

Develop a Hypothesis	Design, Plan & Propose - Ideas	
	VERSION	1.0

Develop a Hypothesis

All research projects should be designed to answer a specific question, usually by testing a well-formed hypothesis. Traditional application of the scientific method involves determining whether or not there exists a cause-and-effect relationship between observed phenomena. This is done by disproving the (“null”) hypothesis that there is no cause-and-effect relationship between the observed phenomena. Whatever process is used, it should not only result in a question or hypothesis statement that is both quantifiable and relevant to potential sponsors of the research.

Research questions are the link between the problem at which the project is aimed, the study design, the results, and the conclusions. Because research questions are the backbone of research projects, considerable care needs to be taken in choosing and developing research questions. A particularly important distinction needs to be made between exploratory/descriptive and confirmatory research. Exploratory and descriptive research takes place when a problem is not well known or defined. Such research may lead to new discoveries and insights that provide the basis for explanatory and predictive theories. Confirmatory research takes place when enough is known about the problem to be able to construct plausible theories or models. Then the aim becomes building trust in these theories, which is conventionally done by formulating and testing hypotheses.

To enhance the cumulative value of public health research, researchers need to determine, based on the state of their field, whether their research needs to be exploratory/descriptive (also called: hypothesis-generating) or whether enough existing exploratory work has given rise to theories that may be tested in confirmatory research (also called: hypothesis-testing). Making this determination can be difficult and risky. Subjecting ill-informed, preliminary theories to confirmatory research is due to increase the rate of null results and reduce the rate of scientific progress. Peer-review at this stage of research can be helpful in order to reduce wasteful research effort. Such peer-review may be implemented at the stage of applying for funding research, submitting research protocols for ethical review, or preregistering study hypotheses, design, and methods. Pre-registration of study protocols is now common practice for testing the effects of interventions but is increasingly expected under the principles of Open Science by journals and funders for other research types as well.

A particularly common type of theory in health sciences is that within a given population with a particular health problem (P), a particular intervention (I) relative to a comparison condition (C) increases the chance of beneficial outcomes (O) in particular settings (S). Each of the components of such theories may be a parameter that can be tested as a research hypothesis, the results of which can be summarized and evaluated before accepting or revising such theory (see www.prisma-statement.org for the way in which clearly defining PICOS facilitates cumulative research). However, theories may also come in many other different forms and types, and thus lead to additional types of parameters for research questions.

Plan/Act

- Reduce the research question to one or more individual hypotheses, each of which may be tested.
- State the hypothesis(es) clearly for potential sponsors of the research.

Checklist

- Has the literature on the study problem been surveyed sufficiently to determine whether exploratory or confirmatory research is justified?

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- In the case of exploratory and descriptive research with quantitative research designs:
 - Is the purpose of inferential statistics clearly communicated?
 - Are the conclusions formulated in the form of hypotheses to be tested in future confirmatory research?
- In the case of confirmatory research with quantitative research designs:
 - Are the parameters to be tested clearly identified and based on existing and accepted taxonomies or nomenclature (e.g., PICOS) to facilitate systematic research synthesis?
 - Is the timeline transparent between formulating hypotheses and designing the study and analysis plan, collecting and processing data, testing the hypotheses, and drawing conclusions (e.g., by using preregistration)?
 - Is the derivation from theory to hypotheses logical and sufficiently supported by other evidence to be compelling to you and others?
 - Can the hypothesis be tested with old or new data?
 - If the study can be done with old data, is the goal to test reproducibility or robustness of outcomes from previous tests of the hypothesis?
 - If the study is to be done with new data, is the goal to test replicability or generalizability of outcomes from previous tests of the hypothesis?

LINKS

	Link
Do you really want to test a hypothesis? Video by Daniel Lakens (15 min)	https://youtu.be/gVqFAQC8O14
Why Hypothesis Testers Should Spend Less Time Testing Hypotheses (paper by Scheel ea, 2020)	https://journals.sagepub.com/doi/full/10.1177/1745691620966795
Preregistration. Video by Daniel Lakens (15 min)	https://youtu.be/-fz_kZvWpw
Templates of OSF preregistration forms for exploratory, confirmative, and systematic review studies	https://osf.io/zab38/
PRISMA statement	http://www.prisma-statement.org/

DOCUMENT HISTORY

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DOCUMENT APPROVAL

Role	Name	Date
Project Leader	Dr. Seta Jahfari	30APR2021