The Person-Oriented Versus the Variable-Oriented Approach: Are They Complementary, Opposites, or Exploring Different Worlds?

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The present commentary gives a brief overview of the person-oriented and variable-oriented approaches, how they are commonly used in longitudinal research, and what one should take into consideration before using either approach. In addition to presenting an empirical example on girls' adjustment problems using both approaches, this commentary uses the contributions in the present issue of *Merrill Palmer Quarterly* to illustrate some of the main issues surrounding these two perspectives. Special attention is also given to the contrast between the person-oriented and variable-oriented approaches in terms of aggregation and disaggregation, model appropriateness and usefulness, and prediction as a goal. Future directions with regard to implementing a person-oriented approach are discussed, including the importance of conceptual clarity, practical and theoretical training, and method development.

The scholarly contributions to this issue of *Merrill Palmer Quarterly* included a person-oriented approach and a variable-oriented approach. Each article presented results using both methodological approaches when analyzing longitudinal data from a specific research area. In this commentary we focus on a discussion of what we perceive are the main issues involved when contrasting the person-oriented approach with the variable-oriented approach, many of which were raised in the contributions.

To provide a conceptual framework for our discussion, we will begin with a brief overview of the nature of the person-oriented and variable-oriented approaches, including tentative definitions at the theoretical and methodological level, how the two approaches are commonly used together

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for understanding development using longitudinal data, and the choice of approach in relation to the problem-method match.

We then discuss person-oriented and variable-oriented models from three perspectives: the evaluation of whether a model is appropriate or not, the importance of prediction as a scientific goal, and the issue of causality. Our discussion is complemented by examples from the contributing authors of the present issue of *Merrill Palmer Quarterly* and by our own empirical example, which deals with the development of girls' adjustment problems in school. This example illustrates many of the issues raised. Specific issues that may pertain to longitudinal developmental research are then discussed. It could be argued that the key information in longitudinal developmental research is the developmental trajectories of the individuals. This information can be regarded and treated in different ways, and we discuss three different aspects: the variable space, aggregation and disaggregation of trajectories, and identification of "missing" trajectories. We conclude by highlighting issues we believe have important implications for the future direction of person-oriented and variable-oriented approaches in longitudinal research.

Before we start the overview of the nature of person-oriented and variable-oriented approaches, a word of caution must be sounded on the different meanings given to the term "person-oriented" in the literature and also in the different contributions to this issue. Considering the complexity of this concept and the absence of a generally accepted definition of it, this is not surprising. It could be regarded as indicative of what Jack Block (2000) called the "jingle fallacy," where different researchers apply the same label to concepts that are not identical. More specifically, the jingle fallacy (Thorndike, 1904) refers to cases where the same term (in this case "person-oriented") is used for different entities (e.g., "focus on clusters based on individual patterns" or "focus on the study of the single individual"). The jingle in "person-oriented" is indeed evident when one looks at the array of different usages of the concept. For some time to come we will have to live with this, as will be elaborated on in our discussion section. However, to avoid confusion it is then important that the researcher is explicit about how the concept is being used. Definitional issues of the concepts "person-oriented" and "variable-oriented" are discussed in the first section.

The Nature of the Person-Oriented and Variable-Oriented Approaches

Von Eye and Bogat's Conceptualization of the Person-Oriented and Variable-Oriented Approaches

It was pragmatic of von Eye and Bogat in their contribution when they demarcated their conceptual framework for each of these approaches in

relation to several different theoretical approaches in the literature. Their definition was extensive, including, among others, theoretical aspects from Hans Eysenck's personality theories, work by Bergman and Magnusson on the person-oriented approach, and more methodological aspects especially related to data aggregation. In their six tenets for the person-oriented approach, von Eye and Bogat state that the individual's structure and dynamics of behavior are partly unique to that particular individual. Furthermore, because of the complexity, many factors and their interactions need to be taken into account. In spite of this complexity, they stress the existence of lawfulness and structure of development, which is best described by patterns of the involved factors. Often only a limited number of patterns tend to emerge as typical patterns. Specifically, an important issue raised by von Eye and Bogat was aggregation of habitual reactions that has taken place when moving up from that habitual level to the level of personality characteristics, creating scales or variables measuring inter-individual differences. In this way, variables are constructed that may not mirror the basic information at the individual level. Their argument appears valid and implies that the conventional use of standard variables as components in patterns studied in the person-oriented manner can be problematic in that an uncompromising person-oriented approach could lead to a different way of structuring the basic observations than that offered by applying standard variable-oriented methods (such as item analysis and factor analysis) for the purpose of constructing scales.

To a certain extent, von Eye and Bogat's measurement issue parallels that of Magnusson when he discussed different measurement models in both approaches (Bergman, Magnusson, & El-Khouri, 2003). The contribution by Bornstein, Gini, Suwalsky, Leach, and Haynes also touched upon this point. Although von Eye and Bogat gave weight to the undivided pattern of information as a characteristic of the person-oriented approach, they stressed to a higher degree the focus of the person-oriented approach on carrying out research in a manner that the results are interpretable at the individual level, regardless of whether the statistical method used is based on patterns or variables.

Our Definitions of "Person-Oriented" and "Variable-Oriented"

We will now elaborate on our definition of the person-oriented approach, which is grounded in the holistic-interactionistic, metatheoretical paradigm as developed by Magnusson (Magnusson & Törestad, 1993). According to this paradigm, the individual is an active agent in the person-environment system. The system is hierarchical and must be studied by carefully separating its different levels (from the molecular to the global). At each level, the system functions as an integrated, organized totality that is formed by

the interactions among the elements, and the totality derives its meaning from these interactions and all elements considered simultaneously (Magnusson, 1990). Magnusson also introduced the concept of the person-oriented approach and developed it theoretically together with Bergman (Bergman & Magnusson, 1997; Magnusson, 1988, 1999).

Within the Magnusson-Bergman tradition, a "person-oriented" approach is one in which the focus is to understand development at the individual level by regarding the individual as a functioning whole with processes operating at a system level and its components jointly contributing to what happens in development. By "components," we mean, for example, behaviors, biological factors, perceptions, goals, and values, among other aspects that make up the structure of the individual. The components of interest will vary with the specific system under study. Of course, no one can study the totality of the organism in a single study.

Considering the involved components all together and the principles guiding their evolvement as a system over time, on a developmental time scale, is the essence of the *theoretical* aspect of the person-oriented approach. It should be noted that although in a person-oriented approach one talks about components, they have no meaning in themselves and are only interpretable as parts of a goal-directed process where they are inextricably interwoven and believed to interact. The *methodological* aspects of the person-oriented approach focus on identifying a subsystem relevant to the problem under study, measuring its components, and studying them all together as an undivided whole, which is often done by applying some type of pattern-oriented approach.

Our definition of the variable-oriented approach also differentiates between the theoretical level and the methodological level. At the *theoretical* level, the theories are developed by considering the basic concepts as variables whose developmental importance usually is indicated by statements about (causal) relations between these variables. At the *methodological* level, this implies an interest in measuring the relevant variables and studying their relations across time, which is often done by using linear statistical models.

It is clear that the person-oriented and variable-oriented approaches are different, both theoretically and methodologically. One could sum up the essential difference between them by saying that one approach takes a holistic and dynamic view of the individual as an integrated totality over time, whereas the other approach views the individual as a summation of variables over time (Magnusson & Allen, 1983). From our standpoint, one could also posit that the two approaches are used to study the individual from two different worlds.

Common Combinations of Person-Oriented and Variable-Oriented Approaches

In actual research, things are seldom as clear-cut as in the delineation indicated above. Various hybrids between person-oriented and variable-oriented approaches are common, including the following:

1. Accepting a theoretical conceptualization that is to some extent person-oriented, in that a process perspective is applied that may imply interactions and nonlinearities, but carrying out the statistical analyses using a standard variable-oriented approach. This is perhaps the most common situation, and it is exemplified by the variable-oriented analyses made in many of the contributions to this issue.

2. The study of the single individual using variable-oriented methods, for instance p-technique correlations. Here, the single individual is at focus and the dynamics of the individual's development are believed to be captured by, for instance, applying linear models using variables varying across time from the same individual (Jones & Nesselroade, 1990; Nesselroade & Jones, 1991). We have no example among the contributions of this type of approach, which is truly individual-based. It becomes completely person-oriented if, instead of variables, patterns of variable values are treated as the basic analytic unit.

3. The study of interindividual development using a method where one first searches for typical multivariate patterns believed to reflect the system at a given time point or at all time points and then studies how they evolve. To the extent this is done within a person-oriented theoretical framework and these typical patterns reflect each individual's pattern, this approach is truly person-oriented. An example of this approach is found in the contributing article by Asendorpf and Denissen when they look at the long-term predictive validity of early personality types for later personality, intelligence, and relationship outcomes at age 17 and 22. Another example of this approach is evident in the contribution by Bornstein and colleagues when they search for clusters representing typical patterns of emotional availability in their two-step cluster analyses where they attempted to find clusters that focused on short-term stability by using as input in one and the same analysis a value pattern based on data from two time points, separated by 1 week. And yet another way of studying typical patterns was illustrated by the contribution by Laursen, Furman, and Mooney. At each age, they identified typical patterns of social support by first categorizing each of the three support variables and then used configural frequency analysis to indicate which of the 12 resulting three-variable patterns occurred more frequently than expected by chance. Identical typical patterns occurred at the two ages, which indicates structural stability. These typical patterns also

showed individual stability, since the subjects tended to stay in the same typical pattern across 2 years.

4. The study of interindividual development by searching for typical univariate developmental patterns, often done using methods originating within the latent growth curve tradition. If it can be assumed that the key aspects of the studied system can be represented by a single dimension, this approach could be characterized as person-oriented. Such an approach is exemplified in the contribution given by Lyytinen and colleagues, where a single latent dimension of "reading-related factors" was assumed to reflect the trajectory of interest.

5. The combination of variable-oriented and person-oriented methods applied to the same sample. In a way, this is done in most of the contributions, since the overriding topic of this issue is to compare the two approaches. A more clear case is the integration of person-oriented and variable-oriented methods in a coherent set of analyses, as exemplified by Connell, Dishion, and Deater-Deckard, where a mixture model approach was used to find developmental types of substance use and then predictors of them were studied. Another example is given in Hirsh-Pasek and Burchinal when they studied mother and caregiver sensitivity over time by applying hierarchical linear models and by identifying trajectory groups using a method developed by Nagin (1999). By using trajectory information, they predicted language and academic outcomes. They argued that the hierarchical linear model or variable-oriented method appeared to give the most useful results for predicting the outcomes. They ascribe this result to a lack of qualitatively different trajectories identified by the trajectory group analysis or person-oriented method they applied, but they point out that a person-oriented methodology could be more useful when there are qualitatively different trajectories. This is a reasonable conclusion, and qualitatively different trajectories are presumably much more common in the case of studying multivariate developmental trajectories than in the case of studying univariate ones, which they investigated.

Matching the Method to the Problem

Matching the method for analysis to the scientific problem under investigation is of paramount importance. It has been mentioned many times that there is a frequent mismatch in empirical developmental research between, on the one hand, theories based on complex dynamic processes, mechanisms, interactions, mutual causality, nonlinear relations, and the like (i.e., a rather similar perspective to the person-oriented approach theoretical rationale), and, on the other hand, using variable-oriented statistical meth-

ods for analyzing the data that do not take these aspects into account, such as the standard application of methods for studying linear models (Bergman & Magnusson, 1997; Richters, 1997). This inconsistency should be taken seriously and it provides a strong argument for considering using a person-oriented approach in a number of settings.

In this issue, examples are given of how to better align problem and method as well as how to include elements of the person-oriented approach framework in one's research. We hope this will spur further research along these lines. However, we think that, although they should be commended for their contributions, the authors collectively would be the first to admit that they would have liked to do more but that there were obstacles.

One of the obstacles to a more advanced and sophisticated application of the person-oriented approach is obscurity. Frequently, in developmental psychology there is a vagueness of guiding theories and a lack of precise ideas of how the studied system operates. Rarely, mechanisms are identified that could be expressed by a sound, albeit tentative, quantitative model. This is natural, considering the highly complex phenomena under study and the incomplete knowledge we have today in most fields. But it often precludes precise predictions and the construction of realistic mathematical models of the phenomena under study, which, if possible, is highly desirable (Meehl, 1998). One often has to make do with "box and arrows" models that are far removed for the dynamics believed to drive development and which are difficult to use as starting or reference points for person-oriented theory building and empirical research. The vagueness in the theoretical arena also hampers the possibilities to find appropriate methodological tools, especially within a person-oriented framework. In each field, one simply has to do the best one can, starting with the available theoretical framework, but the most important long-term goal must be to develop more precise and testable theories of the mechanisms that drive development. These hypothesized mechanisms can then, depending on the specific situation, be tested using a person-oriented or a variable-oriented approach.

It is interesting that, from an epistemological standpoint, there are some similarities between the situation just described and the situation in the field of epidemiology. Within epidemiology, complex phenomena are also studied developmentally in non-experimental settings, and, like developmental psychologists, epidemiologists often have to resort to less precise theories and to statistical models of the data for the purpose of summarizing the observations and relating them to a theory. Like developmental psychologists, they cannot, in most cases, really explain the processes under study. An interesting difference between developmental psychology and epidemiology, however, is that the input used for epidemiological theory

formulation comes in many cases from fairly well understood and more fundamental physiological systems aided by, for example, biochemical knowledge and results from controlled experiments using animal models (e.g., their basic understanding of the physiological aspects of cancer and of certain causal factors of it helps in studying its risk factors). It is often much more difficult for developmental psychologists to specify basic subsystems that are of importance for the whole system under study and that can be studied in detail and reveal mechanisms that are helpful in generating hypotheses. Increased efforts along these lines seem necessary.

Another issue that is an obstacle to a more advanced and sophisticated application of the person-oriented approach is the comparatively underdeveloped methodology for carrying out person-oriented analyses where the individual is in focus and multivariate patterns are studied as wholes. Presently, there is a useful tool chest for this purpose, but new and improved methods urgently need to be developed. For instance, the weakness of many person-oriented methods (e.g., cluster analysis) in not adequately handling errors of measurement needs to be addressed. However, the success of most variable-oriented methods in this respect should not be exaggerated, since the assumptions about the errors made by these methods are often not very realistic. Hirsh-Pasek and Burchinal's conclusion that their data better matched the model assumptions of their variable-oriented approach than of their person-oriented approach deserves to be discussed from these viewpoints.

Person-Oriented and Variable-Oriented Models

The brief discussion of the problem-method match just given brings to the foreground the issue of comparing person-oriented and variable-oriented models. This is done in three respects: with regard to how the appropriateness of a model is to be ascertained (partly an extension of the previous section), with regard to the role of prediction as a scientific goal, and with regard to causality.

Evaluating the Appropriateness of a Model

In variable-oriented analyses, often an explicit statistical model of the data is applied that can be tested and that also includes error terms in the model. This can also be the case in more person-oriented analyses, for instance, if mixture modeling or latent transition analysis has been used for the analyses. In a less developed form, a method based on cluster analysis also can provide a model, since the clusters typify the data at the pattern level, and

the success of the analysis to summarize the relations in the data can and should be studied.

However, what has just been said paints too simplistic a picture. Let us take the variable-oriented case. Assume that you have applied, for instance, a structural equation model, examined the fit of it to your data, and found out that the results lead to a rejection of the null hypothesis and that the model is considered to be not true. The results you obtained can then be difficult to interpret. First, sample size is important for the power to reject a false model, since a small sample increases the risk of not being able to reject a false model and since a large sample (almost always a good thing to have) increases the risk of rejecting a good but not perfect model (yes, this can be regarded as a risk since a model is never totally accurate). Partly to counter these problems, various fit indices have been developed (Bollen & Long, 1993). Different models may also fit the data equally well, and good fit does not necessarily mean a model is valid. These are well-known considerations in the structural equation modeling literature, and the frequently given advice of concentrating on comparing two or more realistic model alternatives rather than focusing on the fit of a single model appears to be sound (see, e.g., Bollen, 1989, and Jöreskog, 1993). These issues deserve more consideration than they are usually given in empirical research, especially when one is working with a limited sample size as well as many parameters to estimate. It can also be problematic to accept a model with large random error components and a low level of explained variance but which fits the data well. It could be argued that modeled error is still error, and that large error components indicate that the model does not explain the data. Depending on the specific situation, this may or may not be acceptable.

Structural equation model fit is usually tested by examining if the model can reproduce the correlation or variance-covariance matrix. Such matrices are not the basic data, and the observed model fit to such matrices only reflects the "true" fit of the model to data to the extent that the linear correlations adequately reflect all important properties of the data (Bergman, 1988). If a person-oriented theoretical perspective is accepted, this assumption may be judged to be unrealistic and, for instance, higher-order interactions believed to prevail, as demonstrated by von Eye and Bogat's example of Meehl's paradox given in their contribution.

With regard to types as models of data, one cannot solely go on the success of the classification in summarizing the individuals' value patterns. As pointed out by Asendorpf and Denissen in their contribution, there has to be a trade-off between the precision in the categories, as reflected by the homogeneity of the subjects within each category, and the simplicity and theoretical meaningfulness of the classification. Validity aspects should

also be considered when evaluating the types if one wants them to express something more than a summary of patterns in data, as exemplified by the work done by Asendorpf and others to validate the RUO personality types (resilient, undercontrolled, and overcontrolled; Asendorpf, 2003). This line of reasoning is strongly advocated by Meehl and his colleagues when they suggest procedures for finding what they call "natural clusters," by which they approximate mean classes that are not just good summaries of multivariate data but also exhibit validity and generalizability (Meehl, 1992; Waller & Meehl, 1998).

For a statistical model to be theoretically informative, it must be constructed in such a way that its characteristics match the important aspects of the theory and its parameters are interpretable in a theoretically meaningful way. We argue that today this is rarely the case if a process-oriented theoretical perspective is applied. For instance, parameters are seldom included in statistical models that mirror the size and discontinuity of interactions in continuous time. Below we will argue that such considerations may be more important than considerations about predictive power.

Prediction and Understanding Need Not Be Related

One way of comparing the usefulness of person-oriented or variable-oriented approaches that is sometimes followed is to compare how well each approach allows you to predict important phenomena. Indeed, some regard predictive power as the main criterion. One such approach is elaborated in the contribution by Asendorpf and Denissen, where they used regression analysis to compare the predictive power of personality types and dimensions. The criteria to be predicted were measured at ages 17 and 22 and concerned personality, quality of relationships, and intelligence. In general, both personality types and dimensions predicted a broad range of outcomes. In the instances when the variable-oriented approach produced somewhat better predictions, the squared correlations were not significantly increased when types were added as dummy variables after the Big Five factors in the regression equations. When the order of entry was switched, the Big Five Factors often gave a significant additional contribution to the prediction. These results are interesting, since they concern very long-term predictions, which are a precious commodity in empirical research. In some cases the person-oriented approach did well and the authors concluded that profile form may be in some instances more stable than levels of values in single variables. They imply that types then may be more useful for long-term predictions than for predictions in a cross-sectional or short-term longitudinal setting. These results and others in the

same tradition presenting a fairly equivalent view (for a review see Asendorpf, 2003) add to our understanding of one aspect of the usefulness of the person-oriented approach relative to the variable-oriented approach.

However, predicting a phenomenon well does not necessarily imply understanding the involved developmental mechanisms—and vice versa, understanding them does not always imply that the phenomenon can be well predicted. Predictive power should not be the overarching criterion for judging the usefulness of a scientific approach. As Magnusson (1998) pointed out, the overriding criterion should instead be whether the approach helps you understand the developmental process. You may succeed in predicting a phenomenon (which is of obvious value from an applied viewpoint) without it having any general scientific value (e.g., finding a complicated regression equation that well predicts vocational success in a specific setting but cannot be generalized). Likewise, you can have a good understanding of a phenomenon without being able to predict it well (e.g., a well-functioning dynamical system model that indicates a system characterized by chaos for certain ranges of parameter values, such as a set of differential equations describing long-term weather behavior). Considering the complexity of the nonlinear and sometimes chaotic relations within and between individual subsystems and the environment, it can be unrealistic to expect to precisely predict an individual's behavior across contexts and over long time periods (Magnusson & Stattin, 1998). It may even be completely impossible to the extent that chaos factors are involved, but we may in spite of this learn to understand much about the developmental process, including knowing what we cannot predict and why that is the case. In this context, it is interesting to note a *third source of influence,* in addition to genes and environment being some chaotic variation at all phenotypical and behavioral levels that may contribute to an inherent unpredictability (Molenaar, Boomsma, & Dolan, 1993).

When judging the usefulness of a model, an important consideration is its simplicity and clarity. Obviously, this type of consideration is related to the aspect of understanding just mentioned. As an example, take a case where the power of a person-oriented approach and a variable-oriented approach to predict an outcome are compared as a means of evaluating the differential merits of the two approaches. The predictive power must then be weighted against the simplicity and general applicability of the models produced by the two approaches. For instance, a system defined by a number of continuous variables, that is summarized by one categorical variable with a small number of categories, and that describes the individuals' value patterns well, provides a powerful and simple model of the relationships in the data. If it holds across samples and shows stability over time, it also can

be used to generalize. If, by using this approach, one can predict important phenomena almost as well as when applying, for instance, a complicated linear model with many variables using the original dimensional data, the classification model may be preferable from a theoretical scientific perspective.

In this context, Casti's (1989) distinction between a simulator and a "true" model, where a simulator might allow for (slightly) better predictions than a "true" model, is relevant. The simulator, however, is more complicated, and its properties are more difficult to interpret in a meaningful way in relation to theoretical conceptualizations of the system under study. The essential properties of a simulator would also tend to be more tied to a specific set of observations and more difficult to generalize—in contrast to a "true" model, which, we believe, should be more generally applicable. Casti gave the example of comparing Ptolemy's epicyclical and Copernicus's elliptical models of the solar system. Although the former one, with Earth as the center, generates at least as good predictions of planetary motion as the second model, it is a simulator because it is much more complex and must be reformulated to incorporate observations of newly discovered planet-like objects. The example of Ptolemy's model of the universe may seem excessive, but we believe it is useful in order to make a point. Moreover, it should not be interpreted that we imply that a variable-oriented dimensional approach always creates more of a simulator than of a "true" model as compared to a person-oriented classification approach.

Understanding Causality in Context

It is often difficult to discuss prediction without taking up causality, since the concepts are to some extent related. Most causal models in the behavioral sciences imply predictability, but, of course, the opposite need not be true. A person-oriented view complicates the interpretation of causality in non-experimental settings (for discussions on causality from a variable-oriented perspective see Cook & Campbell, 1979, and Sobel, 1996). From a person-oriented perspective, it is usually meaningless to isolate one factor and say it causes another. This would imply that the system is constructed in a way that it is conceivable to change, for instance, X by one unit to see what happens to Y. However, the components are inextricably interwoven and you cannot normally change X without changing both Y and Z, and if Y and Z were changed, X would also be changed in a feedback loop. To give an example: Assume that you want to study the causal relation between the quality of one's relationship with parents and later social adjustment and that, in a variable-oriented analysis, you construct a linear model and inter-

pret the structural equation regression coefficient between the two variables (after controlling for other relevant factors) as an indication of the causal effect. You would then interpret the size of this coefficient as, *ceteris paribus,* indicating the effect of change in the first latent variable on change in the other latent variable. From a person-oriented perspective this is problematic, since one cannot usually assume, in such a system, that it is possible to conceive a change in the relationship with parents for constant levels in the factors you want to control for, since these factors interact dynamically with the relationship with parents and will normally change as the relationship with parents change. In other words, they operate together as a whole, and the idea that you can keep them constant to isolate the effect of parent relations is simply not credible. In this context, the person-oriented and variable-oriented approaches are clearly opposite.

Empirical Example: The Development of Girls' School Adjustment Problems

Background

To help clarify many of the points we made, we provide an empirical example that is similar to many of the contributions in this issue in that an example of each type of approach is used on the same longitudinal data set and the usefulness of the person-oriented approach and the variable-oriented approach that were employed are compared. We, however, especially want to examine the complex relation that can exist between understanding and predicting a phenomenon and how this relation can be contingent on whether a person-oriented or a variable-oriented approach has been applied for analyzing a longitudinal data set.

For comparative purposes it is natural to partly model our study after the one presented by Asendorpf and Denissen in their contribution, since, like them, we also want to compare the predictive power of the two approaches, that is, to compare the predictive power of the Time 1 continuous variables to that of Time 1 clusters summarizing the information contained in the value patterns in the continuous variables. This is done by using linear regression analysis with an outcome at Time 2 as the dependent variable and with either Time 1 continuous variables as predictors (variable-oriented prediction analysis) or Time 1 dummy-coded cluster membership as predictors (person-oriented prediction analysis). The squared multiple correlations were then compared between the two types of analyses. However, we also particularly stress the aspect of the understanding of the phenomenon that is obtained by the two approaches. This necessitates a more in-depth analysis

of the findings produced by the two methods. We extended the analyses in three ways. First, we studied the quality of the classification produced by the person-oriented analysis, both with regard to how well it represented the individual patterns and how stable it was across time. Second, we also compared the predictive power of the person-oriented and variable-oriented models (clusters vs. regression weights) when the criterion for predictive power was changed from the customary proportion of the total variation explained (i.e., R^2) to another measure of predictive power, namely the proportion of the total absolute deviations around the mean that was explained. And third, we repeated the analyses with another set of outcome variables that were coded for typical outcome patterns. These patterns reflect a person-oriented approach to summarizing the information at the dependent, outcome side.

Sample and Variables

We chose an empirical example dealing with the study of the development of girls' school adjustment problems using data from the longitudinal research program Individual Development and Adaptation (IDA; Magnusson, 1988). This sample is useful as a data base for analyzing many person-oriented scientific problems dealing with individual development, since a basic concern guiding all data collections in the IDA program is that individual development is a dynamic process and that in order to understand the process we must try to identify relevant patterns of factors operating in the process of human ontogeny as well as the mechanisms by which they operate (Magnusson & Bergman, 2000). The first IDA data collection was carried out in 1965 on three school-grade cohorts (third, sixth, and eighth grades) of boys and girls in an entire community. Over 1,000 children were studied in each cohort. The third graders, age 10, were referred to as the main group and have been followed throughout their school years and into middle age with very low sample attrition. They continue to be followed. The main cohort girls at ages 10 and 13 will be the focus of our example.

For this illustration we were especially interested in the role of inhibition in relation to externalizing problems in the process of the development of school adjustment problems. The theoretical framework was taken from a similar study of the development of boys' school adjustment problems (Bergman et al., 2003), although, to simplify and concentrate on the essential methodological issues, we reduced the number of variables under study. The following four variables were studied: aggression, motor restlessness, low school motivation, and inhibition. They were all based on classroom teachers' ratings produced at age 10 and at age 13. The variables were

measured on seven-point scales (1–7, with 7 meaning an extreme expression of the characteristic under study). For example, a teacher rated each girl on aggressiveness from "(1) She works in harmony with the teacher and has positive contacts with classmates. Her relationships to others easily become warm and affectionate," to "(7) She is aggressive against teachers and classmates. She may, for example, be impertinent and impudent, actively obstructive or incite to rebellion. She likes disturbing and quarreling with classmates." Motor restlessness, low school motivation, and inhibition were rated similarly. Between the first and the second measurement points, all girls had new classroom teachers. Only girls with complete data from both ages were included (n = 460 girls, 90.2% of all girls that belonged to the cohort at age 10).

Statistical Methods and Findings

LICUR (Bergman, 1998; Bergman et al., 2003) provided the main tool for the person-oriented analyses. The first step in LICUR is to identify and remove unclassifiable individuals. A residue of multivariate outliers at each age is then identified and brought to a residue. Afterward, only the nonresidue subjects are used in the main analyses. Using standard parameter settings in the RESIDUE module of SLEIPNER, our statistical package for person-oriented analysis (Bergman et al., 2003), one residue object was identified at age 10 and none at age 13. The residue subject was removed, and all further analyses were based on the 459 subjects with complete data.

In the second step, cluster analyses of the value profiles in the four variables were carried out for each age separately. This was done using Ward's method based on standardized data for finding a classification that maximized the explained variance. For this purpose, the CLUSTER module in SLEIPNER was used. Applying LICUR criteria, an eight-cluster solution was chosen at both age 10 and age 13 (at age 13 a nine-cluster solution was equally appropriate, but this is not a critical issue). Both solutions were well functioning with explained variances of, respectively, 68.4 and 67.6% and with homogeneity coefficients for the clusters ranging between 0.38 and 0.96, all below one, which often is indicated as an upper limit for an acceptable homogeneity (for details, see Figure 1).

In the third step, the classifications were linked across time. Structural stability was studied by comparing the cluster means in the four variables (i.e., the centroids) between ages to establish the degree of similarity between the clusters obtained at the different ages. To do this, the clusters had to be matched one-to-one between ages, and for this purpose a matching procedure developed by Bergman (1998) was used with the analyses

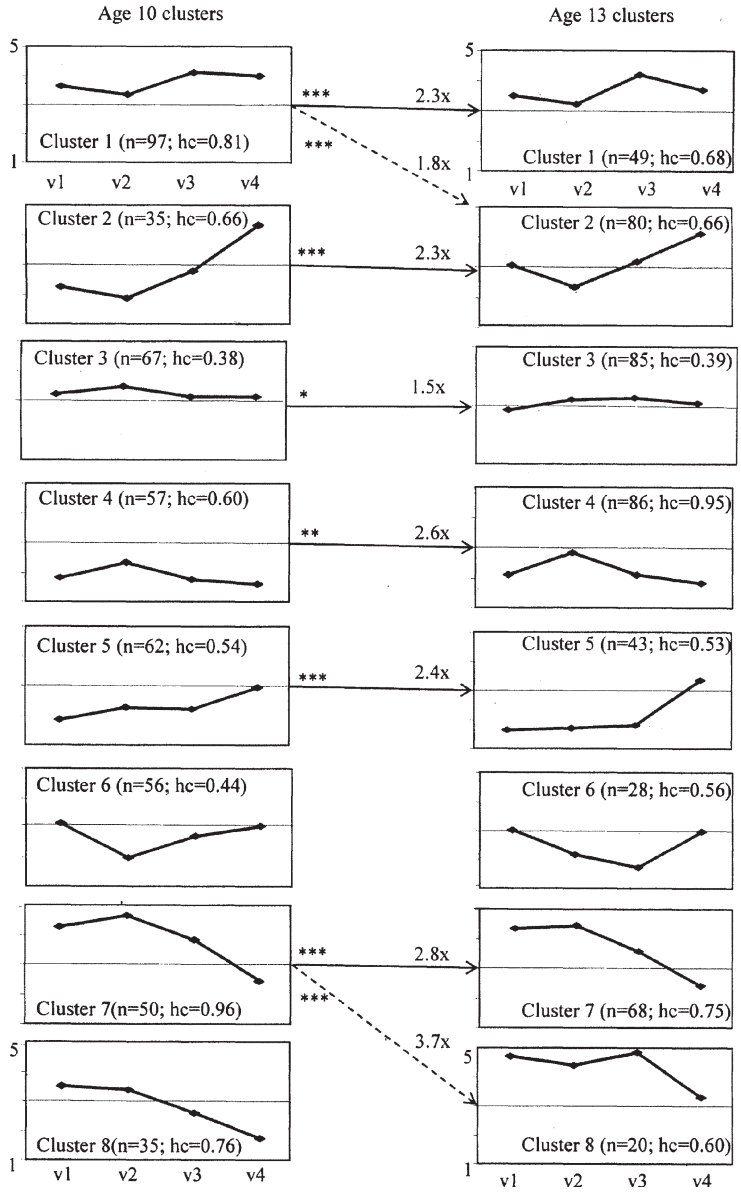

Figure 1. Graphical illustration of the girls' cluster means (*z*-scores + 3) at ages 10 and 13 and the links across age ($N = 459$). *Note.* v1 = aggression, v2 = motor restlessness, v3 = low school motivation, v4 = inhibition, and hc = homogeneity coefficient. Full arrows indicate significant developmental stability, and dotted arrows indicate significant change across age. $^{*}p < .05$, $^{**}p < .01$, and $^{***}p < .001$ when testing for significant developmental streams using an exact hypergeometric test.

carried out using the CENTROID module in SLEIPNER. The CENTROID module matches each cluster centroid in one solution with the most similar cluster centroid in the other solution. The outcome was a set of eight paired centroids of decreasing similarity. Five cluster pairs matched closely across age (Cluster 1 to 5) with averaged squared Euclidean distances (ASEDs) below .18 and two cluster pairs matched fairly well (Cluster 6 and 7) with ASEDs of .26 and .28, respectively. The eighth match (Cluster 8 at age 10 and 13) was poor with an ASED of 2.49. In general, this indicates structural stability for seven of the eight clusters.

Finally, the cluster solutions were cross-tabulated to look for individual stability and change of cluster membership by performing exact tests on single cells in two-way contingency tables by using hypergeometric probabilities. For this purpose, the EXACON module in SLEIPNER was used.

The results of the cluster analyses and the linking of clusters over time are shown in Figure 1. Figure 1 is information dense, and only certain key aspects of the results that are relevant to the methodological points we want to make will be commented upon. In the figure, each line graph represents a cluster illustrating plotted z+3 scores for the cluster means in aggression (v1), motor restlessness (v2), low school motivation (v3), and inhibition (v4). The first column represents clusters at age 10 and the second column represents clusters at age 13. It is seen that, for instance, a cluster especially characterized by inhibition and low school motivation not only emerged at both ages but also showed significant individual stability (Cluster 1). It was 2.3 times more likely than expected by chance that if a girl started in Cluster 1 she would also end up in this cluster. There was also a significant individual change in that more often than expected by chance a girl who started in Cluster 1 would end up in Cluster 2, also characterized by high inhibition but with no other adjustment problem being above the average level. Together with the individual stability for Cluster 2, the results indicate that stable high inhibition was a strong feature of the results. Another interesting finding about structural and individual stability was that a typical pattern emerged that was characterized by generalized adjustment problems but with inhibition being below average (Cluster 7), perhaps indicating a strong tendency for externalizing problems to come together in a syndrome and low to moderate inhibition being a promotional factor for this syndrome.

In our opinion, the person-oriented analysis provided information about longitudinal relations at the pattern level that are of theoretical relevance and that could not be arrived at by standard variable-oriented analyses. For the present purpose it is perhaps sufficient to summarize the findings as indicating that a successful classification of the four variables was obtained at both ages and that it showed a reasonable degree of both struc-

tural and individual stability. The classifications at both ages seem to be useful for developmental analysis, and, specifically, the classification at age 10 thus shows promise of being useful for predictive purposes and for comparing the predictive power of the variable-oriented and person-oriented approaches in this context.

With regard to the variable-oriented predictive power, we first considered behavioral stability between age 10 and age 13 by computing the stability coefficients for the four variables. They were .42, .50, .51, and .44, respectively, indicating a moderate level of stability. Second, a standard variable-oriented method was applied, using multiple regression analysis with the four continuous variables measured at age 10 as the predictors and each of the variables measured at age 13 as the outcome. The results are summarized in Table 1 in terms of the proportion of explained variance. To examine the comparative predictive power of the person-oriented method (i.e., of using the clusters for prediction), parallel analyses to the above were made but with the independent variables instead being dummy variables, coding for cluster membership at age 10 (seven dummy variables coded for the eight clusters). The significance of the change in R^2 was also reported when the dummy-coded clusters were added as predictors to the four continuous variables, and vice versa. To make the results less bound by the method for measuring the quality of the prediction, predictive power

Table 1. Squared Multiple Correlations When Predicting the Age 13 Outcome From Age 10 Data Using Multiple Regression Analysis

	Age 13 (Dependent variable)			
Age 10 (Independent variables)	Aggression	Motor restlessness	Low school motivation	Inhibition
The four continuous adjustment variables	.23	.29	.28	.22
The seven dummy variables coding for cluster membership	.23	.25	.24	.13
All eleven variables	.25	.32	.30	.24
Significance of increase in predictive power when adjustment variables are added to clusters	**	***	***	***
Significance of increase in predictive power when clusters are added to adjustment variables		***		

Note. All squared correlations are significant at $p < .001$.

$p <$. 05, ** $p < .01$, and *** $p < .001$ indicate the significance of the change in the squared correlation.

Table 2. Proportion of Explained Absolute Deviations When Predicting the Age 13 Outcome From Age 10 Data Using Multiple Regression Analysis.

	Age 13 (Dependent variables)			
Age 10 (Independent variables)	Aggression	Motor restlessness	Low school motivation	Inhibition
The four continuous adjustment variables	.14	.18	.18	.08
The seven dummy variables coding for cluster membership	.14	.15	.16	.04
All eleven variables	.15	.19	.20	.09

was also measured by the proportion of the absolute deviations explained by the regression equations (Table 2).

It is seen in Table 1 that the predictive power, as measured by R^2, was equal for both methods when predicting aggression at age 13 but with a slight advantage for the variable-oriented method for motor restlessness and low school motivation, and a considerable advantage for inhibition. In no case was the predictive power high. As seen in Table 2, when instead of R^2, the proportion of explained absolute deviations was used as a measure of predictive power, the same picture emerged but both methods did even more poorly, explaining less than 20% of the absolute deviations.

In additional analyses, the outcome variables (i.e., age 13 variables) were treated as a pattern reflecting the outcomes of the system under study. They were described by the age 13 clusters, and membership in each cluster (dummy coded) was treated as a dependent variable and predicted by (1) logistic regression analysis with the four continuous predictor variables as the independent variables (variable-oriented approach) and (2) logistic regression analysis with dummy-coded age 10 clusters as the independent variables (person-oriented approach). Neither method showed any appreciable predictive power. Although the Nagelkerke R^2 values were significant in most cases, they were low (ranging between .03 and .28) and were equally often larger for one method than for the other. In no case did the logistic regression improve on the number of correct predictions that could be made by simply predicting that everyone did not belong to the cluster.

To sum up, when applying the proportion of explained variance as the measure of predictive power and a single outcome variable as the outcome, our results indicate that the variable-oriented approach had slightly higher predictive power than the person-oriented approach. However, this should

not be interpreted as indicating a superiority of variable-oriented approach over person-oriented approach in these cases, even if one were to regard predictive power as central. It seems that in most cases the person-oriented approach gave almost as good a prediction using a much simpler model of the data (one categorical variable with a small number of different categories) as the variable-oriented approach gave using the full dimensional data. A similar finding was reported in the contribution by Asendorpf and Denissen when they pointed out that although their analyses were in favor of the variable-oriented approach using five dimensions, the person-oriented approach using only two personality types still fared well.

Interestingly, in our example, when the outcome was changed from a single variable to a pattern, the advantage of the variable-oriented approach completely disappeared and no method was useful for linear prediction at either age. This result is noteworthy. The results in Figure 1 showed that there were strong and significant developmental streams between most clusters—yet this did not show up in demonstrated linear predictive power. According to the method used for measuring predictive power, neither using the ordinary variable-oriented approach with all four continuous age 10 variables as the predictors nor using a person-oriented approach with dummy-coded age 10 clusters as predictors resulted in useful predictions of typical patterns at age 13. We would argue, however, that the results reported in Figure 1 increase our understanding of the structuring of the adjustment problems as patterns and their developmental connections—in spite of the fact that no linear predictive power worth mentioning could be demonstrated by standard approaches. That is, it is a case of not being able to predict phenomena but of partially understanding them.

Some Aspects of Developmental Trajectories

The Variable Space

In most studies of developmental trajectories, univariate trajectories are studied, often by applying some form of latent growth curve modeling. As we previously pointed out, if attempts are made to move away from studying the average curve to studying individualized trajectories—for instance, allowing for different classes of subjects to follow different typical trajectories—then, in a way, the approach can be regarded as person-oriented. It can be a natural approach if the appropriate focus of the study is on development in a single dimension of overriding importance and on factors that relate to this development, but the approach can also provide a starting point for the analyses in other situations. From a person-oriented theoreti-

cal perspective, however, we would often expect the system to be studied across time to consist of many key factors whose pattern development is the object of study. However, adequately modeling the full complexity of such multivariate developmental patterns is difficult. For instance, it cannot be done by simple extensions of univariate latent trajectory analysis. Some simplified model must be found that retains the essential developmental structures of the multivariate data. An example of such a model can be the earlier-described LICUR approach in which *first* at each age a classification is made of the multivariate patterns at that age into typical patterns, and *then* class membership with regard to what typical pattern an individual belongs to is linked between adjoining ages. One must be willing to assume that the essential aspects of the multivariate pattern development are captured by this stepwise age change in typical pattern membership and that, when explaining the typical pattern memberships at Time k, it is sufficient to consider the typical pattern memberships at Time k-1 and that the influence of earlier typical pattern memberships from Time k-2 and backwards is completely channeled by the Time k-1 information.

Aggregation and Disaggregation

In their article in this issue, von Eye and Bogat discussed the person-oriented approach and variable-oriented approach from the viewpoint of statistical aggregation, expounding the dangers of interpreting results of aggregated analyses as valid at the disaggregated level and arguing that a person-oriented approach, properly applied, is a way of circumventing the ecological fallacy. Their points are amplified by Molenaar's (2004) conclusion that only for ergodic processes can results obtained at a group level be assumed to hold at an individual level. These are general points that, of course, also apply to the study of developmental trajectories. In their contribution, Connell and colleagues reasoned in a similar vein when they discussed the possibility of heterogeneous responses to prevention strategies. They dealt with response heterogeneity by disaggregating developmental trajectories into five classes where predictors were studied that included the effects of random assignment to intervention. They also stressed the usefulness of their variable-oriented approach as a way of studying the effects of the intervention program they studied at a global level, even coining it "the gold standard" for this purpose. This emphasizes the point that the level one wants to make inferences at is a decisive factor for evaluating the effects of aggregation.

Broadly speaking, von Eye and Bogat posit that the person-oriented approach usually cannot rely on aggregated data, since this can lead to misrepresenting the characteristics of the data at the individual level. The

variable-oriented approach is usually based on the assumption of homogeneity of individuals, but the person-oriented approach is quite the contrary and considers the possibility of distinct subgroups within a population. Rather than using aggregate-level parameters, they suggest that subdivisions of the sample are necessary, since doing so allows for different models to hold for different groups. The models are then, to some extent, custom-made based on the particular group or individual and better represent the uniqueness of the individual or particular group. They further discuss various aspects of aggregation in relation to person-oriented and variable-oriented approaches by presenting and giving illustrations of three of Schmitz's four theorems (2000), which caution the use of aggregate-level parameters for deriving conclusions about individuals and relationships between individuals. They also present three new propositions for person-oriented research. For brevity we will briefly comment on one of the propositions, although all three deserve consideration by developmental researchers. In their first proposition they suggest that higher-order interactions can necessitate a person-oriented qualification of statements made based on lower-order interactions, which is related to what we see as the core principle of the person-oriented approach, that is, the overriding importance of the whole pattern and the danger in breaking it up in the analysis. It is noteworthy that in their mentioned empirical example of this principle they used a log-linear model, which is a variable-based model, to address a person-oriented research question and demonstrated a three-way interaction. This postulation, along with the authors' contention that an important aspect of the person-oriented approach is disaggregation of models of data (models that could be variable-based), suggests that it may not be necessary to use pattern-based methods, which take the whole value pattern into account to carry out a person-oriented approach. We agree that certain criteria for the person-oriented approach can be fulfilled by using appropriate variable-oriented analyses. However, we do not think this should become the standard methodological rationale for analyzing a scientific problem within such an approach. To us, the core of the theoretical person-oriented perspective is the indivisibility of the components defining the system under study, and the methodological rationale should in most cases match this by using some pattern-based method.

Studying What Does Not Occur in Development

Bergman and Magnusson (1997) argued that, as well as being interested in typical developmental trajectories that are traveled by many, there might also be an interest in developmental trajectories that are not followed. An

approach complementing the search for typical patterns and their development is then looking for what they called "white spots," that is, developmental patterns that rarely occur and the boundaries of areas containing such patterns. (This idea has some similarities to the study of "repellents" in the study of dynamical systems and to the concept of "antitype" within configural frequency analysis.) Concerning antitypes, in their contribution, Laursen and colleagues studied them with regard to social support network patterns, cross-sectionally, and by looking for rare developmental combinations of typical age-specific patterns. These analyses gave valuable complementary information to the standard analyses of types.

Although rarely used, this white spots approach can be relevant for theory testing and exploration. On the surface, in simple cases, this approach may look like the standard situation with "non occurrence" coded as an outcome value and then used as the dependent variable (e.g., when studying resilience, you study the relationships to the unexpected, not poor, outcome), but the rationale is clearly different from a standard approach in most complex developmental settings. To take an example from the Lyytinen and colleagues' article, a white spots approach could be to predict from theory the most unlikely developmental paths for those in the risk group that showed early signs indicating a predisposition for dyslexia and to find out the extent to which these predictions hold. An ensuing detailed qualitative analysis of the deviant cases might then aid in detecting imperfections and moderating circumstances in the scope of the theory (cf. the application of prodigal analysis as proposed by Cairns & Rodkin, 1998).

Conclusion and Future Perspectives

What Is "Person-Oriented"?

We believe that an important task for promoting improved applications of the person-oriented approach is that careful attention be paid to the jingle fallacy as alluded to previously. At the present stage it is probably premature to aim for one comprehensive definition for the person-oriented approach, acceptable to all researchers. Different definitions will have to coexist for quite some time. For the present it is probably wise to follow Paul Meehl's example when he talked about the difficulties in defining the concept of a "taxon" and said that "In the early stages of any science we usually can't define the core concepts precisely, contrary to the simplistic operationalism taught in beginning psychology and sociology classes" (1992, p. 120). Future research will bring forward new knowledge and concepts that will, we hope, lead to more conceptual clarity of what "person-

oriented" should be and perhaps replacing it with new, more precise concepts. We are then convinced that the notion in our definition of the individual pattern as reflecting the system under study will play a central role.

What has just been said, however, should not be regarded as a license for vague or careless conceptualization. It is, of course, important that a researcher strives to clarify his or her definition of person-oriented and relates it to the position of other researchers on this issue. It is also important that a clear distinction is made between the theoretical and methodological aspects of the person-oriented approach. For instance, one sometimes finds in the literature caricatures of definitions of the person-oriented approach such as "it is cluster analysis" or "it is categorizing people." Statements of this kind ignore the theoretical aspects of the approach and define it by the method used, which may or may not imply a person-oriented approach, depending on the appropriateness of the method as it is used in the specific context of the researcher's scientific problem and data.

Pattern-based methods, despite their imperfections, are today the most natural methodological realization of the person-oriented approach, but these do not need to be implemented with a categorical approach like cluster analysis. For instance, in the future we also have the possibility of applying methods for studying nonlinear dynamical systems. Refinements of certain variable-oriented methods, such as general growth mixture modeling, and tailoring such methods to theoretical person-oriented demands offer interesting possibilities, but the challenge is then to ensure that the system as a functioning whole is reflected by the method. From our person-oriented perspective, simply because one focuses on the individual and the results apply at a disaggregated level, this in itself is not sufficient for one's approach to be called person-oriented. The integrity of the whole system under study must also be retained as far as possible.

The Importance of Considering Issues of Data Aggregation

The issue of the ecological fallacy and problems of data aggregation were discussed in a previous section of this commentary and were also extensively discussed by von Eye and Bogat in their contribution. They demonstrated that a careful consideration of this issue is important in almost every empirical study concerned with explaining individual development. Broadly speaking, it brings to the foreground the question of whether the empirical results apply to the *individual* level, explaining individual development, in contrast to group or average development, which might or might not reflect individual development. Such considerations are also important when choosing between variable-oriented and person-oriented approaches.

Here, a person-oriented approach might offer a solution in many cases, but it must be pointed out that, when applied in the context of studying inter-individual variation, this approach can also be hostage to assumptions about the correspondence between group-level results and individual-level results (e.g., does a cluster interpreted as a typical pattern really describe the individual patterns that form the cluster well?). However, broadly speaking, most results from a proper application of a person-oriented approach would not be subjected to the ecological fallacy. That is not to say that a standard variable-oriented approach is generally inferior from this perspective; it all depends on the specific situation and how the analyses are carried out. The weight that should be given to the ecological fallacy and to problems of aggregation also depends on the purpose of the research. A sociologist being primarily interested in processes at the group level is in a different position than a developmental psychologist interested in individual development. To take one example, the main findings reported in Glen Elder's seminal book *Children of the Great Depression* (Elder, 1974) should not be put into question because of aggregation problems.

Developing Methods That Improve the Match of Method to Theory

As a science, we need to develop methodological approaches that better match our theoretical conceptualizations. This match foremost concerns the compatibility between the properties of the mathematical-statistical model used to represent the data and the essential features of the theory guiding the research. Is a "true" model (in the sense discussed earlier) applied, or is it only a simulator? To be sure, any reasonable model fitting the data can be useful for purposes of summing and organizing the data, and in many cases that may be as far as we can come today, considering the complexity of the research area and the state of current knowledge. This, however, is not what we should strive for in the future. Further advances in constructing models that can *explain* developmental change as well as be theoretically and meaningfully interpreted at the mechanism level are of the greatest value and thus, even in the face of difficulties, must be given high priority. We then believe that the paradigm offered by nonlinear dynamical systems holds promise for the future and that it will become increasingly important. Possibly, within the coming decades this approach will replace the statistical linear models approach as the Rolls Royce of modeling and explaining development. From our perspective, we note that nonlinear dynamic modeling can be a genuinely person-oriented approach.

Broadly speaking, variable-oriented methods are further developed than person-oriented methods with regard to two key aspects. One is that

they offer greater possibilities of constructing and testing more complete and formal models of the data, and the other is that they have greater facilities for handling (benign) errors of measurement so that they do not distort the results. When structural equations modeling was introduced and made available to researchers in the form of well-functioning programs, it was a major step forward for the variable-oriented approach (Jöreskog, 1973, 1993; Jöreskog & Sörbom, 1989). It is then promising that certain approaches within this tradition are now further developed to incorporate elements of the person-oriented approach, as exemplified by the work of Muthén (1997) and Nagin (1999; Nagin & Tremblay, 2001) and witnessed in several contributions in this issue. However, currently these types of methods only partially fulfill the demands of a methodology tailored to the person-oriented approach. We should continue our strivings in developing new and improved methods for this purpose. The fact that it is difficult to find suitable formal mathematical-statistical models that are truly person-oriented, however, should not be an argument against the endeavor. If the theoretical conceptualizations demand a different model of reality than the one offered by, for instance, the linear model approach, this should be attempted regardless of the technical difficulties. We are optimistic that the future will bring considerable advances in this regard if the growing interest in the person-oriented approach leads to strong methodological efforts along these lines, a point also made by Bornstein and colleagues in their contribution.

As mentioned above, an especially attractive alternative methodological approach is the study of nonlinear dynamical systems, which has been highly developed and has been successful in the natural sciences (Gleick, 1987). In this approach, differential or difference equations are constructed that explain the mechanism of change in the system at a pattern level. This kind of approach has begun to find its way into psychology, as evidenced by, for instance, the work of Kelso (1995), Boker and Nesselroade (2002), and Smith and Thelen (1993). To be sure, the complications involved when applying nonlinear dynamical systems in nonexperimental settings in developmental psychology are formidable, but the gains could be large, since the use of such methods can lead to a much better theory-method fit. For instance, the parameters of such models often have a better chance than those of a standard statistical model to be theoretically meaningful. Even if, at first, it will in most cases be possible neither to formulate a realistic mathematical dynamical model nor to acquire the necessary data (which often have to be of a time-series character with control over important back-

ground parameters), just the introduction at the theoretical stage of the concepts and ideas offered by this approach could be fruitful (Bergman, 2001).

The Need for Intensive Studies of Individual Development

There is a need for intensive studies of individual development. When individual development is at focus, it is not certain that the conventional longitudinal approach, which is most often characterized by the study of inter-individual differences in development for large groups with relatively few measurement points, is optimal. In line with what Asendorpf and Denissen argued in their contribution, we claim that data are also needed that more closely mirror detailed aspects of individual development. It is necessary to follow it intensively to be able to study the dynamics of change, for instance, by studying transition points (as exemplified by Nurmi and his colleague's work; Nurmi & Salmela-Aro, 2002) and by studying development in the single individual (as exemplified by Nesselroade & Featherman, 1991, and Schmitz & Skinner, 1993). However, such intensive data with so many measurement points are difficult and expensive to obtain and normally set severe restrictions to the sample size. Examples of good compromises between the demands for sample size and the demand for detailed developmental information are given in the contributions to this issue by Lyytinen's Jyväskylä Longitudinal Study of Dyslexia, from which results were reported by Lyytinen and his colleagues, and by Weinert and Schneider's (1999) longitudinal study on the genesis of individual competencies, which provided the data for the empirical analyses in Asendorpf and Denissen's article.

We would posit that, whenever possible, at least a small sample that is intensively studied should be embedded within a conventional longitudinal study to allow for a complementary study of individual dynamics and for comparisons of results. Of course, depending on the choice of method for analysis, a small sample more or less limits the precision of the conclusions that can be reached from the study and can make it difficult to generalize the results to the population from which the sample was drawn. This problem can be especially troublesome when a person-oriented approach is applied and focused on explaining inter-individual differences in patterns, since types (which in a way can be regarded as higher-order interactions) often are more prone to sampling variation than, for instance, means and correlations (Bergman et al., 2003). From this perspective, there are alternative strategies for researchers using a small sample size, for example, i-states-as-objects (ISOA) analysis (Bergman & El-Khouri, 1999), where at the first stage an

age-invariant classification system is constructed based on k × n analytical objects, where k is the number of measurement occasions and n is the sample size. This method is well suited to small samples with many measurement occasions and is an alternative analytical strategy that, for instance, could be tried by Bornstein and his colleagues in their contribution.

Training in the Person-Oriented Approach

A last point we would like to make in regard to future perspectives is the need for training in the person-oriented approach. For those of us who have worked with the person-oriented approach for many years, it is an observation that the training in the theoretical and methodological aspects of it is slow to gain momentum. In their contribution, Hirsh-Pasek and Burchinal have also pointed this out in regard to the lack of use of person-oriented methodology in early cognitive development research. Today we have a situation where many researchers start to apply the person-oriented approach without any proper training in its research tools. For instance, cluster analysis has become rather popular, but in some cases the understanding of the possibilities and limitations of this method in a person-oriented context appears limited. This is most apparent in the sometimes incomplete appreciation of the importance of the match between the variables in the studied profile to the key characteristics of the system under study, the importance of technical aspects of the cluster analysis, such as the results' sensitivity to errors of measurement, and the importance of establishing the trustworthiness of a cluster solution (see Bergman et al., 2003). Another technical issue that merits serious attention concerns what is a sufficient sample size in person-oriented analyses. This, of course, depends on the specific situation and the method used, but for some ambitious analytical goals the number of subjects that are needed can be higher than in a standard variable-oriented setting (e.g., if higher-order interactions characterizing a small number of subjects are at focus, Bergman et al., 2003). Such matters should therefore be considered in the design of the study. This was realized by Laursen and colleagues in their contribution and led them to limit the number of variables in the pattern they studied.

More generally in terms of training and education, as pointed out by Bergman, von Eye, and Magnusson (2006), an important task is to arrange for international workshops, teaching the person-oriented approach with regard to theory, methods, and computer programs to carry it out.

Final Words

Finally, we return to our title: The person-oriented versus the variable-oriented approach: Are they complementary, opposites, or exploring different worlds? We hope that the contributions in this issue, including our commentary, have shown that the two approaches can be complementary and, in the ideal case, give a binocular view. To the extent that similar conclusions can be drawn from the results of applying both approaches, the findings are considerably strengthened by this demonstrated generalization across approaches. But the person-oriented and variable-oriented approaches can also be opposites in that the choice of one approach rather than the other one implies the acceptance of one set of assumptions about reality and the rejection of another set of assumptions. Of course, this choice should not be general but specific to the scientific problem under study.

In a typical variable-oriented analysis it is believed that the mechanism governing individual development can be revealed by studying the relations between variables across individuals and across a few measurement occasions. In a typical person-oriented analysis it is believed that this mechanism is mirrored by the typical configurations across time of the individuals' value pattern in the factors that define the studied system. Normally, neither approach can lay claims to produce results that have an immediate, convincing affinity to the mechanism we are interested in. Both require that different assumptions are accepted to produce interpretable results. As previously discussed, these assumptions are very different, and most methodological realizations of the two approaches are also so disparate that they are partly windows into different worlds. One is a linear world of variables, and the other is a world of patterns of inextricably interwoven components.

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