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Typology of alcohol users based on longitudinal patterns of drinking

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HIGHLIGHTS

- Idiographic methodology examined the longitudinal patterns of alcohol use.
- A dynamic cluster analysis was employed to identify homogenous longitudinal patterns.
- The analysis employed 180 daily observations of alcohol use for a sample of 177.
- Eight distinct patterns of alcohol users were identified.
- The patterns may be used to design tailored interventions for problem drinkers.

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ABSTRACT

Objective: Worldwide, alcohol is the most commonly used psychoactive substance. However, heterogeneity among alcohol users has been widely recognized. This paper presents a typology of alcohol users based on an implementation of idiographic methodology to examine longitudinal daily and cyclic (weekly) patterns of alcohol use at the individual level.
Method: A secondary data analysis was performed on the pre-intervention data from a large randomized control trial. A time series analysis was performed at the individual level, and a dynamic cluster analysis was employed to identify homogenous longitudinal patterns of drinking behavior at the group level. The analysis employed 180 daily observations of alcohol use in a sample of 177 alcohol users.
Results: The first order autocorrelations ranged from −.76 to .72, and seventh order autocorrelations ranged from −.27 to .79. Eight distinct profiles of alcohol users were identified, each characterized by a unique configuration of first and seventh autoregressive terms and longitudinal trajectories of alcohol use. External validity of the profiles confirmed the theoretical relevance of different patterns of alcohol use. Significant differences among the eight subtypes were found on gender, marital status, frequency of drug use, lifetime alcohol dependence, family history of alcohol use and the Short Index of Problems.
Conclusions: Our findings demonstrate that individuals can have very different temporal patterns of drinking behavior. The daily and cyclic patterns of alcohol use may be important for designing tailored interventions for problem drinkers.

1. Introduction

Worldwide, alcohol is the most commonly used psychoactive substance. It has the highest rates of dependence or abuse as a primary substance and the highest rate of treatment admissions for dependency or abuse (Substance Abuse and Mental Health Services Administration, 2009). Heavy drinking has been found to predict alcohol related problems, such as increased risk for injury, increased risk for alcohol impaired driving and poorer psychosocial and health outcomes (Brewer & Swahn, 2005; Marczinski, Combs, & Fillmore, 2007; Quinlan et al., 2005; Standerwick, Davies, Tucker, & Sheron, 2007). In addition, heavy alcohol use is associated with higher rates of illicit drug use, with 29% of heavy alcohol users also using illicit drugs (Substance Abuse and Mental Health Services Administration, 2009). Heavy drinking is a public health problem and requires a systematic approach to advance understanding of the dynamics and the processes of behavior among the substance users, particularly when high diversification of this population is an obstacle to the integration of research findings on alcohol use.

Heterogeneity among alcohol users has been widely recognized and addressed by researchers and clinicians for many years. To date, efforts to identify homogenous subpopulations of alcohol users have been primarily based on quantity and frequency of alcohol use, age, comorbidities, and family history of substance use and other psychosocial

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variables (Babor et al., 1992; Basu, Ball, Feinn, Gelernter, & Kranzler, 2004; Moss, Chen, & Yi, 2007), resulting in multiple typologies that have had limited ability to account for high variability among the alcohol users. Most substance use research has focused primarily on cross-sectional data. The relationship between quantity and frequency of alcohol use and alcohol related problems are well established, but there is a limited understanding about how they affect specific symptoms of alcohol abuse and dependence. In particular, there has been limited attention directed towards longitudinal patterns of drinking behavior and their influence on severity of alcohol use. These patterns are relatively stable in daily and cyclical fluctuations of drinking behavior for extended periods of time (Mundt, Searles, Perrine, & Helzer, 1995).

1.1. Longitudinal patterns of alcohol use

Several recent studies based on college student populations have emphasized the need to examine the fluctuations in the quantity and frequency of alcohol use over time in relation to the academic calendar (Del Boca, Darkes, Greenbaum, & Goldman, 2004; Dierker et al., 2008; Goldman, Greenbaum, Darkes, Obremski-Brandon, & Del Boca, 2011). These studies have focused on young adults and their longitudinal trajectories of alcohol use based on group-level data. An exception is the work of Dierker et al. (2008), who utilized daily data and examined behavioral patterns for each study participant separately.

Mundt et al. (1995) was one of the first to focus on developing a typology based on differences in the daily and cyclic patterns of alcohol use between dependent and non-dependent individuals. Fluctuations in daily drinking behaviors were utilized to characterize different subtypes of alcohol users. To our knowledge, this is the first study of alcohol use implementing idiographic methodology. The findings reveal the significant differences in temporal drinking patterns between dependent and non-dependent alcohol users, who were otherwise similar on the measure of quantity and frequency of alcohol use. This study demonstrates that these traditional measures are insensitive and unable to account for high variability among alcohol users.

The recent study by Hoeppner et al. (2012) was the closest to the current study in approach, using time series analysis and cluster analysis to develop a typology of drinking patterns among college students. The study identified five distinct patterns: a) Low-Weekend, b) Low-Latent, c) Medium-Weekend, d) Medium-Thursday, and e) High. (The results of the individual time series analysis were not presented.) For all patterns, the level of consumption for Sunday to Wednesday was relatively low, and the highest drinking took place on Friday and Saturday with two groups also being high on Thursdays. The drinking patterns were consistent across the whole year.

1.2. Nomothetic and Idiographic research methodology

There are two different general approaches to research: nomothetic and idiographic. Nomothetic methods are based on inter-individual variation, focus on mean differences between groups and have been the dominant approach in the behavioral sciences for the last fifty years. Idiographic methods are based on intra-individual variation, focus on the pattern of change over time, and are employed extensively in disciplines like economics, business, and electrical engineering. Group-level nomothetic methods typically require data collection on a very limited number of occasions from a large number of individuals. Random sampling can provide a basis for the generalization of the findings to the population level. Idiographic methods involve intensive longitudinal data, often on a single individual. Idiographic methods can provide unique information about the pattern of change over time. Repeated assessments on an individual cannot be assumed to be independent so idiographic methods typically assess the autocorrelation between the observations. Information from autocorrelation patterns can be employed to make inferences about possible generating functions for the variable of interest. Nomothetic models have a limited ability to capture the heterogeneity of the population and lack the sensitivity to account for extreme forms of heterogeneity, which are common in populations of substance users (Molenaar, 2004).

Nomothetic and idiographic methods will not necessarily provide the same answer to a research question. For the two approaches to produce equivalent results, the assumptions of the classical Ergodic Theorem must be met: 1) homogeneity of the population and 2) stationarity of the data across time (constant mean and variance). Only under these two conditions can results obtained from the group-level data be applied to individual subjects. A significant consideration should be given to the assumptions underlying the ergodic theorem in addiction research methodology, because it is largely based on population-level data, but it mainly describes person-specific processes (Molenaar, 2004; Molenaar & Campbell, 2009). Group level methodology emphasizes central tendencies of the population and consequently obscures natural patterns of behavior change, their multidimensionality and unique variability within each individual. This one-size-fits-all approach of nomothetic methods leads to limited understanding of the individual-level patterns of behavior change and consequently limits treatment effectiveness.

Idiographic research examines individual-level data with a large number of observations from a single subject, collected at equal intervals and over an extended period of time. This method of data collection allows for highly accurate estimates of within-subject variability and longitudinal trajectories of behavior, which consequently yields more accurate inferences about the nature of such behavior specific to an individual (Velicer, 2010). The limitation of this design is a restricted generalizability of the findings to the population level. Findings on substance use behavior derived from group level designs and single subject level designs are not interchangeable unless conditions of ergodic theorem are met, which is unlikely in addiction research or any other area of social science (Molenaar, 2004; Molenaar & Campbell, 2009; Velicer, 2010; Velicer, Babbin, & Palumbo, 2014; Velicer & Molenaar, 2013; Velicer, Palumbo, & Babbin, in press). Each of these two methods aims to answer different research questions. Nomothetic research is focused on group-level relations and inter-subject variability, and its findings are generalizable to a population level data but cannot be used to make inferences on a single-subject level. On the other hand, idiographic research is able to characterize highly heterogeneous processes, which are common in substance use behaviors.

In order to overcome the challenges of nomothetic and idiographic research and integrate the advantages of both methods to further advance understanding of the dynamics of substance use behavior, a new methodological and statistical approach will be employed. This involves a two-step process. First, an idiographic analysis (time series analysis) is performed on each individual's longitudinal profile. Then, a cluster analysis of the longitudinal profiles (dynamic typology) is performed to group the profiles into homogeneous subgroups or dynatypes. The separate dynatypes will each satisfy the ergodic theorems. This approach can address the challenges of a highly heterogeneous population, investigate the pattern of change over time, provide information about the autocorrelation function, and allow for inferences from individual to subgroup level.

1.3. Relating autocorrelation patterns to alcohol regulation

The autocorrelation observed in a time series analysis can provide critical information about the alcohol regulation model that is a basis for the observed pattern of alcohol consumption. To illustrate this, we will briefly describe the results of a study (Velicer, Redding, Richmond, Greeley, & Swift, 1992) designed to determine which of three models of nicotine regulation best represented different smokers. Three alternative models have been proposed to account for nicotine's effectiveness in maintaining smoking: (a) the fixed-effect model, (b) the nicotine regulation model, and (c) the multiple regulation model. Leventhal and Cleary (1980) provide a review of the literature and a description of each of the three models. Velicer et al. (1992) identified each of the three models