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Individual patterns of alcohol use ☆

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HIGHLIGHTS

- Individual alcohol use trajectories were analyzed from time series of daily reports.
- A novel methodology was developed to identify statistically distinct use patterns.
- Patterns were classified into mutually exclusive categories.
- Patterns were used to monitor transitions between recreational and problem use.

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ABSTRACT

Aims: We present methodology to identify statistically distinct patterns of daily alcohol use and classify them into categories that could be further used in monitoring of transitions between patterns such as transitions from regular to problem use.
Data: The study analyzed individual patterns of adult alcohol consumption from two datasets containing short (<6 month) and long (up to 2 years) daily records of drinking. These data were collected over the period between 1999 and 2003.
Results: By using a non-parametric (Kolmogorov–Smirnov) test we have identified distinct drinking patterns and classified them into 8 types according to their means, percentages of non-drinking days and variances of consumed amount during drinking days. For each studied individual we calculated a transition chart that characterizes transitions between the types.
Conclusions: Individual daily consumption patterns can be identified, and classified into distinct patterns. Changes between the patterns could be related to life events or environmental trends, and thus provide insights into pathways towards either heavier use or recovery.

1. Introduction

The National Institute on Alcohol Abuse and Alcoholism (NIAAA) and Centers for Disease Control and Prevention (CDC) suggest criteria for alcohol dependence and heavy drinking that are based on summaries of weekly and daily alcohol consumption levels (NIAAA, 2004). These summaries are considered static (i.e., change in time is ignored). In this paper we identify specific patterns that describe the nature of consumption, statistically significant changes in individual daily drinking, and the timing of these changes. We then show that these patterns can be meaningfully categorized and that the transitions between categories are predictive of future changes in alcohol use.

The typology of individual alcohol use has been extensively studied over the last 25+ years and a variety of use types have been identified (Leggio, Kenna, Fenton, Bonenfant, & Swift, 2009; Moss, Chen, & Hsiao-ye, 2007). However, little research has focused on the dynamic nature and prognostic potential of these typologies. Among such scarcely published research it is worth noting a few developments. Periodicity has been shown to be a prominent feature at both the population and individual levels (Mundt, Searles, Perrine, & Helzer, 1995; Said & Wegman, 2009). Chung, Maisto, Cornelius, and Martin (2004); Chung, Maisto, Cornelius, Martin, and Jackson (2005) analyzed drinking patterns and the relationship of drinking patterns and symptom occurrence in treated adolescents. Gueorguieva et al. (2010) identified several latent classes in daily use and examined the probability of changes in classification after alcohol treatment.

Existing definitions (NIAAA, 2004) do not consider whether the individual changes his or her drinking patterns; the same amount of consumption could reflect an increase, decrease, or stability of use. Modern technology (e.g., Interactive Voice Response [IVR], smartphones,

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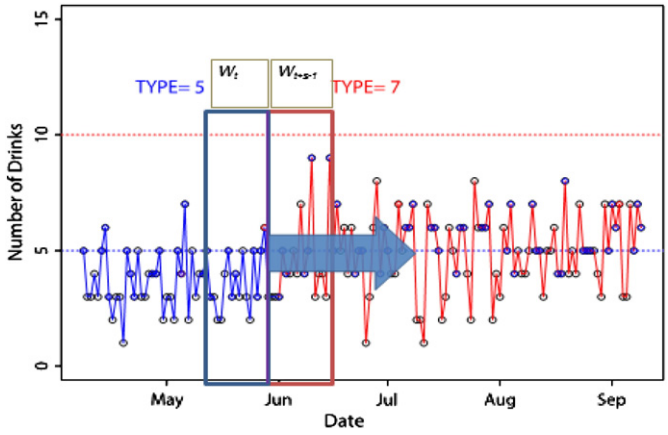

Fig. 1. "Moving Windows" method to identify patterns of alcohol use trajectories. Distributional properties of sliding windows W_t and W_{t+s-1} are compared to each other. The point when the distributions become significantly different signifies the change in patterns. We illustrate the point at which the pattern switched from type 5 to type 7 as the number of drinks increases.

secure blogs) allows us to collect large quantities of data, conduct more formal Ecological Momentary Assessments, and produce detailed individual trajectories describing daily use. In turn, the identification of increased trends could be used to deliver personalized interventions (Helzer et al., 2008).

2. Data

We used two existing data sets containing daily IVR reports collected by the University of Vermont and described in Helzer and Searles (2001), Helzer, Badger, Rose, Mongeon, and Searles (2002) and Helzer, Badger, Searles, Rose, and Mongeon (2006). One data set was collected from a sample of 200 subjects (68% men) recruited between 2000 and 2003 from primary care clinics. At screening subjects met either NIAAA criteria or one or more CAGE (cut-annoyed-guilty-eye) items for heavy drinking. Participants provided daily reports for up to 6 months (time series length ranged from 100 to 180 observations, with 68% completing all 180 days). The second data set contains reports from 33 men recruited from bars. The participants reported daily for 2 years. Twenty-two subjects met the DSM-IV criteria for alcohol abuse/dependence. None of the subjects were in alcohol-related treatment during the study. Individual series ranged from 560 to 720 sequential reports. In both studies, participants were required to respond to approximately the same number of questions about alcohol consumption in the previous day.

Because the data are not representative of any specific population, we are not attempting to make population projections. We consider a within-subject analysis where an individual trajectory is just a sample from a potentially longer drinking behavior of that specific individual.

3. Methods

Throughout the paper we use the following terminology: (1) Trajectory: the entire time series containing all the observations; (2) pattern type: a set of rules that define pattern classification; and (3) pattern: a part (a "chunk") of the trajectory that corresponds to a specific pattern type. Our methodology comprised three major steps: descriptive analysis, pattern identification (chop the trajectory into distinct patterns), and pattern classification (assign the pattern a typology).

3.1. Missing data

In the short series the amount of missing data was quite substantial, and of 223 individuals we selected 156 who reported sequences at least 42 days (6 weeks) long. For these individuals we selected the longest nonmissing sections of data. There were only a few isolated missing observations (less than 2%) in the long series. For the purpose of consistency they were imputed by the median values from the days a week before and a week after.

Table 1
Description and classification criteria of the pattern types.

Pattern types	Description	Classification criteria
Type 1	Abstinent or very occasional drinker with no high drinking days	• Percentage of nondrinking days greater than 70% • Maximum of daily number of drinks less than 5 for men and 4 for women
Type 2	Abstinent or very occasional drinker with high drinking sometimes	• Percentage of nondrinking days greater than 70% • Maximum of daily number of drinks greater than 4 for men and 3 for women
Type 3	Mostly occasional drinker with relatively low or medium risky drinking	• Percentage of nondrinking days less than or equal to 70% but larger than 50% • Average consumption on a drinking day less than or equal to 4 for men and 3 for women
Type 4	Mostly occasional drinker with relatively medium or high risky drinking	• Percentage of nondrinking days less than or equal to 70% but larger than 50% • Average consumption on a drinking day greater than 4 drinks for men and 3 for women
Type 5	Frequent and steady drinker mostly with relatively low or medium risky drinking	• Percentage of nondrinking days less than or equal to 50% • Average consumption on a drinking day less than or equal to 4 drinks for men and 3 for women • Standard deviation of nonzero daily number of drinks less than or equal to 1.5 for men and 1 for women
Type 6	Frequent but unsteady (binge) drinker mostly with relatively low or medium risky drinking	• Percentage of nondrinking days less than or equal to 50% • Average consumption on a drinking day less than or equal to 4 drinks for men and 3 for women • Standard deviation of non-zero daily number of drinks greater than 1.5 for men and 1 for women
Type 7	Frequent and steady drinker mostly with relatively medium or high risky drinking	• Percentage of nondrinking days less than or equal to 50% • Average consumption on a drinking day greater than 4 drinks for men and 3 for women • Standard deviation of nonzero daily number of drinks less than or equal to 2.5 for men and 2 for women
Type 8	Frequent but unsteady (binge) drinker mostly with relatively medium or high risky drinking	• Percentage of nondrinking days less than 50% • Average consumption on a drinking day greater than 4 for men and 3 for women • Standard deviation of nonzero daily number of drinks greater than 2.5 for men and 2 for women