of behaviour are relevant to the experiment at hand. Although some variables traditionally have been used, this does not mean that they are the only, or even the best, indexes of behaviour. Take for example, the behaviour of a rat pressing a bar or a pigeon pecking a key, responses that are used in studies of animal learning. The most common dependent variable is the number of presses or pecks observed. But the force with which a key is pecked can also lead to interesting findings, as can the latency (the time taken to respond). Researchers can usually come up with several dependent variables that may be appropriate. Let us say we wish to study the legibility of the typeface that you are now reading: We cannot observe. Here are some dependent variables that had been used in the past: retention of meaningful information after reading text, time needed to read a fixed number of words, number of errors in recognizing single letters, speed in transcribing or retyping text, heart rate during reading, and muscular tension during reading – and this list is far from exhaustive.

Reasons of economy argue for obtaining as many dependent measures at the same times as is feasible. Despite this, the typical experiment uses only one, or at the most, two dependent variables simultaneously. This is unfortunate: just as the generality of an experiment is expanded by having more than one independent variable, it is also expanded with several dependent variables. The reason why more dependent variables are not used at once is probably because it is statistically difficult to analyze several dependent variables at once. Although modern computer techniques make the calculations quite feasible, many experimental psychologists have not been well trained in these multivariate statistical procedures and, thus, hesitate to use them. Separate analyses could be conducted for each dependent variable by itself, but this loses information in much the same way that a separate analysis of independent variables ignores interactions. Multivariate analysis is complex; nevertheless, you should be aware that it is often advantageous to use more than one dependent variable in an experiment.

Study Session Summary

Summary

In this Study Session, we discussed that independent variables are selected because an experimenter believes they will cause changes in behaviour. Null results are obtained when an independent variable fails to cause changes in behaviour. Null results can have more than one interpretation. This implies that experimenters must be careful to produce a strong manipulation of the independent variable. Independent variable is manipulated by the experimenter whereas the dependent variable is observed and recorded. Ceiling and floor effects result from an inadequate range for the dependent variable. They prevent the influence of an independent variable from being accurately reflected in a dependent variable. The dependent variable is the response measure of an experiment that is dependent on the participants' responses to our manipulation of the environment. A control variable is a potential independent variable that is held constant during an experiment. It is not manipulated during an experiment. We also noted that the levels of one independent variable are differentially affected by the levels of other independent variables.

Assessment

Assessment

SAQ 5.1

How will you determine an independent variable in experimentation?

SAQ 5.2

How will you select a dependent variable in experimentation?

SAQ 5.3

What is a control variable? Discuss how it influences experiment?

SAQ 5.4

1. What are the advantages of using multiple independent variables?
2. Explain why multiple dependent variables would be advantageous?

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Study Session 6

Experimental Designs

Introduction

The purpose of experimental design is to minimize extraneous or uncontrolled variation, thereby increasing the likelihood that an experiment will produce valid, consistent results. Volumes of books have been written about experimental design. Here, we shall examine some common techniques used to improve the design of experiments.

Learning Outcomes

When you have studied this session, you should be able to:

6.1 *outline* the basic steps in experimental design.
6.2 *point* out the merits of different designs to the experiment.
6.3 *present* ways of controls in an experiment.
6.4 *indicate* ways of minimizing errors in an experiment.

6.1 Basic Steps to Experimental Design

One of the first design decisions an experimenter must make is how to assign subjects to the various levels of independent variables. The two main possibilities are to assign only some subjects to each level or to assign each subject to every level. The first possibility is called a between-subjects design and the second, a within-subjects design. The difference can be shown with a simple example. Thirty students in introductory psychology have signed up for an experiment that you are conducting to test ability to remember nonsense words. Your independent variable is the number of times you will say each items: one time or five times. You expect that an item presented five times will be learned better than an item presented only once.

The between subjects design calls for you to divide your subjects in half – that is, into two groups of fifteen students each – with one group receiving five repetitions and the other, one repetition. (How to select which subjects to put in each group is discussed shortly).

The within subjects design has all thirty subjects learning with both levels of the independent variable – that is each is tested with one repetition and again with five repetitions. (How to determine the order when each subject gets these two treatments is also discussed later).

Which design should you use?

6.2 Forms of Experimental Design

6.2.1 Between- Subjects Designs

The between-subjects (two groups) design is conservative. There is no chance that one treatment will continue to contaminate the other because each person receives only one treatment (one repetition or five repetitions but not both). One drawback, however, is that the between-subjects design must deal with differences among people, and this decreases its efficiency – that is, its ability to detect real differences between one and five repetitions of the memory items.

In any between-subjects design, the experimenter must try to minimize differences among the subjects in the two or more treatment groups. Clearly, if we took the best five memorizers and deliberately placed them in the one-repetition group and put the worst five in the five-repetition group, we might wind up with no difference in results-even, perhaps, with the one-repetition group doing better. To prevent this outcome, the experimenter must ensure that both groups are equivalent at the start of the experiment.

Equivalent Groups

One way to do this would be to administer a memory test to all thirty subjects before the regular experiment started to obtain a baseline measure of the subjects' ability to memorize nonsense words. Subjects' baseline scores could then be used to form pairs of subjects that have equal or very similar scores. One member of each pair would be randomly assigned to one group and the other member to the second group. This technique is called matching. One difficulty with matching is that an experimenter cannot match subjects on every possible characteristic. Thus, there is always the possibility that the groups, even though matched on some characteristic(s), differ on some other characteristic that may be relevant (matching is discussed in greater detail later in this Study Session).A more common technique used to ensure that equivalent groups are formed is randomization. Randomization means that each person participating in an experiment has an equal chance of being assigned to any particular group. In our repetition experiment, one way to form two groups by randomization would be to draw names out of a hat. Or, we could ask each person to step forward and then throw a dice. Even throws would be assigned to one group, and odd throws to the other. If we do not have any dice, a table of random members could be used to generate even and odd digits. This method of assigning subjects to experimental conditions has no bias, since it ignores all characteristics of the subjects; we expect that the groups so created would be equivalent on any and all relevant dimensions. However, randomization does not guarantee that groups will always be equal. By chance, a greater number of better memorizers might be assigned to one of the groups. The odds of this occurring can be calculated by the methods of probability theory as applied to statistics. This is one reason why experimental designs and statistics are often treated as the same topic. However, design is concerned with the logic of arranging experiments, whereas statistics deals with calculating odds, probabilities, and other mathematical quantities.

If we are sure that all relevant dimensions have been dealt with, matching is preferable to randomization. But because we seldom are sure, randomization is used more often.

6.2.2 Within-Subjects Designs

Many experimental psychologists would prefer the within-subjects (one group) design in which all thirty subjects are tested with one repetition and again with five repetitions (or vice versa). It is more efficient, since each subject is compared with himself or herself. Any differences resulting from one versus five repetitions cannot be the result of differences between the people in the two groups, as might be the case for the between-subjects-design.

General Practice Effects

There is a risk, however, in the more efficient within- subjects design. Imagine that all thirty subjects first learn a large number of items with five repetitions and then learn with one repetition. By the time subjects begin the one repetition treatment, they might have become more proficient in learning nonsense words, or they might be experiencing some boredom or fatigue with the task. Both possibilities are termed general practice effects**.** These effects are usually assumed to be the same for all treatment conditions so that it does not matter whether subjects learn with one repetition followed by five repetitions or five followed by one repetition. Because general practice effects are the same for all treatment conditions, they can be controlled largely through counterbalancing**.** With counterbalancing, the experimenter faces the difficulty of determining the order in which treatments should be given to subjects. Again, one solution is to use randomization by drawing the treatment titles out of a hat. Using a random-number table, or using a computer to order conditions randomly. However, although counterbalancing treatments through randomization produces equivalent orders in the long run, it is less likely to be suitable when there are only a small number of treatments. In most experiments, the number of subjects exceeds the number of treatments, so randomization is a good technique for assigning subjects to treatments.

- Complete counterbalancing makes sure that all possible treatment orders are used. In the repetition experiment, this is easy, since there are only two orders: one and five repetitions, five and one repetitions. Half the subjects would receive one repetition followed by five repetitions, and the other half would get the opposite order. As the number of treatments increases, the number of orders becomes large indeed. Three treatments have 6 different orders; four treatments have 24 different orders; five treatments have 120 different orders; and so on. As the levels of an independent variable increase, complete counterbalancing soon becomes impractical.
- Counterbalancing does not eliminate the effects of order. It does allow experimenters to evaluate possible order effects. If such effects are present, and especially if they form interactions with other more important independent variables, steps should be taken to

correct the design. The experimenter might decide to repeat the experiment, using a between-subjects design to avoid order effects. Alternatively, the original experiment could be re-analyzed as a between - subjects one, by examining behaviour in just the initial condition experienced by each subject.

Differential Carryover Effects

Differential carryover effects pose a more serious problem than do general practice effects. In differential carryover effects, the effect of the early part of the experiment on the later part of the experiment varies, depending on which treatment comes first. Imagine that all thirty subjects first learn items with five repetitions and then learn with one repetition. As a result of their earlier experience with five repetitions, they might decide to repeat to themselves four more times the item that is only presented once. This would destroy any differences between the two levels of the independent variable. This is an example of a differential carryover effect given that the effect of the first treatment on the second treatment differs, depending on which treatment comes first. This is not the case with general practice effect in which subjects approach the second treatment in the same way (i.e., with greater skill, boredom, or fatigue), regardless of the treatment they receive in the first phase of the experiment. Differential carryover effects can be diminished somewhat through counterbalancing, but counterbalancing cannot eliminate these effects entirely. If there is any reason to expect differential carryover effects, we can do one of two things in addition to counterbalancing. We can use the between-subjects design or build in a sufficient time delay between the two treatments. Because the between-subjects design is less efficient, it will require that many more subjects be tested, but this is preferable to conducting a seriously flawed experiment. If we decide to insert a time delay between the two treatments, we must identify duration of time that is sufficient to eliminate the possibility of differential carryover effects.

Small-n-Designs

Before turning to a discussion of mixed designs, we would like to mention a variant on the traditional within-subjects design, the small-n-design. Small-n-Designs present the levels of the independent variable or treatments to a small number of subjects or a single subject. Because few subjects are tested, a substantial number of observations are recorded for each subject, resulting in a very economical and highly controlled experiment. Small-n-designs experiments are common in psycho-physical, clinical, and operant-conditioning research. Just as with the within-subjects design, the experimenter must be careful to counterbalance treatments and anticipate any problems associated with administering multiple treatments to individual subjects.

6.2.3 Mixed Designs

Experiments need not be exclusively be within-subjects or between-subjects design. It is often convenient and prudent to have some independent variables treated as between- subjects and others as within-subjects in the same experiment (assuming the experiment has more than one independent variable, of course). If one variable – for example the administration of a drug – seems likely to affect others, it can be made between-subjects variable. When trials or repeated practice on a task is of interest, it is of necessity to have a within-subjects variable. Frequently, a mixed design is used, in which some variable is imposed between-subjects to see its effect across a second, within-subjects variable. This was the case in the Martell and Willis (1993) study described earlier. The experimenters designated performance feedback (positive versus negative) as a between-subjects variable based on the expectation that subjects would be reluctant to believe the negative feedback after receiving positive feedback (or vice versa) concerning the group. In contrast, it seemed reasonable for each subject to observe the group engaging in both effective and ineffective behaviours – a within-subjects variable. This type of compromise design (mixed design) is not as efficient or economical as a pure within- subjects design, but it is often safer.

6.3 Control Conditions

Independent variables must be varied (or manipulated) by the experimenter. This implies that each and every independent variable must vary either in amount (quantitative variation) or in kind (qualitative variation) within the experiment. For example, if the amount of regard given to a rat is an independent variable, the amount chosen by the experimenter might be one and four pellets of food. Alternatively, we could offer different kinds of regard, such as food and water. The technical term for a single treatment or condition of an independent variable is **level.** We would state that in the first example, the levels of the independent variable are one and four food pellets and food and water, in the second example. Many experiments contain, in addition to independent variables, some **control group** (between-subjects design) or **control condition** (within-subjects design). In its simplest form, the control group does not receive the levels of interest of the independent variable. In the reward example just described, a control group of rats would receive no reward or an experimenter might be interested in the effect of noise on studying. Using a between-subjects design, the experimenter would expose one group of subjects to loud noise for half an hour while they are studying. This is the level of interest of the independent variable. A control group would study the same material for half an hour in a quiet setting (a very low level of noise). Then both groups would be tested on the material. Any obtained differences on the test between the two groups would be attributed to the effect of noise

The important characteristic of a control condition is that it provides a **baseline** against which some variable of interest can be compared. Sometimes the best baseline is no treatment, but often the best baseline requires some activity. A frequent example occurs in memory research, where a group of subjects is required to learn two different lists of words. The experimenter is interested in how learning the words in one list interfere with learning the words in the other. The experimental group (receiving the level of interest of the independent variable) first learns list A. But then learns list B, and then is tested again on list A. The experimenter would like to show that learning list B interferes with retaining the knowledge of list A. But before any conclusion of this sort can be reached, a comparison control condition is required. Merely comparing the final test of list A with the first test is insufficient, because subjects might do worse on the last list A test simple because they are tired, or they might do better because they have had extra practice. A control condition with no treatment would have a control group learn list A, then sit around for the time it takes the experimental group to learn list B, because subject might practice or rehearse list A while they are sitting around. This would improve their final performance on the last list A test and incorrectly make it appear that in the experimental group, list B interferes more than it really does with list A. A proper baseline condition would occupy the control group during the time the experimental group is learning list B. Perhaps, the experimenter would have them do arithmetic or some other "busy work" that would prevent rehearsal. Sometimes, the control condition is contained implicitly within the experiment. Recall the memory experiment discussed earlier, in which the independent variable was the number of repetitions of an item or five. No experimenter would bother to include a control group or condition with zero repetitions, since no learning could occur under this odd circumstance. The control condition is implicit, in that five repetitions can be compared with one, and vice versa, since the experimenter might well be as interested in the effects of a single repetition level as a control condition. But it does provide a baseline for comparison – and so, for that matter, does the five-repetition condition, since the one-repetition results can be compared with it.

Many types of experiments require more than one baseline. In physiological and drug research, for example, a control for surgical or injection trauma is needed. So, a subject might receive a sham operation or the injection of an inert substance (a placebo) in the control condition; those would also be compared with other controls that receive no operation or no injection.

6.4 Errors in Experimental Designs

It is quite easy to formulate an inadequate experimental design. In this Study Session, we shall discuss only a small sample of errors in design, ones that are so common, which you should be aware of. Examples include demand characteristics, experimenter effect, and automation of experiments.

6.4.1 Demand Characteristics

Laboratory experiments attempt to capture behaviour as it is really influenced by the independent variable. Sometimes, the laboratory setting itself or the knowledge that an experiment is underway may alter patterns of behaviour. Many times, research participants spontaneously form hypotheses or assumptions about the experimenter's purposes in conducting the experiment and then behave or respond in a way that will satisfy this assumed, purpose. Try this simple demonstration to convince yourself that such effects occur. Tell five of your friends that you are conducting an experiment for your psychology class and would like their cooperation as subjects. If they agree, ask them to hold three ice cubes in their bare hands. Note how many of them hold the ice cubes until they melt. Now ask five other friends to hold the ice cubes without mentioning anything about an experiment. Instead of holding the ice cubes until they melt, they will consider your request somewhat strange and soon so inform you. There is something unusual about the ready compliance of those friends who know they are participating in an experiment: Most of them are willing to hold the ice cubes for a longer period of time. Psychologists call the cues available to subjects that allow them to determine the purpose of the experiment, or what is expected by the experimenter **demand characteristics.** To the extent that the behaviour of research participant is controlled by demand characteristics, instead of by independent variables, experiments are invalid and cannot be generalized beyond the test situation.

A well-known example of a demand characteristic is the Hawthorne effect, named after the Western Electric Company, plant where it was first observed. The company was interested in improving workers' morale and productivity. Thus, it conducted several experiments (such as improving lighting) to better the workers' environment. No matter what experimental manipulation was tried, worker productivity improved. The worker knew they were in a "special" group and, therefore, tried to do their best at all times. The demand characteristics were more important in determining the workers productivity than were the experimental manipulations.

6.4.2 Experimental Effects

A pitfall closely related to demand characteristics is the **experimenter effect,** which influences the outcome accidentally by providing participants with slight cues as to the experimenter's expectations. For example, an experimenter might not be aware that he or she nods approvingly when a correct response is given and frowns after errors. The gender, race, and ethnicity of the experimenter are also potential experimenter effects. Experimenter's characteristics are more likely to bias the results of an experiment in research that focuses on issues related to these characteristics. For example, the race of an experimenter who is conducting an experiment, concerning the effect of skin color on work performance ratings may affect the outcome of the experiment.

These effects are not limited to experiments with humans. The experimenter effect can also occur in seemingly objective experiments with animal subjects. Rosenthal and Fode (1963) told student experimenters that the rats they were to test in a maze were from special strains: either maze-bright or maze-dull. Actually, the rats came from the same population. Nevertheless, the rats that were labeled maze-bright had fewer errors than those labeled maze-dull and this difference was statistically reliable. The student experimenters were observed while they tested the rats: They did not cheat or do anything overt to bias the results. It seems reasonable to state that the lucky students who got supposedly bright rats were more motivated to perform the experiment than those unfortunate ones who had to teach stupid rats to go through the maze. Somehow this affected the results of the experiment – perhaps because experimenters handled the two groups of rats differently.

The best way to eliminate this kind of experimenter effect is to hide the experimental condition from the experimenter on the premise that experimenters cannot communicate what they do not know. This procedure is termed a **double blind experiment** because the information that could lead to a biased experimental outcome has been deliberately withheld. This procedure was applied to a specific experiment on air pollution, where neither the experimenter nor the research participants knew which subjects were in which of behavioural effects of air pollution. Subjects breathed either pure air or air taken from a busy roadway. The air was contained in tanks; the experimenter did not know which tank held pure air and which tank held polluted air. The subjects' poorer performance in polluted air could not then, be attributed to the experimenter inadvertently disclosing the air quality to subjects, or treating them differently.

Experimenter's effects are not always this subtle. One of the authors was once involved in an experiment concerning the human eye-blink response. Several experimenters helped conduct the same experiment, and it was soon noticed that one of them obtained results that were quite different from those of the rest of us. His subjects started out experimental sessions with massive flurries of frenzied blinking. The cause of this odd behaviour was easily discovered. To record eye blinks, the experimenter must attach a tiny metal rod to the subject's eyelid with special tape---ordinarily a painless procedure. However the experimenter in question had a very heavy thumb and was unable to attach the rod without irritating the eye, causing the strange flurries of blinking When an experimenter suspects that some aspect of his or her appearance or manner (e.g., gender, race, ethnicity) may alter the pattern of subjects' behaviour, then a possible solution is to incorporate this as an additional independent variable or control variable in the experimental design. If an African American experimenter is conducting a research on skin colour and work performance ratings, he or she could ask a white colleague or research assistant to test half of the subjects and then compare the effects of skin colour in the two experimenters' race conditions.

6.4.3 Automation of Experiments

Experimenter effects can be eliminated or greatly reduced by having computers or other equipment conduct the experiment, so that the subject is untouched by human hands. In many laboratories, a subject enters a testing booth and sees a message on a screen that tells her or him to push a button to begin. Pushing the button causes instructions for the experiment to appear on the screen. The entire experiment is then conducted by a computer. The experimenter appears at the end of the data collection to debrief the participant, giving the aims of the study and explaining how the subject has helped advance science. Until then, the experimenter simply monitors the equipment and the subject to ensure that the subject is following instructions and that nothing untoward happens. Such automation obviously reduces the dangers of experimenter bias.

Study Session Summary

Summary

In this Study Session, you learnt that experimental designs are concerned with assigning subjects to experimental groups in ways that are expected to minimize extraneous variation. *Within-subjects and between-subjects* are two examples of experimental designs. When using the *within-subjects design*, the same subjects go through all the treatments while in the *between-subjects design*, different groups of subjects are exposed to different treatments.

The between-subjects design is safer, but the within-subjects design is more efficient. In any between-subjects design, the experimenter must try to minimize differences among the subjects in the two or more treatment groups. This can be achieved by ensuring that the groups are equivalent from the beginning of the experiment, using matching or randomization. You also examined ways to interpret experimental design.

Assessment

Assessment

SAQ 6.1

Outline the basic decision to make in experimental design.

SAQ 6.2

What are the merit of the following designs:

a) between-subject design,
b) within-subject design, and
c) mixed design?

SAQ 6.3

Present a way of utilizing controls in an experiment.

SAQ 6.4

What are the three main sources of error.

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Study Session 7

Quasi-Experiments

Introduction

For one reason or another, many variables cannot be manipulated directly. One deterrent to the manipulation of variables in experiments is the ethical considerations, which all scientists must have. For instance, it is ethical to survey or otherwise observe the use of drugs by college students as long as permission is obtained. By no stretch of the imagination, however, would it be ethical to create a group of drug abusers and compare their activities with a non abusers' group that we have also created. A second barrier to manipulation is Mother Nature. Some variables, such as the sex of our subjects, cannot be varied by the experimenter (except in a very rare and controversial circumstance). Other variables, such as natural disasters (tornadoes, hurricanes) or unnatural disasters (wars, airplane crashes, etc) are both physically and morally difficult to implement. However, can we do experiments that concern these phenomena? After all, such variables and other like them are fascinating and may play an important part in human experience. You can, conduct **quasi experiments** regarding them. We shall now examine how to conduct quasi experiments.

Learning Outcomes

When you have studied this session, you should be able to:

7.1 *discuss* the quasi-experimental method.
7.2 *point out* the merits and demerits of quasi-experiments.
7.3 *draw* sound inferences in a quasi-experiment.

7.1 The Meaning of Quasi-Experiments

A Quasi-Experiment is similar to the ex post factor examination in correlation research, except that two or more levels of the variable of interest are examined rather than correlated. We wait for Mother Nature to do her work, and then we compare the effects of that "Independent variable" with the effects that occur when that variable is not present or differs in some way. If we compare the reading ability of men with that of women, we have conducted a quasi-experiment.

Advantages of quasi-experiments are obvious. They use naturally occurring independent variables, most of which have a high degree of intrinsic interest and important practical implications. In a quasi-experiment, we take advantage of observation and correlation procedures and combine them with the power of experimentation. A typical quasi-experiment has a subject variable as an independent variable. If we want to find out about almost any inherent subject variable (age, sex, race, or ethnic group), socially caused subject attribute (social class, region mental illness, brain damage, or effects of disasters), we have to select rather than vary our independent variables, unless it is possible to do the experiment directly on infra-human organisms.

7.2 Implications of Quasi-Experiments

Although quasi-experiments are interesting and can contribute very important research, we should caution you here that the advantages of quasi-experiments are gained at the expense of control. When the researcher has to take what is given, what is given may include several important confounding variables. Because much research in psychology is concerned with subject variables and because quasi-experiments, using subject variables are likely to be confounded, we now have to examine the problems involved and possible solutions to them.

An experimenter cannot manipulate a subject variable while holding other factors constant; he or she can only select subjects who already have the characteristic in some varying degree and then compare them on the behaviour of interest. If the subjects in the different groups (say, high, medium, and low IQ) differ on the behaviour, we cannot conclude that the subject variable difference has produced or is responsible for the difference in behaviour. The reason is that other factors may be covariant and confounded with the subject variable. If high IQ subjects perform some task better than low IQ subjects, we cannot say that IQ produces or causes the difference, because the different groups of subjects are likely to vary on other relevant dimension such as motivation, education, and so forth. When subject variables are investigated, we cannot safely attribute differences in behaviour to this variable, as we can with true experimental variables. Such designs, then essentially produce correlations between variables.

Note

We can say that the variables are related but we cannot say that one variable produces or causes the effect in the other variable.

The above is a very important point. Let us consider an example. Suppose an investigator is interested in the intellectual functioning (or lack thereof) of people suffering from schizophrenia. People diagnosed as belonging to this group are given numerous tests that are meant to measure various mental abilities. The researcher also gives these tests to another group of people, so-called normal. He or she discovers that schizophrenics do especially poorly relative to normal people in tests involving semantic aspects of language, such as understanding the meanings of words or comprehending prose passages. The investigator concludes that the schizophrenic perform these tests more poorly because they are schizophrenics and that their inability to use language well in communication is likely attributable to schizophrenia.

Studies such as this are common in some areas of psychology. Despite the fact that conclusions similar to this are often drawn from such studies, they are completely unwarranted. Both conclusions are based on correlations, and other factors could well be the critical ones. Schizophrenics may do more poorly than normal people for a number of reasons. They may not be as intelligent as motivated, as educated, or as wise at taking tests. It may simply be that they have been institutionalized for a long time, with a resulting poverty of social and intellectual intercourse. So, we cannot conclude that the reason that the two groups differ on verbal tests is attributable to schizophrenia or its absence in the two groups. Even if we could conclude this, it would certainly not imply the other conclusion, that language problems are involved in causing schizophrenia. Again, all we would have is a correlation between these two variables, with no idea of whether or how the two are casually related.

Use of subject variables is very common in all psychological research, but it is absolutely crucial in such areas as clinical and developmental psychology. Therefore, the problems with making inferences from such research should be carefully considered. A primary variable in developmental psychology is age, a subject variable. This means that much research in this field is correlational in nature, In general, the problem of individual differences among subjects in psychology is one that is often ignored; though, there are often appeals to consider this problem as crucial. Here, we shall consider a way of attempting more sound inferences from experiments employing subject variables.

7.3 Drawing Sound Inferences in Quasi-Experiments

7.3.1 Matching Again

The basic problem in the investigation of subject variables and in other ex-post factor research is that whatever differences are observed in behaviour may be caused by their confounded variables. One way to try to avoid this problem is by marching subjects on the other relevant variables. In the comparison of schizophrenics and normal people, we noted that the two groups were also likely to differ on other characteristics such as IQ, education, motivation, institutionalization, and perhaps even age. Rather than simply comparing the schizophrenics with normal people, we might try to compare them with another group more closely matched on these other dimensions, so that, we hope, the main difference between the groups would be the presence or absence of schizophrenia. For example, we might use a group of patients who, on the average, are similar to the schizophrenics in terms of age, IQ, length of time institutionalized, gender, and some measure of motivation. When the two groups have been matched on all these characteristics, then we can more confidently attribute any difference in performance between them to the factor of interest, namely, schizophrenia. By matching, investigators attempt to introduce the crucial characteristic of experimentation – being able to hold constant extraneous factors to avoid confounding – into what is essentially a correlational observation. The desire is to allow one to infer that the variable of interest (schizophrenia) produces the observed effect.

Several problems are associated with the matching method. For one thing, it often requires a great deal of effort because some of the relevant variables may be quite difficult to measure. Even when one goes through the trouble of taking the needed additional measures, it may still be impossible to match the groups, especially, if few subjects are involved before matching is attempted. Even when matching is successful, it often greatly reduces the size of the sample on which the observations are made. We then have less confidence in our observations, because they may not be stable and repeatable. Matching is often difficult because crucial differences among subjects may have subtle effects. In addition, the effects of one difference may interact with another. Thus, subtle interactions among matched variables may confound the results. To illustrate these difficulties, let us reconsider some of the work done by Brazelton and associates on neonatal behaviour (Lester and Brazelton, 1982). Brazelton's primary interest is in cultural differences in neonatal behaviour, as measured by the Brazelton Neonatal Behavioural Assessment Scale. The general strategy is to compare neonates from various cultures and ethnic groups with neonates from the United States. In these quasi-experiments, culture or ethnic group, which is a subject variable, is the quasi-independent variable. Attempts are usually made to match the babies from different cultures along various dimensions, such as birth weight, birth length, and obstetrical risk (including whether the mother received medication during birth, whether the baby was premature, and so on). Lester and Brazelton show that there is a synergistic relationship among these factors. Synergism in a medical context means that the combined effects of two or more variables are not additive; the combined effect is greater than the sum of the individual components. This means that the variables interact.

The way in which neonatal characteristics and obstetrical risk interact is thus explained. Studies have shown that the behaviour (as measured by the Brazelton scale) of slightly underweight infants is more strongly influenced (negatively) by small amounts of medication taken by the mother than is the behaviour of neonates who are closer to the average in weight. Even though the neonates are carefully selected, subtle and interactive effects of the matched variables are rarely under direct control, which means that the possibility of confounding is always present.

Another problem with matching involves the introduction of the dreaded regression artifact. Under certain conditions in many types of measurements, a statistical phenomenon known as regression to the mean occurs. The mean of a group of scores is what is taken as the average: the total of all observations divided by the number of observations. For example, mean height in a sample of 60 people is the sum of all their heights divided by sixty. Typically, if people who receive extreme scores (that is very high or very low) on some characteristic are retested, their second scores will be closer to the mean of the entire group than are their original scores. Consider an example. We give 200 people a standard test of mathematical reasoning for which there are two equivalent forms, or two versions of the test that we know to be equivalent. The average (mean) score on the test is 60 of 100 possible points. We take the 15 people who score the highest and the 15 who score the lowest. The mean of these groups is say, 95 and 30 respectively. Then, we test them again on the other version of the test. Now we might find that the means of the two groups are 87 and 35. On the second test, the scores of these two extreme groups regress toward the mean: the high – scoring group scores more poorly and the low scoring group does somewhat better. Basically, this happens for the high-scoring group because some people whose "true scores" are somewhat lower than actually tested lucked out and scored higher than they should have on the test. When retested, people with extremely high scores tend to score lower, near their true score; the situation is reversed for the low scoring group. That is, to some of them who score below their “true scores” on the first test, retesting leads to their scoring higher or nearer the true score.

This regression toward the mean is always observed under condition, where there is a less-than-perfect correlation between the two measures. The more extreme the selection of scores, the greater the regression toward the mean. It also occurs in all types of measurement situations. If abnormally tall or short parents have a child. It will likely be closer to the population mean than the height of the parents. As with most statistical phenomena, regression to the mean is true of groups of observations and is probabilistic (that is, it may not occur every time). For example, a few individual subjects may move away from the mean in the second test of mathematical reasoning, but the group tendency will be toward the mean.

But, how does regression toward the mean affect quasi-experiments in which subjects have been matched on some variable? Again, consider an example. This one, like much ex post facto research done or applied to societal problems, has important implications. Let us assume that we have an educational program that we believe will be especially advantageous for increasing the reading scores of Hausa children in the southwestern Nigeria. This is especially important because the scores of Hausa children may be typically lower than those of the Yoruba’s, presumably, because they are from two different cultural environments. We find, much to our surprise, that the Hausa children actually perform worse after the reading program than before it, and the Yoruba children improve. We conclude, of course, that the program helped Yoruba children but actually hurt Hausa children, despite the fact that it was especially designed for the latter.

This conclusion, even though it may seem reasonable to you, is almost surely erroneous in this case, because the regression artifacts consider what happened when the Hausa and Yoruba children were matched on initial reading scores. Since the populations differed initially, with the Hausa children scoring lower than their Yoruba counterparts. In order to match the two samples, it was necessary to select the Hausa students, having higher scores than the mean in their group and the Yoruba students, having lower scores than the rest for their group mean. Having picked these extreme groups, we would predict (because of regression to the mean) that when retested, the Hausa children would have poorer scores and that the Yoruba children would have better ones, on the average, even if the reading improvement program had no effect at all! The exceptionally high-scoring Hausa children would tend to regress toward the mean of their group, and the low scoring Yoruba would regress toward the mean for their group. The same thing would have happened even if there had been no program and the children had been simply retested. The same outcome would likely have been obtained if children had been matched on IQs instead of reading scores, since the two are probably positively correlated. So, simply finding another matching variable may not be a solution. One solution would be to match every large sample of Hausa and Yoruba children and then split each group, giving the reading program to one subgroup but not to the other. All would be retested at the end of the program. One of the subgroups of Hausa and Yoruba children should, of course, be random). Regression to the mean would be expected in both subgroups, but the effect of the reading program could be evaluated against the group that had no program. Perhaps, the Hausa children with the reading program would show much less drop (regression to the mean) than those without, indicating that the program really did have a positive effect.

Because quasi-experimental research with subject variables is conducted quite often to evaluate educational programs, its practitioners need to be aware of the many thorny problems associated with its use. One may not be able to say much with regard to the results or draw important conclusions because of confounding variables. Matching helps alleviate this problem in some cases, where its use is possible, but then one introduces the possibility of regression artifacts. But, many researchers seem to be unaware of this problem.

When matching is a practical possibility and when regression artifacts are evaluated, we can feel somewhat more confident of conclusions from our results. But we should remember that what we have is still only a correlation, though, a very carefully controlled one. Matching is sometimes useful, but it is not a cure-all. As in our earlier example, if we compare schizophrenics with others on mental test performance, and the schizophrenics still perform worse than the new matched control group, could we then conclude that schizophrenia produces inferiority in language usage? No, we could not. The outcome could still be attributed to something else, some other difference between the two groups. We can never be absolutely sure that the outcome is caused by schizophrenia.

Study Session Summary

Summary

In this Study Session, we have stated that quasi- experiments in psychology often employ subject variables. These variables are measures, such as age, IQ, mental health, height, hair, colour, sex, and the myriad other characteristics, which differ from one person to another. Such variables are determined after the fact, since they are often inherited dispositions (or at least, people come to the psychological study with the variables already determined). Such studies are correlational in nature.

Assessment

Assessment

SAQ 7.1

Discuss the concept of a quasi-experimental method.

SAQ 7.2

Itemize major positive and negative implications of quasi-experimental methods

SAQ 7.3

How will you draw sound inferences in quasi-experiments.

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Study Session 8

Essentials of Experimental Research

Introduction

The purpose of this Study Session is to expose you research language in psychology, which is necessary for you to master, if you want to read and write about psychological research.

Learning Outcomes

When you have studied this session, you should be able to:

8.1 define and *use* correctly all of the key words printed in bold:

- **problem**
- **sampling**
- **hypothesis**
- **descriptive statistics**
- **inferential statistics**

8.1 Issues in Conducting an Experiment

One problem for the new researcher is related to the lore of the laboratory. Everybody knows there are certain "obvious" ways to perform certain kinds of research. These ways differ from area to area but are well known within each category. They are so well known that researchers seldom bother to explain them. Indeed, they are quite surprised when new researchers are ignorant of these obvious methods and techniques. Animal researchers often deprive animals of food for several hours before the experiment or keep their pigeons at a certain percentage of the weight the pigeons would attain if they had food continuously available. Although, the reasons for this are obvious to the researcher, they may not be obvious to you. How does an experimenter know how many items to use in a memory experiment? How long should an experiment take? Why is one dependent variable selected from a set of what appear to be equally valid dependent variables? The next sub-section will answer the questions.

8.1.1 From Problem to Experiment

All research aims at solving a problem. This problem can be abstract and theoretical or concrete and applied. The problem may arise from an observation made more or less casually, such as that people seem to be more aggressive during the summer Here, the problem can be stated as "why does summer heat cause aggression?" Or more sceptically as "does high temperature cause aggression?"

A problem may arise from an accidental discovery in a laboratory, such as the finding of mold on a piece of bread. Solving this problem – why is the mold growing here? – led to the discovery of penicillin. Finally, a problem may arise directly from a theoretical model, for instance, when we ask, “why does reinforcement increase the probability of the occurrence of the behaviour that preceded it”?

Tip

The first step the experimenter must take is to translate the problem into a testable hypothesis. Then, the hypothesis must be transformed into an experiment with independent, dependent, and control variables.

8.1.2 From Problem to Hypothesis

A problem is, more or less, a vague statement that must be verified or a question that must be answered. Unless either is made specific and precise, it cannot be experimentally tested. Any hypothesis is a particular prediction, derived from a problem, often stated in this form: If A, then B. The crucial distinction between a problem and a hypothesis is that a hypothesis is directly testable, whereas a problem is not. An experimental test must be capable of disproving a hypothesis. The purpose of any experiment is to test hypotheses about the effects of an independent variable(s) on the dependent variable. To do this, we must collect **data.** Once obtained, these data must be analyzed. Once analyzed, data must be reported. These aspects are briefly discussed in turn.

8.1.3 Obtaining Data

Outlining an experimental design does not establish all the conditions needed for data acquisition. Although the design tells you how to assign subjects to experiments, it does not tell you how to get the subjects. Without subjects, there are no data. Psychologists who investigate animal behaviour have much more control over subject selection than those who study humans. Although, animal psychologists must bear the additional expense of obtaining, housing, and feeding their subjects, they can select the strain they wish to purchase and always have subjects available, barring some catastrophe. Research with humans most often uses as subjects college students enrolled in introductory psychology. Provided that his participation is used as a learning experience for the student, it is considered ethical and proper (APA, 1973). If the experiment is not used as a learning experience, the experimenter should pay subjects. Since college students are a select population, experimenters need to be careful about generalizing results to other subject populations. For example, techniques from a programmed learning system designed to teach inorganic chemistry might not prove successful in the teaching of plumbing.

The technique of selecting subjects from some population is called **sampling.** Sampling is necessary because it is usually impossible to test the entire population, say all college sophomores in the United States. **Random sampling** means that any member of a population has an equal chance of being selected as a subject. Furthermore, each selection is independent of other selections so that choosing one person does not affect the chances of selecting anyone else. Since a typical researcher does not have access to all college students, the experimenter tries to select randomly from the population that is available to him or her. Often even this step is impractical. So, the researcher can only randomly assign subjects to the various experimental conditions. After your sample has been selected and your design is fixed, one major decision remains. Should you test your subject one at a time or in a group? Both procedures have advantages and disadvantages. The biggest advantage of group testing is management of time. It is faster and therefore better to test subjects in groups. But, there are many instances where all other things are far from being equal.

For example, take a listening experiment in which separate words are presented to the left and the right ears. One hurried doctoral student decided to save time and test her subjects in a group. She forgot that unless subjects were positioned exactly between the two loudspeakers, one message would reach one ear before the other message reached the other ear. This invalidated the independent variable. Of course, it would have been fine to test subjects in a group if each subject wore earphone, thus avoiding this difficulty. The other problem in group testing is the possibility that subjects will influence one another, thus influencing the data. Perhaps a subject may cheat and copy answers from another or the sexual composition of the group may alter motivation.

8.1.4 Analyzing Data

The immediate result of an experiment is a large series of numbers that represent behaviour under different conditions. Understanding some elementary principles about statistics is crucial to the conduct of psychological research. There are two branches of statistics, descriptive and inferential. Data are usually condensed by descriptive statistics. Descriptive statistics are used to summarize and organize raw data using histograms, and frequency polygons. The most common are the mean and the standard deviation. As part of the data analysis, means are calculated for each level of each dependent variable, as well as for combinations of independent variables to show interactions. Inferential statistics allow us to make inferences about the reliability of differences among conditions.

8.1.5 Reporting Data

Many different styles and formats can be used to report data. The format is given in the Publication Manual of the American Psychological Association.

Study Session Summary

Summary

In this Study Session, you learnt that selecting subjects from some population is called sampling. Random sampling means that each member of the population has an equal chance of being selected. Data collected can be analyzed using descriptive and inferential statistics.

Assessment

Assessment

SAQ 8.1

Present a case scenario in order to define the following terms: problem, sampling, hypothesis, descriptive statistics, and inferential statistics.

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Study Session 9

Conducting Research in Psychology

Introduction

In this Study Session, you will be exposed to how to conduct research within ethical limits. You will examine the issue of scientific fraud and how to monitor ethical practices within the field of psychology.

Learning Outcomes

When you have studied this session, you should be able to:

9.1 *engage* in research using animals and humans with proper conduct.
9.2 *point out* scientific fraud and monitoring ethical practices.

9.1 Ethics of Research in Psychology

9.1.1 Conducting Research with Animals in Psychology

Animals are also the subjects of research because they are interesting, and also form an important part of the natural world. Animals serve as convenient, highly controlled models for human and other animals. Animals are often used to answer questions that would be impossible to answer by using human beings. Some people believe, however, that animals should not be used in various kinds of research. Therefore, a consideration of why animals are used in research is important, and an ethical safeguard for animals is necessary.

Arguments against Research with Animals

Animal-right advocates believe that research on animals should have the same prohibitions. According to those advocates, researchers need to uphold the rights of both human beings and animals because, for example, they believe that experimental destruction of a monkey's brain is as ethically reprehensible as the destruction of a human being. Three points summarize the position of the animal-rights advocates:

1. animals feel pain and their lives can be destroyed, as it is true of humans;
2. destroying or harming any living thing is dehumanizing to the human scientist; and
3. claims about scientific progress by animal research is a form of racism and, like interracial bigotry, is completely unwarranted and unethical.

Neglecting the rights and interests of other species has been called **speciesism**. Most experimental psychologists, have strong reservations about the validity of these points. Let us consider each in turn.

Arguments for Research with Animals

1. The first point is that animals feel pain and suffering. Certainly, this is true, but ethical standards exist in all scientific disciplines that use animals as research subjects. A major portion of these principles concerns the proscription of undue pain and inhumane treatment. No ethical psychologist would deliberately inflict undue harm on an animal. When pain suffering is inflicted on an animal, it is only after considerable deliberations by the scientist and the appropriate ethics review boards. Such deliberation weighs the suffering of the animal against the potential benefits of the experiment. It is only when the benefits far exceed the harm is the experiment approved and conducted. Finally, an important point to make about behavioural research on animals is that much of it does not involve pain or physical harm to the animals being studied.
2. The second point of the animal-rights activists is that the destruction of any living thing is dehumanizing to the human scientist. Presumably, plants are not meant to be included here; for, as human beings, we must destroy plants if not animals to survive even if this proscription against killing living things is limited to animals. This point has a number of serious implications, apart from eliminating animal research. If one uses this argument against animal research, then one should not eat meat of any kind. Likewise, one should not use any products derived from the destruction of animals {e.g. leather}. Finally, if the destruction of animals is dehumanizing, then is it not also dehumanizing to benefit from the destruction of animals? If so, then a true believer in animal right should forsake most of the wonders of modern medicine because virtually all of them benefited from animal research. However, consistent adherence to a belief in animal rights is often difficult. The difficulty was illustrated in the results of a survey of activists who attended a large rally in support of animal rights. It was reported that a substantially higher percentage of activists claimed to be vegetarians or vegans (people who eat no animal products, including milk and eggs) than do people in general. Many activists said they did not use leather goods. Nevertheless, a majority of animal-rights activists (53 percent) reported that they bought leather goods, ingested animal flesh, or both.
3. Finally, there is the charge that scientific progress at the expense of animals is simply speciesism, the belief that the sacrifice of members of other species is justified if our species is benefited. As a criticism against animal research, this argument ignores the fact that a significant amount of animal research also benefits the welfare of animals. For example, the research on learned taste aversion in rats has led to new, no lethal means of keeping coyotes away from sheep and crows away from crops. Similarly the research on how hatchling ducks imprint on human caretakers has been used to better prepare artificially incubated condor chicks for the wild. In any case, even if using animals for the benefit of human beings is a form

of speciesism, it is doubtful whether many people would give up the benefits already derived or even give up the possible future benefits to be derived from animal research. Consider this quote from Robert J. White, an eminent neuro-scientist and neuro-surgeon, who conducted research on monkeys that involved removing the brain of the animal: "As I write this article, I relive my vivid experiences yesterday when I removed at operation a large tumor from the cerebellum and brain stem of a small child. This was a surgical undertaking that would have been impossible a few decades ago, highly dangerous a few years ago, but is today thanks to extensive experimentation on the brains of lower animals, routinely accomplished with a high degree of safety" (1971), p. 504).

Tip

In addition to the benefits of experimental neuro-surgery, numerous benefits are derived from behavioural research with animals. Psychological experiments with animals have led directly to benefits in the treatment of such diverse psychological problems as bedwetting, phobias, and compulsive disorders such as anorexia, nervosa and depression. Moreover, animal experiments have given rise to behavioural technologies, such as biofeedback that have been used to help individuals with neuromuscular disorders to regain control of their bodies. Psychological research with animals has also demonstrated experimentally the link between psychological stress and physical health. Other studies have demonstrated that the detrimental effects of physically separating an infant from its parents – as is necessary when a newborn must be placed in an incubator to sustain its life – can be largely reversed simply by stroking the infant during three 15-minute periods during the day. A variety of other benefits that have arisen from behavioural research on animals, the point being that the benefits of psychological experimentation on animals are substantial, contrary to the claims made by some animal-rights activists. Gallup and Suarez (1985) reviewed the rationale, extent and use of animals in psychological research. They considered the possible alternatives and concluded that in many cases, there is no viable alternative to the use of animals in psychological research.

Guidelines for the use of Animals in Research

Psychologists have focused on the humane and ethical treatment of animals which are used in research for a long time. According to Young (1928), one early statement of humane treatment of animals asserted that animals used as research subjects "… shall be kindly treated, properly fed, and their surroundings kept in the best possible sanitary condition" (p. 487). This concern is echoed in the modern guidelines of the APA (1981a) governing research with animals, which state as a general principle the following:

> *An investigator of animal behaviour strives to advance understanding of basic behavioural principles and or to contribute to the improvement of human health and welfare. In seeking these ends, the investigator ensures the welfare of animals and treats them humanely. Law and regulations*

notwithstanding, an animal's immediate protection depends upon the scientist's own conscience.

As it is in virtually any human enterprise, abuses of humane treatment sometimes occur in the use of animals for research. However, these abuses go against the standard practice of animal researchers. Ethical researchers treat animals humanely. When unethical treatment of animals is uncovered, the researchers in question should be punished. One should not conclude that because abuses occur, animal research should be prohibited. The view of animal-rights activists (Plous, 1991) is based on a philosophical position, and this position prohibits the use of animals for human benefit as a general rule, not just for research. You must decide for yourself what attitude to take toward animal research, but the importance of the issue necessitates that you critically consider each side of the debate and its implications.

The following list outlines the five primary considerations for researchers, using animal subjects:

1. The acquisition, care, use and disposal of all animals are to be in compliance with current federal, state or provincial and local laws and regulations.
2. A psychologist trained in research methods and experienced in the care of laboratory animals should closely supervise all procedures involving animals should also be responsible for ensuring appropriate consideration of their comfort, health and humane treatment.
3. Psychologists should ensure that all individuals using animals under their supervision have received explicit instruction in experimental methods and in the care, maintenance and handling of the species being used. Responsibilities and activities of individuals participating in a research project are consistent with their respective competencies.
4. Psychologists should make every effort to minimize discomfort, illness, and pain of animals. Surgical procedures are to be performed under appropriate anesthesia; techniques to avoid infection and minimize pain are followed during and after surgery.
5. When it is appropriate that the animal's life be terminated, it is done rapidly and painlessly.

These guidelines are designed for experienced researchers. The APA (1981b) has also provided guidelines for the student researcher.

Guidelines for the Use of Animals by Student Researchers

1. In the selection of science behaviour projects, students should be urged to select animals that are small and easy to maintain as subjects for research.
2. All projects must be pre-planned and conducted with humane considerations and respect for animal life. Projects intended for science fair exhibition must comply with these guidelines as well as with additional requirements of the sponsor.
3. Each student undertaking a school science project using animals must have a qualified supervisor. Such a supervisor shall be a person who has had training and experience in the proper care of

the species and the research techniques to be used in the project. The supervisor must assume the primary responsibility for all conditions of the project and must ensure that the student is trained in the care and handling of the animals as well as in the methods to be used.

4. The student shall do relevant reading about previous works in the area. The student's specific purpose, plan of action, justification of the methodology, and anticipated outcome for the science project shall be submitted to, and approved by, a qualified person. Teachers shall maintain these on file for future reference.
5. No student shall inflict pain, severe deprivation or high stress levels or use invasive procedures such as surgery, the administration of drugs, ionizing radiation, or toxic agents unless facilities are suitable both for the study and for the care and housing of the animals and unless the research is carried out under the extremely close and rigorous supervision of a person with training in the specific area of study. These projects must be conducted in accordance with the APA Principles for the care and Use of Animals.
6. Students, teachers and supervisors must be cognizant of current federal and state legislation and guidelines for specific care and handling of their animals (e.g. the Animal Welfare Act). Copies of humane laws are obtainable from local or national humane organizations. A recommended reference is the Guide for the Care and Use of Laboratory Animals, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, Stock Number 017-040-00427-3.
7. The basic daily needs of each animal shall be of prime concern. Students must ensure the proper housing, food, water, exercise, cleanliness and gentle handling of their animals. Special arrangements must be made for care during weekends, holidays and vacations. Students must protect their animals from sources of disturbance or harm, including teasing by other students.
8. When the research project has been completed, the supervisor is responsible for proper disposition of the animals. If it is appropriate that the animal's life be terminated, it shall be rapid and painless. Under no circumstances should students be allowed to experiment with such procedures.
9. Teachers and students are encouraged to consult with the Committee on Animal Research and Experimentation of the American Psychological Association for advice on adherence to the guidelines. In cases where facilities for advanced research by qualified students are not available, the Committee on Animal Research and Experimentation will try to make suitable arrangements for the students.
10. A copy of these guidelines shall be posted conspicuously wherever animals are kept and projects carried out, including displays at science fairs.

9.1.2 Principles Governing Conduct of Research with Human Beings

Scientific knowledge and techniques that can be used for human betterment can be turned to manipulative and exploitative purposes as well. Just as results of research in atomic Physics can be used for cancer treatment, it can also be used as a destructive weapon. So methods used to eliminate problem behaviour or to facilitate learning in school may be used to manipulate political allegiance and to create artificial wants. This double-edged potentiality of scientific knowledge poses ethical problems for all scientists. In this Study Session, we shall look at the principles outlined for conducting research with human beings.

The American Psychological Association (1981a, 1987, 1989) has provided guidelines for researchers. The association outlines ten general principles governing the conduct of research with human participants. You should read and understand these ethical principles before you conduct a research project with human participants. A psychologist should carry out investigations with respect and with concern for the dignity and welfare of the people who participate and with cognizance of federal and state regulations and professional standards governing the conduct of research with human participants.

1. In planning a study, the investigator has the responsibility to make a careful evaluation of its ethical acceptability. To the extent that the weighing of scientific and human values suggests a compromise of any principle, the investigator incurs a correspondingly serious obligation to seek ethical advice and to observe stringent safeguards to protect the rights of human participants.
2. Considering whether a participant in a planned study will be a "subject at risk or a "subject at minimal risk", according to recognized standards, is of primary ethical concern to the investigator.
3. The investigator always retains the responsibility for ensuring ethical practice in research. The investigator is also responsible for the ethical treatment of research participants by collaborators, assistants, students, and employees, all of whom, however, incur similar obligations.
4. Except in minimal-risk research, the investigator establishes a clear and fair agreement with research participants, prior to their participation that clarifies the obligations and responsibilities of each. The investigator has the obligation to honour all promises and commitments included in that research that might reasonably be expected to influence willingness to participate and explain all other aspects of the research about which the participants inquire. Failure to make full disclosure, prior to obtaining informed consent requires additional safeguards to protect the welfare and dignity of the research participants. Research with children or with participants who have impairments that would limit understanding and/or communication requires special safeguarding procedures.

5. Methodological requirements of a study may make the use of concealment or deception necessary. Before concluding such a study, the investigator has a special responsibility to (i) determine whether the use of such techniques is justified by the study's prospective scientific, educational, or applied value; (ii) determine whether alternative procedures are available that do not use concealment or deception; and (iii) ensure that the participants are provided with sufficient explanation as soon as possible.
6. The investigator respects the individual's freedom to decline to participate in or to withdraw from the research at any time. The obligation to protect this freedom requires careful thought and consideration when the investigator is in a position to of authority or influence over the participant. Such positions of authority include, but are not limited to, situations in which research participation is required as part of employment or in which the participant is a student, client, or employee of the investigator.
7. The investigator protects the participant from physical and mental discomfort, harm, and danger that may arise from research procedures. If risks of such consequences exist, the investigator informs the participant of the fact. Research procedures likely to cause serious or lasting harm to a participant are not used unless the failure to use these procedures might expose the participant to greater harm or unless the research has great potential benefit and fully informed and voluntary consent is obtained from each participant. The participant should be informed of procedures for contacting the investigator within a reasonable time period following participation should stress, potential harm, or related questions or concerns arise.
8. After the data are collected, the investigator provides the participant with information about the nature of the study and attempts to remove any misconceptions that may have arisen. Where scientific or humane values justify delaying or withholding this information, the investigator incurs a special responsibility to monitor the research and to ensure that there are no damaging consequences for the participant.
9. Where research procedures result in undesirable consequences for the individual participant, the investigator has the responsibility to detect and remove or correct these consequences, including long-term effects.
10. Information obtained about a research participant during the course of an investigation is confidential unless otherwise agreed upon in advance. When the responsibility exists that others may obtain access to information, this possibility, together with the plans for protecting confidentiality, is explained to the participant as part of the procedure for obtaining informed consent. Research involving human participants rarely offers a completely clear glimpse of what is ethical. The responsibility for ethical practice rests on the researcher, review boards, and journal editors who review research for publication. In limited instances, a researcher might justify deception, concealment, and breaches of confidentiality. However,

such questionable ethical practices must be avoided if possible. Ethical violations are not prerequisites of good research.

9.2 Scientific Fraud and Monitoring Ethical Practices

Evidence in the past has shown that some researchers engage in fraudulent practices in their research. We shall look at some of the examples in this section and also monitoring of research.

Deliberate bias introduced by scientists is considered as Fraud. When scientists engage in research, they expend substantial time and effort, and their prestige and career advancement often depend on the success of their research. Under these pressures, some scientists are not completely honest in the treatment of their experiments and data. Instances of deliberate falsification can range from forging or cooking up data in which observations, which are reported, were never in fact made. A frequently cited example of forging is the case of Sir Cyril Burt. He was a well respected psychologist who studied the role of heredity in intelligence. He published several papers reporting data collected on identical twins, some reared together, and others reared apart. The data were collected in the period 1913-1932. In three papers, he reported a correlation in 1Q scores of 944 for twins reared together and of 771 for twins reared apart. Although the correlations were identical for the three papers, each reported an appreciably different number of subjects. That the correlations remained unchanged despite the addition of new subjects is extremely improbable. This evidence, along with other suspicious facts, led some scientists and historians to conclude that Burt's data were not completely honest (Kohn, 1986; Broad and Wade, 1982).

There are a number of examples of forging data. A famous case is that of the "Piltdown man" discovered in England in 1912. The Piltdown man consisted of a skull human old appearance and an apelike jawbone. The bones supposedly represented the missing link between apes and humans. The finding was widely, although not universally, accepted for fifty-seven years until suspicious scientists used a variety of dating method to show that the jaw was of modem origin whereas the skull was substantially older. The scientists discovered that the jaw was identical to that of an orangutan. Piltdown man was a hoax, and although there are a number of theories as to who perpetrated the fraud, the evidence is inconclusive.

Deliberate researcher bias can be more subtle than forging data. A researcher can choose not to report results that are incompatible with a personal theory or even with his or her political or social beliefs. Similarly, a biased scientist may design projects such that negative or ideologically bad results are unlikely.

How do we detect fraud? Science is self-correcting. The truth will win out. When an important finding is published, the scientific community takes it seriously and pursues the implications of the reported data. When other scientists try to repeat the fraudulent experiment, they will fail to get the reported results, and failures will eventually lead scientists to conclude that the findings were not real. Thus, the repetition of experiment is important to detecting scientific fraud. Direct, specific repetitions are called **replications.** It may take many failed replications and years of effort, however, before the entire scientific community agrees that the fraudulent results should be discarded. Discarding fraudulent result is a fact that illustrates the serious consequences of scientific fraud.

Most ethical review boards monitor scientific practices that could lead to scientific fraud. Moreover, individuals guarantee granting agencies that they have not engaged in fraudulent practices. Upon discovering fraud, the granting agencies suspend the grant and may attempt to recover funds that have been expended. Researchers who are guilty of fraud will not receive additional grants. Thus, institutions and granting agencies also play a role in containing fraud.

Monitoring Ethical Practices

The American Psychological Association established an Ethics Committee that fulfills a number of purposes. Through publications, educational meetings, and convention activities, the Ethics Committee educates psychologists and the public about ethical issues related to research in psychology. The committee also investigates and adjudicates complaints concerning unethical research practices. Examples of these cases can be found in an APA (1987) publication titled casebook on Ethical Issues. The Ethics Committee also publishes an annual report in *American psychologist*. In addition to the ethical guidelines established by APA, any institution that receives money from the federal government – which means virtually every U.S. institution that engages in research --- must have an **institutional review board (IRB)** that oversees the protection of human subjects and an institutional animal care and use committee that oversees the protection of animal subjects. All experiments must be approved by the members of these committees. Federal regulations require that each IRB have at least five members who are qualified to review the kind of research typically conducted within the institution. Furthermore, if an IRB regularly reviews research involving vulnerable individuals (e.g., children, prisoners, the mentally disabled), the committee should include at least one member whose area of expertise deals with such individuals. There must be at least one member whose primary concern is in scientific area and one member whose primary concern is in a nonscientific area. There must also be someone on the committee, usually an attorney, who can ascertain whether proposed research violates any laws or federal regulations. Finally, regulations require that at least one member of the committee be otherwise free from affiliation with the institution. This diversity in membership helps to ensure that the rights of individuals participating in research are protected.

How does an IRB make its decision regarding the ethicality of a particular research project? First, it assesses the level of risk involved in the procedure. Many psychological experiments are classified as involving only "minimal risk." Minimal risk means that the experimental procedures involve no greater risk than is associated with daily activities. If greater than minimal risk is deemed necessary for research purpose, then the IRB must decide if these risks are reasonable in relation to the benefits that would be gained from the research. The IRB also ensures that participants are fully informed prior to the experiment and that their safety and confidentiality are safeguarded.

An acquaintance with the institutional review process should help to re-assure you that ethical research in psychology, and in other sciences, is the rule, not the exception. Because of safeguards built into the structure of research institutions, scientists cannot simply rely solely on their own judgment to protect the humans and animals participating in their experiments. Further, the boards help to emphasize honesty in research, which aids in reducing fraudulent practices.

Study Session Summary

Summary

In this Study Session you learnt that using animals in experimental research is beneficial to both animals and human beings. We discussed that both sets of guidelines for the use of animals and humans for research. Finally, we noted that scientific fraud can be detected by replications of research, and it is monitored by institutional boards granting agencies.

Assessment

Assessment

SAQ 9.1

Discuss the arguments against/ for research with animals.

SAQ 9.2

Discuss the potential for scientific fraud; and monitoring ethical processes.

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Readings

http://www.simplypsychology.org/Ethics.html retrieved July, 2013.

http://www.efpa.be/ethics.htm retrieved July, 2013.

http://www.apa.org/topics/ethics/ retrieved July, 2013.

Feedback to Self Assessment Items

SAQ 1.1

1. Boring best believed historical sophistication should be combined with experience in technical procedure. He believed this would enable the researcher have a proper perspective to evaluate the full significance of new concepts and techniques.
2. Curiosity and wonder are what had motivated study in the natural sciences. Psychology eventually became a field which shared this level of interest with the notion of Cartesian Dualism. It held that the mind and body were separate entities which could nevertheless interact with themselves. This assertion eventually evoked significant interest in the study of psychology.

SAQ 1.2

1. Perhaps the best way to understand what deficiencies there would be in modern psychology is to understand what contributions they made to the study.
    - John Locke: He was the first to propose the epistemological question of the limits of knowledge. More importantly, he set the scholarly precedent of differentiating between inner science and outer science.
    - George Berkeley: He helped delineate the notion of primary and secondary qualities. He was equally responsible for the thory of perception of distance.
    - David Hartley: He was the first to apply the association principle as a fundamental explanation of all experiences and activity. Furthermore, he was able tocouple the workings of the nervous system with psychological theories.
    - Etienne Bonne de Cadillac: He focused more on sensations transmitted through outer senses. His work helped demonstrate that the outer senses could exclusively account for all the ideas and mental operations of man.
    - Thomas Reid: He built on John Locke's notion of inner senses. Through his book, Inquiry, he showed how intuitions are fundamental constitution of the human mind which regulates conscious experience.
    - Immanuel Kant: Without Kant the prerequisite for psychology to be referred to as an empirical science will be non-existent. Additionally, with his book Anthropologie, he analyzed the nature of cognitive powers, feelings of pleasure and displeasures, affects and process.

SAQ 2.1

1. Charles B. Well used anatomical evidence to support the assertion that the ventral roots of the spinal cord contain only motor and the dorsal roots, only sensory fibres. This helped overturn centuries of tradition in which it was implicitly assumed that nerve fibres were indiscriminate with respect to sensory or motor function and established the fundamental distinction between these two types of nervous processes.
2. Thomas Brown's combination of intuitionalism and empiricism helped advance the concept of "muscle sense" which moved towards a more balanced sensory-motor view by including the sensory side of movement perception. Also, he contributed through detailed elaboration of the secondary laws of association.
3. Herbart objected to the possibility of experimental verification. This may be partly because of the critical distinction he made between ideas above and below the threshold of consciousness.
4. Purkyne's "breadth and systemacity" explored the parameters of sensory experience that helped lay the foundation for future laboratory work.
5. 'Just Noticeable Differences' refers to the smallest perceptible difference between two sensations. By this, Weber provided proof of the possibility of establishing quantitative relationship between variations in physical and mental events.

SAQ 2.2

1. The relationship between physiology and experimental psychology is most observable from the fact that the nervous system mediates between the mind and the empirical world.

SAQ 3.1

- ✓ Gustav Theodor Fechner: His work marked the formal beginning of experimental psychology. He performed scientific experiments which laid the foundations of the new psychology and the basis of its methodology.
- ✓ Wilhelm Wundt: Began the study of sense perception. He argued for the need to transcend the limitations of the direct study of consciousness through the use of genetic, comparative, statistical, historical, and experimental methods.
- ✓ Hermann Ludwig Helmholtz: He helped clarify the physiological basis of animal heat, a phenomenon that was sometimes used to help justify vitalism.
- ✓ Franciscus Cornelis Donders: Assessed the time taken to respond to a stimulus under conditions of choice and simple non-choice.

SAQ 3.2

The evolution to experimental psychology began with Gustav Theodor Fechner's scientific rigor in the first experiments which laid the foundations for the new psychology and still lie at the basis of its methodology. He demonstrated the potential for quantitative, experimental exploration of the phenomenology of sensory experience and established psychophysics as one of the core methods of the newly emerging scientific psychology. Wilhelm Wundt's rejection of a metaphysical foundation for psychology helped transcend the limitations of the direct study of consciousness through the use of genetic, comparative, statistical, historical, and, particularly, experimental methods. This design led is in effect the foundation of experimental psychology.

SAQ 4.1

1. An independent variable is a manipulation of the environment controlled by the experimenter.
2. A dependent variable is the response measure of an experiment that is dependent on the subject.

SAQ 4.2

Major advantage of experimental method is that it helps reach meaningful conclusions while ruling out extraneous variables. Also, the process is economical in the sense that the experimenter controls the situation by creating the conditions of interest.

SAQ 4.3

A good rationale for experimentation is that it helps trim down the large number of competing theories. Also, experiments help validate or invalidate existing theories. In addition, they can be replicated.

SAQ 5.1

An independent variable is one which is manipulated by the experimenter. They are selected because they usually cause changes in behaviour. This is the main criterion in selecting one, that is, that they can produce noticeable responses when they are manipulated

SAQ 5.2

A dependent variable is the response measure of an experiment that is dependent on the participants' responses to our manipulation of the environment. The main factor which determines how they are chosen is stability, that is, it must show an exact response for every give change in the independent variable.

SAQ 5.3

A control variable is a potential independent variable that is held constant during an experiment, because it is controlled by the experimenter. Having controls help prevent extraneous variables which may have effect on the dependent variables. The goal is to ensure that whatever noticeable effect is observed is a result of the independent variables.

SAQ 5.4

1. Multiple independent variables are important in experimentation. One, it is often more efficient to conduct one experiment with, say, three independent variables than to conduct three separate experiments. Second, experimental control is often done better, since with a single experiment, some control variable are more likely to be held constant than with three separate experiments. Third, and most important, the result generalized-that is, shown to be valid in several situations-across several independent variables are more valuable than data that are yet to be generalized. Fourth, this allows us to study interactions, the relationships among independent variables.
2. The dependent variable is used as an index of behaviour. It indicates how well or poorly the subject is performing. The advantage, then, of having multiple dependent variables is that it increases the generality of the experiment with respect to application.

SAQ 6.1

The most important decision is how to assign subjects to the various levels of independent variables: either through between-subjects design, within-subjects design or a mixed variety.

SAQ 6.2

- The main advantage of the between-subject design is that it is conservative. There is no chance that they will contaminate each other.
- The within-subject design possesses the merit of being more more effective, since each subject is compared to himself or herself.
- Mixed designs is a compromise of the between-design and within-design models. It is often a safer method.

SAQ 6.3

Controls create a baseline against which variables of interest can be compared.

SAQ 6.4

The major sources are demand characteristics, experimenter effect and automation of experiment.

SAQ 7.1

A Quasi-Experiment is an ex post facto experiment which involves comparing the effects of a naturally-occurring “Independent variable” with the effects that occur when that variable is not present or differs in some way. An example is comparing the reading ability of men with that of women.

SAQ7.2

- The positive implication of quasi-experiments include the fact that it involves the use of naturally-occurring independent variables which have high intrinsic interest and practical implications.

- The negative implications are that it is done at the expense of experimental controls hence there is the inability of drawing exact inferences.

SAQ 7.3

One method of drawing sound inferences in quasi-experiments is through matching. This essentially drawing parallels between study group and another group. For example, while it may be inappropriate to match schizophreniacs with normal people, the matching method would match them up with normal of relatively lower IQs. This method is not bereft of its flaws. First, the matching process can be very difficult to do. Also, there is the problem of regression artefact.

SAQ 8.1

Assuming we want to understand violent acts amongst ethnic minorities then the Problem would perhaps be why ethnic minorities are more prone to violence. This problem serves as a spur for the experiment. Sampling is a technique that involves selecting subjects from a population. In this case, the experiment would involve sampling people from the ethnic groups in question. Hypothesis is an informed prediction. In this case, one hypothesis could be: If a person is from an ethnic minority group he or she is more prone to violent acts. Descriptive statistics is used to summarize and organize raw data using histograms and frequency polygons. Inferential statistics would allow the researcher make inferences about the reliability of differences among conditions.

SAQ 9.1

Arguments that can be made against use of animals in research include the fact that animals feel pain and their lives can be destroyed, as it is true of humans; also, destroying or harming any living thing is dehumanizing to the human scientist; and claims about scientific progress by animal research is a form of racism and, like interracial bigotry, is completely unwarranted and unethical.

Arguments for use of animals in research include the fact that usually ethical standards apply in the treatment of these animals. Finally, it can be argued that animal research potentially benefits animals themselves.

SAQ 9.2

Fraud is deliberate bias in experiments. It could involve deliberate falsification of data or lack of honesty in the treatment of experiments.

Monitoring fraud is done through he inherent elf-correcting feature of science. This means that science is a dynamic discipline and researchers build off each other’s works. Hence, there is chance that a particular experiment will be replicated. If the results can’t be replicated then there is high likelihood there might have been experimental fraud.

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