Causality in Psychopathology

Glossary of causal, design, and measurement terms, concepts
February, 2006

Websites for Statistical/Research Design Definitions:
http://www2.chass.ncsu.edu/garson/pa765/statnote.htm (NCSU)
http://www.cmh.edu/stats/definitions.asp (Children's Mercy Hospital)

*Attenuation: A reduction in estimates of covariance, usually a result of measurement error, unreliable measures, restricted range of obtained measures, inappropriate statistical analysis. Refers to a condition in which the obtained measures of covariance or functional relation are less than the true degree of covariance or functional relation.

*Autocorrelation: (Serial correlation; serial dependency): The extent to which values in one part of a time-series predict values in subsequent parts of the time-series. It occurs when residual error terms from measures of variable taken at different times are correlated (Vogt, 1993).

*Base Rate: The unconditional probability of an event or category for a specified time, condition, or place (e.g., rate of persons coming to a mental health center from a specific ethnic group or who report family violence; rate of a client’s panic episodes prior to treatment).

Behavior: Most often used to refer to a class of responses (e.g., hitting, interrupting); often used synonymously with response class (Johnston & Pennypacker, 1993).

Behavioral Chaining--A series of behavior-environment events in which each event serves as a discriminative stimulus for the following event (Donahoe, & Palmer, 1994)

*Behavior disorder/Behavior problem: Generic terms of convenience used to refer to any target of clinical intervention. The use of these terms does not imply that the disorder/problem is an empirically validated construct or that it is composed of a reliably covarying set of behaviors, such as is implied in DSM-III-R. It also does not imply that there is an "underlying" cause to a group of "symptoms". Thus, "behavior disorders" or "behavior problems" may be used, interchangeably, at a variety of levels to refer to self-stimulatory behaviors, self-reported depressed affect, amount of exercise, negative self-statements, and excessive caloric intake.

Behavioral scientist-practitioner: A generic term used to refer to any clinician or behavioral scientist who is assessing, treating or conducting research on behavior disorders. This term implies an integration of empirical methods with clinical assessment and treatment.
**Catalytic variable**: A variable that is necessary for the causal relation between two other variables. It "enables" such a relation. <

*Causal discontinuity*: Variation in the strength or form of a causal relation between two variables. The variation may be a function of time, the magnitude (or other parameter) of the variables, or developmental epochs of the person. E.g., traumatic life stressors may affect mood only when the intensity or duration of the stressor is above or below a specific level.

**Causal indicators**--When an aggregated score of an assessment instrument is presumed to be a function of the variables of which it is composed (Bollen & Lennox, 1991).

*Causal latency*: The time between a causal event (or a change in a causal variable) and its effect. Effect can be defined as the initial effect, maximum effect, or some other criteria.

*Causal marker*: A variable that covaries with the strength of causal relation between two other variables (e.g., laboratory response to a stressor that covaries with a person's response to a stressor in his or her natural environment).

*Causal mechanism*: The means through which a causal effect is produced. It answers the questions of "How or why does X cause Y?"

*Causal model* (of behavior disorders): A qualitative and/or quantitative description of the variables hypothesized to be associated with variance in a behavior disorder. It emphasizes important, controllable causal variables and depicts the form, strength, and direction of causal and noncausal (correlational) relations.

*Causal Relation*: Two variables have a causal relation when they have a functional relation, the hypothesized causal variable reliably precedes the effect, there is a logical mechanism for the hypothesized causal relation, and alternative explanations for the observed covariance can reasonably be excluded.

*Causal variable*: A variable which controls a proportion of the variance in another variable; causal variables precede and are correlated with their effects, have a logical connection with their effects, and the association between the causal variable and the effect cannot be wholly attributed to a common effect of another variable.

**Causal vector diagrams**: Vector diagrams illustrating the strength and direction of functional and causal relations among a set of variables.

**Ceiling Effect**: Low magnitudes of variability or shared variance because one or both variables has approached its upper limit.

**Client**: Any target of clinical intervention or assessment procedures. A client may refer to a family, group, or institution, as well as a single person.

**Clinical Significance/Substantive Significance**: The extent to which an obtained measure or effect (e.g., intervention effect, estimate of shared variance between variables) is important, has practical value, or can guide clinical judgments. The
degree to which measures contribute meaningful information. Often contrasted with “statistical significance”.

**Coefficient:** The numerical factor in an algebraic term (Karush, 1989), most often used as a multiplier.

**Cohort:** A group of individual with a common characteristic (e.g., age, grade level, disorder) that are assessed for a period of time. E.g., a group of psychiatric patients admitted at a particular time, a group of newly married couples.

**Cohort Effect:** Systematic differences between two cohorts recruited at different times. E.g., differences between two groups of newly married couples recruited at different times.

**Comorbidity:** A higher than chance co-occurrence between behavior problems or disorders. The probability of one problem or disorder is significantly increased, given the occurrence of another problem or disorder.

**Confidence Interval:** A range of values (e.g., of a mean or proportion of variance) that are presumed, with a particular probability, to be consistent with obtained data. With a 95% confidence interval, for example, 95% of repeated samples will results in values within the interval and contain the true mean or other parameter; 95% of samples will include the true value of the parameter.

* **Confounding:** A design flaw in which it is impossible to attribute variance in a dependent variable to a particular independent variable because the independent variable covaries with another independent variable. E.g., Treatment A and B differ in content and length, so the effects of content cannot be separated from those of length. In causal language, confounding occurs when alternative explanations have not been satisfactorily addressed in the design.

**Condition:** See ”Domain”

* **Conditional Probability:** The chance that an event will occur, given that some other event has occurred. If A and B are events, the conditional probability of A given B is the probability of A, assuming B holds. If $P(B) > 0$, then the conditional probability of $P(A|B)$ of A given B is $P(A \text{ and } B)/P(B)$ (James and James, 1992; see Schlundt, 1985, for example of clinical application).

**Conditioned (Conditional) Stimulus:** A stimulus whose behavior-eliciting properties result from being paired with other eliciting stimuli, usually within a classical-conditioning paradigm (Donahoe, & Palmer, 1994)

* **Confound; Confounding Variable:** A variable that attenuates the effect of another, that attenuates a functional relation; it that makes it difficult to draw inferences about the relations between other variables.

* **Constant conjunction:** An invariable association between two events: Whenever Y occurs, X occurs. The idea that the causal variable must always be present if the effect occurs. Proposed by some as a necessary but insufficient condition for
inferring causality, but rejected by many philosophers of science. It is not a condition that is necessary for causal inference in psychopathology.

**Construct**: A synthetic variable, usually composed of multiple systematically related elements, that is inferred but cannot be directly observed. Similar to a “latent variable”.

**Construct systems** (in psychology)—a orderly conceptual system that integrates multiple variables and relations for the purpose of making predictions, explaining behavior, or guiding interventions. Construct systems may vary in level (e.g., neurophysiological vs. psychodynamic) and may have various foci (e.g., behavior disorder vs. treatment construct systems).

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*Continuous function*: Where the values of a dependent variable are equally associated the values of another variable throughout the values of both variables.

**Critical level** (in causal relations): A "threshold level" in causal relations; when variation in the causal variable is associated with variation in a dimension of a behavior disorder, only when the value of the causal & dependent variable exceeds a particular level.

**Deterministic functional equation**: A functional equation in which the criterion is completely determined by the predictors.

**Dimension (of a behavior problem, causal variables)**: (a) Quantitative attribute of an event, such as the frequency, duration, magnitude, cyclicity, rate of an event. A fundamental quantity, on which psychological/behavioral phenomena can be measured. (b) A homogeneous facet of a construct, such as a “one-dimensional” measure of fear. A multidimensional variable has several facets or aspects.

**Diathesis-stress model** in psychopathology: A model of behavior disorders which hypothesizes a biologically determined vulnerability to the effects of psychosocial stressors. Genetic and other physiological factors are presumed to affect the chance that a person will manifest schizophrenic symptoms, or other behavior disorders, upon exposure to environmental stressors.

**Discontinuous function**: Where the units of change of one variable, as a function of a second variable, vary according to the values of either variable.

**Distal Cause**: Often refers to variable that affects the probability that a person will develop a behavior problem (examples include early trauma, family learning history, genetic predisposition). In contrast to "proximal cause".

**Domain** (of a causal relation): Conditions under which a causal relation, or a particular form or strength of the causal relation, is operational. Domains may involve
developmental stages, environmental settings and contexts, physiological states, parameter values, time, persons, or the presence or absence of particular variables. e.g., the causal variables that account for aggressive behavior on the part of a psychiatric patient may be different in hospital and home settings, or vary as a function of medication level.

**Dynamic**: A adjective indicating that the object or relation changes across time or as a function of some parameter.

*Dynamic causal relation*: A terms suggesting that the form or strength of a causal relation can vary across time or some other parameter. e.g., the degree to which smoking is affected by social settings can vary across time.

*Effect size*: (1) A coefficient of the statistical relation between two variables. It is usually expressed as some form of "proportion of variance accounted for," conditional probability, etc. (2) In treatment outcome research, it is a way of expressing the difference between two groups in a metric that can be applied across studies (e.g., difference between means divided by pooled standard deviation) (Kazdin, 1992). (3) In treatment research--the mean difference between the control group and the treatment group [(mean1 - mean2)/SD of control group] or [(mean1 - mean2)/pooled SD] and then adjusted by instrument reliability coefficient.

**Equilibrium latency**: The time required for the effects of a causal variable to stabilize.

**Equilibrium state**: A condition in which the effects of a causal variable have stabilized.

**Equilibrium time**: See "Equilibrium Latency".

*External validity*: The degree to which results can be generalized across elements within a facet--across other settings, sexes, ages, medication conditions, levels of a disorder

**Form** (of a causal relation): The mathematical function that best expresses the relation between two variables (e.g., log, liner, sine wave, parabolic, quadratic).

**Functional relation**: A functional relation exists when two or more variables have shared variance: Some dimension (e.g., rate, magnitude, length, age) of one variable is associated with some dimension of another. In an alternative language, variables are functionally related when they demonstrate a mathematical relation (Haynes, 1992). A mathematically describable relation between two or more variables.

*Functional plateau*: A special case of causal discontinuity in which a variable may have no causal relation to another variable (e.g., a behavior disorder) while its values remain within a particular range, but no significant causal relations if its values fall below or above that range.

*Functional relations*: A mathematically describable relation between two or more variables.

**Functional variable**: Any variable that demonstrates a mathematical relation with another variable of interest.
*Generalizability: The degree to which measures or inferences from one set of data can be presumed to be indicative of the measures and inferences that can be drawn from other sets of data. Typically, it addresses the degree to which measures can be presumed to be valid indicators of variables across facets, such as subjects that differ in age, sex, ethnicity, level of a disorder, medication state, setting, or other assessment context.

*Generalizability theory: A measurement theory that addresses sources of variance in obtained measures. Presumes that there are multiple sources of variance across facets such as rater, instrument, assessment context, setting, subject age, medication state, sex, assessment method, instructions, etc.

*Interactive causal relations: Usually refers to a multiplicative functional relation where the effect is a product of two or more variables. Diathesis-stress is one example. In a two variable causal model, implies that both variables are necessary for an effect.

*Intervening cause. (Gerald Young)--Events that occur in a causal sequence that alter or replace the previously primary component of the chain; An event that comes between the initial event in the sequence and the end result, thereby altering the natural course of events that might have connected the original cause and its effect. Similar to "mediating variable".

*Latent causal variable: A causal variable that remains inactive unless triggered by other variables.

*Level of a variable: Refers to the number of variables or paths included in a variable. High-level variables can be partitioned into many lower-level variables and paths. The number of elements or components subsumed by the variable label (Haynes et al., 1993, 1994). Behavior problems, goals and causal variables at higher or lower levels (sometimes termed “molar” or “molecular”; “higher order” or “lower order”). A higher level behavior problem is illustrated by “depression,” that can refer to multiple lower-level phenomena such as motor slowness, negative affect, insomnia, and eating disturbances.

*Marker variable: A variable whose value is correlated with another variable of interest or the relation among variables. For example, a parental history of hypertension may serve as a marker variable for an increased probability of developing hypertension (the variable of interest) or a heightened cardiovascular response to laboratory stressors (the relation between environmental stressors and cardiovascular response).

*Mediating variable: A variable that accounts for, or explains, the relation between two other variables; similar to a “causal mechanisms” and "intervening variable" (Baron & Kenny, 1986; Shadish, 1996)**
**Moderating Variable:** A variable that influences the strength and or direction of the relation between two other variables (Baron & Kenny, 1986). A variable whose value covaries with (affects) the magnitude of a causal relation (Shadish, 1996).

**Momentary time sampling:** Measuring a variable at a single instant in time. Sometimes referred to as "flash-point" sampling.

**Negative Predictive Power:** (1) true negative rate/true negative + false negative rate; the proportion of individuals indicated as not having a disorder/behavior who truly do not; Sometimes confused with “specificity”.

**Necessary cause.** (Gerald Young) The cause without which the effect cannot occur.

**Original causes:** The "first" cause in a sequence of events leading to a causal effect. For example, anoxic birth conditions may be considered an "original cause" of impaired social functioning.

**Parameters** (of causal variables or behavior disorders): Dimensions that may be applied to the quantitative description a behavior problem or causal variable, such as magnitude, duration, level, latency, frequency, recovery rate, or intensity.

**Partial function:** A causal relation that only partially accounts for behavior. For example, the probability of relapse into schizophrenic behaviors following the cessation of psychotropic medication may be "partial function" of the degree of emotional support received from friends, indicating that other variables also contribute to the probability of relapse.

**Path coefficient:** A coefficient that expresses the strength of relation between two variables; usually expressed as the proportion of shared variance between the variables. Path coefficients may be either obtained or predicted.

**Phase-state:** The time course context of a variable. The phase state of a variable is its historical and projected curve at the time of measurement.

**Positive Predictive Power:** (1) indicates the “hit rate” for an assessment instrument score; true positive rate/true positive + false positive rate; e.g., the proportion of individuals identified by an instrument who truly have the disorder/behavior Sometimes confused with “sensitivity”.

**Positivism:** An epistemological system that stresses the importance of observable scientific facts and the relations among observables; a demeaning of inferential constructs.

**Power (of a measure):** (1) The predictive accuracy of a measure from an assessment instrument. Usually estimated by the proportion of persons it accurately classifies (such as those with and without a disorder). (2) In experimental design: The probability of detecting a difference between groups when a difference truly exists (Kazdin, 1992); affected by sample size, measure reliability.

**Predisposition:** A "risk" factor. A person has a "predisposition" for a behavior when the probability of that the behavior will occur, given a particular condition, is
greater for the person than for people on the average. Similar to "vulnerability". Predispositions may be conditional or unconditional.

*Proximal cause: A causal variable that accounts for variance in the onset, intensity or duration of behavior across time or settings. e.g., a variable that accounts for the onset of a panic episode, the duration of a migraine headache, the amount of drug ingested.

*Proximate Causation. (From Gerald Young): Proximate causation refers to the "essential" or "dominant and responsible" cause. Where other causes occur, the proximate one "necessarily" sets the others in operation. A proximate cause may be "a natural and continuous sequence", with other factors not intervening or breaking the chain; (in psychopathology often refers to the cause that immediately leads to onset of behavior problem--see "proximal cause")

*Psychosocial stressor: An event characterized by social interaction that leads to negative behavioral, cognitive or physiological consequences. They may include events such as marital arguments, rejection by an important person, and disapproval from a supervisor.

Rate-of-change: The magnitude of change of a variable across a period of time.

Recidivism: The probability of manifesting a behavior problem following successful treatment of that disorder.

Recovery (post-stress): Rate or speed of recovery to prestress levels following termination of a stressor, the degree to which a measure approximates prestress level following termination of a stressor.

*Risk factor: Like marker variables, a risk factor is any variable whose value is statistically associated with a parameter of a behavior disorder. Although the phrase is not used consistently in the literature, a risk factor, but not a marker variable, implies the operation of a causal variable. Driving without a seatbelt may be considered a risk factor for bodily injury in an accident.\ Sensitivity: The probability that a person with a particular attribute will manifest a particular behavior. The proportion of positive cases so identified by a measure from an assessment instrument. See also Positive Predictive Power.

Slope: A coefficient of rate and direction of change of one variable in relation to another. It often refers to the rate and direction of change of a variable over time.

Specificity, of a measure: The probability that a person without a particular attribute will be so identified by a particular measure. The proportion of negative cases so identified by a measure. See also “Negative Predictive Power”

*Specificity, of a variable: The degree of molarity or precision of a variable (or measure) and can refer to (a) The diversity and number of elements subsumed by a variable, (b) The degree to which the dimensions or parameters of a variable are specified, (c) The degree to which situational and temporal conditions relevant for the target variable are specified; and (d) The level of specificity of clinical judgments based

**State-phase functions**: The time-course of the magnitudes of causal and dependent variables. Similar to state-space functions.

**Symptom**: Synonymous with "behavior problem". It does not imply that there is an underlying cause, as is sometimes the case with medical models.

**Synthetic causal model**: A multivariate causal model which depicts various causal weights and paths, the directionality of causal relations, and interactions among causal variables. In this sense, "synthetic" means "integrative".

**Threshold level**: See "Critical Level".

**Time cluster**: The pattern of occurrence of a causal variable across time.

**Time-course**: (a) The values of a variable dimension as a function of time; (b) the temporally related dimensions of a variable, such as cyclicity, latency, duration, and rate. The time-courses of variables are frequently presented in graphical form with time on the horizontal axis and the value of the variable on the vertical axis. (Haynes et al., 1995).

**Time-lagged correlations**: Correlating serial data points at time point 1 with those at subsequent or prior time period. The time lag of the correlations may vary.

**Transitional period**: That interval between two equilibrium states; often, but not necessarily, characterized by increased slope and variability of variables.

**Transitional state**: The condition of a person (or behavior) between a change in a causal variable and the establishment of an equilibrium state.

**Trigger** (triggering cause): A variable which controls the immediate onset of a behavior problem. It usually occurs in close temporal proximity to the behavior problem.

**Triggered causal variable**: A causal variable that does not appear, is inactive or is not measurable, unless preceeded by another causal variable.

**Vulnerability**: The degree to which an individual is susceptible to developing a behavior disorder given the occurrence of particular causal events. A "vulnerable" person is one with a relatively higher probability of developing a disorder when exposed to specific conditions.

**Vulnerability factor**: A variable that affects the probability of a behavior disorder, or affects the probability of onset of a behavior problem, given the occurrence of triggering variables. A risk factor. May refer to factors that affect probability of a behavior problem across persons, time, or settings.