Analysing change among study abroad students. A Novel Application of the Person-Centred Approach to alcohol use patterns.

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Contributors

GA, SM and EM designed the study and wrote the protocol. GA and AS conducted the statistical analysis. GA wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

Disclosure of interest

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Abstract

This study re-analysed longitudinal data on international students' alcohol use to demonstrate the practical value of person-centred statistical techniques, such as Latent Class Analysis (LCA) and its longitudinal extension Latent Transition Analysis (LTA). These techniques offer new analytic perspectives, can reveal typologies (i.e., subpopulations characterized by different profiles) and examine change (i.e., transition probabilities) in outcomes of interest. The use of these approaches remains limited in the intercultural research field, however. A step-by-step guide to the use of LCA and LTA is presented. The analyses demonstrate how alcohol use profiles can be identified, how transitions across profiles as students move from home to overseas can be examined and are affected by students' motivation to study abroad and their adjustment to the host environment. The validity for study abroad students of the four-class model of drinker types found in other populations was confirmed. Results, however, challenge the dominant view that most students increase alcohol intake during study abroad experiences, and indicate that moderate drinkers are at greatest risk of transitioning to heavy drinking as they travel abroad. Implications and suggestions for use of these statistical techniques by intercultural research specialists are discussed.

Keywords: person-centred approach; latent class analysis; latent transition analysis; study abroad; alcohol use; motivations to study abroad; psychological adjustment.

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Introduction

A key focus of interest for scholars and practitioners in the field of intercultural research and international mobility is change. Moving from a familiar home environment and travelling internationally is transformative for individuals and communities (Berry, Phinney, Sam, & Vedder, 2006; Schwartz, Unger, Zamboanga, & Szapocznik, 2010). Intercultural travellers engage in a more or less successful process of acculturation and integration into the host cultural environment, face challenges and can grow as a person. For international students, for example, travelling abroad encourages future educational and professional opportunities, increases intercultural competence and enhances students' global perspective (Stone & Petrick, 2013), but also has a dramatic effect on health-related behaviours such as alcohol use (Aresi, Moore, & Marta, 2016a; Aresi, Moore, Berridge, & Marta, 2019).

Developmental psychologists describe change both quantitatively and qualitatively (Shaffer & Kipp, 2013). Quantitative development consists of incremental changes. In the context of second-language acquisition, for example, this means to widen one's vocabulary by learning new words. Conversely, change can be more dramatic. Qualitative development can be understood as "a change-in-kind that makes individuals fundamentally different than they were before" (p. 39). For example, the transformation into a proficient language user capable of using and understanding humour in a second language.

The analysis of longitudinal change in the international mobility field has typically used the traditional variable-centred approach (e.g., regression analyses) that reveal quantitative change and consider the aggregate effect of travel across all students, thus excluding heterogeneity in behavioural trajectories. This approach risks obscuring important variations in the timing and

intensity of change across individuals (Morin, Bujacz, & Gagné, 2018). For these reasons, person-centred statistical models capable of capturing qualitative change have grown in popularity.

The person-centred approach to analyse qualitative change

The person-centred approach (e.g., mixture models, latent profile analysis, latent class analysis, cluster analysis, growth mixture analysis) relaxes "the assumption that all individuals are drawn from a single population, and considers the possibility that the sample might include multiple subpopulations characterized by different sets of parameters" (Morin et al., 2018, p. 805). This results in a classification system that groups individuals into distinct profiles or classes. Profiles can then be analysed longitudinally to identify qualitative change such as transitioning to different profiles. This approach offers several advantages over traditional methods in the analysis of change. For example, identifying subgroups of individuals may help elucidate multiple pathways to diverse outcomes (i.e., equifinality and multifinality[1]), including cultural adjustment, academic success, and second-language acquisition. In addition, grouping people into similar types better reflects the way most people think about people (i.e., types of students, types of employees, etc.) (Morin et al., 2018). Once developed, these typologies can be used to design more targeted interventions and communication campaigns, or inform interventions, training or university/community-based services. For these reasons, over the last decade, facilitated by statistical advancements (see, among others, L. M. Collins & Lanza, 2010), person-centred statistical techniques have been used in several fields including development, health and educational psychology.

Despite its advantages, there is little research using the person-centred approach that have longitudinally examined issues that are relevant to the field of international mobility. One recent example is the study of Demes and Geeraert (2015) that used Latent Class Growth Analysis to examine patterns of cultural adjustment experienced by high school students participating in an intercultural exchange programme. The study found five different profiles of acculturative stress experienced by students, demonstrating that an assumption of a single temporal pattern (e.g., initial culture shock followed by adaptation over time) did not adequately convey the variability of

reactions to intercultural relocation. Other recent studies (Bulut & Gayman, 2020; Grigoryev & van de Vijver, 2018) used latent class or profile analysis, but did not extend their analyses longitudinally.

Using alcohol drinking patterns as an example, the present study aims to demonstrate the value of using the person-centred approach in the field of intercultural relations, and student international mobility in particular.

Variable- and person-centred approaches to study alcohol use among study abroad students

Research has established a robust relationship between an increase in alcohol use and studying abroad (Credit Mobility in particular), and students experience of negative health outcomes in consequence (Aresi et al., 2016a; Aresi, Moore, & Marta, 2016b; Aresi et al., 2019; Ferrari, Aresi, & Marta, 2017; Hummer, Pedersen, Mirza, & Labrie, 2010; Marcantonio, Jozkowski, Angelone, & Joppa, 2018).

Study abroad students' alcohol use provides a good example of how change can be studied from different perspectives and how this can have implications at a practical level. To date, changes in drinking patterns have been studied using the traditional variable-centred approach, thus capturing quantitative change and general trends, and reinforcing the idea that the majority of students drink heavily overseas. However, such changes may well vary across subgroups of students. Some may experience a significant increase in their alcohol use. For others, change may be negligible, and some may moderate their consumption. The proportion of students belonging to each 'transition type' and the factors that predict these transitions are of interest to international educators because they can be used to challenge stereotypical representations of the study abroad experience as an opportunity to "party" (Aresi, Fattori, Pozzi, & Moore, 2018; Pedersen, LaBrie, Hummer, Larimer, & Lee, 2010).

Person-centred analyses offers a more nuanced understanding into the relationships between behavioural patterns, risk and protective factors (covariates exogenous variables or covariates in the LCA/LTA vocabulary), such as demographic or psychosocial factors. For example, previous studies

using variable-centred techniques demonstrate an increases in alcohol use is associated with socio-demographics (i.e., gender and age), adherence to the heavy drinking lifestyle of a typical study abroad student, and feelings of being on holiday (i.e., situational disinhibition) (Aresi, Fattori, et al., 2018). However, at least two further factors are worth examining for conceptual and statistical reasons: the motivation to study abroad and psychological adjustment to the host environment. While motivations to study abroad are key in understanding the study abroad experience, their effect on alcohol use has received relatively little attention (Aresi, Alfieri, Lanz, Marta, & Moore, 2017). In addition, because motivations precede the experience abroad, it is of interest to study their effect on the *transitions* of behavioural patterns as students go overseas. Students' psychological adjustment instead has received greater attention. Studies have found that better adjusted students drank more heavily and increased their use of alcohol to a greater extent compared to those who were less well adjusted (Aresi et al., 2019; Ferrari et al., 2017), thus demonstrating theoretical models linking successful acculturation to moderate alcohol use among migrant populations are not applicable to exchange students (Aresi, Moore, & Marta, 2021; Zemore, 2007). In this regard, LCA/LTA can offer additional and novel insights into whether the adjustment–drinking relationship exists in the entire student population or whether it is specific to heavy drinking subgroups.

The current study

Previous research using LCA demonstrated there are four distinct subgroups of alcohol users among young people, and that this typology holds across different countries and cultures (Aresi, Cleveland, Marta, & Alfieri, 2018; Aresi et al., 2020; Cleveland, Lanza, Ray, Turrisi, & Mallett, 2012; Cleveland, Mallett, White, Turrisi, & Favero, 2013), and has temporal stability (Cleveland et al., 2012). The four subgroups are: those who have not been drinking recently (Current Non-Drinkers, CND), two classes of weekend drinkers distinguished by the probability of engaging in risky drinking (Weekend Non-Risky Drinkers, WNRD, and Weekend Risky Drinkers, WRD), and one class of Daily Drinkers (DD).

The four classes of drinkers can be fruitfully used to examine alcohol use patterns trajectories, though their validity has yet to be assessed among study abroad students. By applying the drinker classes to a large sample of credit mobility students, we will demonstrate the value of person-centred approaches and LTA in examining change in any outcome of interest for international mobility researchers and practitioners. In our analyses, we will also demonstrate how the person-centred approach can offer a more nuanced understanding of the effect of factors that are relevant to geographic and intercultural mobility, such as motivations to study abroad and psychological adjustment, and of health outcomes that follow the abroad experience (i.e., distal outcomes).

Aim and hypotheses of study

We used LTA to examine classes of alcohol use and transitions across classes in an international sample of study abroad students as they travelled abroad. Our study had five aims.

(a) To identify drinking classes based on a set of alcohol-related behaviours. Because the validity of the four-class model of drinker types has been established cross-culturally and across a number of settings (Aresi et al., 2020; Cleveland et al., 2012; Cleveland et al., 2013), we expect to find the same four classes of drinkers among students at both time points: at pre-departure (Hypothesis 1) and during the study abroad experience (Hypothesis 2).

(b) To examine the stability of the latent class solution over time (across their transition from home to abroad).

(c) To examine the probability of transitioning from one class to another over time. We expect a greater proportion of students will shift to a heavier drinking class (Hypothesis 3).

(d) To examine how students' psychological adjustment is related to T_2 class membership, and how pre-departure motivation to study abroad affects class membership and transition probabilities from one class to another class over time.

(e) To examine how T_2 class membership is related to the extent students experience alcohol negative consequences as they return home (i.e., distal outcome).

Methods

This study involves the secondary analysis of data collected in a longitudinal survey of study abroad students (Aresi et al., 2019). The original study sampled students at T_1 (on arrival in their host country, at which time data on pre-departure behaviour was collected), T_2 (four months through the period abroad), and T_3 (four months after they had returned home). Only T_1 and T_2 data are in the current study, though T_3 data on alcohol-related consequences were used to demonstrate the analyses on a distal outcome. Two cohorts were recruited in the original study, the first starting at the beginning of the first semester (September 2015) and the second at the beginning of the second semester (February 2016). At T_1 approximately 1,800 international students (across both cohorts) in 200 cities from 40 European countries were approached by representatives from an international student association. Only those who were contacted within the first two weeks after arrival were asked to participate in the study, to provide their e-mail address, and to complete an online survey containing questions relevant to the month before they departed[2]. Four months through their period abroad participants were emailed a link to a second survey. Alcohol use was measured at each wave, data concerning students' motivations to study abroad were collected at T_1. Respondents' were eligible if they were participating in a study abroad programme (i.e., credit mobility), intended to stay abroad for a period of four months or more, and travelled from and to a European country.

Data

Validated measures were used wherever possible, otherwise the survey was translated by native speakers from English (and back translated for accuracy) into Dutch, French, German, Italian, and Spanish. To ensure translated versions retained the original meaning, any incongruence

between the original and each back translated English version was resolved through discussion between translators and the research team.

The T_1 survey was completed by 908 eligible students, 785 completed the T_2 survey (86.5%). Participants had a mean age of 22.2 years (*SD* = 2.29, range 18 to 36 years) and 73.6% were female, thus making the sample broadly comparable to the available data on students participating in the Erasmus Student Mobility for Studies Action programme. Data on students participating to this popular university credit mobility programme indicate 60.5% are women and mean age is 23 years (European Commission, 2015). The mean number of years in formal tertiary education was 3.1 (*SD* = 1.35). Areas of study varied with Social Science, Business and Law (36.9%), Humanities and the Arts (20.4%) and Science, Mathematics and Computing (13.6%) the most common. Students originated from 42 countries in total with Spain (13.5%), Italy (9.9%), Germany (9.7%), France (7.1%), the United Kingdom (6.7%) and the Netherlands (4.8%) being the most frequent. Participants travelled to 33 different countries with Spain (12.9%), Italy (8.9%), the United Kingdom (8.6%), France (8.6%), Germany (7.5%), Belgium (4.8%) and the Netherlands (5.7%) being the most frequently visited. Most students (68%) planned to spend up to a semester abroad (about 16 to 20 weeks), while the remainder planned to spend the entire academic year in the host country.

Alcohol consumption

A drinking-day beverage-specific quantity measure, the Daily Drinking Questionnaire (R. L. Collins, Parks, & Marlatt, 1985), was used. The measure included validated images of alcoholic beverages to show examples of standard drinks (containing 10g of pure ethanol) (Kuntsche & Labhart, 2012). Participants indicated the number of drinks consumed each day of a typical week, how many times during the past month they had consumed alcohol until they were drunk (defined as staggering when walking, not being able to speak properly, vomiting or an inability to recall events during the drinking session), and the number of times they had consumed four (females) or

five (males) or more drinks within two hours to measure frequency of Heavy Episodic Drinking (HED). All items referred to the 30-day period before each survey.

Motivations to study abroad

The Multidimensional Motivations to Study Abroad Scale (MMSAS) was used to assess the importance of different motivations to study abroad prior departure (Aresi et al., 2017). The MMSAS consists of 27 items and nine subscales that encompass the different reasons why students decide to study abroad. Respondents were prompted as follows: "Think about the reasons why you want to study abroad. How important is each one of the following motivations to you?". Participants responded to a scale from one (not important at all) to five (very important). For this study, the Get Away (i.e., 'get away from home environment') and the Academic (i.e., 'better academic knowledge') subscales were selected as covariates potentially affecting class membership and transition probabilities. Both scales consist of three items. Internal consistency of both was above conventional limits ($\alpha > 0.80$).

Brief Psychological Adaptation Scale (BPAS)

An eight-item scale measured students' psychological well-being as it relates to their adaptation to the host country. The scale demonstrates construct validity, structural unidimensional validity, and good internal reliability for all languages used in this study except Dutch (Demes & Geeraert, 2014). Respondents were prompted as follows: "Think about living in [host country]. In the last two weeks, how often have you felt…" to items such as "out of place, like you don't fit into the [host country] culture". Participants responded to a scale from one (never) to seven (always).

Alcohol negative consequences

The Brief Young Adult Alcohol Consequences Questionnaire (BYAACQ) (Kahler, Hustad, Barnett, Strong, & Borsari, 2008) was used to assess the number of negative consequences participants experienced because of alcohol use over a 30-day period. This is a 24 yes/no item scale that has demonstrated test–retest reliability over a six-week period. Item examples are "I have had a

hangover (headache, sick stomach) the morning after I had been drinking" and "My drinking has gotten me into sexual situations I later regretted".

Analytic Strategy

LTA was performed using the five steps proposed by Nylund (2007) and recently updated by Sorgente, Lanz, Serido, Tagliabue, and Shim (2019). Analyses were performed in MPlus 7 (L. K. Muthén & Muthén, 1998-2015) using the robust maximum likelihood estimator (MLR).

Step 1: Study measurement model alternatives for each time point

At each time (T_1 and T_2) we identified sub-groups of individuals characterized by common patterns of multiple alcohol use behaviours using Latent Class Analysis (LCA). Specifically, the latent class variable obtained at each time point was based on ten dichotomous indicators: (1) past month alcohol use; (2) past month drunkenness; (3) past month HED; and (4 to 10) the seven Daily Drinking Questionnaire indicators of alcohol use for each day of a typical week.

In accordance with our theoretical framework, we expected to find the same four classes (CND, WNRD, WRD and DD) of drinkers at each wave. We therefore compared the four-profile solution with the three- and five-profile solutions based on statistical (absolute and relative model fit indices) and conceptual standards (Nylund, 2007). There is a wealth of model fit indices available. In this paper, we have selected the most widely used in the literature though they are rarely used all simultaneously. As measures of *absolute model fit*, both the likelihood ratio chi square goodness of fit (χLRT2) and the standardized residuals for each response pattern can be consulted. Specifically, the best model should be the one with the fewest number of classes that did not reject the χLRT2 null hypothesis (p-value > .05) and where the number of standardized residuals with large values (i.e., > |3|) does not exceed 5% (Masyn, 2013). As measures of *relative model fit*, both statistical tests and descriptive measures must be used. The statistical tests that can be adopted are the adjusted Lo-Mendell-Rubin likelihood ratio test (adjusted LMR-LRT) (Lo, Mendell, & Rubin, 2001) and the parametric bootstrapped likelihood ratio test (BLRT) (McLachlan & Peel, 2000), where statistically significant p-value suggests that the k-class model (where k is the

number of classes) fits the data significantly better than a model with one less class. As descriptive measures of relative model fit, we used four different measures. Specifically, we used two information criteria: the Consistent Akaike Information Criterion (CAIC) and the sample-size adjusted Bayesian Information Criterion (ssBIC), where smaller values indicate better fit. Furthermore, we used the approximate Bayes Factor (BF) and the approximate correct model probability (cmP), both made popular by Nagin (1999). The BF compares two models at a time (k and k+1 model) and the best model is the most parsimonious k-class model with BF > 3. In contrast, the cmP compares all models under consideration. In this case, any model with cmP > .10 could be considered a candidate model. Once the best solution(s) was selected, we also examined entropy values as a useful summary of the classification accuracy, but these were not be used to determine the optimal number of profiles (Lubke & Muthén, 2007). Entropy values with values closer to 1 indicate better classification of cases, where .70 is often used as cut-off (Fonseca & Cardoso, 2007).

Step 2: Measurement invariance

The two retained LCA solutions (one at each time point) were integrated into a single longitudinal model allowing for systematic longitudinal tests of measurement invariance (i.e., profile similarity).

Step 3: Explore specification of the LTA model without covariates

In this step, the autoregressive paths from the latent class variable at time *T* and the latent class variable at time *T*+1 were added to the model. Results of this autoregressive path are expressed by transition probabilities that consist of the probability of transitioning from a particular latent status at time *T* to another latent status at time *T*+1 (L. M. Collins & Lanza, 2010). As suggested by Asparouhov and Muthén (2014), the LTA model was estimated using the manual auxiliary three-step approach in order to avoid measurement parameters shifting.

Step 4: Include covariates

Using the guidelines by B. O. Muthén and Asparouhov (2011), the 'Get Away' and 'Academic' motivations to study abroad, measured at T_1, were included as covariates in order to assess whether they affect (1) the class membership at T_2 (i.e., during the study abroad experience), and (2) the any class transitions from T_1 to T_2. A regression path from these covariates to the latent class at T_1 was also included in order to control for their association. In addition, we examined how students' psychological adjustment affected T_2 class membership.

Step 5: Include distal outcomes

The last step was including distal outcomes in the model. Distal outcomes are variables measured after the period in which the variables in the longitudinal model were collected; in our case, once students have returned their countries of origin (T_3). The Wald test was used to test whether a latent class variable affected the outcome (Nylund, 2007).

Results

As required in LCA/LTA models, those participants with missing values on one or more indicator or predictor variable (n = 51) were excluded from analyses, resulting in an analytic sample of 734 students. Table S1 presents frequency data for the drinking indicators. During the study abroad experience there was an increase in the proportion of students reporting all alcohol use and risky drinking indicators, except drinking on Saturday and Sunday, which yielded a small decrease of 1 to 2%. The most significant increases involved drinking on weekdays (for example, the proportion of Tuesday drinkers more than doubled) and risky drinking indicators (Table S1).

LTA results

Step 1. Study measurement model alternatives for each time point

At each time point, three different measurement models were compared according to their absolute and relative fit indices (Table 1). CAIC and ssBIC reported the lowest values for the four class solution, at both time points. The other fit indices, except for LMR-LRT, also supported this

four-class solution. The standardised residuals (Stdres) at T_1 showed the 4-class model was the most parsimonious one in respect of the number of standardized residuals larger than |3| that did not exceed 5%; the BLRT at T_2 had a non-significant p-value, suggesting that the four-class model fits the data significantly better than a model with one less class; the BF showed the four-class solution was the most parsimonious k-class model with a value > 3; and the 4-class solution was the model with the highest value of cmP at both time points. For all models, entropy was above acceptability thresholds. Examination of item response probabilities of the four-class models confirmed the profiles reflected the drinking statuses found in previous studies (e.g., Aresi et al., 2020): one current non-drinker class (CND), and three classes of drinkers: daily drinkers (DD), weekend risky (WRD) and weekend non-risky drinkers (WNRD) (Table S2). Therefore, the best solution was the four-class model, confirming Hp1 and Hp2 hypotheses.

Table 1

Step 2: Measurement Invariance

As shown in Table 2, the full invariant model (in which all parameters were kept equal across T_1 and T_2) was statistically different from the baseline model, that is, the model in which all parameters were free to vary across the T_1 and T_2 latent class solutions ($p < .001$). Therefore, it is not possible to assume full measurement invariance. We had to free (i.e., let them vary across T_1 and T_2) six parameters[3] before obtaining a model statistically equal to the baseline ($p > .05$). Specifically, for the WRD class, the item-response probabilities of reporting Tuesday and Thursday drinking, and drunkenness indicators were free to differ across the two times. For the DD class and the WNRD class, respectively, the drunkenness and HED, and Saturday drinking indicators were released. The item-response probability plots of the partial invariant solution are reported in Figure 1.

Table 2

Figure 1

Despite the differences in those six parameters, the interpretation of the four drinking classes remained broadly the same across time. The CND configuration at both time points (14% and 11% of participants at T_1 and T_2, respectively) was defined by very low probabilities of reporting any of the current drinking behaviours. WNRDs were most likely to report drinking only on weekends, though were unlikely to report any of the risky drinking behaviours (i.e. drunk in the past month and heavy episodic drinking). WRDs were distinguished by elevated probabilities of reporting risky drinking behaviours. The proportion of WNRDs in the sample decreased from pre-departure to during the study abroad experience (from 46% to 32%), whereas that of WRDs increased (from 37% to 52%). A small proportion of students were Daily Drinkers (DDs; 3% and 5% of the sample at T_1 and T_2, respectively), and were characterized by high probabilities of drinking on all seven days of the week. Members of the DD class, however, reported average probabilities of risky drinking behaviours, as they were less likely to engage in heavy drinking than weekend risky drinkers.

All free parameters, except one (Saturday drinking among WNRDs), showed an increased probability from T_1 to T_2. The WRD class were still characterised by heavy drinking during weekends, though the likelihood of any drinking during weekdays such as Tuesday and Thursday increased when compared to pre-departure likelihoods. DDs were still characterised by daily drinking though they displayed a marked increase in heavy drinking and drunkenness. Overall, this means that alcohol use profiles remained stable, though there was a shift towards more frequent and heavier drinking. The decrease in Saturday drinking among WNRDs at T_2 is likely due to the transition of a fairly large proportion of non-drinkers (CND) towards this drinker class (see following paragraph on transition probabilities) as they travelled abroad.

Step 3: Examine change of class membership over time

Parameters of the final partially invariant model were used to perform the three-step approach. Specifically, we included the autoregressive path from the latent class variable (alcohol use profile) at T_1 to latent class variable at T_2, which can be represented trough transition

probabilities. Table 3 displays transition probabilities corresponding to the probability of membership in each latent class at time T+1, given the latent class membership at time T. For example, people who are in the CND class at T_1 have a 59.2% probability to be in the CND class at T_2, a 31.8% probability to be in the WNRD class, a 8.9% probability to be in the WRD class, and a 0% probability to be in the DD class. Figure 2 is a Sankey diagram, which is a specific form of flow diagram providing a straightforward visualisation of transition directions and quantity through arrows. Overall, lighter drinking students displayed a tendency of shifting towards heavier drinking classes, whereas those who already belonged to heavy drinking classes (WRD and DD) at T_1 remained in the same class (WRD) or shifted to the other (i.e., 41.4% of DDs moved to WRD) at T_2. Therefore, Hypothesis 3 was confirmed.

Table 3

Figure 2

Step 4: Include covariates in the LTA model

The 'Get Away' and 'Academic' motivations were included in the model to: (1) test their impact on T_2 class membership; (2) control for their covariance with T_1 class membership; and (3) test their impact on the transition from drinking classes at pre-departure (T_1) to during the experience abroad (T_2). Results indicate that a greater motivation to get away was associated with the likelihood of being a WNRD as compared to a CND during the study abroad experience (β = .497; p = .020; OR= 1.644). In contrast, neither 'Academic' motivation nor T_2 class membership were significantly related. At T1, we also found that WRD had a greater motivation to get away (β = .338; p = .004; OR = 1.402), but were less academically motivated (β = -.428; p = .002; OR = 0.651) when compared to CND. In order to examine how these two covariates affected the specific transition that individuals experience from T_1 class to T_2 class, transition probabilities were estimated when each motivation was at its respective mean value, and they were one standard deviation above the mean. Table 4 reports percent changes in transition probabilities as the

covariates increased. Regarding 'Get Away', results indicate that among moderate weekend drinkers (i.e., WNRDs) a greater motivation to leave one's home environment increased by almost 10% the chances students shift to heavier drinking patterns, namely WRD. In contrast, this motivation had a negligible effect on transitions from the other drinking classes: those who did not drank and those who drank heavily at pre-departure continued to do so when abroad and regardless of how intense their desire was to leave their home environment. The 'Academic' motivation did not have the protective effect against heavy drinking that we expected: a shift towards more moderate drinking patterns was not observed. High academic motivations increased by 31% and 4% the chances of DDs and WNRDs respectively to maintain or shift to daily drinking. Similarly, academically motivated WRDs were slightly more likely (5%) to continue drinking in the same manner and less likely to shift to daily drinking.

Table 4

In addition, we investigated the effect that psychological adjustment to the host country environment had on T_2 class membership. Results demonstrate that DDs (β = 1.021; p = .001; OR = 2.775) and WRDs (β = .620; p = .005; OR = 1.859), but not WNRDs (β = .345; p = .052; OR = 1.412), reported a greater adjustment when compared to CND.

Step 5: Include distal outcomes

Results of the final set of analyses demonstrate that, at post-return (T_3), students experienced the same number of alcohol-related negative consequences regardless the class they belonged to during the study abroad experience (T_2).

Discussion

Using study abroad students' alcohol drinking patterns as an example, this study demonstrates the value of the person-centred statistical approach to analyse change. This approach has several advantages over traditional multivariate analyses: when change is not incremental, has a qualitative nature, and when researchers are interested in subpopulations characterized by different

change patterns. LCA and LTA can be used to identify such subpopulations (i.e., classes or profiles), examine transitions across profiles over time and the effect that other factors have on transitions. Furthermore, typologies are aligned with the ways in which people think about 'types' of people (Morin et al., 2018), which can facilitate the communication of research results.

By re-analysing longitudinal data from an international sample of credit mobility students, we have replicated work in other areas and extended the validity of the four-class model of drinker types (Aresi et al., 2020; Cleveland et al., 2012; Cleveland et al., 2013) to this population (Hypotheses 1-2). As compared to previous studies (Aresi et al., 2016a; Aresi et al., 2019), the use of person-centred techniques used in the current analysis provides a new perspective on this phenomenon. It demonstrates that pre-departure lighter drinking patterns were predominant (about 60% of the sample), but were not representative of the majority of students when they were overseas. Many but not all students transitioned to heavier drinking as they moved abroad (Hypothesis 3). A large proportion (about 40% overall) of abstainers (i.e., CND) shifted to weekend moderate (WNRD) or heavy (WRD) drinking, and one out of three moderate drinkers (WNRD) moved to one of the two heavy drinking classes (WRD and DD). Those non/moderate drinkers displayed a 'qualitative' change because they adopted new habits by either going from no to some alcohol use, or by displaying new behaviours such as drinking a lot of alcohol in a short amount of time (i.e., HED) and getting drunk. In other words, it's not just that they drank more (i.e., 'quantitative' change) during the study abroad experience, they drank differently. These results offer *per se* important new information on how students' alcohol use trajectories that could guide intervention development in this high value group.

The 'Get Away' and 'Academic' motivations to study abroad and psychological adjustment to the host environment were included in the model to demonstrate how the effect of exogenous variables (i.e., covariates) on class membership and transition probabilities from one class to another across time can be examined in LTA models. With regard to class membership, for example, results showed that, pre-departure weekend heavy drinkers were more motivated to get

away and were less academically motivated, compared to the non-drinking group, suggesting that for these students the exchange programme is a way to escape from their home environment and has little to do with the desire to experience a different academic system or learn something new (Aresi et al., 2017). With regards transitioning, results indicate that these motivations have differential effects on each drinking class. For example, moderate weekend drinkers (i.e., WNRDs) with a greater motivation to leave one's home environment were more likely to engage in heavy drinking once abroad, though this was not true for the other types of drinkers, whose alcohol use remained unchanged and regardless of how intense their desire to leave their home environment was. Contrary to our expectations, the 'Academic' motivation did not have a protective effect against heavy drinking, though it did have some unexpected effects on those who were already drinking heavily. Interestingly, academically motivated daily drinkers were more likely to continue drinking every day. These students represent a small group of drinkers displaying a propensity to engage in heavy drinking and get drunk. Previous studies suggest this is a high-risk group with prodromal signs of alcohol abuse and dependency, including drinking to cope with negative emotions (Aresi et al., 2020; Cleveland et al., 2012; Cleveland et al., 2013). We speculate that high academic motivations may exert greater pressure on these students leading them to drink as a maladaptive strategy to cope with stress (Piumatti, 2018; Piumatti, Lietz, Aresi, & Bjegovic-Mikanovic, 2019; Russell, Rosenthal, & Thomson, 2010). While this requires confirmation, it does highlight the practical value of the typological approach. Unique risk factors in this group would have been overlooked in traditional multivariate models. Instead of universal interventions for all prospective study abroad students (Pedersen, Neighbors, Atkins, Lee, & Larimer, 2017), a subgroup of academically motivated heavy drinkers may benefit from targeted preventive or counselling interventions in order to successfully navigate their exchange experience.

Analyses of the effect of students' psychological adjustment, confirm and extend those of previous studies on exchange student samples (Aresi et al., 2019; Ferrari et al., 2017). This result is likely to reflect the popular notion among students that studying abroad is an opportunity to have

fun and party which often involves alcohol use (Aresi, Fattori, et al., 2018), though our analyses go further by indicating it is not drinking *per se* but heavy drinking (i.e., WRD and DD classes) that may distinguish students reporting higher levels of adjustment. This is conceptually important because it offers insight on how host country adjustment is differently understood by members of this population (i.e., live the Erasmus student party life). It also offers an explanation to why theoretical models linking successful acculturation to moderate alcohol use among migrant populations may not extend directly to exchange students (Aresi et al., 2021; Zemore, 2007).

Lastly, the result on lack of differences in post-return alcohol negative consequences across the drinker classes further confirms the idea that students may consider their overseas experience as liminal or a time-out from their normal life. Therefore, increased drinking appears to be connected to situational factors such as less social and role constraints and obligations, feeling of being on holiday, desire to enjoy their limited time abroad (Aresi, Fattori, et al., 2018; Aresi et al., 2019; Brown & Stephan, 2013; Marcantonio et al., 2018). Fortunately, once students return home they also go back to their previous habits.

Several limitations of the current study suggest avenues for future research. First, only self-report measures were employed, which might be susceptible to response bias. Second, as is typical of longitudinal observational studies, participation was subject to attrition. This happened already at T_2 but was particularly apparent at T_3, thus preventing us from including data on students' post-return alcohol use patterns. Third, sensitivity analysis to test whether the hierarchical structure of our data (individuals nested into home/host countries) had any effect on our results were not possible due to insufficient sample size (< 50) at country level (Maas & Hox, 2005). This might be addressed in future studies using data from a larger number of countries.

Conclusion

A step-by-step guide for the use of LCA and LTA is presented, an approach that provides an analytic perspective that identifies typologies and quantifies change over time. This person-centred approach has at least three purposes. First, LCA can be used to acknowledge the heterogeneity in

any population of interest and facilitate a more nuanced perspective on the existence of subgroups or profiles. We have demonstrated this by showing how study abroad students' alcohol use profiles differed, and which initial profile was associated with the greatest likelihood of transitioning to heavy drinking as they travelled abroad (i.e., moderate drinkers). We also examined what factors may interact with such transition (i.e., motivations to study abroad). This is helpful to indicate a potential target for intervention. This provides novel insights compared to previous research, in which the dominant view shared by both scholars, the media and students is that most students increase alcohol intake during study abroad experiences (Aresi, Fattori, et al., 2018; Juvan & Lesjak, 2011; Kingsbury, 2013). In practical terms, the person-centred approach can be applied across the intercultural research and international mobility field. Typologies can be developed using a number of descriptors, including wellbeing, cultural adjustment, intercultural competence, and second-language acquisition. The validity of these typologies can be examined in a range of settings, such as different study abroad programmes or local communities, and ethnic groups and cross-culturally. Second, LTA facilitates the analysis of change over time in a way that captures qualitative shifts, reflecting the supposition that travelling abroad and getting in contact with different cultures has a transformative effect on people. Third, these person-centred approaches have practical value in the field. For example, they can be used to profile target populations for communication purposes. Alternatively, LTA can be used to examine the differential effects of initiatives on subgroups of students, ethnic groups and staff of international education offices or community-based counselling services, for example new culturally based interventions and innovations in teaching strategy, training, new policies and strategies to promote intercultural competence, better adjustment outcomes and wellbeing.

Notes

[1] Multifinality refers to the concept that people can experience the same life events or have similar histories yet their developmental outcomes can vary widely. Equifinality refers to a diversity of pathways leading to the same outcome.

[2] The validity of the retrospective assessment of behaviours, including alcohol use has been well established, especially when valid quantity-frequency measures, such as the DDQ, are used. See, for example, Koenig, Jacob, and Haber (2009).

[3] Parameters were let free one at a time starting form the greatest deviation in absolute value between the baseline and the full invariance models.

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Table 1

Model fit statistics for Latent Class Analysis models with three to five latent classes prior departure (T_1) and during the study abroad experience (T_2)

Model	*-LL*	SCF	$\chi 2$ *LRT* (p value)	Stdres	LMR- LRT (p value)	BLRT	CAIC	ssBIC	BF	cmP	SSS	Entropy
Prior departure												
Three class	2930.820	1.23	837.809 (p > .05)	4.10%	236.389 (p = .113)	< .001	5985.342	5971.182	0.00	0.00	55	.932
Four class	2861.773	1.09	666.525 (p > .05)	2.46%	136.217 (p = .001)	< .001	5889.771	5870.743	336800053.78	1.00	33	.791
Five class	2845.116	1.06	554.579 (p > .05)	2.46%	32.861 (p < .001)	< .001	5898.980	5875.084	0.00	0.00	17	.821
Abroad												
Three class	3230.634	1.45	834.522 (p > .05)	5.97%	310.537 (p = 0.275)	< .001	6584.970	6570.810	0.00	0.00	81	.781
Four class	3124.395	1.01	363.732 (p > .05)	1.49%	209.590 (p < .001)	< .001	6415.015	6395.987	6483329324.41	1.00	41	.846
Five class	3110.696	1.02	332.771 (p > .05)	1.49%	27.026 (p = .031)	.050	6430.140	6406.244	0.00	0.00	33	.851

Note. LL = log likelihood; SCF = scaling correction factor of the robust maximum likelihood estimator; $\chi 2$ LRT = likelihood ratio chi square goodness-of-fit; Stdres = standardized residuals; LMR-LRT = Lo–Mendell–Rubin likelihood ratio test; BLRT = bootstrapped likelihood ratio test; CAIC = Consistent Akaike information criterion; ssBIC = sample-size adjusted Bayesian information criterion; BF = Bayesian factor; cmP = approximate correct model probability. SSS = smaller class numerosity

Table 2

Chi-square difference tests based on log likelihood values

	-LL	SCF	*d*	Δ	*df*	*p-value*
Baseline model	5989.65	1.02	89			
Full invariance	6046.64	1.05	46	115.38	43	< .001
Partial invariance	6011.47	1.04	52	43.98	37	.200

Note. -LL = model log likelihood; SCF = scaling correction factor of the robust maximum likelihood estimator; d = number of free parameters; Δ = difference test value; df = degree of freedom of the difference test.

Table 3

Transition probabilities (%) from each latent class prior departure (T_1) and during the study abroad experience (T_2)

		Classes at T_2			
		CND	WNRD	WRD	DD
Classes at T_1	CND	**59.2**	31.9	9.0	0
	WNRD	5.0	**61.6**	29.9	3.5
	WRD	1.5	3.2	**89.2**	6.2
	DD	0	13.5	45.1	**41.4**

Note. Probabilities of being in the same class at both time points are in bold.

Table 4

Changes in the transition probabilities (%) as 'Get Away' and 'Academic' motivation scores increase from the mean value to one standard deviation above it

Get away					
		Classes at T_2			
		CND (11%)	WNRD (32%)	WRD (52%)	DD (5%)
Classes at T_1	CND (14%)	0	0	0	0
	WNRD (46%)	-4.6	-6.9	9.9	1.1
	WRD (37%)	0	0	0	0.0
	DD (3%)	0	1.2	-3.6	2.4

Academic					
		Classes at T_2			
		CND (11%)	WNRD (32%)	WRD (52%)	DD (5%)
Classes at T_1	CND (14%)	0	0	0	0
	WNRD (46%)	-3.3	1.8	-2.4	3.9
	WRD (37%)	0	0	5.3	-5.3
	DD (3%)	0	-0.4	-31.0	31.5

Table S1

Percent of students reporting alcohol use behaviours at pre-departure (T_1) and during the study abroad experience (T_2)

	Pre-departure	Abroad
Alcohol use indicators		
Any drink in past month	86.0	89.0
Drunk in past month	38.3	48.8
Past month HED	65.7	71.1
Any drink Monday	8.2	11.7
Any drink Tuesday	9.9	21.4
Any drink Wednesday	14.3	25.6
Any drink Thursday	23.0	40.7
Any drink Friday	66.8	71.4
Any drink Saturday	70.8	69.2
Any drink Sunday	13.2	11.4

Note. N = 734 for all variables.

Table S2

Item-response probabilities and class prevalence rates for the four-class LCA model prior departure (T_1) and during the study abroad experience (T_2)

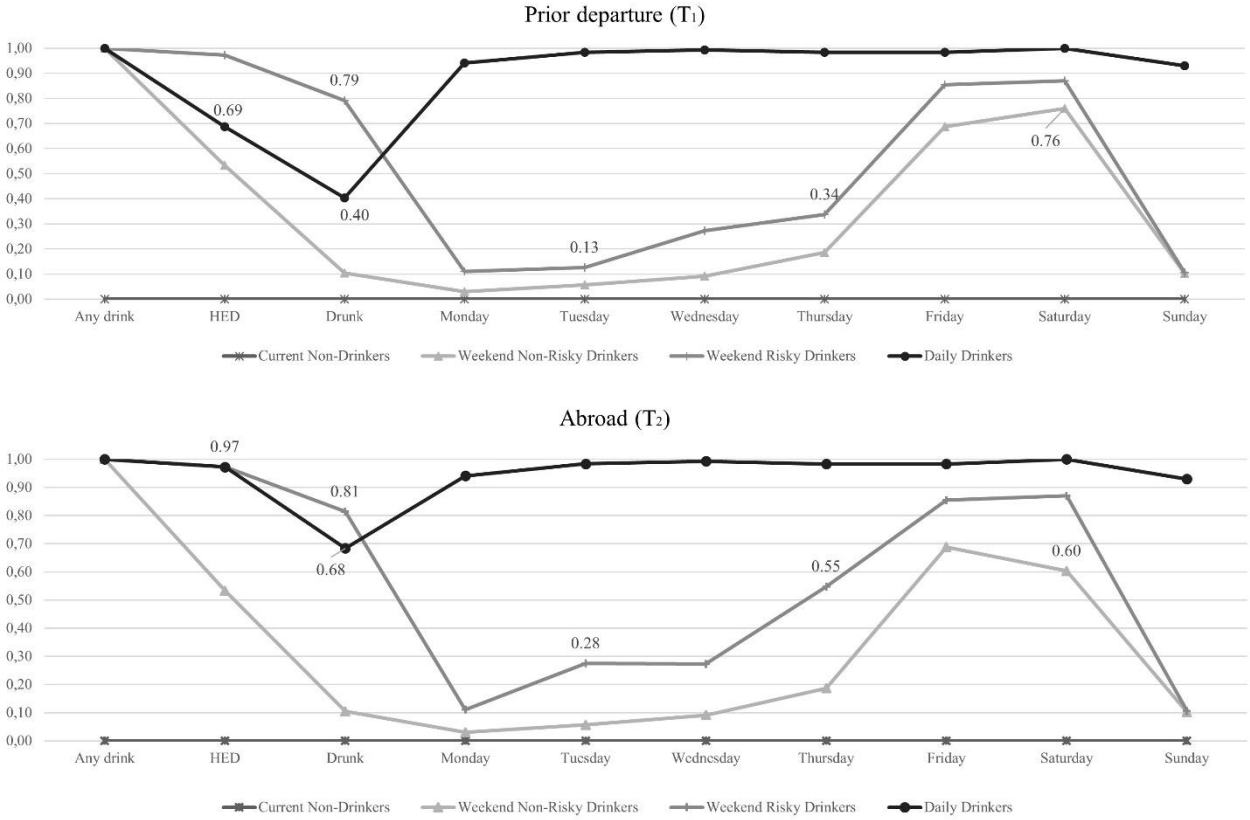
	Latent Class			
	Current Non-Drinkers	Weekend Non-Risky Drinkers	Weekend Risky Drinkers	Daily Drinkers
Prior departure				
Any drink in past month	0.00	**1.00**	**1.00**	**1.00**
Drunk in past month	0.00	0.15	**0.76**	0.43
Past month HED	0.00	**0.55**	**1.00**	**0.73**
Any drink Monday	0.00	0.02	0.08	**0.86**
Any drink Tuesday	0.00	0.05	0.11	**0.72**
Any drink Wednesday	0.00	0.06	0.18	**1.00**
Any drink Thursday	0.00	0.14	0.34	**0.82**
Any drink Friday	0.00	**0.66**	**0.89**	**0.86**
Any drink Saturday	0.00	**0.75**	**0.90**	**0.84**
Any drink Sunday	0.00	0.11	0.13	**0.70**
Estimated Prevalence	14%	41%	40%	5%
	Current Non-Drinkers	**Weekend Non-Risky Drinkers**	**Weekend Risky Drinkers**	**Daily Drinkers**
Abroad				
Any drink in past month	0.00	**1.00**	**1.00**	**1.00**
Drunk in past month	0.00	0.09	**0.83**	**0.69**
Past month HED	0.00	0.50	**0.98**	**0.97**
Any drink Monday	0.00	0.03	0.11	**0.93**
Any drink Tuesday	0.00	0.07	0.27	**1.00**
Any drink Wednesday	0.00	0.13	0.32	**0.97**
Any drink Thursday	0.00	0.25	**0.54**	**0.97**
Any drink Friday	0.00	**0.71**	**0.84**	**1.00**
Any drink Saturday	0.00	**0.61**	**0.86**	**1.00**
Any drink Sunday	0.00	0.08	0.08	**0.88**
Estimated Prevalence	11%	31%	52%	6%

Note: Entries in bold font indicate class-defining probabilities (>0.50). HED = heavy episodic drinking; BAC = blood alcohol content; Estimated Prevalence refers to model-based estimate of latent class prevalence rates.

Figure Captions.

Figure 1

Item-probabilities plots for partial invariant four-class model prior departure (T_1) and during the study abroad experience (T_2).



Note. Values of parameters let free to vary across time are displayed.

Figure 2

Sankey diagram showing the movement direction and flow quantity from each latent class prior departure (T_1) and during the study abroad experience (T_2).