The most rudimentary research questions in social psychology concern the direct and unqualified association between two constructs. Classic examples are, Does behavior reflect attitudes? and Does similarity breed attraction? Although such questions represent a fundamental, perhaps essential, starting point for research on social behavior, they are but a starting point for constructing a detailed and informative account of it. In a theory-oriented discipline such as social psychology, we want to know how attitudes give rise to behavior and why similarity engenders attraction. Moreover, we want to know the situations in which, or the people for whom, these associations are strongest and weakest—that is, the conditions that qualify the association.

Questions of “how” and “why” concern mediators. Mediators are variables that represent constructs proposed to explain the association between two variables. In social psychology, mediators, sometimes termed intervening variables or mechanisms, usually reflect cognitive, affective, or motivational processes by which an independent variable influences a dependent variable. For instance, attitudes might influence behavior through an elaborate cognitive process that involves selective attention and biased processing of behavioral cues in the immediate environment (i.e., selective attention and biased processing mediate the attitude-behavior relation). Mediators enrich theoretical accounts of social phenomena by virtue of their focus on process.

Questions that address the conditions that qualify an association concern moderators. Moderators are variables that represent constructs proposed to magnify, attenuate, cancel, or reverse the association between two vari-
ables. Statistical moderation can take many forms, but the defining feature of a moderated effect is that the association between the independent variable and the dependent variable differs in strength or form at different levels of the moderator. For example, attitudinal similarity might be more predictive of attraction for women than for men (i.e., gender moderates the similarity-attraction effect). Moderators define the limits of theoretical accounts of social phenomena through their focus on qualifying conditions.

The basic logic of research on mediated and moderated effects is straightforward, although there are complications and potential pitfalls to the implementation of either. In the simplest studies of mediation or moderation, a third variable is introduced into a research design that previously focused exclusively on the effect of an independent variable on a dependent variable. In the case of mediation, the third variable usually is reflective of a process (e.g., emotion regulation, deliberation) and believed to be associated with both the independent and dependent variables. In the case of moderation, the third variable usually captures some relatively fixed characteristic of the individuals or groups being studied (e.g., gender, group size), feature of the immediate situation (e.g., number of people present, presence or absence of a mirror), or secondary quality of the independent variable (e.g., attitude importance, domain of ego threat) and need not be associated with either the independent or dependent variable in order to moderate their association.

At the conceptual level, the evaluation of a mediated effect involves partitioning the effect of an independent variable on a dependent variable into two portions, the direct effect and the indirect effect. This evaluation assumes a documented or demonstrable effect of the independent variable on the dependent variable, and the question is whether any portion of this effect can be attributed to a particular intervening variable. The direct effect is that portion of the effect that is not transmitted through the intervening variable. In the three-variable case, the remaining portion of the effect is transmitted through intervening variable as an indirect effect. Although the inferential outcome of a test mediation often is cast in either-or terms, need not be the case. It is possible that particular mediator accounts for none of documented direct effect, all of the effect, some, but not all, of the direct effect. Because any particular intervening variable likely represents only one of several mechanisms which an independent variable influences dependent variable, the latter inferential outcome, partial mediation, is a more likely outcome than full mediation, if an inferential favoring mediation is warranted.

The evaluation of a moderated effect, conceptual terms, involves an evaluation of effect (direct or indirect) of an independent variable on a dependent variable at different levels of a moderator variable. In contrast evaluations of mediated effects, there is assumption of a previously documented or demonstrable association between the independent and dependent variables. Indeed, one of the more appealing features of research that includes possible moderator variables is the prospect of finding an effect (albeit a qualified effect) of the independent variable on dependent variable when no main effect (i.e., unqualified association) can be inferred. Traditionally in social psychology, moderate effects have been referred to as interacting effects and evaluated as a matter of course in research involving factorial designs, for which data typically are analyzed using analysis of variance. Increasingly, however, social psychological studies include at least one independent variable or moderator variable that is measured along a continuum rather than manipulated. The inclusion of such variables is a departure from a pure factorial design, and the resultant data are best analyzed using techniques that do not evaluate interaction effects as a matter of course (e.g., multiple regression). In such cases, researchers must manually
construct interaction terms and evaluate them in strategically specified predictive equations. Inferences regarding moderation are complicated by the fact that there are many patterns by which the effect of an independent variable on a dependent variable can vary across levels of a moderator variable. These range from the crossover pattern, in which the independent variable has opposite effects on the dependent variable at the two levels or extremes of the moderator variable, to interactions in which the effect is discernibly stronger or weaker but does not change direction when moving from one extreme to the other along the scale of the moderator variable.

In the remainder of this chapter, we describe and illustrate, using a detailed example, basic strategies for designing studies of mediated and moderated effects in social psychology. These strategies address the three primary concerns of social psychological research: measurement, design, and analysis. In the measurement section, we outline a general approach to measurement that provides a strong foundation for testing hypotheses that involve mediation or moderation. With regard to design, we discuss strategies for gathering data that allow for inferences essential to definitive tests of mediation and moderation. Finally, we outline statistical approaches to testing for mediated and moderated effects. We conclude the chapter with a section on the various stumbling blocks to a full implementation of the strategies we present.

MEASUREMENT ISSUES

One approach to empirical research in social psychology is to develop a list of variables relevant to a phenomenon of interest, find a single self-report measure of each, and, on one occasion, administer the set to as many participants as possible from the population of interest. There are numerous drawbacks to this opportunistic approach to empirical research. All variables are measured at the same time, at one point in time, and the same strategy is used to measure all variables, yielding a single score for each one. Although the opportunistic approach would appear to be maximally flexible, affording the researcher considerable latitude in how to analyze the data once they are gathered, the approach is severely limited because, with rare exceptions, the status any variable is assigned in a statistical hypothesis test is arbitrary.

Persuasive tests of mediated and moderated effects are possible only in studies that conceptualize and measure constructs with reference to their predetermined status in a theoretical account of the phenomenon or process of interest, a reasoned approach to empirical research. In such theoretical accounts, hypothetical constructs can be classified uniquely as causes, effects, mediators, or moderators, and the variables that represent them in empirical research can, in turn, be classified uniquely as independent, dependent, intervening, and moderator variables, respectively. Access to a rich and detailed theoretical account is essential to the development and testing of hypotheses regarding social behavior, particularly hypotheses that posit mediated and moderated effects.

Practical Benefits of Theory

Because of Lewin's (1951) early influence, social psychologists have long been committed to building theoretical accounts of the phenomena and processes they study. The most complete, and therefore useful, accounts clearly specify the status of the constructs they comprise. The fundamental distinction is between cause and effect and their empirical counterparts, the independent and dependent variables. At the core of this distinction is the concept of causality (Mark & Reichardt, Chapter 12, this volume; West, Biesanz, & Kwok, Chapter 13, this volume). The fundamental criteria for establishing causality are that (a) the cause and effect are associated (i.e., causation implies correlation), (b) the cause
precedes the effect in time, and (c) the cause-effect association persists after the cause has been isolated from potential confounding variables either through randomized experimentation or through statistical control. (See Pearl, 2000, for a detailed treatment that addresses both statistical and philosophical concerns and Salmon, 1997, for a purely philosophical treatment.) The first criterion is met through empirical means, although attempts to establish an association through empirical means might initially be motivated by a theoretical account that prescribes the association.

The temporal relation between constructs is difficult to establish; however, a well-articulated theory makes use of logic and published findings to assert the temporal precedence of some constructs over others. Finally, firm causal inferences from a documented association between two constructs requires that the association remain after the putative cause has been isolated from other constructs. These potential alternative causes range from features of the typical operational definition of the putative cause (e.g., self-report bias, experimental artifacts) to constructs that are similar to or frequently co-occur with it. Thorough theoretical accounts prescribe processes that are specific to the posited causal constructs.

Satisfaction of these criteria establishes an important asymmetry in the association between two constructs such that, with a reasonable degree of certainty, one can be designated the cause and the other the effect.

In addition to causes and effects, detailed theoretical accounts specify mediators and moderators. Among the constructs elaborated in theories, mediators typically are the most abstract, as they often are mentalistic or otherwise phenomenological in nature (Kimble, 1989). Mediators occupy a position of both cause and effect in models that include mediated effects. In a three-variable model, the intervening variable is a proximal effect of the independent variable (or its interaction with a moderator) and a proximal cause of the dependent variable. Moderators typically are less abstract, often referring to fixed quality of individuals or groups or salient features of situations. Although moderators may be specified in the initial statement of a theoretical account, they also may be added to the account on the basis of empirical findings that emerge from tests of the theory's basic tenets using different methods and samples. For this reason, moderators often signal an evolving theoretical account that has increased in specificity in order to more precisely account for manifestations of the phenomenon.

**Formally Designating the Status of Variables in a Model**

An effective way of communicating statistical hypotheses regarding the status of and associations among a set of variables is the path diagram. A *path diagram* represents variables either as boxes or ellipses, and associations between variables as either straight, single-headed arrows or curved, double-headed arrows. Boxes indicate variables for which there are scores in the data matrix (e.g., scale scores, observer ratings); ellipses indicate latent variables, which are inferred from the commonality among subsets of observed variables but for which there are not scores in the data matrix (e.g., factors, components). Straight lines indicate directional associations (i.e., regression terms), and curved lines indicate nondirectional associations (i.e., correlation terms). Although path diagrams are a staple of structural equation modeling, when used for communicating the status of and associations among a set of variables, they neither convey nor imply a particular analysis strategy. In the section of this chapter on analysis issues, we outline multiple statistical approaches to evaluating the associations depicted in the path diagrams we present.

Figure 10.1 is a path diagram representation of a model that includes the four types of variables we have described, nonarbitrarily...
arranged on the basis of reasoned conceptualization and measurement. At the core of the model is the basic association between an independent and a dependent variable. The independent variable is represented at the left of the diagram as a box, indicating that it is in the data set as a single (perhaps composite) score. The dependent variable is represented at the right of the diagram as an ellipse, indicating that it is not explicitly represented in the data set. The dependent variable in this case is a latent variable inferred from the commonality among three variables for which there are scores in the data set, Y1, Y2, and Y3. Notice that two arrows point to each of these variables. This indicates that variability in Y1, Y2, and Y3 has been partitioned into two sources—that portion each shares with the other two (i.e., the latent variable) and that portion unique to each one, designated u1, u2, and u3, respectively. The strength of the association between Y1, Y2, and Y3 and the latent variable they represent is captured in the factor loadings, /1, /2, and /3. In this hypothetical model, only the dependent variable was operationally defined in multiple ways and modeled as a latent variable; however, as we demonstrate later in the chapter, the strongest model is one in which all variables are assessed using multiple operations. The association between the independent and dependent variables is expressed in c1, a regression coefficient. Variability in the dependent variable not explained by other variables in the model is captured by the residual, e2.

At the center of the path diagram in Figure 10.1 is a single box representing an observed intervening variable. Note that the inclusion of this intervening variable provides an alternative means by which the independent variable can influence the dependent variable. The combination of paths a1 and b1 represents the indirect effect of the independent variable on the dependent variable through the intervening variable. This indirect effect can be contrasted with the direct effect of the independent variable on the dependent variable via path c1.

A model that includes only the independent, dependent, and intervening variables connected by paths a1, b1, and c1 makes a "main effect" assumption regarding the independent-dependent variable association and its
explanation by the intervening variable. In all likelihood, the magnitude of the $c_1$ path would vary across populations and situations. Indeed, it is possible that the linear effect of the independent variable on the dependent variable is apparent only for certain people or under certain conditions. Moderator variables capture such qualifying conditions, and one position a moderator variable might occupy in a model is illustrated by the remaining two variables in Figure 10.1. Note that statistical tests of moderator hypotheses require, in addition to the independent variable, two variables, one for which data were gathered directly, labeled “Moderator Variable” in the diagram, and one either implicit in the statistical analysis (e.g., interaction effects in analysis of variance) or created by the investigator, labeled “IV x MV” in the diagram. Although it is the latter that represents the moderated effect of the independent variable, the former must be included for statistical reasons (Cohen, Cohen, West, & Aiken, 2003; Evans, 1991). The moderated effect of the independent variable on the dependent variable, $c_3$, or indirectly via $a_3$ and $b_1$, is the effect of the interaction term, $IV \times MV$, above and beyond the main effects of the independent variable ($c_1, a_1 \rightarrow b_1$) and moderator variable ($c_2, a_2 \rightarrow b_1$) on the dependent variable. In this model, the unqualified and qualified effects of the independent variable on the dependent variable are expressed both as direct effects and indirect effects through the intervening variable.

The only details in Figure 10.1 we have not covered are the curved arrows that connect the independent and moderator variables and their interaction term. These represent possible covariation between each pair of variables, and the coefficients $r_1$, $r_2$, and $r_3$, index that covariation. Although the magnitude of these coefficients is not always evident to researchers testing moderated effects (e.g., when multiple regression analysis is used), knowledge of this information is important. Of particular concern are coefficients $r_2$ and $r_3$, which can be sufficiently large that statistical tests of the moderated effect are compromised (more will be said about this in the section of this chapter devoted to analysis issues). This collinearity problem is remedied rather simply by rescaling scores on the independent and moderator variables as deviations from their mean score, a strategy known as centering. An additional virtue of centering is that it facilitates interpretation of effects by establishing a zero point for variables in the model (Aiken & West, 1991). Both the $r_1$ coefficient and the $c_2$ path have significant implications for statistical tests of moderated effects as well, but we defer our discussion of these implications until the section of the chapter on analysis issues.

To summarize, the path diagram is a useful tool for communicating the status of variables in a data set and the form of the associations among those variables. Path diagrams distinguish between observed and latent variables and between directional and nondirectional associations. Our labeling allows for important distinctions between types of directional associations. Path coefficients we label “$a$” concern the association between independent and intervening variables. Those we label “$b$” concern the association between intervening and dependent variables. Coefficients we label “$c$” concern the association between independent and dependent variables. Path diagrams also distinguish between errors of measurement, which we label “$u$” (for “uniqueness”), and errors of prediction, which we label “$e$.” These are the basic building blocks for describing and implementing tests of mediated and moderated effects and provide a foundation for identifying and discussing relevant measurement, design, and analysis issues in the remainder of the chapter.

An Example

In one theoretical account of the association between attitudes and behavior, the association between an attitude toward an
Mediation and Moderation

object and behavior toward the object is moderated by two factors: attitude accessibility and motivation to deliberate about the object (Fazio, 1990). When attitude accessibility is high and motivation to deliberate is low, the association between attitude and behavior should be strong. Conversely, when the attitude is relatively inaccessible and the motivation to deliberate about the object is relatively high, the association between attitude and behavior toward an object should be weak. In other words, the influence of attitudes on behavior is qualified by accessibility of the relevant attitude and motivation to deliberate about the object of the attitude.

Research inspired by this model has focused on the mechanism by which highly accessible attitudes influence behavior. One such mechanism is the orientation of visual attention toward the object. That is, when an attitude is accessed, it functions to orient visual attention toward the object (Roskos-Ewoldsen & Fazio, 1992). Attention directed toward the object gives rise to perceptions of the object, which are proximal determinants of behavior toward the object (Fazio & Williams, 1986). This attitude-to-behavior process model is shown as a path diagram in Figure 10.2.

In the path diagram, Attitude toward Object, as specified in the theoretical account, is an independent variable. Attitude Accessibility and Motivation to Deliberate are moderator variables, and their moderation of Attitude toward Object is expressed in the Attitude × Accessibility and Attitude × Motivation interaction terms. Orientation toward Object and Perceptions of Object are intervening variables that mediate the unqualified (i.e., direct) effect of attitude on behavior as well as the effect of attitude on behavior as qualified (i.e., moderated) by attitude accessibility. Behavior toward Object is, in this theoretical account, a dependent variable.

Optimal Measurement

Researchers are tempted to take at face value the empirical associations between variables in a model such as the one depicted in Figure 10.2; however, these associations reflect...
more than just the strength and direction of associations in the context of the model. They also reflect the quality of the operational definitions—their reliability and validity as observable manifestations of the constructs prescribed by the theoretical account guiding the research. Although the reliability and validity of operational definitions is important in any social psychological study, the importance of these concerns is magnified in studies of mediated and moderated effects. As we illustrate in the section on analysis issues, fallible measures of intervening variables can lead to an inference of no mediation when the intervening variable partially or fully mediates the independent-dependent variable association, or only partial mediation when, in fact, the intervening variable fully accounts for the association. The fallibility of moderator variables is particularly worrisome because it compounds error in the operational definition of the independent variable. For these reasons, reliable and valid measures are essential in research on mediated and moderated effects.

Any variable could be measured in a variety of ways. Specific strategies range from the ubiquitous self-report method to emerging strategies such as physiological monitoring (Cacioppo, Tassinary, & Berntson, 2000) and implicit associations (e.g., Greenwald & Farnham, 2000). For instance, in the attitude-to-behavior process model, attitude accessibility typically is measured as the latency in responding to attitudinal statements or in pressing a computer key indicating like or dislike when presented an image or descriptor of the attitude object (e.g., Fazio, Powell, & Williams, 1989; Roskos-Ewoldsen & Fazio, 1992). Although attitude accessibility is virtually always indexed as response latencies, the stimulus to which research participants respond and the medium by which the stimulus is presented vary from one study to the next.

The goal of this measurement strategy is to capture variability in the theoretical construct, attitude accessibility. It is well known, however, that any measurement strategy captures other sources of variability as well. These sources can range from nuisance constructs such as fleeting distractions or facility with language to problematic confounding constructs such as socioeconomic status or concern for appropriateness. Variability that is common to variables that were measured in the same way but represent different constructs is referred to as method variance. First highlighted by Campbell and Fiske (1959) in their demonstration of the insights provided by a matrix of correlations among several traits each measured using several methods (i.e., multitrait-multimethod matrix), method variance reflects not what a score represents but how it was obtained.

The critical concern when key constructs are measured using a single method is that the substantive and methodological sources that give rise to variability in scores generated by the measure are completely confounded. In such cases, extraneous method constructs are an alternative explanation for any observed associations. The method explanation is particularly compelling when all variables in a model are measured using the same method. The solution to this problem is rather straightforward: Either within each study or across studies within a research program, operationally define key constructs using different strategies. When constructs are operationally defined using multiple, different measurement strategies, it is possible to divorce construct-relevant from construct-irrelevant variance, thereby clarifying inferences from observed associations between variables.

As an example, assume that we measured attitude toward an object with multiple measures reflecting different measurement strategies. More specifically, imagine that we acquired data on five measures of attitude: peer report (Y1), teacher report (Y2), self-report feeling thermometer (Y3), self-report semantic differential (Y4), and self-report
Likert-type scale (Y5). We might model the theoretical construct represented by these measures, attitude toward object, as shown in Figure 10.3. The path diagram in Figure 10.3 reflects a measurement model. That is, the focus is within rather than between constructs. The model indicates that variability in each of our measures can be attributed to three sources: construct, method, and uniqueness. First, look above the boxes representing our five measures. Note that a single latent variable, Attitude toward Object, influences all five variables; the strength of this influence would be captured in the factor loadings, $l_1$ to $l_5$. Now look below the five boxes. Note that each variable is influenced by its own uniqueness term. In many measurement models, these two components, commonality and uniqueness, would be all that is required to model the theoretical construct as represented by these measures. For illustrative purposes, the model depicts two additional features of measurement models. First, note that $u_1$ and $u_2$ are correlated. Recall that $Y_1$ and $Y_2$ are peer and teacher reports, respectively. The correlation, $r_1$, reflects the fact that these two measures share something in common that they do not share with the remaining measures; both represent a third-party perspective regarding the participant's attitude. (Because only two variables are involved, we model this commonality as a simple correlation rather than as a factor.) $Y_3$, $Y_4$, and $Y_5$ are affected by a second latent variable (technically, a subfactor), which reflects the fact that they share a common influence beyond the influence they share with $Y_1$ and $Y_2$. Factor loadings $l_6$ to $l_8$ reflect the influence of this method factor on these variables and, when contrasted with $l_3$ to $l_5$, provide information about the relative influence of construct and method on those measures.

Were this measurement model substituted for the Attitude toward Object box in Figure 10.2, associations involving the attitude construct would not be biased by measurement error in the variables representing that construct because variability unique to individual measures or subsets of the measures (i.e., parcels) would be divorced from...
variability common to all the measures. This is a powerful strategy for contending with measurement error that is particularly advantageous for tests of association involving mediators and moderators, for which the ill effects of measurement error are pronounced.

DESIGN ISSUES

Although our focus now shifts to issues of design in studies of mediated and moderated effects, measurement remains a primary concern, for even if all constructs that are not manipulated are measured using several different strategies and measurement error extracted, the correct inference regarding the associations in a model is not always clear. The efficacy of a set of measures for testing mediated and moderated effects can vary dramatically depending on when the measures were administered relative to each other. The issue of timing is relevant for two key issues in such tests of reasoned models: causal priority and tests of mediated effects.

Before elaborating on these issues, we note three basic strategies for administering a set of measures relevant to questions involving mediation or moderation in quasi- and non-experimental designs. The most rudimentary is sometimes referred to as the one-shot strategy and epitomizes the opportunistic approach to empirical research. In this strategy, all measures are administered at one sitting. A more sophisticated approach is the sequential strategy. In this strategy, the variables are assigned different statuses by the investigator, and the timing of measurement for each variable corresponds to its status in some model. For instance, if an investigator wants to test the hypothesis that attitude toward an object causes behavior toward the object and this causal influence is mediated by orientation toward the object, he or she might measure attitude at one point in time, orientation at a later point in time, and behavior at a later point still. A third approach is the replica strategy, in which all variables in the model measured at two or more points in time.

Asserting Causal Priority

Most theoretical accounts go beyond simply stating that two constructs are associated to posit that one causes the other. 1 of such propositions make serious demands on the design of the study. The opportunistic approach described at the beginning of chapter is not adequate for tests of causal priority because, in the absence of explicit temporal ordering, the status of most variables generated by this one-shot strategy in a statistical model is arbitrary.

The sequential strategy offers some improvement in this regard; however, it is limited in an important way: Unless the putative cause is manipulated and participants randomly assigned to levels of it, there is no means of differentiating directional from nondirectional associations between variables. This situation is illustrated in Fig. 10.4. The simple path diagram in the top portion of the figure represents a sequential model in which attitude toward an object was measured at Time 1 and the behavior toward the object at Time 2. The ambiguity in the meaning of a significant path, c, stems from the fact that attitude at Time 1 is not isolated from stable behavioral tendencies toward the object, and behavior at Time 2 is not isolated from stability in attitude toward the object. As such, it is not clear whether c is a true representation of the association between attitude and behavior, or whether it, to some unknown degree, reflects the stable association between attitude and behavior.

Moreover, despite the fact that the sequential measurement strategy has introduced a temporal distinction between attitude and behavior toward the object, it is not possible to infer directionality. There is no statistical procedure for sorting out the various explanations...
for an association, and the ambiguity persists even in the context of more complex models such as the one shown in Figure 10.2.

One solution to this inferential conundrum is illustrated in the path diagram in the bottom portion of Figure 10.4. Note that attitude and behavior toward the object are measured at both points in time, reflecting the replicative strategy. By including behavior at Time 1, it is possible to model the stability of behavior toward the object, reflected in $c_2$, yielding a model in which the association of interest between attitude at Time 1 and behavior at Time 2, $c_3$, is based only on variability in behavior unique to Time 2. The inclusion of attitude at Time 2 permits the modeling of stability in attitude toward the object, $c_1$, as well as the possibility that the direction of influence runs from behavior to attitude, $c_4$. In the absence of random assignment to levels of a manipulated variable, the replicative measurement of key constructs allows for persuasive tests of causal hypotheses by ruling out alternatives that undermine causal inferences using data generated by one-shot and sequential strategies.

**Timing and Tests of Mediation**

Another issue relevant to when constructs are measured concerns the spacing between measurement occasions. For instance, referring back to Figure 10.4, we might ask whether the test of the critical association reflected in $c_3$ is more persuasive if Time 1 and Time 2 are separated by 15 minutes, 3 days, or a month. There are no simple recommendations regarding the spacing between measurement occasions; however, it is important that the spacing be consistent with the framing of the measures. For instance, if, in a study conforming to the design illustrated at the bottom of Figure 10.4, the spacing between Time 1 and Time 2 were 1 week, it would not be reasonable to ask respondents to report on their behavior during the past 30 days (a frame often used in research on problem behaviors such as drug use).

A more subtle point concerns the spacing between the independent and intervening variables and the intervening and dependent variables in a model such as the ones depicted in Figures 10.1 and 10.2. The issues are easiest to