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Development of the Geographical Proportional-to-size Street-Intercept Sampling (GPSIS) method for recruiting urban nightlife-goers in an entire city

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ABSTRACT

We developed the Geographical Proportional-to-size Street-Intercept Sampling (GPSIS) method in order to obtain a sample of nightlife-goers which accounted for the diversity of spaces, patrons and locations within two Swiss cities. Popular nightlife zones were identified and quantified using social media data and local experts' knowledge. Young people were recruited in the streets on Friday and Saturday nights on three consecutive weekends using the 'fixed-line method, pro-rated for the zone's estimated popularity. Of the 3092 young adults approached, 896 agreed to pre-register. The importance of recruitment in multiple zones and over multiple weekend-days was evidenced by significant variations in participant demographics and registration rates between recruitment zones, times and weather conditions. To conclude, by combining a geographical approach with *in situ* recruitment, GPSIS has considerable potential as a tool for recruiting samples that represent the diversity of the nightlife population and spaces.

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Introduction

Urban nightlife is characterised by a broad diversity of cultures, entertainment offerings, venues and patrons, and is often spread over large geographical areas within a city. According to Chatterton and Hollands (2002) ethnographic work in large UK cities, the urban playscape in nightlife areas is divided into different spaces (labelled as 'mainstream', 'residual' and 'alternative'), which relate to different production, regulation and consumption cultures and are located in different parts of the city. Such cultural and spatial divisions of recreational nightlife scenes were also found, for example, for juvenile substance use in Zurich (Demant & Landolt, 2014) and in different cities in the UK (Chatterton & Hollands, 2003; Measham & Moore, 2009; Roberts, 2015). Ethnographic studies in San Francisco (Cavan, 1966) and Toronto (Purcell & Graham, 2005) further revealed several distinct categories of bars and nightclubs. The latter study identified obvious differences in the patrons' characteristics (e.g. age,

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gender and dress code) and activities between different nightclubs, as well as a distinct geographical distribution of nightclubs across the city (e.g. techno in the entertainment district, salsa and alternative scenes downtown, and live music in the suburbs).

While numerous public health studies have documented elements of individual practices in urban nightlife, quantitative research has generally failed to account for the diversity of spaces, patrons and locations. One of the main reasons for this is related to the recruitment strategies traditionally used. In epidemiology, sampling is usually based on a *randomised selection, e.g. of households* (Dietze, Livingston, Callinan, & Room, 2014), to obtain a representative sub-sample of a given population, with the advantage that the information obtained can be transferred to or held true for an entire population. However, since many participants may be unfamiliar with the nightlife in a given city, such a recruitment strategy necessitates contacting a very large random population in order to eventually achieve a large enough sample of nightlife-goers. In smaller-scale studies, *convenience sampling* (Northcote & Livingston, 2011), *snowball sampling* (i.e. recruitment using seed-participants' social networks to access specific populations), *respondent-driven sampling* (i.e. weighted snowball sampling: Bellis etal., 2008; Bryant, 2014) and *online network sampling*, such as adverts on Facebook (Lea, Reynolds, & de Wit, 2013; Rife, Cate, Kosinski, & Stillwell, 2016) or using Amazon Mechanical Turk (Boynton & Richman, 2014), proved to be efficient and cost-effective recruitment methods for reaching specific groups of nightlife-goers. However, since participants might know each other or share similar behavioural traits, such recruitment strategies could suffer from selection bias and data contamination and may represent only a fraction of nightlife spaces and patrons (Miller & Sonderlund, 2010). By recruiting people directly in a nightlife setting, *portal sampling* (i.e. at venues entrance or exit: Miller et al., 2013; Thombs et al., 2010) and *street-intercept sampling* (i.e. on the way to and from the entertainment district: Graham et al., 2014; Johnson et al., 2006) strive to obtain ecologically valid data while minimising recall bias. However, such methods are susceptible to sample selection bias since participants are clustered within a selection of recruitment locations, which might not be representative of all nightlife spaces in the city. Finally, *time-space sampling* (i.e. a probability-based portal sampling with randomization of venues, time and patrons: see Muhib et al., 2001; Parsons, Grov, & Kelly, 2008) has the highest potential for generating a representative sample of nightlife-goers. The drawback is that this recruitment method is time-consuming and expensive (Kendall et al., 2008) and cannot include hundreds of nightlife venues simultaneously. It has therefore usually been used to recruit samples of specific, hard-to-reach populations within particular venues rather than across an entire city.

Using a geographical parameter such as the density of alcohol outlets (Ahern, Margerison-Zilko, Hubbard, & Galea, 2013; Groff & Lockwood, 2014; Rowland et al., 2016) appears to be a more successful way of encompassing a city in its entirety by starting from an exhaustive list of registered locations. This enables quantification of people's activities within defined zones such as census boundaries, postcode areas or buffers surrounding locations of interest. The official registry of alcohol outlets, however, is not the best estimator of the geographical distribution of young nightlife-goers since it excludes alternative drinking locations such as homes, streets and parks. With their almost full registry of locations and all-year-long real-life check-ins, online location-based social networks (LBSNs, i.e. social networks allowing people to share their physical location in real-time with friends by means of their smartphone: Bentley, Cramer, & Müller, 2014) offer promising opportunities for capturing geographical activity over an entire city from the perspective of nightlife-goers themselves. Although LBSN users' primary objective when sharing their location (known as a 'check-in') is to meet friends or keep a record of the places they have been to and who was with them (Frith, 2014; Lindqvist, Cranshaw, Wiese, Hong, & Zimmerman, 2011), the collection of check-ins from thousands of real-life nightlife-goers provides a unique estimator for identifying and quantifying attendance of popular nightlife venues or areas.

We developed the *Geographical Proportional-to-size Street-Intercept Sampling (GPSIS)* method with the aim of recruiting as representative a sample as possible of young people on nights out. Its three-step procedure consists of (a) identification and delimitation of popular nightlife zones accounting for different types of venues and patrons, (b) quantification of the popularity of nightlife zones and definition of recruitment quotas per zone in proportion to its attendance, and (c) application of a

systematic method for approaching and recruiting participants on the street in each zone over multiple nights. Since the procedure combines systematic *in situ* sampling within proportional-to-size clusters, nightlife-goers theoretically have the same probability of being recruited whichever zone they are in. In contrast to portal and time-space sampling, GPSIS has the advantage of sampling all young people participating in urban nightlife, even those who are not at a bar or nightclub. Furthermore, nightlife activities are subject to constant change, depending notably on the events taking place, the time and weekday, but also on the weather conditions. This dynamic feature of nightlife-going populations (i.e. different individuals may go to different places at different times on different weekends) makes the recruitment of a representative sample of nightlife-goers unrealistic in absolute terms. However, as a multi-site systematic method, GPSIS has the advantage of maximising the diversity of the people approached and, consequently, the potential representativeness of the final sample.

This aim of this paper is to describe the development and implementation of GPSIS in two major nightlife hubs in Switzerland and to evaluate its potential for recruiting representative samples of young people on nights out. Specifically, we will (a) investigate the extent to which the selection of recruitment zones based on LBSN data represented a diversity of drinking location types, (b) compare participant recruitment quotas based on LBSN data with local experts' estimations and with the samples actually recruited for each recruitment zone, (c) compare the demographic characteristics of the people approached and the registration rates across zones, (d) investigate the impact of external conditions (time of day and weather) on registration rates, and (e) explore participants' and recruiters' feedback on the recruitment process.

Methods

Procedure

The development of GPSIS was part of a larger study (Labhart & Kuntsche, 2016; Santani et al., 2016) which used a smartphone application to collect event-level data on young people's nightlife behaviour in the cities of Lausanne and Zurich (approximately 20,000 to 30,000 nightlife-goers per night in Lausanne and 100,000 in Zurich: see Frutiger, 2012; Zürich City, 2014) located respectively in French-speaking and German-speaking Switzerland. On Friday and Saturday nights over seven consecutive weekends, participants aged 16 to 25 were requested to document their evenings using an Android smartphone application developed for the study. From 8 pm to the end of the night, series of event-level questionnaires were used to document the drinks consumed, the locations attended, and the characteristics of the environment. Participants had to take a picture of each drink and make a 10-s video clip of the environment when attending a new location. Additionally, the participants' activities and displacements were automatically recorded by the smartphone sensors (e.g. GPS, accelerometer). Participants were given a monetary incentive of CHF 100 (approximately GBP 70) if they completed at least 10 nights of participation. They were instructed to document any night, including when they did not go out or did not drink, in order to provide an overview of the different kinds of situations young people experience on Friday and Saturday nights. Finally, 20 qualitative interviews were conducted in each city. The study protocol was approved by the Lausanne and Zurich Cantonal Ethics Commissions for Research on Human Beings (protocol 145/14).

Mapping popular nightlife zones using social networks

The implementation of GPSIS started with the identification of the most-frequented nightlife zones in Lausanne and Zurich. For this, we used geolocalised check-ins from Foursquare, the most popular LBSN. More than 50 million people use Foursquare every month and 65 million places are indexed worldwide (Foursquare HQ, 2016). This data source was chosen since it provided an almost exhaustive catalogue of nightlife locations such as pubs, clubs and parks in most cities (Bentley et al., 2014; Hecht & Stephens, 2014) and had users similar to the targeted age groups for the study (Frith, 2014; Lindqvist et al., 2011). For each registered location, Foursquare provided full information on the type

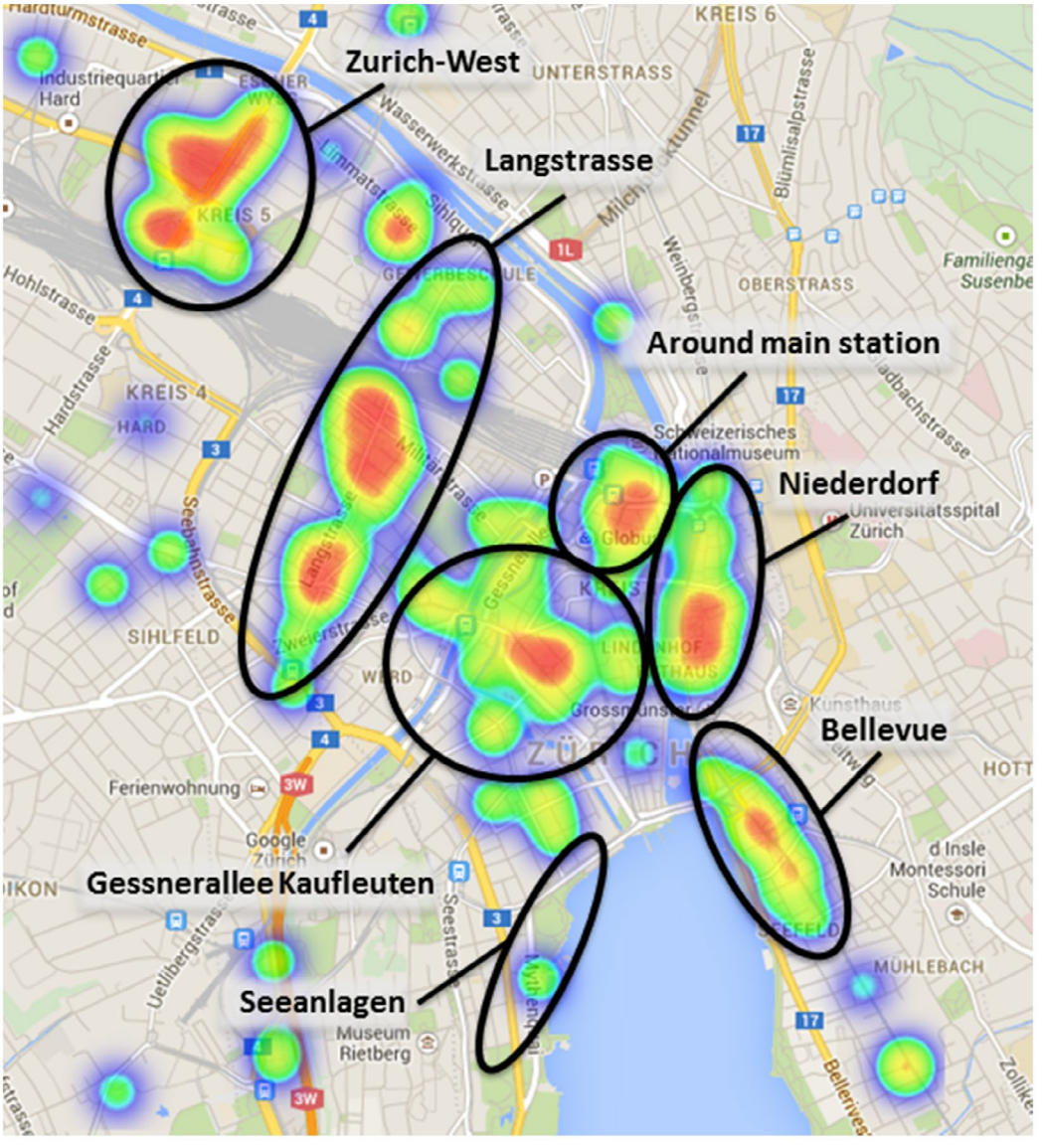

Figure 1a. Heat map showing the density of Foursquare check-ins and the seven selected recruitment zones in Zurich.
Note: Locations with fewer than 50 check-ins were omitted to enhance the visual impression of geographically confined zones.

of location, the number of check-ins and the geographic coordinates. Locations were filtered by city and type to retain only check-ins related to nightlife activities (i.e. location types: bars, nightclubs, cinemas, theatres, public parks and streets) in Lausanne and Zurich. This data-set, accounting for all-year-long check-ins until August 2014, comprised 36,590 check-ins from 148 different locations in Lausanne and 116,099 check-ins from 506 locations in Zurich. Finally, to gain an overview of popular nightlife zones, heat maps of Foursquare check-ins were generated for each city (Figure 1a). Locations with fewer than 50 check-ins were omitted in the maps in order to enhance the visual impression of geographically confined nightlife zones within the entire city.

Selection of recruitment zones

The selection of recruitment zones was discussed with various local nightlife experts. To obtain different perspectives on nightlife activities, we held separate meetings with street social workers, who were in charge of managing daytime and evening activities for young people, and with community-based police officers in charge of nightlife security. After introducing the study and the recruitment strategy, the experts were provided with the heat maps of Foursquare check-ins and were first asked whether the popular zones shown on the maps corresponded to their experience of the city's nightlife. Since the heat maps represented nightlife activity over almost the past three years, the experts were then asked to indicate the most adequate recruitment zones in order to encompass current trends, such as the emergence of popular new venues and seasonal effects, and to ensure a broad diversity of venue types (e.g. mostly bars vs. mostly nightclubs vs. mostly parks) and populations across recruitment zones. On the basis of these criteria, we proposed seven zones in each city. The experts agreed with the choice of zones in Lausanne. In Zurich, they suggested that we add a new recruitment zone next to the lake (see 'Seeanlagen' in Figure 1b) as many frequent nightlife-goers would spend part of their evenings and nights in lakeside parks (i.e. because the recruitment was taking place in September) and that we drop a zone in which the two major drinking venues had closed in the previous months. During these meetings, we also asked for advice and safety precautions to integrate into the guidelines for the recruiters.

Definition of recruitment quotas

Recruitment quotas per recruitment zone were defined using both the filtered Foursquare check-ins, which were considered to be the most objective source of data available, and estimations from the local experts, which were regarded as the most accurate experience-based data. While estimates were provided in Lausanne, the experts in Zurich only provided relative indications rather than specific

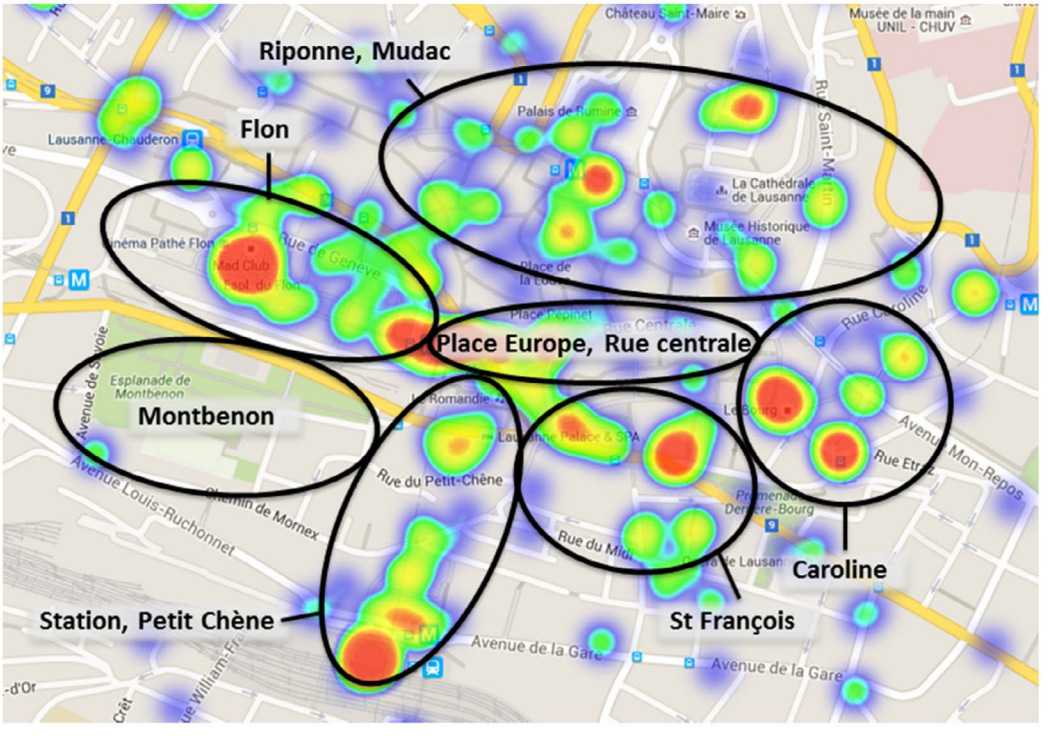

Figure 1b. Heat map showing the density of Foursquare check-ins and the seven selected recruitment zones in Lausanne.
Note: Locations with fewer than 50 check-ins were omitted to enhance the visual impression of geographically confined zones.

estimates (e.g. 'much more', 'more' or 'less' than the quotas from Foursquare) as no official statistics were available (Table 1). The 'ideal' recruitment quotas were defined by averaging the two estimates in Lausanne, while in Zurich, we aimed to follow both indications (e.g. 'much more' than the 1.4% estimated by Foursquare in Seeanlagen) but without using pre-set quotas. Overall, the experts recommended that we increase the recruitment quotas in zones dominated by parks and at the lakesides (e.g. Montbenon, Seeanlagen and Bellevue) to account for seasonal effects (i.e. because young people spend time in parks during warm evenings in September). They also advised us to decrease the quotas in zones with a high density of pubs and clubs due to a possible over-representation of check-ins (e.g. Flon) and in zones patronised by older nightlife-goers (e.g. Langstrasse).

Systematic recruitment approach

Recruitment took place with the approval of the local authorities on Friday and Saturday nights on the first three weekends of September 2014. Most recruiters were local university students who were close to the upper age range of the target population (Lausanne: 8 women, 2 men, mean age = 25.2 [SD = 2.8]; Zurich: 10 women, 3 men, mean age = 23.8 [SD = 3.8]). About a week before the recruitment took place, they were provided with a recruitment guide including a description of the study, the recruitment procedure and a number of safety recommendations, such as remaining with the team of recruiters at all times and leaving the area if they felt unsafe. Before the first recruitment session, a kick-off meeting was organised to familiarise recruiters with the online recruitment form, remind them of and discuss the recruitment procedure, practise what they would say when they approached potential participants and form teams of two to four recruiters in a relaxed atmosphere. Recruiters were also provided with bright lime-green t-shirts displaying the study logo, which were designed to attract attention and ease contact with potential participants. So that they could demonstrate how the Youth@Night application worked, recruiters were provided with an open version for installation on their own smartphone and a leaflet containing screen captures of most features.

Recruitment sessions took place between 9 pm and midnight with approximately 10 recruiters in each city simultaneously. This timeframe was chosen in order to reach young people on their way to the nightlife districts while minimising the risk of encountering people who were inebriated (Pennay et al., 2015). Following a strict time schedule, the recruiters approached young people in the target age group as they passed by on the street, introduced the study and pre-registered volunteers. The 'fixed-line method' (i.e. approaching every *n*th person crossing a virtual line on the street) was used to ensure a random selection of passers-by (Graham et al., 2014; Johnson et al., 2006). To be eligible, participants had to be between 16 and 25 years of age, have consumed alcohol at least once in the past month, have gone out in the city of recruitment at least once in the past month and own a smartphone with Android OS 4.0.3 or higher. After describing the study's goal, methods and incentives, recruiters pre-registered volunteers by recording their phone number, email address, age and gender. To prevent data contamination, a maximum of two persons could pre-register within the same group of friends. When people declined to take part, recruiters also recorded their age, gender and reason for declining whenever possible.

After pre-registration, participants were automatically sent an email containing hyperlinks to the study homepage and the consent form. After signing the online consent form, participants were instructed to complete a baseline questionnaire, download and install the study application on their smartphone and start using it the following Friday night. Emails, text messages and phone calls were used to support participants and give them reminders throughout this procedure. An online FAQ page also provided additional information on the study. Participants could unsubscribe and withdraw from the study at any time.

After each weekend, the samples of people approached and of pre-registered participants were compared with the ideal quotas. The schedule for the following weekend was then designed in such a way as to compensate for any deviation. Assuming that two-thirds of those approached would not be interested in participating or would refuse to provide personal information (Kuntsche, von Fischer, & Gmel, 2008), two-thirds of the interested persons would not be eligible (i.e. out of age range or no

Table 1. Recruitment quotas, diversity of nightlife venues, recruitment outcomes (number of people approached, pre-registration rate, age and gender of participants) and stay-points per recruitment zone and city.

	Lausanne								Zurich							
Recruitment zones:	Caro-line	Flon	Station, Petit Chêne	Mont-benon	Place Europe, Rue centrale	Riponne, Mudac	St François	Total	Belle-vue	Gess-nerallee, Kaufleu-ten	Lang-strasse	Nieder-dorf	Seeanla-gen	Around main station	Zurich-West	Total
Foursquare check-ins																
Proportion of check-ins per zone (%)	9.8	28.8	10.4	5.7	14.3	19.9	11.0		17.3	27.3	23.2	10.5	1.4	6.2	14.2	
Check-ins in pubs (%)	54.0	39.6	52.5		52.8	84.9	17.7	48.6	26.5	49.7	48.1	47.5	33.7	56.8	31.1	42.7
Check-ins in clubs (%)	26.3	16.1	7.1		11.3		9.0	10.6	8.5	7.9	19.3	0.4		12.6	23.9	12.3
Check-ins at cinemas, theatres and music venues (%)	4.5	21.7	40.3	7.5	0.9			11.4	10.4	3.5	6.9	2.6	1.2	3.5	16.3	7.2
Check-ins on streets and plazas (%)	15.3	22.6	0.1		35.0	15.1	73.3	27.3	49.1	30.7	8.8	47.4		26.5	28.7	29.6
Check-ins in parks (%)				92.5				2.1	5.4	8.3	17.0	2.1	65.1	0.6		8.3
Local experts																
Proportion of people per zone (%)[a]	10	20	10	10	25	20	5		++	–	–	+	++	+	o	
People approached in the street																
N	129	347	111	97	295	220	135	1334	412	95	157	343	219	407	125	1758
Proportion of people per zone (%)	9.7	26.0	8.3	7.3	22.1	16.5	10.1		23.4	5.4	8.9	19.5	12.5	23.2	7.1	
Mean age[b]	20.1	19.9	20.3	19.4	19.4	19.9	19.0	19.7	19.1	19.7	22.1	19.5	19.0	19.8	21.4	19.6
Proportion of men (%)[c]	63.2	50.6	58.6	50.6	43.5	50.6	44.1	50.2	46.1	48.0	37.5	60.2	51.0	63.6	64.2	55.1
Pre-registration status																
Agreed to pre-register (%)	31.8	31.1	24.3	34.0	35.3	44.5	31.1	34.0	28.6	27.4	16.6	24.8	32.9	18.7	20.0	24.3
Not interested (%)	27.9	29.4	39.6	21.6	28.5	17.3	34.1	27.9	16.0	29.5	26.1	22.2	11.4	42.0	40.0	26.2
No compatible phone (%)	31.0	29.7	25.2	29.9	26.1	29.5	30.4	28.7	48.3	43.2	47.8	49.6	35.6	32.2	33.6	41.9
Not in age range (%)	9.3	7.5	10.8	14.4	9.8	7.7	3.0	8.5	7.0	0.0	9.6	2.6	20.1	6.1	6.4	7.2
Pre-registered participants																
Proportion of people per zone (%)	9.1	23.8	6.0	7.3	23.0	21.6	9.3		27.6	6.1	6.1	19.9	16.8	17.8	5.8	
Mean age[d]	20.0	19.3	20.0	19.2	19.4	19.7	18.9	19.5	18.8	17.9	20.2	19.3	18.6	19.0	19.5	19.0
Proportion of men (%)[e]	70.7	49.0	74.1	60.6	48.1	57.7	50.0	55.2	58.1	44.0	52.0	65.5	73.2	64.4	84.0	63.6

Note: Recruitment zone names and locations are shown on the maps in Figure 1.
[a]Local experts provided specific quotas in Lausanne and relative indications (i.e. '++' = much more, '+' = more, 'o' = no change, '–' = less) in Zurich.
[b]information available for 1497 persons.
[c]information available for 2320 persons.
[d]information available for 881 persons.
[e]information available for 896 persons.

Android phone: Casais & Casais, 2016; Clapp et al., 2009; Graham et al., 2014), and one-third would not register or would drop out over the course of the study (Kuntsche & Labhart, 2013), we estimated that 2700 people had to be approached to obtain the final sample of 100 participants per city.

Measures

Geolocalised Foursquare check-ins were used to plot the density of nightlife activities for local experts and determine pro-rata attendance per zone prior to recruitment. Numbers of check-ins were aggregated per recruitment zone and venue type.

For each person approached in the street, recruiters recorded their age, sex, recruitment zone and intention to participate or not. Reasons for not participating included (a) not interested, (b) outside the target age range, (c) not in possession of an Android phone and (d) refusing to give personal information.

For each recruitment day, hourly weather conditions (temperature and wind speed) were documented using readings from the Federal Office of Meteorology and Climatology.

Participant feedback on the recruitment was recorded in the closing questionnaire after the smartphone study. Participants had to indicate on a four-point scale the extent to which they agreed or disagreed with statements such as 'the recruiters approached me in a friendly and non-intrusive manner' (items and answer categories are provided in Table 3).

Recruiters' feedback and observations were taken from the field diary completed after each recruitment session.

Statistical analyses

In addition to descriptive analyses provided in the Tables, bi- and multivariate tests (χ^2 tests, *t*-tests and analysis of variance) were used to test differences in pre-registration rates, participants' age and gender across recruitment zones, and differences in pre-registration rates across times and days of recruitment. Additionally, for each city, a two-step logistic regression model was used to estimate pre-registration rates based initially on times of recruitment and weather conditions only. In a second step, the age and gender of the people approached were entered into the model in order to assess whether the former set of predictors remained significant over and above the latter. Finally, one-sample *t*-tests were used to assess whether participants' ratings differed from the midpoint of the four-point assessment scale. All analyses were conducted using SPSS 21 (IBM Corp, 2012). In the Results section, we only reported statistically significant test results in order to improve the flow of the text. Unreported test results can be obtained from the authors upon request.

Results

Diversity of locations and recruitment zones

As seen in Table 1, almost half of all Foursquare check-ins occurred in pubs (48.6% in Lausanne and 42.5% in Zurich), followed by streets and plazas (27.7 and 30.1%, respectively). Most recruitment zones were characterised by a high proportion of check-ins in only one type of location (e.g. 84.9% pubs in Riponne, Mudac, 92.6% parks in Montbenon, and 73.4% plazas in St-François) but, at the city level, at least one zone was characterised by either a high proportion of pubs, parks or streets and plazas, highlighting both the uniformity (within zones) and diversity (across zones) of nightlife locations. Additionally, a couple of recruitment zones showed a high proportion of check-ins at several location types (e.g. Flon and Zurich-West), illustrating that a large diversity of nightlife locations might also be found within specific zones.

Demographics and registration rate per city and per zone

In total, 3092 people were approached in the street in Lausanne and Zurich. Mean age was around 19.3 years in both cities and slightly more men were approached in Zurich ($\chi^2_{(1)} = 5.5$, $p = .019$). Across recruitment zones, populations approached were globally homogeneous in Lausanne (i.e. no significant differences for age and gender ratio) but not in Zurich, where the people approached on Langstrasse were about 2.5 years older than in the rest of the city and mostly male.

The pre-registration rate varied greatly between cities (it was almost eight percentage points higher in Lausanne than in Zurich), across recruitment zones in each city ($\chi^2_{(6)\text{Lausanne}} = 17.8$, $p = .007$; $\chi^2_{(6)\text{Zurich}} = 26.8$, $p < .001$) and across participant demographics, with men being more likely to pre-register than women ($\chi^2_{(1)\text{Lausanne}} = 7.3$, $p = .004$, $\chi^2_{(1)\text{Zurich}} = 17.4$, $p < .001$) and pre-registered participants being younger than those who declined to participate ($t_{(510)\text{Lausanne}} = 5.5$, $p < .001$; $t_{(983)\text{Zurich}} = 5.1$, $p < .001$).

Overall, the major reason for declining participation was not having an Android-compatible smartphone. This proportion was almost 13 percentage points higher in Zurich than in Lausanne, which appears to be the main reason for the above-mentioned eight percentage-point difference in pre-registration rates between the two cities. More importantly, the proportion of people not interested in participation was about a quarter in both cities.

Of the 881 pre-registered participants (454 in Lausanne and 427 in Zurich, not tabulated), 629 (71%) signed the online consent form, 367 (58%) completed the baseline questionnaire, 241 (27%) installed the app and documented at least one night and 168 (19%; 94 in Lausanne and 74 in Zurich) documented at least 10 nights with the smartphone application. Participants using the app were slightly younger than the rest of the pool of people approached in Zurich (mean age = 18.5; $t_{(983)} = 3.47$; $p < .001$) but not in Lausanne (mean age = 19.4), and the gender ratios were similar in both cities (53% men in Lausanne and 54% men in Zurich).

Influence of weather and time on registration rate

As seen in Table 2, weather conditions were good on the first weekend (temperature between 18.0° to 19.5° and almost no wind), but colder on the second weekend and slightly more windy on the third. The pre-registration rates were higher on Fridays than on Saturdays as well as between 10 and 11 pm than one hour earlier or later.

Results of the multivariate logistic regression models estimating the registration rate based on time and weather conditions (Model 1 in Table 3) showed that a higher a pre-registration rate was achieved on Fridays and between 10 and 11 pm in both cities, as well as in more pleasant temperatures in Lausanne and in calm wind conditions in Zurich. Most predictors remained significant when the age and gender of passers-by were taken into account (Model 2), except for temperature which became non-significant in both cities.

Feedback from participants and recruiters

Table 4 summarises participants' experience and their feedback on the recruitment. Almost all participants judged that the recruiters' approach was friendly and non-intrusive (98% agreed or strongly agreed) and that they provided clear and complete information about the study (93% agreed or strongly agreed). Additionally, 94% thought that the recruitment happened early enough in the evening so that they were still sober enough to concentrate on what the recruiters told them, and 96% did not feel forced to register. All feedback differed significantly from the midpoint between agreement and disagreement.

The recruiters documented their experiences and the reactions of the people they approached in a recruitment field diary. Firstly, the bright lime-green t-shirts with the study logo worn by all recruiters were perceived as a factor that fostered group cohesion among the recruiters and gave them the

Table 2. Number of people approached, pre-registration rate and weather conditions per recruitment day, time and city.

	Lausanne							Zurich						
	Weekend #1		Weekend #2		Weekend #3			Weekend #1		Weekend #2		Weekend #3		
	Fri.	Sat.	Fri.	Sat.	Fri.	Sat.	Total	Fri.	Sat.	Fri.	Sat.	Fri.	Sat.	Total
Recruitment time														
9–10 pm														
People approached	67	108	98	68	85	117	543	67	92	100	113	168	102	642
% pre-registered	31.3	31.5	31.6	29.4	28.2	36.8	31.9	56.7	27.2	20.0	25.7	15.5	15.7	24.0
10–11 pm														
People approached	98	86	110	66	71	78	509	84	74	107	120	117	79	581
% pre-registered	53.1	44.2	30.9	31.8	46.5	29.5	39.5	35.7	41.9	24.3	16.7	26.5	24.1	27.0
11–12 pm														
People approached	83	92	26	5	48	28	282	63	93	106	100	91	82	535
% pre-registered	34.9	31.5	19.2	20.0	25.0	10.7	28.0	39.7	23.7	23.6	15.0	19.8	14.6	21.9
Total														
People approached	248	286	234	139	204	223	1334	214	259	313	333	376	263	1758
% pre-registered	41.1	35.3	29.9	30.2	33.8	30.9	34.0	43.5	30.1	22.7	19.2	19.9	17.9	24.3
Weather conditions														
Temperature at 10 pm (°C)	18.3	19.5	14.6	16.2	17.3	18.2		18.0	18.4	10.8	12.8	17.8	18.5	
Wind speed at 10 pm (m/s)	1	1	3	5	2	2		0	1	2	2	1	2	

Table 3. Logistic regression models for registration rate on time and weather conditions of recruitment and passer-by demographics, per city.

	Registration rate in Lausanne				Registration rate in Zurich			
	Model 1		Model 2		Model 1		Model 2	
	OR	95%-CI	OR	95%-CI	OR	95%-CI	OR	95%-CI
Weekday (reference = Friday)	0.70*	(0.52–0.95)	3.51**	(1.64–7.53)	0.78*	(0.63–0.97)	0.65**	(0.49-.085)
Time (reference = 10–11 pm)								
9–10 pm	0.67**	(0.51–0.86)	0.30**	(0.14–0.62)	0.93	(0.71–1.22)	0.92	(0.65–1.28)
11 pm – midnight	0.57**	(0.41–0.80)	0.34*	(0.14–0.85)	0.74*	(0.56–0.78)	0.60**	(0.41–0.86)
Temperature (°C)	1.15*	(1.03–1.29)	0.84	(0.65–1.09)	1.01	(0.96–1.06)	0.96	(0.91–1.03)
Wind (m/s)	1.01	(0.86–1.18)	0.75	(0.49–1.14)	0.71**	(0.55–0.91)	0.48***	(0.34–0.66)
Age			0.80***	(0.73–0.87)			0.91***	(0.87–0.95)
Gender (reference = women)			0.98	(0.55–1.83)			2.19***	(1.66–2.89)

*$p < .05$; **$p < .01$;
***$p < .001$.

Table 4. Participant feedback on the recruitment process.

	Strongly disagree	Disagree	Agree	Strongly agree	Mean (SD)	$t(df = 200)$[a]
Coding:	(1)	(2)	(3)	(4)		
1. The recruiters approached me in a friendly and non-intrusive manner	1.0%	1.5%	19.9%	77.6%	3.7 (0.5)	33.1***
2. It was already late in the evening and I was unable to concentrate on what the recruiters were saying	55.2%	38.3%	6.5%	0.0%	1.5 (0.6)	−22.7***
3. The recruiters were available to answer my questions	1.0%	3.0%	31.8%	64.2%	3.6 (0.6)	25.7***
4. The information given by the recruiters was clear and complete	1.0%	6.5%	40.3%	52.2%	3.4 (0.7)	20.1***
5. I felt forced to register	79.6%	16.4%	3.0%	1.0%	1.3 (0.6)	−31.7***

[a]Mean different from 2.5 (= neither agree nor disagree).
***$p < .001$.

legitimacy to approach potential participants. The *t*-shirts' unusual colour caught the attention of passers-by (some started talking to the recruiters out of curiosity) and helped the recruiters to make contact. The recruiters enjoyed being in teams of two to four as this enabled them to support each other. Secondly, when the weather was bad, relatively few people spent time outside, which reduced the pool of potential participants. Thirdly, it was difficult to apply the fixed-line method on quiet streets or in bad weather. In such cases, the recruiters approached all eligible passers-by. Fourthly, it seemed easier to recruit younger participants because the monetary incentive appeared more attractive to them. Finally, participants were generally surprised that they would have to register on their own later rather than completing a questionnaire at the time of recruitment. Many were nevertheless attracted by the innovation of using a smartphone application for a study on nightlife.

Discussion

The aim of this article was to evaluate the feasibility and implementation of the *Geographical Proportional-to-size Street-Intercept Sampling* (GPSIS) method developed to recruit representative samples of nightlife-goers in the cities of Zurich and Lausanne. The first premise of this recruitment method was to use Foursquare to identify the most-frequented zones by adopting a geographical perspective encompassing all nightlife areas. Heat maps of Foursquare check-ins provided a convenient tool for identifying the nightlife 'hotspots' and could be easily reviewed by local experts. As expected, the selection process resulted in varied configurations of different indoor and outdoor locations across zones, echoing the overall diversity of nightlife venues and locations.

The second premise was to quantify attendance of nightlife zones using different sources of information. Due to the dynamics of nightlife activities from one night to the next, considerable attention had to be paid to the issue of how to obtain recruitment quotas that would be representative of the population under investigation. The combination of different sources to quantify attendance of nightlife zones therefore appeared to be a key component of GPSIS's success. As a quantitative data source, the Foursquare check-ins could easily be filtered and aggregated for each zone and venue type to calculate users' attendance in proportion to the size of each zone. However, all-year-long check-ins from users that might not be fully representative for nightlife-goers and locations (Hecht & Stephens, 2014) only constituted long-term tendencies and needed refinement. Qualitative experienced-based knowledge from local experts was therefore an indispensable addition to our study to account for temporary circumstances, such as seasonal effects, even though these experts' opinions may have been distorted by personal perceptions and preferences. In the present study, we triangulated information from two types of sources in order to attenuate their specific limitations. Future research could nevertheless extend the procedure to include more data sources. For example, subjective recruitment quotas might also be requested from club and pubs owners. Additionally, more precise estimations might be obtained by combining Foursquare check-ins with other LBSN sources (e.g. geolocalised tweets) and by filtering LBSN sources by user demographics, season or weekday.

The third premise was the application of a systematic street-intercept method in multiple zones simultaneously and in proportion to the size of each zone. We did not expect problems with this part of GPSIS as the fixed-line method had already been successfully implemented elsewhere. While previous studies (Graham et al., 2014) did not report any time- and weather-related variations, our recruiters' experience showed that the sampling rate (every *n*th person) needed to be adapted to weather conditions and variations in the flows of passers-by and that pre-registration rates varied according to weekday, time and weather conditions. Since all recruitment teams faced similar weather conditions simultaneously and, consequently, similar flows of passers-by, variations in these factors had little impact on the proportional-to-size principle of GPSIS. However, these results highlight the importance of conducting recruitment over multiple time periods and weekends to account for changing recruitment conditions. Notably, higher pre-registration rates were found between 10 and 11 pm than one hour earlier or later. A likely explanation for this is that, in the middle of the evening, when dinner time is usually over and most nightclubs are beginning to open, young people might be more relaxed and have more time to talk to recruiters than at any other period of the evening. Since hourly variations in recruitment rates have not been published in previous studies, more research is needed to determine the most suitable timeframes for recruitment in line with local cultural practices, such as customary dinner time, nightclub opening hours or the existence of happy hours.

The results of the recruitment process also highlight the importance of conducting recruitment in different zones of a given city. This appeared particularly relevant in Zurich, the larger of the two investigated cities, where systematic differences were found across zones in terms of the age and gender of the people approached and in pre-registration rates. In smaller cities, such as Lausanne, the close proximity of the nightlife zones might increase the mixing of populations, whereas nightlife populations might be more segmented in a larger city with more widely scattered nightlife.

As highlighted by the reluctance of the experts to provide numbered recruitment quotas in Zurich, it was almost impossible to achieve a sample that was representative of all nightlife-goers across an entire city given the constantly changing nature of nightlife in general. What can, however, be achieved is to maximise the diversity of the people approached in order to account for the diversity of the population of nightlife-goers. In this respect, in comparison with the previously existing recruitment techniques, the present study confirmed the considerable potential of GPSIS as a tool for maximising the likelihood of approaching a large diversity of nightlife-goers while taking into account the proportional distribution of this diversity across places and times.

The recruitment method was developed independently from the content of the study to be subsequently conducted using the participants' smartphones. However, we observed that the particular type and length of the present study (a 10-night-long diary study) and the type of device used (Android smartphones) introduced a small selection effect in the sample of registered participants, since men and younger people were more likely to pre-register than women and those aged 20 and above. One explanation for the gender effect could be the higher proportion of Android smartphone ownership among men than among women (Benenson, Gassmann, & Reinfelder, 2013). Also, since a majority of the recruiters were young women, this may have encouraged some male participants to pre-register. The age effect may be linked to the size of the incentive, which was fairly small relative to the requirements for participation in the smartphone study. This also concurs with the recruiters' observation that the incentive was more attractive for young people, whose nightlife budget is usually smaller. In addition, while the overall pre-registration rate was lower in Zurich than in Lausanne, the results show that this was largely due to a higher proportion of people not being eligible to participate because they owned an iPhone. All in all, it appears that the lower numbers of registrations among older and wealthier people were probably due to the study constraints and the expected inconvenience of what was an intensive, long-lasting nightlife study for Android smartphone owners only, rather than being a feature of the GPSIS method per se.

Finally, several limitations of the present study might be considered in future developments of the GPSIS method. Firstly, we implemented GPSIS in cities with medium-sized nightlife scenes. As a result, the number of recruitment zones used in the present study might be not be sufficient to account for the diversity of locations and patrons in larger cities. A higher number of recruitment zones might consequently require more teams of recruiters. Secondly, by focusing on the most-frequented zones, the present selection of zones might have favoured mainstream nightlife locations over alternative scenes. The number of recruitment zones could be increased in future research to account for more varied types of nightlife locations and scenes. Additionally, the present study conceived the diversity of nightlife essentially in terms of locations (geographical zones and venue types). Future research might try to find quantitative data sources which allow researchers to account for the diversity of musical preferences and of alcohol and drug consumption patterns among nightlife-goers, for example. Thirdly, the present application of GPSIS relied on freely accessible LBSN data to identify zones and set recruitment quotas. LBSNs have now been recording check-ins around the world for many years, so the GPSIS method should be replicable and implementable in most cities. However, since such data might depend on the smartphone ownership rates and media literacy of the population of interest, alternative sources of information on pro-rata attendance per place might be considered, such as statistics from pubs or clubs or counts of people appearing on safety cameras. Finally, only participants who took part in the smartphone study provided feedback on the recruitment process in the closing questionnaire. Despite this potentially positive selection, the very positive feedback from the participants suggests that street recruitment was generally well-tolerated.

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