Theory-Testing With Cases

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ABSTRACT AND KEYWORDS	
Abstract	Theory-testing with cases is ascertaining whether the empirical evidence in a case or in a sample of cases either supports or does not support the theory. There are two methodologies for theory-testing with cases, (a) testing in a single case ('theory-testing single case study'), and (b) testing in a sample of cases ('theory-testing sample case study'). The functional form of the proposition that is tested determines which of these two methodologies should be used.
Free Keywords	theory-testing; necessary condition; sufficient condition; sample case study; single case study
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Theory-Testing With Cases

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Abstract

Theory-testing with cases is ascertaining whether the empirical evidence in a case or in a sample of cases either supports or does not support the theory. There are two methodologies for theory-testing with cases, (a) testing in a single case ('theory-testing *single case study*'), and (b) testing in a sample of cases ('theory-testing *sample case study*'). The functional form of the proposition that is tested determines which of these two methodologies should be used.

Conceptual Overview and Discussion

There are two types of proposition, (a) about characteristics of single cases, and (b) about differences between cases.

Propositions About Characteristics of Single Cases

Examples of propositions about chartacteristics of single cases are *necessary condition* propositions and *sufficient condition* propositions. The presence (or absence) of such a condition can be observed in a single case. Process theory statements are a subtype of necessary condition statements that state that specific sequences of events are necessary for an outcome to occur: "The process outcome is present *only* if the sequence of events X1-X2-X3-etc is present". The *single* case study is the appropriate strategy for the testing this type of proposition.

Propositions About Differences Between Cases

An example of a proposition about differences between cases is a proposition that expresses a linear relationship between an independent and a dependent variable. Such a relationship can only be observed in a population of cases, not in a single case. The *sample* case study is a strategy for testing this type of proposition.

Applications

First the theory-testing single case study is discussed, and then the theory-testing sample case study.

Theory-Testing Single Case Study

Many theories have the form "X results in Y" or "X contributes to Y" or "X affects Y", etc., in which X is, for example, something that an actor can or cannot do (or a situation or occasion or event that can occur or not occur) and Y is the desired outcome of that action. There are two fundamentally different ways of interpreting such a theoretical statement. Usually it is meant as a statement that explains differences between cases in the value of one (dependent) variable Y by relating them to differences in the values of another (independent) variable X: "If there is more X, then there is more Y". Often, however, such a statement is meant to identify X as an important ('critical' or 'crucial') condition that should be present in order to make outcome Y possible. The intended meaning is that Y is very unlikely to occur if X is absent or, in other words, that Y normally is not possible without the presence of X. This is a *necessary condition* hypothesis ("Y only if X"). If necessary condition is present, this does not *guarantee* that the outcome will occur (which would imply that the condition is 'sufficient') but only that the outcome has become *possible*. The concept of a necessary condition must not be confused with a sufficient condition.

The necessary-condition proposition is an important type of theoretical statement. Necessary conditions and their outcomes can have different forms, but often they are *discrete dichotomous* (or dichotomized) variables (i.e., discrete categorical variables with only two possible values, such as Present / Absent). The condition is a state, an event, or (in process theories) a sequence of events, that must be present in order to make the presence of the outcome possible. The implications of a necessary condition can be visualized as a cross-table as in Figure 1a, in which each dot represents a number of cases. The necessary condition is defined by the absence of cases in the cell "X absent/Y present".

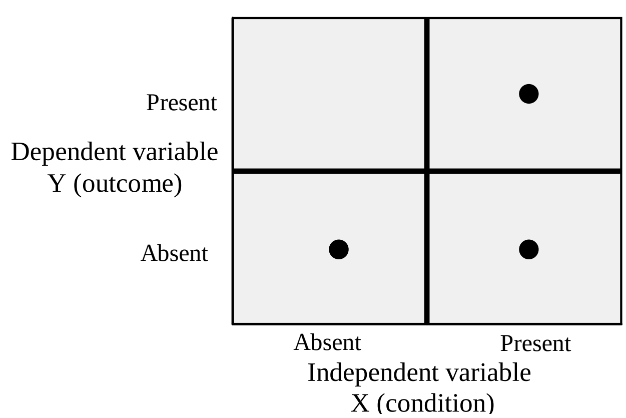

Figure 1a

Theoretical pattern of distribution of cases indicating a necessary condition.

Each dot represents a number of cases

Source: Dul & Hak (2008: 69)

Similarly, the implications of a sufficient condition (i.e., the statement that the outcome will be present if the condition is present) are visualized in Figure 1b. The sufficient condition is defined by the absence of cases in the cell "X present/Y absent".

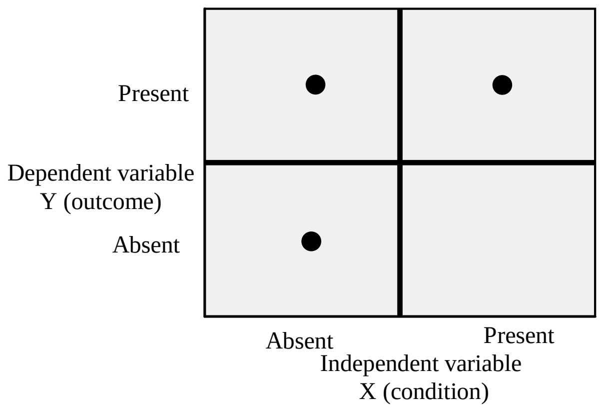

Figure 1b

Theoretical pattern of distribution of cases indicating a sufficient condition.

Each dot represents a number of cases

Source: Dul & Hak (2008: 68)

The methodology of the theory-testing single case study is quite simple and entails seven steps, which are very similar to the methodology of any other type of theory-testing study, be it a survey, an experiment or another type of research strategy. These steps are discussed here, using the example of the test of a necessary condition proposition.

Step 1. Formulate the theoretical statement that will be tested. The theoretical statement that is tested in a theory-testing single case study is a proposition about characteristics of single cases. A necessary condition statement is an example of such a proposition. The proposition "X is necessary for Y" is used here as an example.

Step 2. Select an appropriate case. One case of the theoretical domain is selected for the test. Criteria for case selection differ between the independent variable design and the dependent variable design (see the entry on Pattern matching). In the independent variable design, a case is selected in which Y is present (and an expected pattern is formulated about the value of the independent variable X). In the dependent variable design, a case is selected in which X is absent (and an expected pattern is formulated about the dependent variable Y).

Step 3. Specify the hypothesis for that case. The proposition must be translated into a hypothesis which can be formulated as an expected pattern. In the case in which the outcome Y is present, the expected pattern is "X is present". In the case in which the condition X is absent, the expected pattern is "Y is absent".

Step 4. Measure the relevant variables. Criteria for valid and reliable measurement are the same for any type of research strategy, be it a survey, an experiment, a case study, or another theory-testing research strategy. In the present example, measurement entails ascertaining whether X is present or absent, or ascertaining whether Y is present or absent. The result of this measurement is the "observed pattern".

Step 5. Test the hypothesis. Testing consists of comparing the observed pattern with the expected pattern. In the present example testing consists of determining whether X is present (in the independent variable design) or whether Y is absent (in the dependent variable design).

Step 6. Formulate the test result. The test result is either a *disconfirmation* of the hypothesis or a *confirmation*. In the present example, the hypothesis is disconfirmed if X is absent (in the independent variable design) or if Y is present (in the dependent variable design).

Step 7. Formulate the implications of the test result for the theory. Conclusions about the robustness of a theoretical statement cannot be drawn on the basis of just one test, but only after a series of tests. Hence, discussing the implications of a test result always implies comparing the result with those of earlier tests in a series of replications (see the entry on Replication).

The procedure for testing a sufficient condition proposition follows the same logic. The differences are that other cases must be selected for the test and that, hence, other expected patterns are formulated. In the independent variable design, a case is selected in which Y is absent and the expected pattern is that X is absent as well. In the dependent variable design, a case is selected in which X is present and the expected pattern is that X is present as well.

A proposition about a necessary or sufficient condition should ideally be tested in an experiment. For instance, a sufficient condition proposition ("X will always result in Y") should preferably be tested by an experiment in which (a) a case without X and Y is selected; (b) X is experimentally introduced; and (c) it is observed whether Y occurs. A necessary condition proposition should preferably be tested by an experiment in which (a) a case with X and Y is selected; (b) X is removed; and (c) it is observed whether Y disappears. The occurrence of a predicted change in Y after a change in X (the 'treatment') can be interpreted as a confirmation of the hypothesis, and its non-occurrence as a disconfirmation. However, most such propositions concern important aspects of companies, countries, projects, teams, individual persons, or other units of analysis in which it is not possible or too expensive to remove a condition just for research purposes. When such an experiment is not feasible, the researcher might search for 'natural experiments', i.e., cases in which the condition was removed for other reasons than for research. If an experiment is not feasible and relevant 'natural experiments' are not available, the theory-testing single case study is the only remaining research strategy for testing. It is, therefore, the preferred research strategy by default.

Theory-Testing Sample Case Study

The methodology of the theory-testing sample case study is derived from how theoretical statements about differences between cases are tested in the sample survey, i.e. in a study in which information is collected about a sample of cases from a population (usually by means of a standardized questionnaire) in order to draw conclusions about the population from which the sample was drawn. This entails the same seven steps as in the methodology of the theory-testing single case study. These steps are discussed, using the example of the test of a linear relationship.

Step 1. Formulate the theoretical statement that will be tested. The theoretical statement that is tested in a theory-testing sample case study is a proposition about differences between cases from the theoretical domain. A proposition that expresses a linear relationship, such as "If there is x% more X, then there is y% more Y", is taken here as an example.

Step 2. Select an appropriate sample. As with a test in a sample survey, one population of cases from the theoretical domain must be selected for the test and a random sample is selected from that population.

Step 3. Specify the hypothesis for that sample. The proposition "If there is x% more X, then there is y% more Y" must be translated into an expected pattern. This translation (or specification) can have different forms, of which an expectation about the value of the regression slope b_s in the sample probably is the most useful particularly if, in a replication study, a confidence interval of b is available from previous studies (Smithson, 2000). The expected pattern in such a case can be notated as "$b-w < b_s < b+w$" in which b_s is the regression slope in the sample, *b* is the regression slope in previous studies and *w* is the half-width of the confidence interval of *b*.

Step 4. Measure the relevant variables. The scores of X and Y need to be measured validly and reliably in each case. This is not specific for this specific theory-testing strategy and, thus, the same procedures can be applied as in any other research strategy.

Step 5. Test the hypothesis. Pattern matching in the theory-testing sample case study consists of comparing an expected pattern (as specified in the hypothesis) with the observed pattern. When testing the hypothesis specified as an example in Step 3 above, it is determined whether the regression slope in the sample is in the specified range. Note that no attempt is made to confirm or disconfirm a null hypothesis (Smithson, 2005).

Step 6. Formulate the test result. A test result of a theory-testing sample case study is either a *confirmation* or a *disconfirmation* of the hypothesis.

Step 7. Formulate the implications of the test result for the theory. As with the theory-testing single case study, the implications of the test result for the theory depend on the number of preceding tests as well as of the characteristics of the populations in which these other tests were conducted. Only after sufficient replications the research community might be able to draw a conclusion about the robustness of the theory.

A proposition about a causal (linear or, for that matter, curvilinear or other) relationship between variables should ideally be tested in an experiment in which (a) cases are selected from a population; (b) these cases are randomly assigned to two or more experimental groups; (c) the value of X is manipulated in such a way that it differs between the experimental groups; and (d) it is observed whether the value of Y differs between groups in the expected way. If the experiment is conducted properly, the occurrence of expected differences in Y between groups can be interpreted as a confirmation of the hypothesis. Such experiments are feasible only for a relatively small number of theories in which the value of X can be manipulated.

If an experiment is not feasible and if also a quasi-experiment is not possible, a choice must be made between the theory-testing sample survey and the theory-testing sample case study. The theory-testing sample case study is often a good alternative to a survey that requires the use of questionnaires for data collection in a large sample. Such surveys are plagued by two persistent problems, non-response bias and measurement error. Both problems are reinforced, if not caused, by the distance between the surveyor on the one hand, and the informant or respondent on the other hand, resulting from standardization and the large number of cases involved. The theory-testing sample case study does not completely solve these problems but allows for recruitment and data collection strategies that result in higher response rates and better data quality. In a sample of say 15 cases, for instance, it becomes possible for an investigator to personally visit all sites or informants to recruit them for the study and to collect data in a way in which its validity and accuracy can be checked. On the other hand, sampling error will be much larger in a sample case study and, therefore, the choice between a sample case study and a sample survey is the outcome of a trade-off between the possible extent of sampling error on the one hand and of reductions in selection bias and data error on the other hand. In making this trade-off, it should be considered that potential sampling error can be reduced substantially by selecting a (very) small population for the test, and that the outcomes of a series of replication studies in different small populations from the theoretical domain are much more informative about the robustness of a theory than the outcomes of a smaller number of large studies.

Critical Summary

There are two types of proposition, (a) about characteristics of single cases, and (b) about differences between cases. The *single* case study is the appropriate strategy for the testing of the former type of proposition, whereas the *sample* case study is a strategy for testing the other type. The methodology of both types of theory-testing case study can be described in seven steps, which are very similar to the methodology of any other type of theory-testing study, be it a survey, an experiment or another type of research strategy. As with any theory-testing study, the implications of the test result for the theory depend on the outcomes of preceding tests. Only after sufficient replications the research community might be able to draw a conclusion about the robustness of the theory (see the entry on Replication).

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