



Characterising group-cycling journeys using interactive graphics



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ABSTRACT

The group-cycling behaviours of over 16,000 members of the London Cycle Hire Scheme (LCHS), a large public bikeshare system, are identified and analysed. Group journeys are defined as trips made by two or more cyclists together in space and time. Detailed insights into group-cycling behaviour are generated using specifically designed visualization software. We find that in many respects group-cycle journeys fit an expected pattern of discretionary activity: group journeys are more likely at weekends, late evenings and lunchtimes; they generally take place within more pleasant parts of the city; and between individuals apparently known to each other. A separate set of group activity is found, however, that coincides with commuting peaks and that appears to be imposed onto LCHS users by the scheme's design. Studying the characteristics of individuals making group journeys, we identify a group of less experienced LCHS cyclists that appear to make more spatially extensive journeys than they would do normally while cycling with others; and that female cyclists are more likely to make late evening journeys when cycling in groups. For 20% of group cyclists, the first journey ever made through the LCHS was a group journey; this is particularly surprising since just 9% of all group cyclists' journeys are group journeys. Moreover, we find that women are very significantly ($p < 0.001$) overrepresented amongst these 'first time group cyclists'. Studying the bikeshare cyclists, or bike share 'friends', that individuals make 'first time group journeys' with, we find a significantly high incidence ($p < 0.001$) of group journeys being made with friends of the opposite gender, and for a very large proportion (55%) of members these first ever journeys are made with a friend that shares the same postcode. A substantial insight, then, is that group cycling appears to be a means through which early LCHS usage is initiated.

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1. Introduction

The many economic, health-related and environmental benefits of cycling have precipitated a growing academic interest in understanding cycling behaviour, and particularly the factors that motivate and discourage cycling within cities (Pucher and Buehler, 2012). Here, researchers have identified distinct cycling behaviours related to factors such as gender and social demographics (Anable et al., 2010; Heesch et al., 2012), individuals' life stages (Bonham and Wilson, 2012; Pooley et al., 2011), more obvious weather-related variables (Thomas et al., 2008) and the nature and provision of cycling infrastructure (Garrard et al., 2008; Dill and Gliebe, 2008; Tilahun et al., 2007). Relatively little research, either observational or attitudinal,

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has been published on the subject of ‘group cycling’ – cycling involving more than one person within a limited space and time. Two studies that briefly discuss the subject found that group cycling might be a means through which to overcome barriers around safety (Aldred, 2012) or to reintroduce adults to cycling after not having cycled since childhood (Bonham and Wilson, 2012). Both suggest that group cycling might be important, as it is seen as a means of enabling and motivating cycle behaviour.

In this study, we implement an approach to deriving group-cycling journeys from a comparatively large behavioural dataset: journeys made by members of the London Cycle Hire Scheme (LCHS), a large public bikeshare system. Our ambition is to systematically describe group journeys taken through the LCHS – their nature and spatial–temporal extent. A significant contribution will be to determine whether certain types of LCHS cyclists are more predisposed to group cycling than others, and importantly whether group journeys are different from the journeys those cyclists typically make. In order to meet these aims, it is necessary to simultaneously consider the spatial, temporal and demographic circumstances that underpin group-cycling journeys. Following approaches taken within information visualization, which attempt to identify space–time patterns of group interactions derived from mobile phone logs (Shen and Ma, 2008; Eccles et al., 2007; Slingsby et al., 2013), we develop interactive exploratory interfaces to explore the space–time structure of group-cycling journeys. A secondary contribution is the application of such techniques to this novel research area.

In the first half of the paper we explain the dataset, our approach to processing group journeys and our design and use of exploratory visualization software. In the second, a discussion of findings is structured around four research questions:

- RQ1. Where are group-cycling journeys, when are they made and who makes them?
- RQ2. Are there different types of group-cycling journeys and cyclists?
- RQ3. To what extent are group journeys different from the journeys that cyclists typically make?
- RQ4. To what extent is group cycling a means through which individuals are introduced to the LCHS?

To our knowledge this is the first large-scale study of group-cycle behaviours, either observational or survey based. It should be noted, however, that we only make inferences about group-cycling behaviour through mining LCHS usage records. In addition, our analysis misses a particular type of LCHS usage. To access LCHS bicycles, it is possible to either join the scheme as a formal member, or to pay on the day of travel as a ‘casual’ user. Casual users generally make around 35% of all LCHS journeys. We have a limited set of information on casual users and we do not identify their group behaviours, or group journeys made between members and casual users. Nor do we examine the group-cycling behaviour of LCHS cyclists and ‘regular’, non-bikeshare cyclists.

2. Related work

2.1. Group or social cycling research

As yet there is very little academic research that focuses substantively on group cycling. Two small-scale case studies that briefly discuss the subject found that respondents reported greater feelings of safety when cycling within groups (Aldred, 2012), and that for a small sample of female cyclists, group or social cycling was a motivation for returning to cycling (Bonham and Wilson, 2012). Whilst it would be possible to study group-cycling behaviour in more detail using travel surveys, one reason for the lack of large-scale observational research on the subject may be data availability. Typically in data-driven studies, cycle behaviours are observed by recruiting a small number of self-selected participants and monitoring their travel behaviours over a determinate period of time using GPS (Dill and Gliebe, 2008). In order for group-cycling behaviours to be measured using such means, entire social networks would need to be recruited, which would likely be problematic.

Despite the lack of existing research, there is a growing sub-discipline of work focussing particularly on urban cycling that is of relevance to this study. For example, a well-documented barrier to cycling within cities is that of personal safety (Jacobsen and Rutter, 2012). In his 2003 study, titled ‘Safety in Numbers’, Jacobsen finds that collision rates involving walkers and cyclists actually decline as the number of people walking and cycling in an area increases. It is unlikely that those walking or cycling exercise greater caution towards motor vehicles when there are many other walkers or cyclists in an area, and Jacobsen argues that it is motorists’ behaviours that are moderated by the increased number of pedestrians or cyclists. It is perhaps reasonable to assume that Jacobsen’s ‘Safety in Numbers’ thesis also applies to group cycling: group journeys are likely to be more visible than journeys made independently, and by extension group journeys may be materially safer than non-group journeys. That the bicycles available through the LCHS are arguably iconic and conspicuous, it might be argued that groups of LCHS bikes moving around London simultaneously may represent a special case of the *Safety in Numbers* thesis.

Whilst the real safety of cyclists is clearly important, fears about personal safety and cycling actively affect decision-making processes. Importantly, these fears are not experienced evenly across demographic groups (Garrard et al., 2012). Concerns about cycling safety have been found to be a greater constraint for women than men (Garrard et al., 2012). In the context of the LCHS, existing research into male and female scheme usage has found that women are underrepresented amongst LCHS members, and that those women that do make journeys tend to preferentially select parts of the city generally associated with greater levels of safety (Beecham and Wood, 2013). Following Aldred (2012), we speculate that group cycling may positively influence the perceptions of individual LCHS members, and subsequently their cycling behaviours. Although

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