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ABSTRACT

Although there have been frequent calls for over-time research in mass communication, there are still many reasons that researchers use simpler designs. Each approach: two-time point, panel/repeated measures, and time-series experimental designs, offers its own advantages and disadvantages. By examining the benefits and disadvantages of each approach and looking at several research questions, it appears that many research questions would benefit from using multiple approaches. A history of agenda-setting research suggests that non-theoretical over-time research may be a wonderful entry into questions of process, a place where theories may be developed. Theories allow these processes to be examined with other approaches. Therefore, examining temporal processes without developing theories, regardless of method, would be to the detriment of a researcher's ability to understand the processes and effects of communication. (Three figures are included and 123 references are attached.) (Author/MG)

Examinations of process: A practical guide

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Abstract

Although there have been frequent calls for over-time research in mass communication, there are still many reasons that researchers use simpler designs. Each approach: two-time point, panel/repeated measures, and time-series experimental designs, offer their own advantages and disadvantages. By examining the benefits and disadvantages of each approach and looking at several research questions, it appears that many research questions would benefit from using multiple approaches. For example, a history of agenda-setting research suggests that non-theoretical over-time research may be a wonderful entree into questions of process, a place where theories may be developed. Theories allow these processes to be examined with other approaches. Therefore, examining temporal processes without developing theories, regardless of method, would be to the detriment of our ability to understand the processes and effects of communication.

Examinations of process: A practical guide

Following frequent calls for the study of communication phenomena over time (Schramm, 1971; Rogers, 1976; Kline, 1977; Arundale, 1980), there appears to be a reasonable number of studies in the area of interpersonal communication making use of over-time data, and an increasing number of over-time studies in mass communication (Basil, 1990). There are even books with titles like The Process of Communication (Berlo, 1960), The Process and Effects of Mass Communication (Schramm & Roberts, 1971) and ...Assessing Communication Process (Tardy, 1988). Although this may appear encouraging to those who call for studies of processes over time, the establishment of over-time studies in mass communication research continues to be slow.

Over-time studies in mass communication research are limited for three main reasons. First, mass communication generally occurs in a non-interactive situation which is constrained to the temporal nature of the mass media. Very often, the "process" appears to be binary: an audience chooses to expose themselves to a program for a period of time, yes or no. Because of this non-interactivity, researchers have, through their training, been conditioned to reduce process to "researchable" pre-post questions. By comparison, interpersonal communication is an interactive situation, in which sequence and timing are more ingrained. For example, in face-to-face communication, context (Cappella, 1979), staggering of responses (Cappella, 1979), and talk time (Fitzpatrick & Dindia, 1986) are all important measures of the ongoing "process."

The second limitation of over-time research is that the statistical methods which would be appropriate to examining mass communication theories and paradigms over time are not well established in the field (Cappella, 1977: 47). For example, the most commonly known time-series statistics, like ARMA and ARIMA models, are based on an assumption of stationarity (Arundale, 1980; Box & Jenkins, 1976). Although non-stationarity may be "corrected," these statistics are designed to explore cyclical and other patterns of "error" more than the background effects over which these are taking place. Therefore, research that focuses on message and campaign effects is not particularly well suited to these time-series statistics. Other techniques for analyzing process data, like Fourier spectral analysis, are not well known by researchers.

Third, the most important reason that over-time research has not been well accepted in communication research, is that over-time designs are not usually required in order to examine process. Many researchers believe that most questions can be answered in easier ways. For example, McCombs and Shaw's (1972) "agenda-setting" hypothesis, despite its temporal nature, has been researched with single time-point correlational studies (e.g., McClure & Patterson, 1976). There is some debate whether such simplifications are completely appropriate (Cappella, 1977; Kline, 1977; Basil, 1990).

I do not mean to suggest that over-time research is <u>not</u> applicable to mass communication research. Indeed, there are areas in which time is an integral component of the research: children's attention to the screen (Alwitt, Anderson, Lorch & Levin, 1980), channel switching (Heeter, 1985), public opinion (Ostrom & Simon, 1989), and diffusion of innovations (Roger, 1983). And many other research questions, including the "spiral of silence" and "agenda-setting" hypotheses, would benefit from being analyzed over time. Over-time research may answer some of the processual questions.

In this paper I will argue that although process can be investigated without over-time designs, doing so is to the detriment of our understanding of communication processes and effects. Each research paradigm has its own strengths and weaknesses. Time-series analysis, despite many advantages, is not a cure-all in every situation. Only by investigating communication questions and theories with a combination of approaches can we can best study communication phenomenon as process. In order to elaborate this assertion, this paper will examine three design prototypes: (1) two time-point data like pre-post tests, (2) panel or repeated measure designs, and (3) time series designs. For each prototype, the types of research questions which can and cannot be answered, appropriate statistics and underlying assumptions, threats to reliability and validity, and ideas about which research questions would benefit from being answered will be examined.

Two time-point designs

Hovland introduced experimental control group research to mass communication in the 1940s (Delia, 1987). Largely, this was based on medical and psychological models (Kline, 1977). This form of two time-point design continues to serve as the workhorse of communication researchers (Basil, 1990). Therefore, this section will discuss the strengths and weaknesses of 2 time-point data measured on 500 "things," either people or variables.

Strengths and Weaknesses

Two time-point data, especially when combined with experimental methods which control conditions, are a vast improvement over correlational methods. Even in non-experimental settings, estimates of the amount of television subjects have watched over the past year (e.g., Gerbner, Gross,

Morgan & Signorelli) can be replaced by whether or not they watched a specific program. By combining research or survey designs with behavioral (e.g., Bandura, Ross & Ross, 1963) or other measures like "attitude" toward a candidate (e.g., Pfau & Burgoon, 1988), researchers have been able to carry on a wide variety of research.

Two-wave research has been used in communication to compare everything from the effects of speaker status (Hovland & Weiss, 1953) and one-sided versus two-sided arguments in persuasion (Hovland, Lumsdaine & Sheffield, 1971) to the effectiveness of campaigns (O'Keefe, 1985) and perceptions of television characters (Reeves & Garramone, 1982; Reep & Dambrot, 1988). Two wave studies are usually fast and efficient for several practical reasons (Lang & Lang, 1985), and reliably accommodate a wide variety of subjects in single- or multiple- subject runs.

Cappella (1977: 45) directly challenges Glass, Willson & Gottman's (1975) assertions that only way to investigate process is with time-series designs. Two-time point research may be used to investigate process, but only as long as conflicting theoretical predictions can be made (Greene, 1988; Stempel & Westley, 1981:233-234; Cappella, 1977). In one example of conflicting predictions, Geiger and Reeves (1989) examine two contrasting theories about processing filmic "cuts," one of which predicts a decrement in secondary reaction tasks; their demonstration of a decrement validates one of the competing theories, and its accompanying process.

However, there are at least three main weaknesses with two time-point research and data which are illustrated in Figure 1. The first involves power: finding statistically reliable and significant relationships, especially when constrained to two observations per subject, often involves a large number of subjects. The second problem involves sensitivity: it is difficult to examine the

effect of a political ad (or even a campaign) with a background of larger influences (party identification, news reading, etc.). The third problem is conceptual: it is impossible to determine whether non-experimental or quasi-experimental effects are due to the variable in question or some eccentricity of the stimulus or conditions -- seeing the same effect under slightly different situations is more reassuring, for reasons beyond external validity.

Statistics and Assumptions

Probably because of the long history of two-wave designs, many statistical techniques are readily available for the analysis of two-wave data. These are illustrated in Figure 2. The choice of actual statistics depends on the level of measurement (nominal, ordinal, interval, or ratio) and the exact research question being asked (Lang & Lang, 1985; Cappella, 1977). Before resorting to any statistical analysis, in this and any other analysis, data should always be plotted and examined (Lord, 1956; Cronbach & Furby, 1970).

If comparisons are to be only made across time 2 scores at the nominal and ordinal levels of measurement, chi-squares and log-linear methods are appropriate statistics. For interval-and ratio-level data, several alternative approaches exist. First, multiple regressions between time 1 and time 2 can be computed. Second, subgroups can be "matched" in ANOVAs (or MANOVAs) and multiple regression analyses. Compared to post-test only designs, this approach reduces the error variance and thereby increases the power of the test statistic (Stempel & Westley, 1981:221-225). A third approach is to compute a "change score" by subtracting time 2 from the time 1 score in order to remove auto-correlation (Cappella, 1977: 46). Although some dispute has arisen over the use of change scores (Lord, 1956; Coleman, 1964; Cronbach &

Furby, 1970), recent evidence suggests that change scores do appear to be reliable measures of individuals over time (Bloom, 1964; Rogosa, 1987).

In general, all of the univariate techniques require fairly reliable measures of the dependent variable. However, when constrained to two observations, several multivariate approaches, like multiple indicator LISREL (Herting, 1988; Blalock, 1964a, 1964b, 1971) and factor analysis models, by using several measures of each variable, are touted as being more robust to measurement error. Some researchers, however, are not convinced (Pelz & Andrews, 1964; Pelz & Lew, 1970; Pelz & Faith, 1970, 1973; Cappella, 1977:38; Rogosa, 1980; Duncan, 1985).

Multivariate statistics such as principal components, factor analysis, and cluster analysis are sometimes used to examine patterns in two time-point data. These approaches assume that the underlying structure of data can be determined (Smith, 1972: 179). Also, when dependent and independent variables can be determined beforehand, discriminant analysis may be used to examine causality.

Reliability and Validity

The ability to minimize the potential for test sensitization is one important strength of two time-point studies. Subjects are less prone to test sensitization because of few opportunities to observe the questions. Another approach to the problem of pre-test sensitization is to use a Solomon 4-Group design to examine exactly what the influence of pre-testing is on subjects.

In terms of internal validity, two time-point approaches have been the foundation of the majority of experimental communication research. This design is based on comparing both within and across subjects. This line of research, however, is regularly challenged on its generalizability and external

validity. Therefore, care should be taken in choosing appropriate and varied samples of the population. Another major challenge to this design has been the incorrect belief that two time-points does not process make. Other questions of validity arise from the nature of particular experiments: the thoroughness of theory and conceptualization, the adequacy of the test, and the interpretations that are drawn.

Potential Research Questions

In general, there are two important opportunities for using two time-point designs in process research. First, two time-point experiments are relatively simple to perform. Descriptive and correlational studies would benefit from simple pre-post lab experiments before attempting to ascribe effects or causality. For example, one question which would benefit from the use of a simple research design is whether targeted messages are actually more effective than non-specific ones. If they are more effective, later research may wish to examine the how and why.

A second reason for using two time-point research is to simplify experimentation (Cappella, 1977: 45), especially when over-time effects are known. In this way, replications and variations on the stimulus and conditions which alter the effects may be investigated. For example, complexity effects on attention have been shown to be similar in both repeated measures (Thorson, Reeves & Schleuder, 1986) and time-series designs (Alwitt, et al., 1980; Rotschild, et al., 1986), so further attentional research may wish to use parsimonious two-point designs (Reeves & Thorson, 1986; Geiger & Reeves, 1989).

Panel or Repeated measure designs

Strengths and Weaknesses

The next section will discuss measurement at 20 time-points of 50 people or variables. Panel designs, following a moderate-sized sample of people over a few time points reached their heyday in the 1950s (Markus, 1979). In addition, this general scheme can be used with repeated measures designs with only minor modifications.

Statistics and Assumptions

Panel and repeated measures designs have a wide choice of statistics (see Figure 2). Many single time-point statistics, with special considerations, can also be applied to panel and repeated measures designs. Again, the statistical technique depends on the level of measurement and the research question under investigation. And again, the data should be plotted.

At the nominal or ordinal level of measurement, various stochastic models (Markov, lag sequential, etc.) can be applied to multiple time-point data (Coleman, 1964; Morely, 1984; Dindia, 1988) via chi-square or log-linear techniques (Markus, 1979).

At the interval or ratio levels, cross-lagged correlations (Blalock, 1964a; Duncan, 1985), ANOVAs and MANOVAs can all be used to compare results to chance. However, a researcher must be aware of potential serial (or auto-) correlation which violates the independence rule in these regression procedures. In such cases, especially repeated measures designs, this non-independence of observations and error terms, requires specialized versions of ANOVAs or MANOVAs (Cappella, 1977: 46).

Path and LISREL analyses have also been advocated for these designs (Blalock, 1964, Blalock, 1971; Joreskog, 1970, 1973). However, some debate

on the dependability of path models exists (Pelz & Andrews, 1964; Pelz & Lew, 1970; Pelz & Faith, 1970, 1973; Cappella, 1977:38; Rogosa, 1980; Duncan, 1985). One of the largest problems with LISREL estimation techniques appears to be individual differences: "the presence of persisting individual differences ('long-term' stability) obscured the performance of path coefficients" (Pelz & Lew, 1970:22). So one interesting alternative approach is "individual growth models" (Rogosa & Willet, 1980; Rogosa, Brandt & Zimowski, 1987; Rogosa, 1989). In these procedures, a linear (or higher-order term) function is computed from three or more time points.

Panel designs may also be used to compare changes over time to cohort effects if this is of theoretical interest (Firebaugh, 1989; Glenn, 1979). In order to examine cohort effects, the data must include information on individual's birth dates, or an equivalent. Other frequently used alternatives for panel data analysis are multivariate approaches: principal components, factor or discriminant analysis, and canonical correlations.

Reliability and Validity

Because of frequent exposure to tests, test sensitization is a potentially serious threat to panel or repeated measures designs (see Figure 1). This necessitates research designs which use unobtrusive and non-reactive measures. For example, several designs have made use of covert (Alwitt et al., 1980), physiological (Rotschild, et al., 1986), or engaging measures (Thorson et al., 1986). These measures include observation of eye position, EEG measures, and asking for fast responses to tones while viewing.

Interestingly, because of multiple observations, unreliable measurement may not be as big a problem with panel designs, especially with more robust techniques like "individual growth models" which average over measurement

error (Rogosa, Brandt, & Zimoswki, 1987; Rogosa, 1989). More specifically, these techniques may also use a best-fitting regression line (or higher-order function) to estimate individual growth curves.

Potential Research Questions

Studies of the diffusion of innovations (Rogers, 1983) have done a commendable job of tracking adoption of new technologies over time. Usually, these studies develop post-hoc psychological profiles of innovators, early and late adopters, and laggards. Diffusion, however, has not been examined in a panel design. Such a design could compare psychological measures to individuals' dates of adoption of more than one new technology.

Another potentially informative line of research would be an attempt to follow subjects over McGuire's (1974) multiple stage theory of persuasion. This theory predicts that attention leads to knowledge gain which leads to persuasion which then affects behavior. A panel design could also compare McGuire's theory with alternative theories of persuasion which predict alternative routes to persuasion (e.g., Chaffee & Roser, 1986; Bandura, 1988).

Time-series designs

This section will discuss measurement at 1,000 time-points of 1 person or variable. Ostrom (1978) and Krull & Paulson (1978) provide useful how-to guides on implementation.

Strengths and Weaknesses

Three area of research have been studied rather extensively with time-series methods. These areas are diffusion rates (e.g., Rogers, 1983), public opinion (e.g., Ostrom & Simon, 1989), and attention (e.g., Rotschild, Thorson, Reeves, Hirsch & Goldstein, 1986; Reeves, Thorson & Schleuder, 1986).

Largely, these are areas of research being investigated by later-trained researchers of inherently over-time processes.

The limitation of time-series designs, is, of course, designing a study in which data may be collected over time. A time-series analysis may not be useful when people are highly stable over time or when differences across people are the critical factor. Also, there are practical constraints on the number of times an interviewer may interrupt a 30-second commercial. In addition, it is difficult to find instances in which this can be accomplished in a non-intrusive manner. However, given a relevant research question, and non-intrusiveness or a research question that would not be handicapped by frequent interruptions, I cannot think of any areas to which time-series studies would not be informative.

Statistics and Assumptions

Because of the complexity of time-series analysis, data plotting is especially important before proceeding to the relatively non-intuitive statistics. Although stochastic (Markov, lag-sequential...) time-series statistics are appearing (Cappella, 1977: 41,46), it is generally advised to develop, or consider, data to be at least interval-level (see Figure 2).

For this interval-level data, specialized time-series statistics may be required because of serial- (or auto-) correlation. For example, Generalized Least Squares (GLS), Moving Average (MA), Auto-Regressive Moving Average (ARMA), and ARIMA procedures have been described (Ostrom, 1978; Box & Jenkins, 1976). In general, these time-series statistics involves moving to progressively more complex statistics and procedures until the Durbin-Watson d-statistic indicates no residual autocorrelation. Another approach involves spectral analysis such as Fourier analysis.

However, when autocorrelation is not a problem, simpler techniques, including using time (or higher-order functions) in normal regression equations, are possible. At least one recent paper (Ostrom & Simon, 1989), by the writer of a time-series book no less (Ostrom, 1978), has resorted to such an approach. In Ostrom & Simon's paper, Reagan's popularity is tracked and compared to potential influences such as unemployment, inflation, speeches, and other important events.

Again, because multiple observations are obtained on the variable (or person), unreliable measurement may be able to be countered. Generally, in time-series studies, this involves averaging over repeated measurements or observations (Rogosa, 1989; Coleman, 1968).

Arundale (1980) elaborates a thorough analysis of a method for studying change over time. This model was adopted from economics and demonstrates how the timing of measurements is critical in time-series research. I recommend the paper highly. However, because Arundale (1980) fails to distinguish between unstable traits and measurement error. it is not clear how issues connected with each threat affect his implications for social science research.

Reliability and Validity

Because of the sheer number of observations, test sensitization may be likely, but may not be a problem with time-series designs (see Figure 1). For example, with covert or physiological measures, a subject may be run through warm-up exercises until he or she gets comfortable with the procedures, habituate to being observed, or get over general uncomfortableness with being in a study. Even with non-covert measures, involving stimuli may go a long way in distracting a subject from the testing procedure.

Potential Research Questions

One area which is ripe for time-series analysis is political decision making. Despite frequent calls for studies over time (Chaffee, 19??), research is typically conducted in terms of events. For example, studies examine the effect of a message (e.g., Pfau & Burgoon, 1988), a series of debates (e.g., Chaffee & Choe, 1980) or a campaign (e.g., O'Keefe, 1985). One potential research question which might be addressed involves the popular press and political parties assertion that a candidate may be handicapped by a nasty primary. Since few, if any, studies have been conducted across both primary and general elections, this question has not been addressed. Another limitation in previous political research is the use of aggregate-level cross-sectional samples to measure political effects (e.g., Todd & Brody, 1980). The use of aggregate-level samples eliminates the ability to discern whether changes in public opinion result from people shifting continuously, or if different people shift at different times. This question would also benefit from a time-series analysis.

Conclusions

As explored in this paper, mass communication research has traditionally been studied in the simplest possible instantiations, correlational or two time-point designs. Despite the rejection of the conceptualization of the audience as passive groups to whom the media does things (Schramm, 1971) and several calls for the examination of process as phenomenon over time (Coleman, 1968; Schramm, 1971; Rogers, 1976; Kline, 1977), researchers have not moved away from the use of two time-point research in mass communication (Basil, 1990). There are several reasons for this. First, researchers are aware that a single message usually occurs at a single point in time. They are following paradigms

established by Hovland, Osgood, and Lazarsfeld. Second, researchers are anticipating limitations in statistics. Third, there is still a debate on exactly how process research should be done. For example, Cappella (1977) believes that "process" is too often used as a "god-term," and challenges Berlo's (1960) and Smith's (1972) definitions of process because, to them," process entails viewing events as ever-changing, without beginnings, ends, or any fixed sequence of events, and with all factors affecting one another (1977: 43). Instead, Cappella suggests that the observation of a communication phenomenon over time simply be conceived as a "time-dependent process" (1977: 45). The question of whether process research can be conducted without over-time designs remains.

There are at least two important bits of knowledge that panel or repeated measures and time-series research provide. First, over-time research provides a look into real-time ordering of events. Second, multiple time-point studies provide the opportunity to verify that the things we thought were happening actually are.

In regard to gaining knowledge about the ordering of events, however, Kline notes that:" Ordering...can assist in...causal inference" (p. 139) [my emphasis]. And, with regard to the non time-series methods of research he states that, "in a survey design the ordering of variables...has some kind of time ordering (p. 184) and "the experimental modes takes time into acoount with a before and after measure." (185). In these ways, researchers are aware of the time frame in which the research is conducted and, more importantly, aware of the time ordering in which the variables are measured or obtained. Kline also suggests that "another approach is to collect, or assemble, series of data over time." (p. 185)[my emphasis]. Therefore, in terms of identifying time-ordering, over-time designs appear helpful, but not necessary, in examining process.

With regard to verification of actual events, this examination of process can even occur if processes are thought to occur within a cognitive "black box," (Greene, 1988). Processes can be validated by critical tests of theories which offer conflicting predictions (Cappella, 1977). The use of indirect measures is, by no means, limited to communication researchers: physicists, despite their popular perceptions as exacting scientists, have no ability to directly observe process; in fact, many of their concepts including acceleration, mass and temperature are not even directly observable without instruments (Woelfel & Fink, 19??:3-4).

Several lines of research have been conducted at one or more of the levels of the design "typology:" two time-point, panel/repeated measures, or time-series designs. For example, agenda-setting has been conducted in several instantiations: as single time-point surveys, two-wave, and panel studies (Eyal, et al, 1985). Research on attention has been conducted with repeated measures (e.g., Thorson, et al., 1986; Geiger & Reeves, 1989) and time-series designs (e.g., Rotschild, et al., 1986). Political and public opinion research has been investigated with a single time-point surveys, two time-point experiments, panel surveys (e.g., Chaffee & Choe, 1976; Todd & Brody, 1980), and time-series studies (e.g., Ostrom & Simon, 1989). Clearly then, contrary to Glass et al.'s (1975) assertions, time-series studies are not a clear necessity in examinations of process: process <u>can</u> be investigated without time-series designs.

However, there are other reasons why time-series approaches are useful. Agenda-setting is an interesting case. It been observed as a naturally-occurring time-series process <u>and</u> in experimental settings (Iyanger & Kinder, 1988)? The history of agenda-setting research suggests that non-theoretical over-time research may be a wonderful <u>entree</u> into questions of process, a

place where theories may be developed. And then those processes may be further examined in controlled experimental settings.

So, why the god-reverance of over-time research in communication? I believe a careful reinterpretation of Kline's statement that "continued calls for process models of both mass and interpersonal communication alert us to inadequacies in our traditional research" should omit the last word, "designs" (1977: 198). It is more as a result of inadequacies in research theories that reviewers and other researchers are disappointed with discussions of process. This, in turn, raises calls for over-time research. But in many cases, a better two time-point design guided by theory would adequately provide clues into process (Cappella, 1977). Therefore, it is richer theoretical development, which is needed, not necessarily methodological sophistication.

In sum, the study of process without the use of over-time paradigms is possible. As seen in Figure3, each approach differs with regard to number of subjects, possibility of sensitization, number of observations necessary, power and sensitivity, intrusiveness, difficulty of design, availability of statistics, and the general focus of the research. Examining process with only one of these approaches is isolating ourselves from potentially advantages and rich sources of information available with the other approaches. For example, agenda-setting research suggests that non-theoretical over-time research may be a wonderful way to develop theories. Those theories may be then be examined in controlled experimental settings. Theories are what is important. Our understanding of communication, in terms of both processes and effects, is based on theory. Theories allow these processes to be examined with other approaches. Therefore, examining temporal processes without developing theories, regardless of method, would be to the detriment of our ability to understand the processes and effects of communication.

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FIGURE 1:

Advantages and Disadvantages of Approaches

Pre-Post	Repeated Measures/ Panel Studies	Time-Series
Advantages:		
Many subjects (External validity)	Fewer Subjects	Few Subjects
Efficient (Fast & Easy)	Multiple observations of phenomena	Multiple observations of phenomena
--	Moderately sensitive	Very sensitive
Sensitization unlikely	--	Ss habituate to being observed
Disadvantages:		
Low power	--	--
Low sensitivity	Hard to choose multiple messages	Difficult to design & execute
Single observation of phenomenon	Possible test sensitization	Intrusiveness
--	--	Hard to examine stable phenomenon or differences across people

FIGURE 2:

Statistical Approaches

Pre-Post	Repeated Measures/ Panel Studies (Markov & Lag-sequential)	Time-Series
Categorical:		
Chi-square	Chi-square	?
Log-linear	Log-linear	?
Discriminant	Discriminant	?
Continous:		
Regression (G.L.S. or O.L.S.)	Cross-lagged correlations	Regression (G.L.S. if conditions met)
ANOVA	r. m. ANOVA	--
MANOVA	r.m. MANOVA	--
--	Individual growth models	Individual growth models
	--	ARMA
--	--	ARIMA
--	--	Spectral (Fourier)
Multivariate:		
Factor Analysis	?	?
LISREL	LISREL	?
REQUIREMENTS:		
Reliable measurement	Multiple observations	Multiple observations

FIGURE 3:

Categorical Breakdown of Approaches

	Pre-Post	Repeated Measures/ Panel Studies	Time-Series
Subjects	Many	Moderate	Few
Test sensitization	Unlikely	Possible	Likely
Number of Observations	Low	Medium	High
Power and Sensitivity	Low	Medium	High
Intrusiveness	Low	Medium	High
Design	Easy	Moderate	Difficult
Statistics	Easy	Moderate	Difficult
General Focus	Across people	Across messages, people, or over time	Over time