Topic #4

CONTROL

Central issue is, of course, one of research validity.

Key questions in research:

1. What are the threats to the validity of a contemplated piece of research?

2. What means are available to neutralize these threats?

Control—any means used to rule out possible threats to a piece of research.

➡ important to realize that the concept of control applies to **ALL** research designs and not just experimental research designs

CONTROL (sometimes also referred to as **EXPERIMENTAL CONTROL**)

- The emphasis is on the ability to restrain or guide sources of variability (extraneous variables; threats) in research.

- With experimental control, we are concerned with our ability to rule out possible threats to our study and also the extent to which we can rule out alternative explanations of the research results.

- **Extraneous variable**—variable other than independent; variable that is not the focus of the study but may confound the results if not controlled.

    - **confounding variable**—an extraneous variable whose levels covary with that of the independent variable.

Some common strategies to achieve/enhance control

1. Random assignment to groups
2. Manipulation checks
3. Subject as own control [within-subjects designs]
4. Instrumentation of response
5. Matching
6. Building nuisance variables into the experiment
7. Statistical control

1. **Random Assignment To Groups**

- Rules out plausible alternative interpretations due to chance.
- Controls for **both** known and unknown effects.

2. **Manipulation checks**

- Assess the efficacy of manipulation
- Associated with the IV
- Did the manipulation work as intended?
- Why is it important?
- Techniques of assessment and when.
  - what does one do if the manipulation did not work?

3. **Subject As Own Control [Within-Subject Designs]**

- Within-subjects designs and single-subject designs.
- One of the most powerful control techniques is to have each participant experience every condition of the study.
- Since each individual is unique and varies in several ways that may affect the research outcome, participants as their own control rules out these variations.
- *Potential Problems*:

  (a) practice effects

  (b) irreversibility of treatment effects

  (c) dependability of treatments

  ▪ **order effects—**changes in participants' performance resulting from the position in which a condition appears in the study

  e.g., movie preference; warm-up or practice effects in learning studies

  ▪ **sequence effects**—changes in participants' performance resulting from interactions among conditions themselves.

  - also described as **carry-over effects**

  e.g., taste tests; estimating weights

• *Methods of Control*

□ **Counterbalancing**—a method of control in which the conditions are presented in one order the first time and then another.

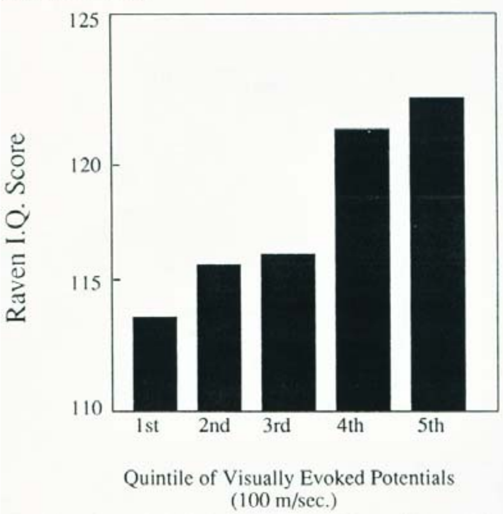
  ▪ reverse—ABC CBA
  ▪ intrasubject
  ▪ intersubject
  ▪ complete
  ▪ incomplete
    ▫ **block randomization** can be considered to be a specific example of incomplete counterbalancing. Block randomization is a control procedure in which the order of conditions is randomized, with each condition being presented once before any condition is repeated (e.g., BCAD ADCB). This procedure controls for both order and sequencing effects.

4. **Instrumentation Of Response—**using a measurement or instrumentation process that is objective, standardized, sensitive, and also generates reliable and valid scores.

   - Ideally, one should be able to take subjective states (e.g., dreaming, anger, general mental ability, lying) and use some objective instrumentation to generate measures or scores (e.g., for dreaming EEG readings versus self-report ratings).

<u>Examples of the use of physiological measures to operationalize general mental ability/intelligence</u>

Figure 2
Mean Raven IQ Score of Five Groups of College Students Showing Progressively More Efficient Nerve Conduction Velocities (From Slow [1] to Fast [5]) in the Visual Tract



Note. From "Conduction Velocity in a Brain Nerve Pathway of Normal Adults Correlates With Intelligence Level" by T. E. Reed and A. R. Jensen, in press, *Intelligence*. Copyright 1992 by Ablex. Adapted by permission.

Table 1
Correlations Between the WAIS Tests and the Variance, Complexity, and Combined Score on the Evoked Potential in the Hendrickson Study

WAIS subtest	Variance	Complexity	Complexity minus variance
Information	−.64	.55	.68
Comprehension	−.50	.53	.59
Arithmetic	−.57	.56	.65
Similarities	−.69	.54	.71
Digit span	−.54	.49	.59
Vocabulary	−.57	.62	.68
Verbal total	−.69	.68	.78
Digit symbol	−.28	.32	.35
Picture completion	−.47	.52	.57
Block design	−.50	.45	.54
Picture arrangement	−.36	.45	.46
Object assembly	−.32	.45	.44
Performance total	−.53	.53	.60
WAIS total	−.72	.72	.83

Note. WAIS = Wechsler Adult Intelligence Scale. From "The Biological Basis of Intelligence" by D. E. Hendrickson, 1982, in H. J. Eysenck (Ed.), *A model for intelligence* (p. 205). New York: Springer-Verlag. Copyright 1982 by Springer-Verlag. Adapted by permission.

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Beyond Brain Mapping: Using Neural Measures to Predict Real-World Outcomes

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Elliot T. Berkman[1] and Emily B. Falk[2]
[1]University of Oregon and [2]University of Michigan

Abstract

One goal of social science in general, and of psychology in particular, is to understand and predict human behavior. Psychologists have traditionally used self-report measures and performance on laboratory tasks to achieve this end. However, these measures are limited in their ability to predict behavior in certain contexts. We argue that current neuroscientific knowledge has reached a point where it can complement other existing psychological measures in predicting behavior and other important outcomes. This *brain-as-predictor* approach integrates traditional neuroimaging methods with measures of behavioral outcomes that extend beyond the immediate experimental session. Previously, most neuroimaging experiments focused on understanding basic psychological processes that could be directly observed in the laboratory. However, recent experiments have demonstrated that brain measures can predict outcomes (e.g., purchasing decisions, clinical outcomes) over longer timescales in ways that go beyond what was previously possible with self-report data alone. This approach can be used to reveal the connections between neural activity in laboratory contexts and longer-term, ecologically valid outcomes. We describe this approach and discuss its potential theoretical implications. We also review recent examples of studies that have used this approach, discuss methodological considerations, and provide specific guidelines for using it in future research.

Keywords

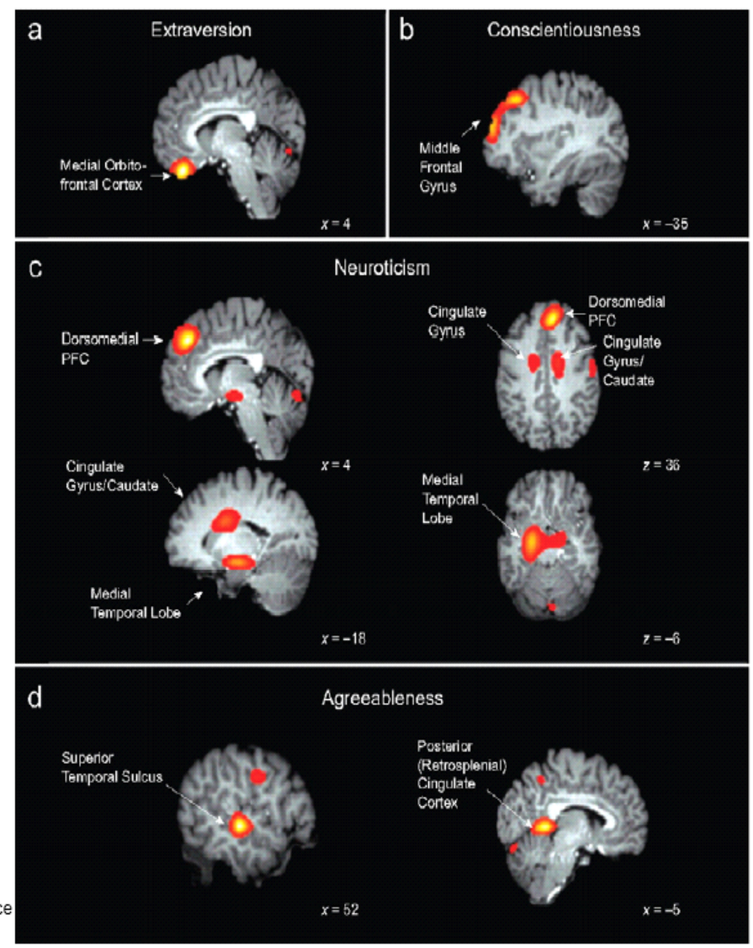
brain-as-predictor, prediction, neuroscience, ecological validity, brain-behavior relationship

Examples of the use of physiological measures to operationalize personality ➡ *f*MRI

Psychological SCIENCE

Fig. 1. Brain regions in which local volume was significantly associated with (a) Extraversion, (b) Conscientiousness, (c) Neuroticism, and (d) Agreeableness, as hypothesized.

DeYoung C G et al. (2010) Psychological Science; 0956797610370159



5. **Matching—**procedure whereby participants are matched on some variables or characteristics of interest.

   - Matching is typically used when it is not possible to use random assignment. So matching is basically a procedure that attempts to obtain equivalent groups in the absence of random assignment.

   - However, if, given the topic domain, it is possible to use random assignment with or after participants have been obtained based on self-selection or natural occurrence, then matching is implemented ***before*** participants are randomly assigned to groups.

   - Have to suspect there is an important variable or characteristic on which participants differ that can be measured and participants matched on.

   - Also have to suspect that there is a relationship between the matched variable and the DV.

     - e.g., a study to assess the effectiveness of an educational intervention program—what are some variables or dimensions we might want to match people on?

   - Matching controls for only **known** effects.

6. **Moderator Variable**—a nuisance variable (another IV) that moderates or influences the relationship between the IV and DV.

   - A control for extraneous variables is to build them into the study as moderator variables by measuring them and analyzing their effects ➡ essentially having another IV.

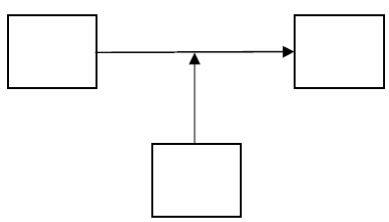
   - A moderator variable is a third variable (in the context of one IV and one DV) that differentially affects the relationship between the IV and DV.

     "*Objective after-action reviews and team performance: The role of task complexity*"

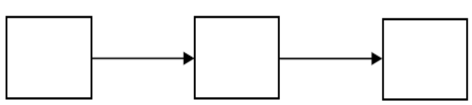
     IV = ?
     MODERATOR = ?
     DV = ?

   - This approach controls for only **known** effects.

– **moderators**



– **mediators**



7. **Statistical Control**

   (a) First determine if the design permits analysis by accepted statistical methods.

   (b) Increase the statistical power of a design (e.g., increase sample size).

   (c) Use the appropriate statistical technique to enhance control (e.g., ANCOVA, partial correlations, hierarchical regressions).

   (d) Increase the number of trials or items—enhances the reliability of the scores obtained from the measure.

➡ **GREATER DEGREES OF CONTROL RESULT IN HIGHER LEVELS OF INTERNAL VALIDITY**

EXPERIMENTER EFFECTS

- The existence of experimenter effects has been extensively documented (Rosenthal, 1976).

- A research study is typically a social situation or interaction amongst people.

- The issue is that the social nature of psychological research studies usually results in the taking of roles which are played by the researcher and research participants. Furthermore, that this interaction between the two can influence the outcome of the study.

- In other words, if the psychological study is a social situation involving interactions among people (researcher and participants), then the social conditions of the study also involve *roles* played by the researcher and participants. Thus, the interactions between these two can influence the outcome of the study.

- Basically, experimenter effects tend to be strongest when the experimenter factor is related to the experimental task that is being performed by participants.

  - For example:

    – If the research focuses on judgments of warmth, then the researcher's mood could influence performance.

    – If the study concerns smoking, then whether the researcher appears to be a smoker or not may be an important variable.

A type of experimenter effect is *experimenter expectancy*

- The researcher is seldom a neutral participant in the research project.
- She/he is likely to have some expectations about the outcome of the study with often strongly vested interests in the meeting of these expectations.
- The issue is one of whether the experimenter will somehow behave in ways that bias the research results in the expected direction.
- The concept of experimenter expectancy is different and separate from intentional bias or fraud.
- With expectancies, the interest is in some less than conscious or unconscious nonverbal way of communicating expectations.

- ISSUE: What are the mechanisms that produce these effects?
  - Some plausible hypotheses that have been evaluated and discarded are:

    (a) obvious efforts to influence participants
    (b) cheating
    (c) systematic errors in recording and analyzing data

  - The suggestion is that nonverbal communications of some sort are responsible. This seems to supported by the fact that expectancy effects have also been observed in animal studies.
    - Clever Hans, the counting horse
    - has been observed with even tapeworms as well
  - Some other forms of experimenter-generated communication to research participants that may also result in experimenter bias may be less subtle and more blatant, although still unintended as illustrated in the participant instructions for a conflict resolution study presented below.

    Can you identify what the expectancy-related issues are?

> Conflict Resolution
>
> Presented below are nine stories involving three different kinds of conflict—between individuals in personal relationships, between individuals in organizations, and between countries. You should read the story about each conflict, and read the seven styles of conflict resolution that follow each story. Your task will be to rate the desirability of each style of conflict resolution from 1 (poor) to 10 (excellent). In other words, how desirable is each of the proposed strategies for resolving the conflict presented in the story? In general, there is no one correct solution for a conflict-resolution situation. It is worth remembering, however, that more intelligent people tend to try to defuse rather than exacerbate the conflicts in which they find themselves. There are many ways to defuse the conflict, only some of which are given below. A key listing of the conflict resolution appears after the problems.

Reducing experimenter bias

1. **More than one researcher** should be included in the design of the study ➡ "two heads are better than one"?

2. **Standardization** of the researcher's behavior in participant-researcher interactions.

   - This can be done by standardizing the instructions and procedures, and in the maintenance of a constant environmental setting.

   - The use of end-of-session checklists that are completed by both the researcher and participants to document their perceptions of the session has also been recommended.

3. **Double-blind procedures**—are those that call for keeping the researcher, as well as the participant, in the dark about the expected outcomes or hypotheses being tested.

   - Double-blind procedures serve to minimize bias due to researcher expectations. Both the participant and researcher are kept in the dark and are unaware of the research hypotheses and conditions.

     In contrast, **single-blind procedures** are those in which (only) the participant is not fully informed of either the nature of the study or the conditions under which she/he is participating. These procedures may sometimes even take the form of **deception**.

     <u>deception</u>
     - conditions under which it can be used?
     - debriefing

     - Single-blind procedures serve to reduce participant expectations but **not** experimenter bias or expectancies.

4. **Automation—**automate the procedures, treatments, and all other aspects of the experiment as much as is feasible.

   - The advantage of automation is uniformity
   - The disadvantage is inflexibility