Dynamic P-Technique for Modeling Patterns of Data: Applications to Pediatric Psychology Research

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Objective Dynamic p-technique (DPT) is a potentially useful statistical method for examining relationships among dynamic constructs in a single individual or small group of individuals over time. The purpose of this article is to offer a nontechnical introduction to DPT. Method An overview of DPT analysis, with an emphasis on potential applications to pediatric psychology research, is provided. To illustrate how DPT might be applied, an example using simulated data is presented for daily pain and negative mood ratings. Results The simulated example demonstrates the application of DPT to a relevant pediatric psychology research area. In addition, the potential application of DPT to the longitudinal study of adherence is presented. Conclusion Although it has not been utilized frequently within pediatric psychology, DPT could be particularly well-suited for research in this field because of its ability to powerfully model repeated observations from very small samples.

Key words dynamic p-technique; longitudinal; methodology; pediatric psychology; structural equation modeling.

Introduction

Pediatric psychology research often focuses on constructs that change over time (Holmbeck, Bruno, & Jandasek, 2006). The developmental focus of the field dictates that medical, behavioral, and psychological phenomena be studied within a dynamic framework with an emphasis on understanding how these factors interact across time. However, pediatric psychology research often fails to capture the dynamic nature of key constructs and, instead, examines constructs within an overly simplistic and static framework (De Civita & Dobkin, 2004). One possible reason for this is the limitations of traditional data analytic techniques for capturing these types of patterns among the kinds of data typically available to pediatric psychology researchers. In light of the importance of dynamic representations of pediatric psychology phenomena, and the limitations of traditional techniques in explicating these patterns, we review a multivariate time-series analytic approach that might be particularly well-suited to the field of pediatric psychology. Specifically, we will discuss dynamic p-technique (DPT), an extension of the p-technique factor analysis model (Cattell, 1952; Cattell & Williams, 1953), as a statistical approach that is likely new to many pediatric psychologists and has the potential to be useful in examining longitudinal patterns in health-related data for a single individual or small group of individuals.

In exploring the application of DPT to pediatric psychology research, we will first provide a brief overview of this technique and its application in other areas of psychology. Second, we will discuss the unique advantages of DPT for pediatric psychology research. Third, we will propose areas of inquiry within the field in which DPT might be particularly useful. To highlight potential applications and to give the reader a look at DPT “in action,” we present an
example using simulated data. We will conclude by comparing DPT to other approaches that may be appropriate for small samples. Throughout this discussion, we will argue that DPT is a potentially useful, but under-utilized, statistical application for studying longitudinal patterns among important constructs in pediatric psychology because it provides a flexible structure for analyzing repeated observations over time.

Overview of P-Technique and Dynamic P-Technique

According to Cattell’s data box (Cattell, 1946), there are three basic dimensions sampled in psychological research: people, occasions, and variables. Based on this conceptualization, Cattell, Cattell, & Rhymer (1947) introduced p-technique factor analysis, a special application of factor analysis specifically designed to capture patterns among many repeated observations. It is a “person-centered” time-series analysis typically used to examine intra-individual variability over time; that is, variables are factor analyzed over time (i.e., occasions) within a person. Similar to traditional factor analysis, these multiple indicators are analyzed within the individual to obtain the relationships among the latent variables as well as among measures and latent variables over time. In contrast to more traditional analytic methods requiring large samples and drawing conclusions based on group data (e.g., analysis of variance, multiple regression), p-technique factor analysis can be utilized with a single individual (or a small group of individuals using a “chained” approach or multiple-group SEM techniques discussed later). Data are typically collected on multiple constructs repeatedly with relatively short intervals between occasions (Little, Bovaird, & Slegers, 2006).

P-technique factor analysis offers an option for statistically rigorous examination of individual data over time, capitalizing on the power of serial observations gathered from one individual. Furthermore, it is a potentially useful technique for capturing dynamic patterns among individuals that are often obscured in large-group analyses (Hawley & Little, 2003).

Despite considerable potential, traditional p-technique factor analysis has been criticized by some authors, particularly for its failure to account for the serial or time-related dependencies of the observations (e.g., Anderson, 1963; Nesselroade, McArdle, Aggen, & Meyers, 2002). In response to this notable limitation, methodologists have modified the traditional p-technique to create dynamic p-technique (DPT; also known as a direct autoregressive factor score (DAFS) model; Engle & Watson, 1981) which explicitly models lagged effects of factors on other factors using auto-correlations to capture these relationships across time (Hawley & Little, 2003; Russell, Jones, & Miller, 2007). In DPT analyses, this can be accomplished by analyzing a lagged covariance matrix (e.g., block-Toeplitz matrix) incorporating both synchronous and time-lagged information (Little et al., 2006; Wood & Brown, 1994). This method allows for the examination of how: (a) different variables relate to each other at the same time (e.g., pain and mood at t, t-1, t-2 etc.; within-lag covariance); (b) the same variable relates to itself over time (e.g., mood at t and mood at t-1; autoregressive covariance); and (c) one variable relates to another longitudinally (e.g., pain at t-1 and mood at t; mood at t-1 and pain at t; cross-lagged covariance). A visual depiction of a hypothetical dynamic p-technique model of pain and mood, illustrating two lags, is presented in Figure 1. In addition, the types of covariances discussed above are labeled in this model. As demonstrated in the figure, researchers have the ability to analyze both stable and dynamic elements across time which could be useful in identifying associations between variables. Therefore, DPT is especially well-suited to examine research questions regarding the effects of multiple variables on each other from day-to-day or from moment to moment.

DPT models can be specified to incorporate multiple lags as indicated by relevant theory; that is, the researcher can examine more than one lag within the repeated observations, however, the number of lags should be guided by theoretical expectations. Figure 2 shows a single-lagged DPT data structure for two variables, pain (p) and mood (m), observed over 200 occasions. In order to create a lagged structure, each observation is matched with the respective record preceding it in time (i.e., the second observation of pain is paired with the first observation of pain, the third observation of pain is paired with the second observation of pain and so forth). This can be repeated in order to create additional lags (i.e., Lag 2, Lag 3, etc.). From this data structure, the raw data or a covariance matrix can be generated and used for the DPT analysis.

DPT models can be estimated using structural equation modeling techniques (SEM; see Nelson, Aylward, & Steele, 2008, for discussion of SEM in pediatric psychology), which allows constructs to be modeled in the latent space and gives this analytic strategy considerable flexibility. Little et al. (2006) highlighted some additional advantages of DPT analysis within an SEM framework. First, a construct can be represented using a latent factor comprised of multiple indicators which controls for measurement error. Second, DPT models can be specified to incorporate both dynamic and static constructs, allowing for the examination of covariates. Finally, although the
focus of DPT analyses is at the individual level, DPT can incorporate more than one individual by one of two ways: (a) using a “chained” approach, whereby estimates are collapsed across all individuals (this approach assumes that the model and parameters are the same across all individuals); or (b) using a multiple-group SEM design to compare models across individuals and simultaneously examine group patterns and individual differences (Little et al., 2006). In this approach, equality constraints can be used to empirically test the invariance of paths across individuals. Typically, using this method, researchers will need a greater number of observations and individuals than with the former approach.

P-Technique in the Psychological Literature

Over the years, p-technique (both traditional and dynamic) has been employed to address a number of topics within the psychological literature. Many of these investigations have centered around the study of mood and personality within adult populations (e.g., Shirfen, Hooker, Wood, & Nesselroade, 1997; Zevon & Tellegen, 1982). Within the developmental literature, p-technique methods have been applied to the study of temperament within the context of mother–child dyadic interactions (Hooker, Nesselroade, Nesselroade, & Lerner, 1987). One of the most interesting applications has been the use of p-technique to study dynamic therapist–client interactions during the psychotherapy process (see Russell et al., 2007, for review). In 1995, a series of papers was published in the Journal of Consulting and Clinical Psychology examining the dynamics of psychotherapeutic interactions in an attempt to identify components of the change process that may be difficult or even impossible to study using more traditional group designs (see Czogalik & Russell, 1995; Luborsky, 1995; Russell, 1995). The application of DPT to the psychotherapeutic process suggests the potential power of this technique in explicating elements of clinically relevant change that are often overlooked in large-N investigations.

Despite some applications in the broader clinical and developmental psychology literatures, p-technique factor analysis and/or DPT has not been frequently utilized within pediatric psychology. In fact, a search for the terms “p-technique,” “dynamic factor analysis,” and “dynamic factor model” within the Journal of Pediatric Psychology (JPP) revealed no studies that utilized this
analytic strategy and only one paper that even mentioned any of these terms in its text (Nelson et al., 2008). Further, we would venture to guess that many, if not most, of the readers of this journal are generally unfamiliar with p-technique, largely because it has not been a part of the standard analytic armamentarium in pediatric psychology.

More broadly, pediatric psychology research has generally lacked rigorous statistical applications for small-N studies, although there have been some notable exceptions using time-series analyses (Chorney, Garcia, Berlin, Bakeman, & Kain, 2010; Schwebel, Summerlin, Bounds, & Morrongiello, 2006; Soliday, Moore, & Lande, 2002). The lack of statistically rigorous methods for analyzing data from very small samples represents an opportunity for growth because the field maintains a general openness to small-N, and even single-subject, studies as a useful methodology for advancing knowledge in the field. This openness is evident in JPPs active solicitation of small-N research through the ongoing special section on Single-Subject Studies. In their introductory paper, the special editors of this section highlighted the potential benefits of small-N research, including its ability to uncover individual changes in a way that is accessible to many clinicians (Rapoff & Stark, 2008). Although they primarily highlighted applied behavior analysis designs, which represent much of the small-N research published in JPP (e.g., Bernard, Cohen, & Moffett, 2009; Cushing, Jensen, & Steele, 2011; Powers et al., 2006), as a methodologically rigorous approach to single-subject data, we believe that DPT may represent a statistically rigorous option for situations in which experimental manipulation of key variables is not possible or several dynamic constructs could be affecting each other across time (see discussion of comparison between DPT and other small-N methodologies later in this article).

**Potential Advantages of P-technique for Pediatric Psychology Research**

Despite its limited use in pediatric psychology research to date, DPT holds several potential advantages for research in this field. As we discuss below, the main advantages of DPT include: (a) enabling researchers to conduct “large-N research” despite a small number of participants; (b) facilitating the study of dynamic patterns of important constructs; and (c) the idiographic (i.e., individual-focused) nature of this approach.

**Large-N Research with Small Numbers of Participants**

Small sample sizes are a common problem in pediatric psychology research (Holmbeck, 2008). Obtaining adequate samples is often difficult or even impossible because of low disease prevalence and the challenges of coordinating multi-site investigations. Although small samples are understandable—and at times unavoidable—they can significantly limit researchers’ ability to address important questions of interest with sufficient power. Furthermore, as pediatric psychology research moves toward testing increasingly complex theoretical models and mechanisms, the limitations of small samples are even more apparent. As a result, researchers are often confronted with an unenviable choice between either conducting analyses with low power or (over)simplifying models to accommodate smaller samples.

Unlike more traditional statistical approaches which require relatively large numbers of participants to obtain adequate power, DPT derives its statistical power from the number of observations over time and can be employed with a single individual or a small number of participants (Little et al., 2006). With sufficient numbers of observations (depending on model complexity; Molenaar, 1985), DPT can allow for complex models that match the complexity of research hypotheses. Simply stated, DPT allows researchers to conduct sophisticated analyses, despite small numbers of participants. For many chronic pediatric conditions, repeated measurement of a small number of individuals over time is often more feasible than studying large numbers of participants. The ongoing care of children and adolescents with chronic conditions can provide an opportunity for collecting large amounts of data within the context of regular medical care, and DPT allows researchers to take advantage of these data to study dynamic processes.

**Examining Dynamic Constructs**

Given the developmental focus of pediatric psychology (Holmbeck et al., 2006), many of the constructs of interest are dynamic in nature. However, these constructs are typically studied as static phenomena in order to simplify statistical analyses. For example, adherence is often represented as a percentage of time in compliance with medical regimens, but this approach ignores the variability in behavior within the time period being studied (De Civita & Dobkin, 2004). Furthermore, adherence patterns may change over time and the factors that influence these changes can only be identified using an analytic strategy that captures this dynamic nature instead of forcing it into a static framework. Rather than a static conceptualization, DPT captures dynamic patterns and can provide researchers with greater insight regarding the longitudinal course of important constructs.

DPT can also be useful in capturing dynamic processes that are likely missed in longitudinal studies with only a
few time points. Meaningful change can occur rapidly and measurement intervals must be tailored to capture these changes (Hawley & Little, 2003). For example, significant medical or psychological changes may occur daily, or even more frequently, during periods of acute illness. However, researchers may shy away from measuring important constructs this frequently because the repeated observations would complicate statistical analyses. As a result, longer intervals of measurement may be adopted, resulting in significant loss of information about the variability of constructs during the interval. In contrast, with DPT, frequent measurement can be embraced and contributes to power to find important patterns among the data. With this technique, statistical models can more closely approximate constantly changing constructs as they are experienced by children and adolescents.

The ability to handle many repeated observations has become increasingly valuable with the development of sophisticated medical data-gathering technologies. For example, technologies such as continuous glucose monitoring (CGM) can produce an abundance of real-time data. For researchers equipped with only traditional data analytic methods, this volume can be overwhelming and lead to decisions of how to collapse data to make it more manageable. In attempting to fit the data to the statistical technique, valuable information (e.g., variability) can be lost and with it the richness to answer sophisticated questions. In contrast, for investigators using DPT, the volume of data produced by continuous monitoring methods is an asset and allows for the study of important phenomena in a naturalistic way.

The study of dynamic patterns using p-technique can be useful both in generating and testing dynamic theories in pediatric psychology. At times, our theories have been limited by our methods, and static conceptualizations have dominated because we cannot easily study dynamic models. By considering a more dynamic statistical approach, researchers may be better able to conceptualize changes over time, perhaps leading to the development of more sophisticated and dynamic theories. Theories involving mediational models, for example, are best examined within a longitudinal framework (Cole & Maxwell, 2003), and might be a particularly useful focus for pediatric research employing DPT. In the earlier stages of research, DPT studies can help to describe important change processes and develop theories about the dynamic interplay between constructs. These theories can be examined later in more large-scale investigations to determine if they generalize to a broader population.

**Idiographic Nature of P-Technique and Evidence-Based Practice**

In contrast to most traditional statistical approaches (e.g., ANOVA, multiple regression), the focus of DPT is on individual (i.e., intra-individual) patterns rather than on group-level characteristics. This idiographic approach is consistent with clinical practice in which decisions are typically made on an individual, case-by-case basis. Therefore, studies that employ this individual-level of analysis may be viewed as especially relevant by clinical practitioners, and the practice implications of such studies may be more apparent and easily implemented in clinical settings (see Borckardt et al., 2008, for a similar argument with respect to time-series analysis for psychotherapy research). Furthermore, the kind of data that are used in p-technique analyses can often be obtained in the course of regular clinical practice (e.g., daily pain or mood ratings), providing an opportunity for collaboration between researchers and clinicians in conducting clinically meaningful applied research. Given pediatric psychology’s emphasis on promoting evidence-based practice (see Nelson & Steele, 2009), and recent call for clinically oriented research in _JPP_ (Drotar, 2010), research using p-technique may be helpful in bridging the gap that often exists between science and practice.

**Conducting DPT Analyses**

A detailed description of the mechanics of DPT is beyond the scope of this article; however, the reader is referred to Wood & Brown (1994) for further discussion and practical resources for conducting DPT analyses. In addition, Nesselroade et al. (2002) provide an overview of this method along with other dynamic factor analysis models with sample syntax for conducting the respective factor analyses. Instead, we offer here a brief discussion of considerations for researchers contemplating utilizing DPT.

As with any longitudinal investigation, researchers planning to use DPT must consider the most appropriate intervals for data collection. Ideally, the intervals selected would be frequent enough to capture the change process in action (Hawley & Little, 2003). For constructs that can change quickly (e.g., mood, pain, certain physiological indicators), daily data collection, or even multiple collections within the day, may be necessary to effectively model the volatile and interactive behavior of key constructs. Such frequent data collection methodologies are already in place in many pediatric clinical settings (e.g., daily diaries for outpatient pain treatment; frequent physiological measures of children in inpatient settings; measurement of blood sugar levels with continuous glucose monitoring), although these data are typically not used for
Example of DPT Using Simulated Data: Daily Measurement of Pain and Mood

To provide a demonstration of DPT analyses applied to a pediatric psychology research topic, we present a hypothetical study examining daily pain and negative mood using DPT. Current conceptualizations of pain highlight the dynamic interplay of pain and mood (Dahlquist & Nagel, 2009). Cross-sectional studies have found that these factors are related (e.g., Varni et al., 1996); however, the way they interact on a day-to-day basis has been less studied (see Gil et al., 2003, for an exception). Using DPT, researchers could examine how these factors relate to each other over time for a single individual or a small number of participants. More specifically, the relationship between pain and negative mood on the same day, for example, could be examined. Further, more predictive relationships between the variables, such as negative mood at time \( t-1 \) affecting pain at time \( t \) (or vice versa; i.e., cross-lagged correlations) could be examined based on theories of causality. Such a study could be feasible using clinically available data. Many cognitive–behavioral treatments for pain already ask youth to track their pain ratings and relevant factors using daily diaries. Beyond their clinical usefulness, such records may also represent a valuable, but largely untapped, source of research data. As mentioned earlier, collaborations between clinicians and researchers around using these records in DPT studies could offer opportunities for clinically relevant investigations consistent with the scientist–practitioner model.

To demonstrate potential DPT analyses for the longitudinal relationship between daily pain and negative mood, we created a simulated data set including 200 observations of both pain and negative mood ratings for a single individual. The data were generated using a first-order dynamic p-technique model and a pseudo-random number generator in the R statistical software (R Development Core Team, 2008). The simulated data included a single indicator of pain that was rated on a 0 to 10 scale (0 = no pain, 10 = highest pain) along with a latent construct of negative mood with five indicators derived from those items of negative affect found on the International Positive Affect Negative Affect Schedule Short Form (I-PANAS-SF; Thompson, 2007). Each indicator of the latent construct of negative mood was a five-point likert-scale item where larger values represent more negative mood. Latent variables in DPT are defined in the same way that they are defined in SEM. Our example allows for bidirectional associations among pain and negative mood using a single lag model. More specifically, a single lagged data structure for each of the indicators was created (note that in Figure 2, negative mood is represented by a single variable to simplify our presentation; however, in the simulated example, this would include five separate indicators of negative mood that are matched with respective subsequent observations). After creating a lagged data structure for each of the indicators, the raw data was then imported into Mplus version 5.2 (Muthén & Muthén, 2008) and syntax for the panel model depicted in Figure 3 was analyzed. Syntax and output for this model are included in the Appendix (see Supplementary Data).

The standardized results from DPT analyses with the simulated data are presented in Figure 3. The lagged effect of pain on negative mood (i.e., pain on the previous day affecting negative mood on the current day) is captured in the regression path from pain at time \( t-1 \) to negative mood at time \( t \), and this path is highly statistically significant (note that the lagged paths are interpreted in the same way regression beta weights are interpreted in SEM). Similarly, the lagged effect of negative mood on pain is represented...
in the path from negative mood at time \( t-1 \) to pain at time \( t \), and this path is also highly statistically significant. In terms of the autoregressive paths (i.e., the relationship between a variable and the lagged version of that same variable), both pain and negative mood had significant paths. It is also worth noting that the lagged relationships are similar for pain and negative mood; that is the standardized estimates for the cross-lagged relationships between pain and negative mood are similar (0.264 for the effect of lagged pain on negative mood and 0.251 for the effect of lagged negative mood on pain) and estimates for the autoregressive relationships were also similar (0.426 for mood and 0.435 for pain). Overall, the conclusions that we would draw from this model are that pain and negative mood have similar lagged relationships with one another over time, resulting in a bidirectional relationship between these two variables. Negative mood is positively associated with pain the next day (i.e., more negative mood is associated with a higher pain rating), and pain is positively associated with negative mood the next day (i.e., a higher pain rating is associated with more negative mood).

**Adherence Research and DPT**

Beyond the pain and mood example presented, many other areas of inquiry within pediatric psychology might benefit from the use of DPT to address core issues. To further demonstrate the potential usefulness of DPT, we discuss the possible application of this technique to the area of adherence. The study of adherence to medical regimens is an important area of inquiry within pediatric psychology and represents one of the core “cross-cutting” issues in the field (La Greca & Mackey, 2009). Despite a growing body of quality research in this area, adherence research has often tended to employ artificially static conceptualizations of this construct (Rohan et al., 2010). Composite adherence rates classifying youth adherence at a certain level (often represented as a percentage of instances in which a child is adherent) may simplify analyses but lose the variability of adherence across time (i.e., a child who is labeled as 50% adherent to a particular medication may be 100% adherent 1 week and then 0% adherent the next). Further, variability in adherence may be clinically relevant and may hold valuable information about the factors that affect adherence from day-to-day (Wu, Aylward, & Steele, 2010). For these reasons, studying patterns in adherence over time has been identified as an important goal for future research in this area.

Largely due to the recognition of the need to examine adherence more longitudinally, more dynamic representations of adherence have begun to emerge in the literature in recent years (e.g., Rohan et al., 2010; Stepansky, Roache, Holmbeck, & Schultz, 2010). However, such research presents numerous challenges such as the need to recruit large samples and retain a large percentage of those participants over time. DPT investigations, on the other hand, could study a small number of individuals, examining their adherence and the factors related to adherence through many repeated observations. Because many medical regimens for pediatric chronic illnesses require daily, or even multiple daily, behaviors (e.g., taking medication), large numbers of observations could be accumulated within a relatively short period of time. Along with measuring adherence behaviors each day (or more frequently, if appropriate) potentially related dynamic factors could be measured on the same schedule. For example, mood, psychosocial stressors, and various physical symptoms might affect day-to-day adherence in a reciprocating and interactive fashion (Gil et al., 2003), and these factors would be candidates for longitudinal study within a DPT framework. Within such a study, adherence on a particular day could be modeled as the outcome of these factors both on that particular day and in the days leading up to that day (measured using lagged effects). Similarly, the “momentum” of adherence from day-to-day could be examined by evaluating the autoregressive correlations of adherence over time. These questions would be difficult, or even impossible, to address within cross-sectional studies using collapsed adherence rates or even in longitudinal investigations in which adherence and related constructs are not analyzed at frequent intervals.

**Comparison to Other Methodologies**

In evaluating the potential usefulness of DPT to pediatric psychology research, a comparison to other small-N methodologies might be helpful. Perhaps the most apparent
methodologies for comparison in this genre would be applied to behavior analysis designs and clinical case studies (Drotar, La Greca, Lemanek, & Kazak, 1995). Applied behavior analysis methods, such as multiple baseline and reversal designs, are undoubtedly valuable approaches within pediatric psychology, particularly for demonstrating the effects of an intervention under well-controlled circumstances (Rapoff & Stark, 2008). However, p-technique provides an analytic strategy that may be more applicable in situations when tight experimental control is not possible (Cattell & Williams 1953; e.g., due to ethical concerns or in a more descriptive/non-intervention study). Similarly, DPT allows the researcher to examine covariances among numerous constructs as they naturally occur, rather than having to isolate and control one factor at a time. Further, p-technique allows for rigorous statistical examination, going beyond the “eye-balling” that is typical in applied behavior analysis. This may be particularly useful for investigations in which the interplay of factors is too complex to evaluate without statistical methods. However, rather than viewing applied behavior analysis and DPT as competing methodologies, it is possible that p-technique methods could be employed to add statistical rigor to already methodologically rigorous applied behavior analysis designs. In a similar vein, DPT may be useful in clinical case studies for quantifying the change process and examining potential mediators. Mediation analyses within a DPT framework require measuring three constructs and evaluating cross-lagged direct and indirect effects as one would within an SEM framework.

In addition to applied behavior analysis designs, other methods to examine dynamic interactions have also been published in JPP, such as time-window sequential analysis (Chorney et al., 2010). Similar to DPT, sequential analysis uses a lagged analysis; however, this method uses dichotomized outcomes; that is, whether the presence of a particular code (0 = nonoccurrence, 1 = occurrence) increases the probability that a “target” code will occur, whereas DPT examines the covariance between continuous outcomes and allows for one to model latent constructs consisting of multiple indicators. In addition to comparing DPT to other small-N methodologies, we should note multilevel modeling (MLM) as a useful analytic strategy for some longitudinal data. In studies with repeated measures, MLM models can be used to examine constructs within a dynamic framework and, depending on the number of observations over time, adequate power can be achieved with relatively small sample sizes (e.g., Valrie, Gil, Redding-Lallinger, & Daeschner, 2007). However, MLM models still require a greater number of participants than DPT analysis.

Limitations of DPT

Although we believe DPT holds considerable promise for certain types of pediatric psychology research, certain limitations should be noted. First, as with all small-N research, the generalizability of findings from p-technique analyses must be carefully evaluated. Just as case studies are often followed up with more large-group investigations to demonstrate generalizability, DPT evaluations may inform subsequent larger-scale projects. DPT, with its emphasis on micro-level individual change, may provide considerable guidance in these larger evaluations, making it an ideal technique for preliminary or pilot work. Second, DPT requires the researcher to be able to collect many repeated observations in a standardized way. Certain clinical phenomena may not lend themselves to such intensive, longitudinal investigation, and therefore may be more appropriately studied using more traditional techniques. Finally, DPT analyses focus primarily on cross-lagged and autoregressive paths rather than the shape and rate of change over time. For researchers interested primarily in shape and rate of change, more traditional longitudinal analyses such as latent growth curve modeling might be more appropriate (although they also require larger samples).

Conclusions

DPT is a flexible and powerful statistical approach that may be especially useful in pediatric psychology research. This technique can be used with small samples without surrendering statistical power and is well-suited to studying dynamic medical, behavioral, and psychological phenomena. Although it has not been widely used in pediatric psychology research to this point, numerous applications are possible in a variety of content areas within the field. Researchers are encouraged to consider opportunities to collect data that are appropriate for DPT analyses and, when such data are available, employ this analytic technique to capture dynamic patterns at the individual level.

Supplementary Data

Supplementary data can be found at http://www.jpepsy.oxfordjournals.org/.

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