



Glasgow's public cycle hire scheme:

analysis of usage between July 2014 and June 2016

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Key points

- There were almost 200,000 rentals in the two-year period following the start of the scheme in late June 2014.
- On average, there were 262 rentals per day.
- Numbers varied seasonally, with three-to-five times more bike rentals in July compared with January.
- More rentals were made on weekdays than at weekends, and the peak times were during the standard commuting periods of 7.30 to 9.30 in the morning and 4.30 to 6.30 in the afternoon/evening.
- There was a steady growth in use of the scheme. In July to June 2015/16 there were 121,743 rentals compared with 70,131 in July to June 2014/15, representing a rise of 74%.
- Four out of five hires were for less than 30 minutes.
- Glasgow Green was the most popular rental location, followed by the Broomielaw and St Enoch Square. Journeys starting and finishing at Glasgow Green were those most frequently made
- One in five journeys started and ended in the same place.
- The average number of hires per hour was affected by the weather conditions. Numbers of hires went up as the temperature increased and on sunny days, and decreased with increasing wind speeds, and rain. Cloudy or showery conditions did not appear to influence the levels of cycle hires.
- Four out of ten people registering for the scheme were women, a higher proportion than normally observed participating in cycle activities in Scotland.
- Nine out of ten people registering for the scheme had home addresses within the city of Glasgow or surrounding area. Those who lived near to a rental location were more likely to be registered users.

1 Introduction

Mass automated cycle hire schemes originated in the 1960s. They have evolved and spread since then, with schemes now available in over 1,000 locations worldwide. The largest schemes can be found in China¹. The Chinese city of Hangzhou has over 66,000 bikes available for rent. In Europe, one of the largest schemes is in Paris which has around 20,000 bikes.

A public cycle hire scheme was introduced in Glasgow on June 24th 2014. The contract for provision of the scheme for three years was awarded to NextBike (<http://www.nextbike.co.uk>), which runs similar schemes in cities across the world.

Figure 1: Glasgow public bike hire scheme rental location, George Square.



Individuals wishing to hire a bike must register with Nextbike either online, via an app, or by phone. They can then hire a bike from any of the Glasgow rental locations (Table 1) using the app, by phone, or using a rental card obtainable from the company. Bikes can be returned to any rental location. An annual subscription of £60 can be paid by those likely to make regular use of the scheme. For subscribers, the first 30 minutes of any ride is then free, with a fee of £0.50 for each additional 30 minute period. The maximum charge per 24 hours is £5. Less frequent users can choose to pay a £10 starting credit amount and then each rental costs £1 per 30 minutes up to a maximum of £10 in any 24 hour period. Special deals are available to staff and students of the University of Glasgow, the University of Strathclyde and

Glasgow Caledonian University, and corporate membership packages are also available.

Data on bike hires was made available to the Glasgow Centre for Population Health (GCPH) by Glasgow City Council for the period from 23rd June 2014 to 30th June 2016. This comprised 204,133 records. After removing incomplete records, records relating to temporary locations used only during the Commonwealth Games held in Glasgow in July/August 2014, and restricting data to the period 1st July 2014 to 30th June 2016 to allow an exact two-year time period of study, there were 191,874 records available for analysis. There were approximately 16,000 people registered to use the scheme during this time. Nextbike were not able to release full demographic information for these people due to data confidentiality requirements, but were able to make available their first name and part of their postcode of residence.

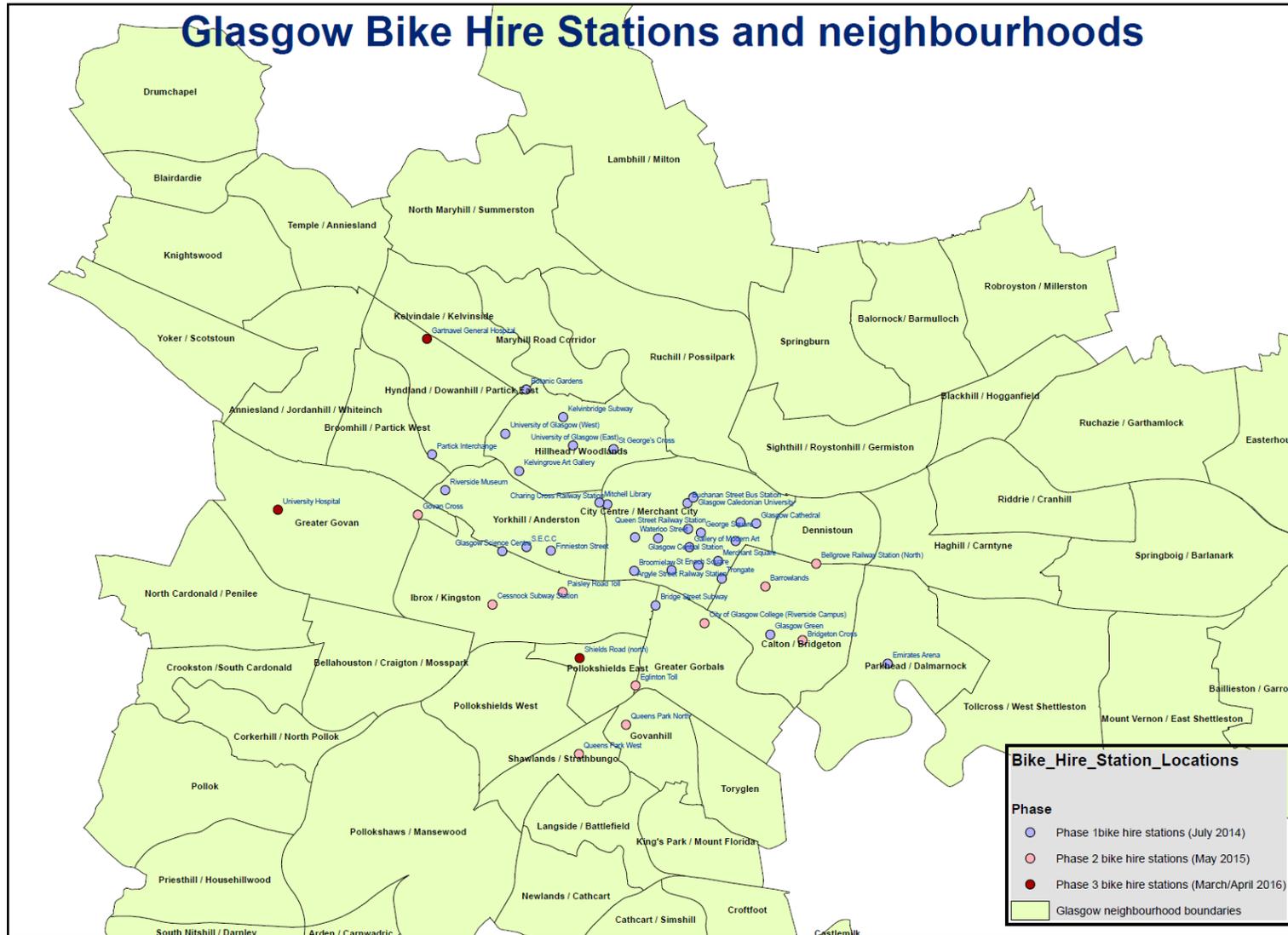
Initially, 400 bikes were introduced to 31 locations (Phase 1, 24th June 2014) with a small number of extra bikes available in reserve for replacing missing bikes or those temporarily unavailable as requiring repair. A further ten locations were added subsequently (Phase 2, 4th May 2015), although the number of available bikes was kept similar. Locations are listed in Table 1 and mapped in Figure 2. On 14th March 2016, the Queen Street station location (city centre) was transferred to Shields Road North (in the south of the city) as a result of the improvement works taking place at the station. A further two rental locations were added on 18th April 2016, at Gartnavel General Hospital (in the west of the city) and the Queen Elizabeth University Hospital (in the south of the city). In February 2017, an expansion to the scheme was agreed by Glasgow City Council¹, with the contract for the provision over the next seven years awarded to Nextbike. During this time, the number of hire stations will increase to 100, and the number of bikes within the scheme will be more than doubled to 900

Table 1. Glasgow's public cycle hire scheme locations.

Location	Phase	Postcode district
Argyle Street Railway Station	1	G2
Botanic Gardens	1	G12
Bridge Street Subway	1	G5
Broomielaw	1	G2
Buchanan Street Bus Station	1	G2
Charing Cross Railway Station	1	G2
Emirates Arena	1	G40
Finnieston Street	1	G3
Gallery of Modern Art	1	G1
George Square	1	G2
Glasgow Caledonian University	1	G4
Glasgow Cathedral	1	G4
Glasgow Central Station	1	G1
Glasgow Green	1	G1
Glasgow Science Centre	1	G51
Kelvinbridge Subway	1	G4
Kelvingrove Art Gallery	1	G3
Merchant Square	1	G1
Mitchell Library	1	G3
Partick Interchange	1	G11
Queen Street Railway Station	1	G1
Riverside Museum	1	G3
Scottish Exhibition and Conference Centre (SECC)	1	G3
St Enoch Square	1	G1
St George's Cross	1	G4
Trongate	1	G1
University of Glasgow (East)	1	G3
University of Glasgow (West)	1	G12
University of Strathclyde (North)	1	G4
University of Strathclyde (South)	1	G1
Waterloo Street	1	G2
Barrowlands	2	G4
Bellgrove Railway Station (North)	2	G31
Bridgeton Cross	2	G40
Cessnock Subway Station	2	G51
City of Glasgow College (Riverside Campus)	2	G5
Eglington Toll	2	G41
Govan Cross	2	G51
Paisley Road Toll	2	G51
Queens Park North	2	G42
Queens Park West	2	G42
Gartnavel General Hospital	3	G12
University Hospital	3	G51
Shields Road (North)	14/3/2016	G41

Phase 1: 24th June 2014; Phase 2: 4th May 2016; Phase 3: 18th April 2016.

Figure 2: Glasgow's public cycle hire scheme locations.

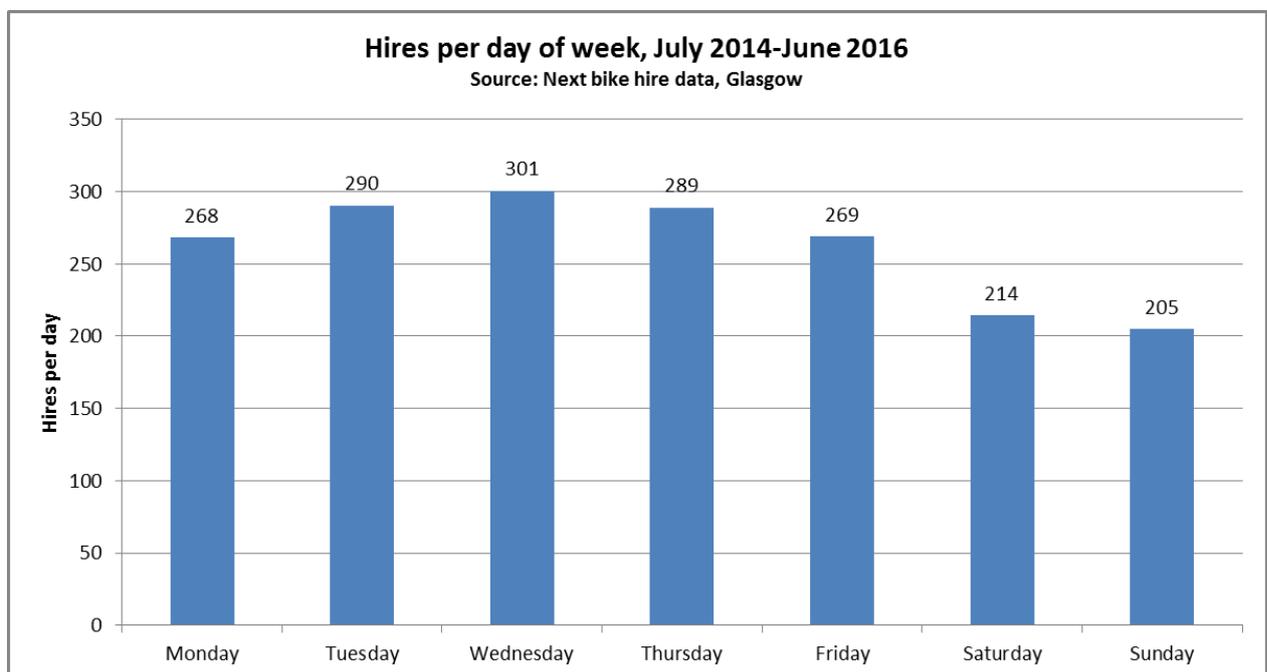


2. Analysis

2.1 Usage

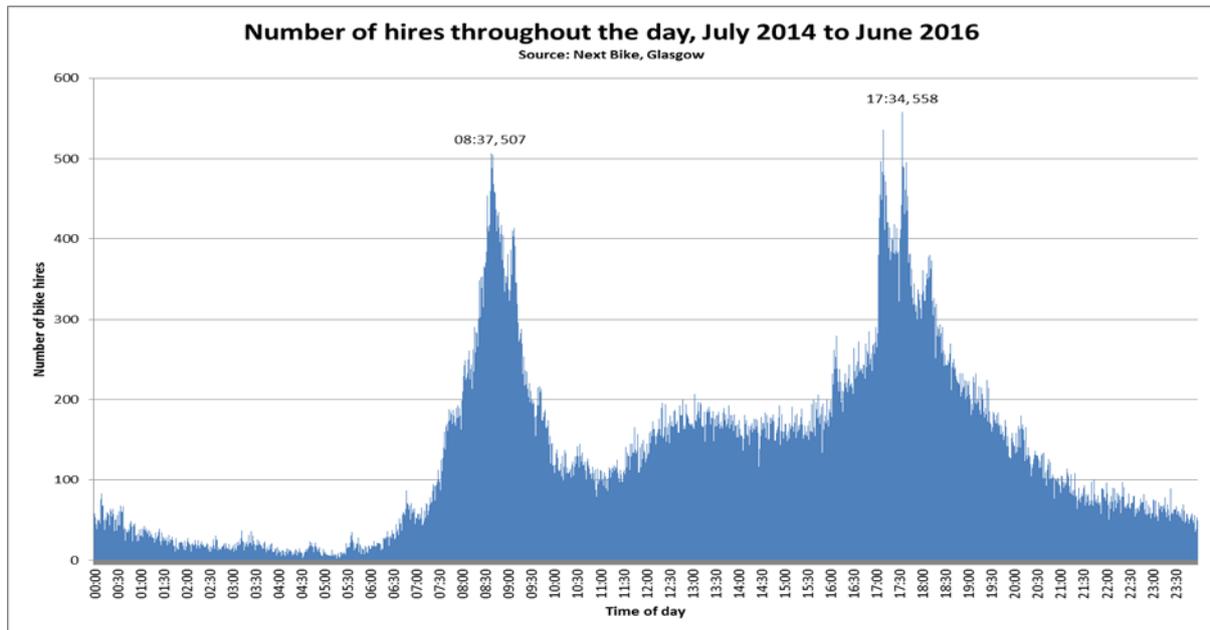
During the two year period from 1st July 2014 to 30th June 2016, there were 191,874 bike hires for which complete data is available. This equates to an average of approximately 262 hires per day. More bikes are hired on weekdays than weekends. The most popular day for hires is Wednesday with around 32,000 hires over the two years (average 301 per day), and the least popular day is Sunday with approximately 21,000 hires (average 205 per day) over this time period. Figure 3 shows the average number of hires per day for each day of the week over two years.

Figure 3: Hires per day of week, July 2014-June 2016.



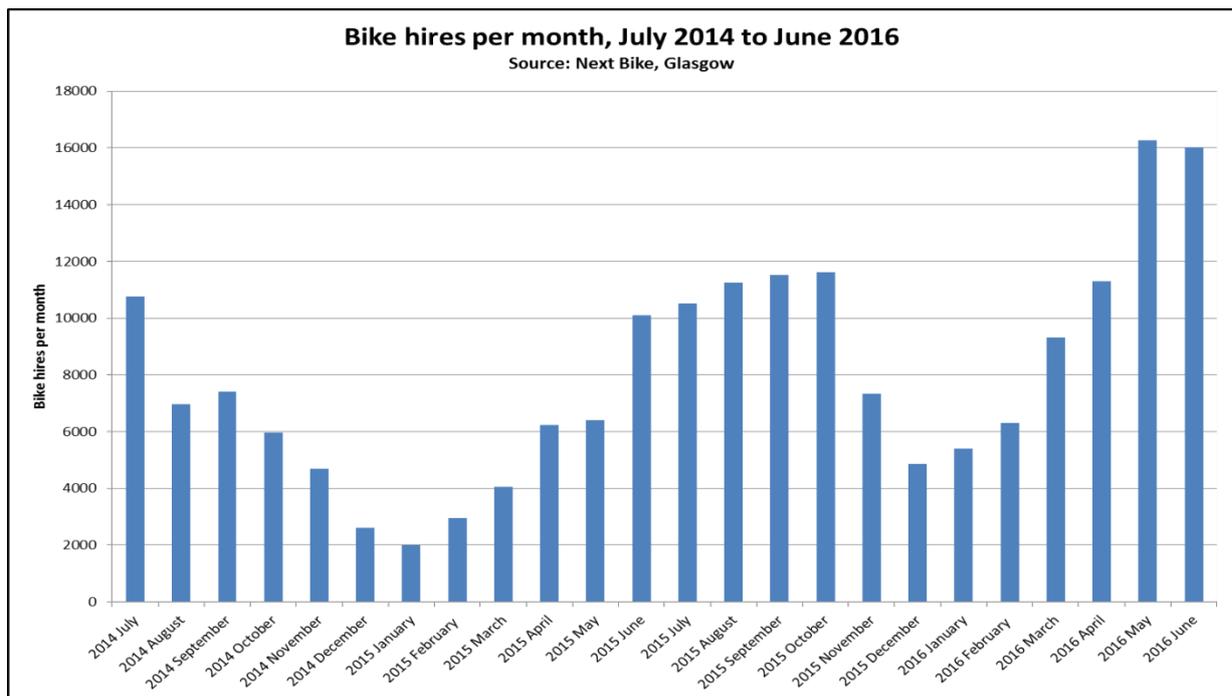
A plot of the number of hires by time of day for the two-year period from July 2014 to June 2016, shows peaks in the data around 8.30 in the morning and 17.30 in the evening, suggesting that a major use of the bikes is likely to be commuting to work and back (Figure 4).

Figure 4: Number of hires throughout the day, July 2014 to June 2016.



The number of hires varies seasonally with values reaching a peak in late summer and falling to a minimum in December and January. This can be seen in Figure 5 which shows the hires per month over the two year period July 2014 to June 2016. Comparing the same months across the two year period, it can be seen that there has been a steady growth in use of the scheme from 2014/2015 to 2015/2016. Overall, in the period 2014/15 there were 70,131 hires and for 2015/16 there were 121,743, representing a rise of 74%. Part of this increase may be associated with the introduction of the additional rental locations in May 2015.

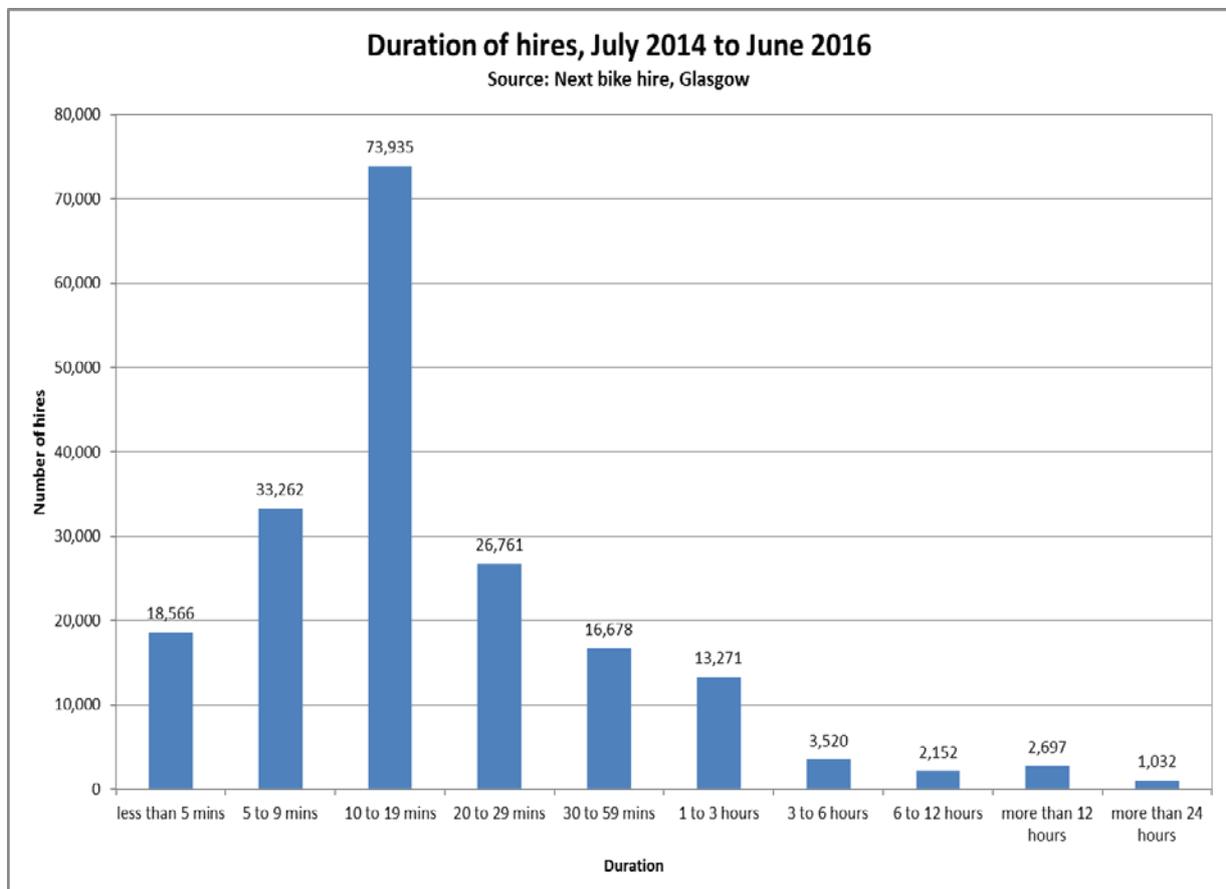
Figure 5: Bike hires per month, July 2014 to June 2016.



2.2 Duration and distance

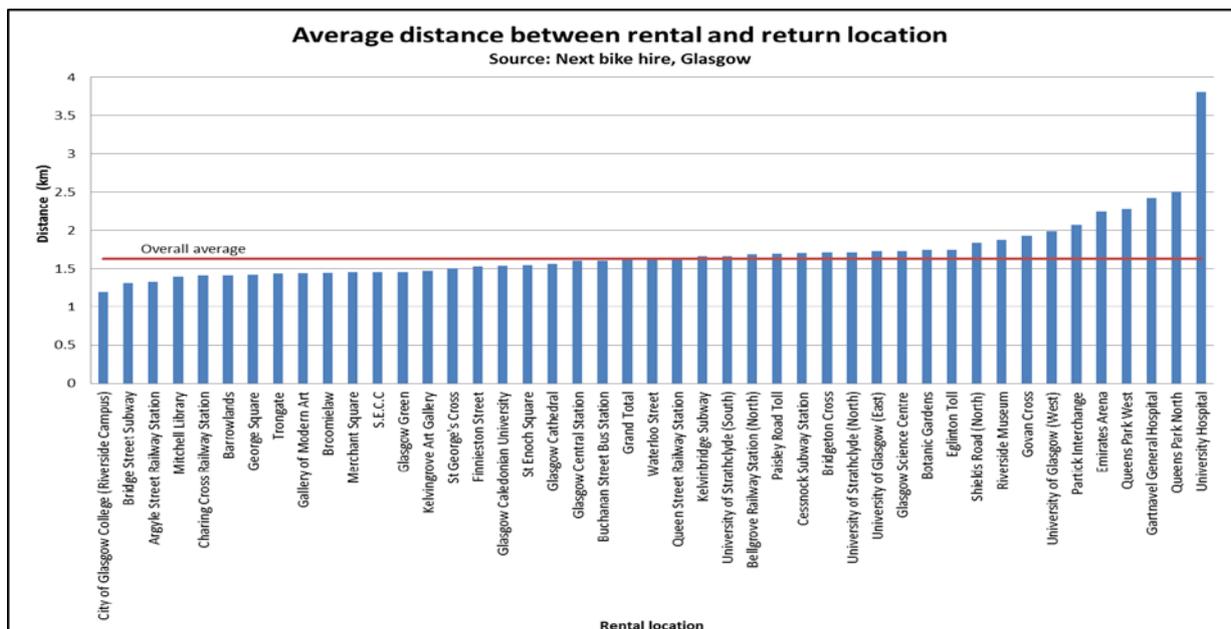
Duration of bike hires vary from less than 5 minutes, up to several days. Some of the very short times recorded do not constitute viable journeys and may relate to users testing out the hire system, or problems with the bike or hire system. Thus the data for hire times less than 5 minutes should be treated with caution. Users are encouraged to check bikes before hiring them but are permitted to return a bike within the first three minutes without incurring a charge if they discover a fault with it. Hires grouped into time categories are shown in Figure 6. The majority of hires (79%) are for less than 30 minutes and by far the most common length of time for a bike hire is 10-19 minutes (39% of all hires). Only 14% of hires were for longer than one hour, and 2% longer than 12 hours.

Figure 6: Duration of hires, July 2014 to June 2016.



It is not possible from the data currently available to determine how far a bike is ridden during each rental period. The only information that is available relating to each journey, is the rental station location and the corresponding return station. For approximately 19% of hires, the rental and return station locations are the same. Figure 7 shows the average approximate distance to the return station used, for each of the different rental locations. These values are based on an assumption of travel in a straight line so are indicative only, not reflecting the actual route which would be taken between locations. It can be seen that the furthest distances travelled tend to be from the two hospital locations of Gartnavel General Hospital and the Queen Elizabeth University Hospital, and also Queen’s Park and the Emirates Arena. As can be seen on the map of locations in Figure 2, these particular points are some of the furthest away from the city centre and other locations. The overall average distance travelled between rental and return stations is approximately 1.6km.

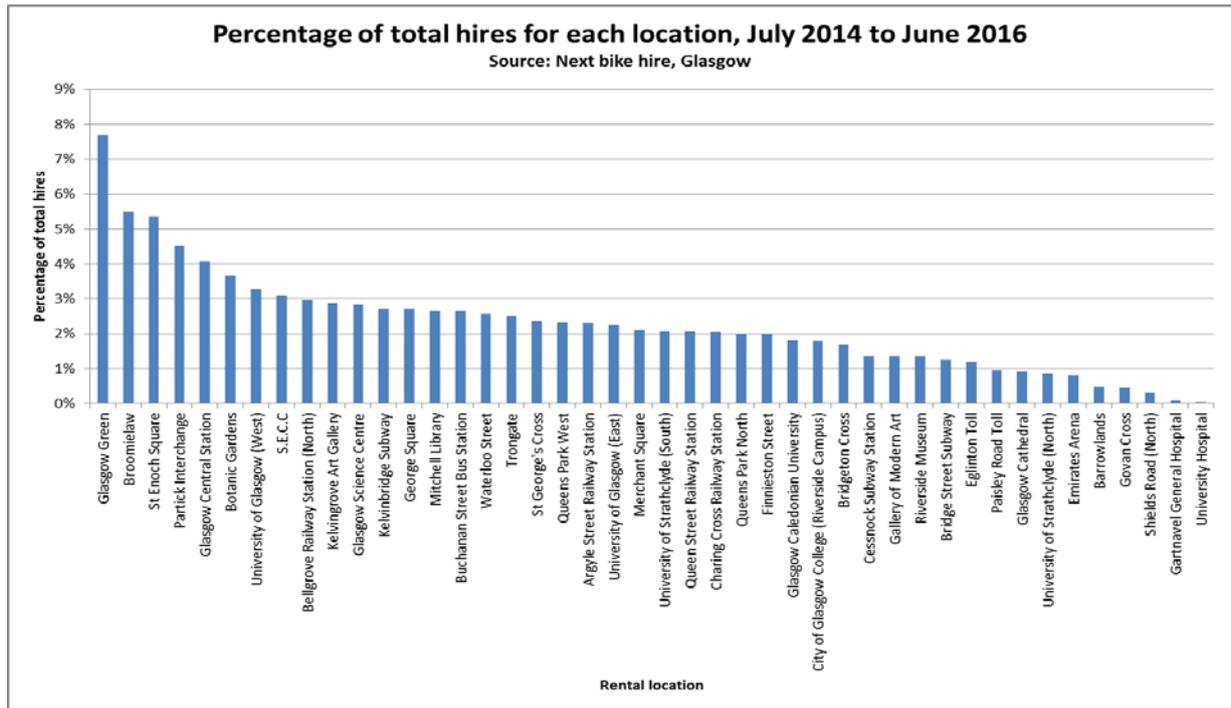
Figure 7: Average distance between rental and return location.



2.3 Route choice

The most popular rental location as shown in Figure 8 is Glasgow Green (7.6% of all hires), followed by the Broomielaw (5.6%) and St Enoch Square (5.3%). However, this information needs to be interpreted in terms of the phase of introduction of a particular station (Table 1).

Figure 8: Percentage of total hires for each location, July 2014 to June 2016.



The same caution about different dates of introduction applies to return locations, shown in Figure 9. The most popular return locations are similar to the rental locations, namely Glasgow Green (7.7%) and the Broomielaw (5.6%).

Figure 9: Percentage of total returns for each location, July 2014 to June 2016.

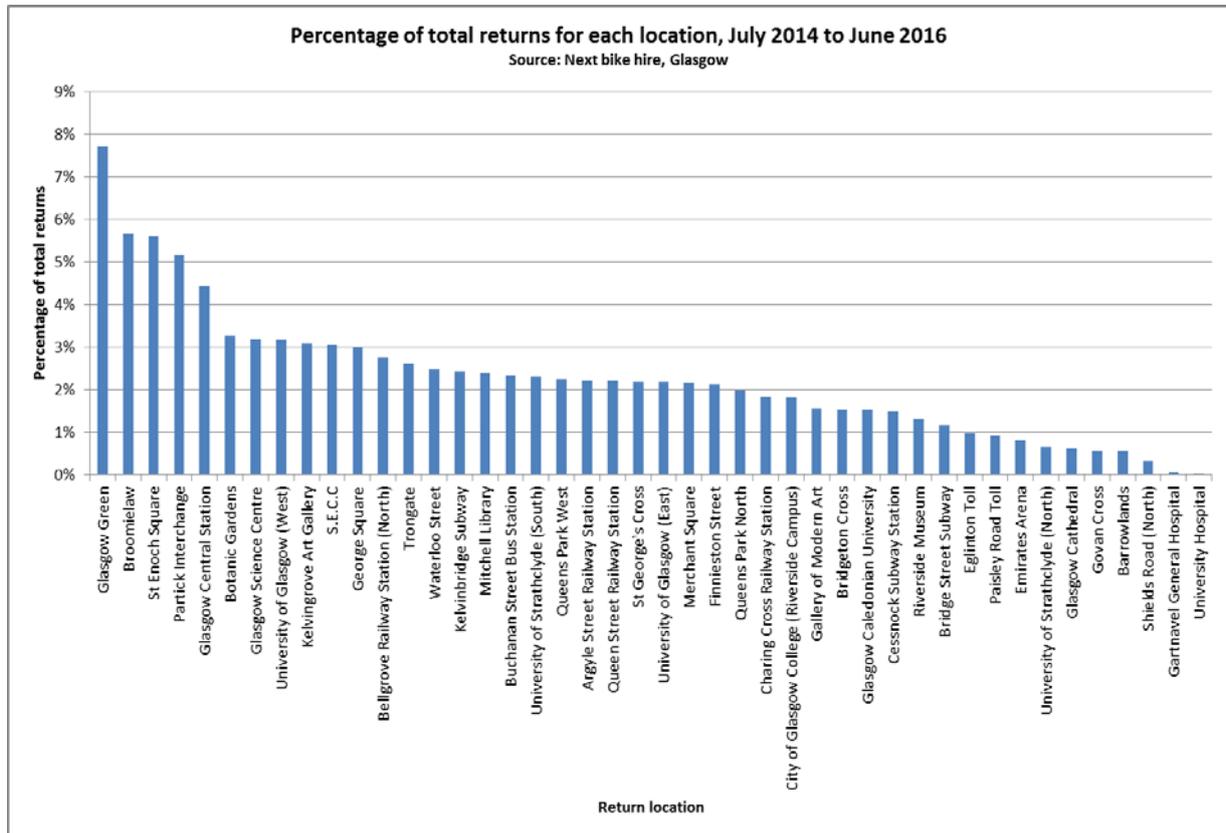


Figure 10 takes into account the variable introduction dates by showing number of hires per day of operation for each location. Glasgow Green has an average of over 20 rentals per day, with values for other locations ranging from 1-15 rentals per day.

Figure 10: Average number of hires per day for each rental location.

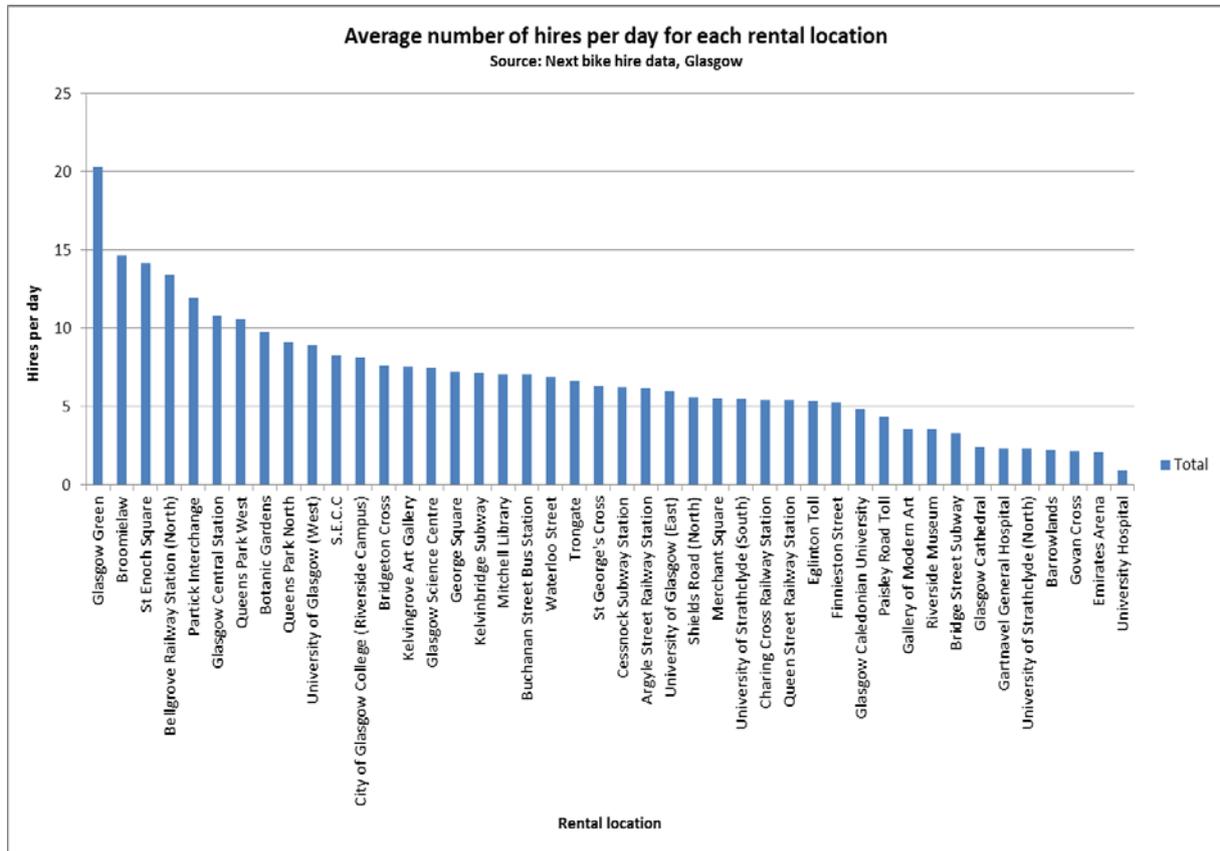


Table 2 shows the most common combinations of rental and return stations over the complete two year period. As this is influenced by the length of time the particular location has been in operation, a further analysis was carried out examining only the last two months (May and June 2016) of the period studied, during which all locations (except Queen Street Station) were in operation (Table 3). In both instances, journeys starting and finishing in Glasgow Green were found to be the most popular, with journeys around and between the Broomielaw, St Enoch Square and Glasgow Green also featuring highly.

Table 2. Most common rental and return location combinations for the two year period July 2014 to June 2016 (not all locations in operation for all of this time).

Rental location	Corresponding return location	Number of journeys
Glasgow Green	Glasgow Green	3,581
Broomielaw	Broomielaw	2,435
St Enoch Square	Glasgow Green	2,373
Glasgow Green	St Enoch Square	2,163
Partick Interchange	Partick Interchange	1,883
SECC	SECC	1,596
Kelvingrove Art Gallery	Kelvingrove Art Gallery	1,518
University of Glasgow West	University of Glasgow West	1,494

Table 3. Most common rental and return location combinations during May and June 2016 (all 43 current locations in operation).

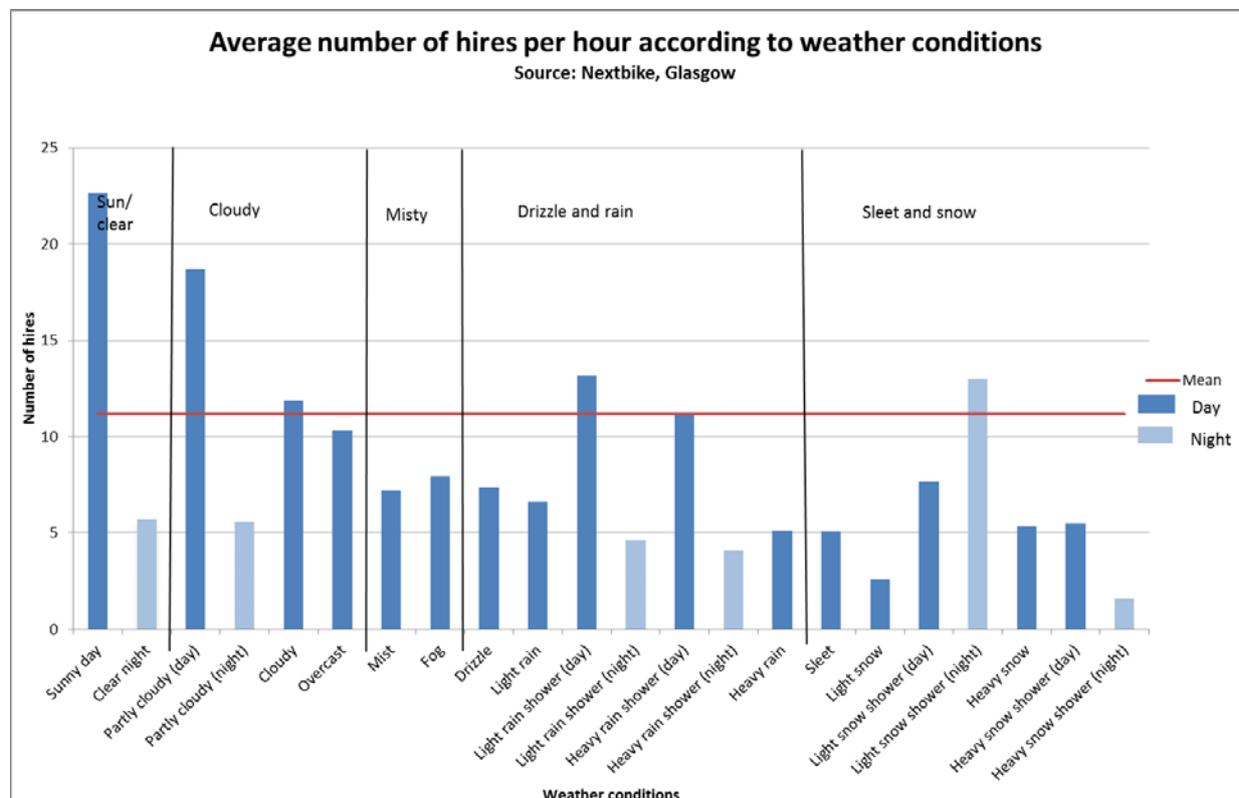
Rental location	Corresponding return location	Number of journeys
Glasgow Green	Glasgow Green	565
St Enoch Square	St Enoch Square	416
Broomielaw	Broomielaw	409
Glasgow Central Station	Glasgow Central Station	385
Partick Interchange	Partick Interchange	353
Kelvingrove Art Gallery	Kelvingrove Art Gallery	344

2.4 Impact of weather conditions

Weather data recorded by the Glasgow Bishopton weather station was supplied to the Glasgow Centre for Population Health by the Urban Big Data Centre (<http://ubdc.ac.uk/>). This provided hourly records indicating the observed temperature, wind speed, wind gust speed, and prevailing weather conditions. The bike hire data was linked to this data enabling the individual impact of the different weather variables on number of hires made to be studied.

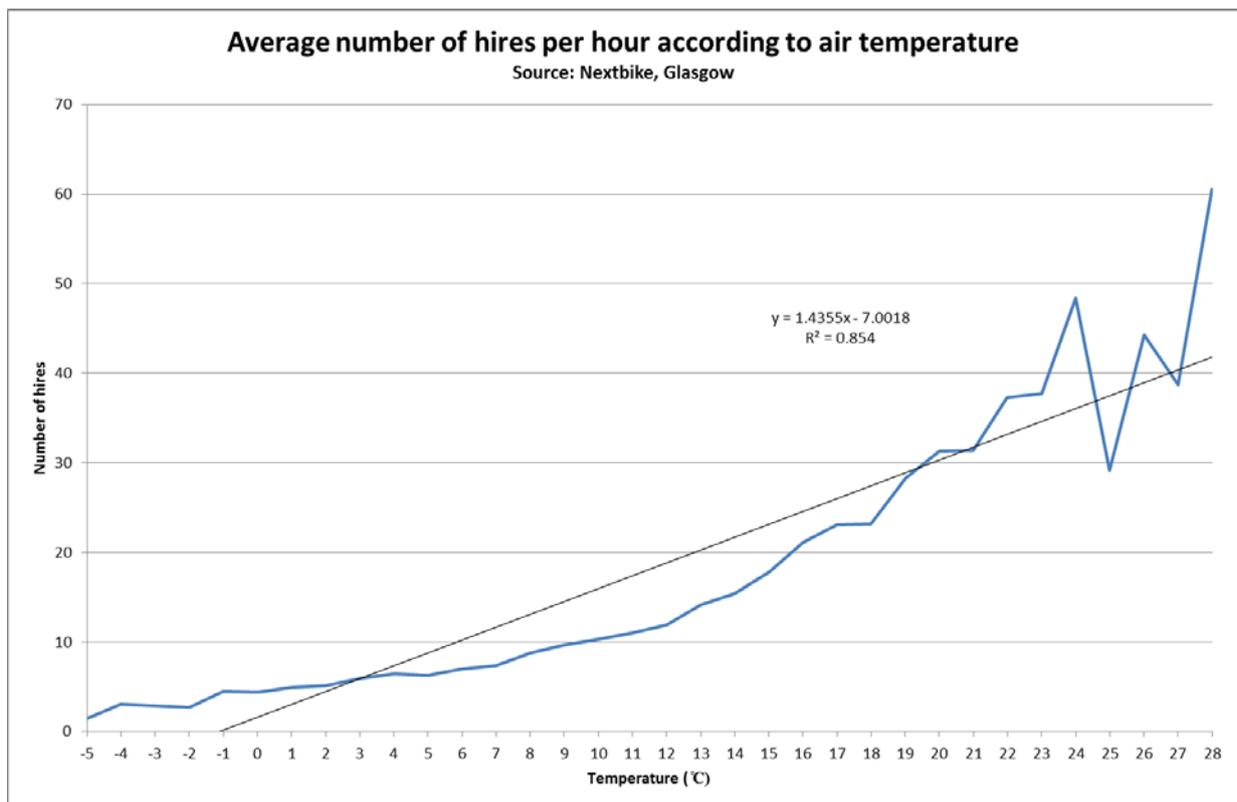
Figure 11 shows the average number of bike hires made in one hour according to weather condition. The overall mean number of hires per hour over the two-year period was approximately 11. It appears that sunny weather does have an impact on the number of hires, with the highest average number of rentals per hour occurring when it was sunny. Numbers were around average in cloudy conditions and when showery, suggesting that these conditions don't impact on users' decisions to rent a bike. Rain on the other hand does seem to reduce numbers, as does snow and mist/fog. Numbers for less prevalent weather conditions such as snow showers are small so the results shown for these instances are less certain than those for more commonly observed conditions. Likewise numbers of hires corresponding to weather observations during hours or darkness are smaller than those for daylight weather observations and again the results should be treated with caution. Columns on the graph relating to observations during hours of darkness are shown with a pattern fill.

Figure 11: Average number of hires per hour according to weather conditions.



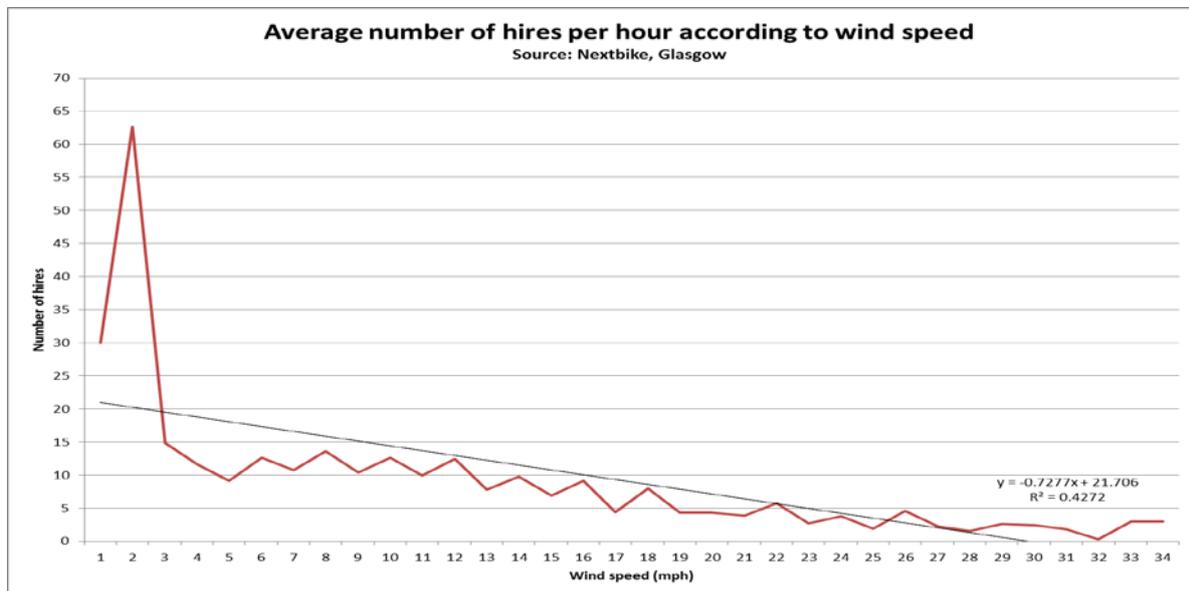
The impact of the air temperature on number of hires is shown in Figure 12. A linear trend line fitted to the data shows a strong relationship between temperature and frequency of hires. As the temperature increases so does the number of hires, with an increase in average number of hires per hour of 1.44 for every 1 degree increase in temperature. Again the numbers at either end of the graph reflect small numbers of occurrences, so should be treated with caution.

Figure 12: Average number of hires per hour according to air temperature.



The number of hires per hour decreases gradually as the wind speed increases, as shown in Figure 13.

Figure 13: Average number of hires per hour according to wind speed.

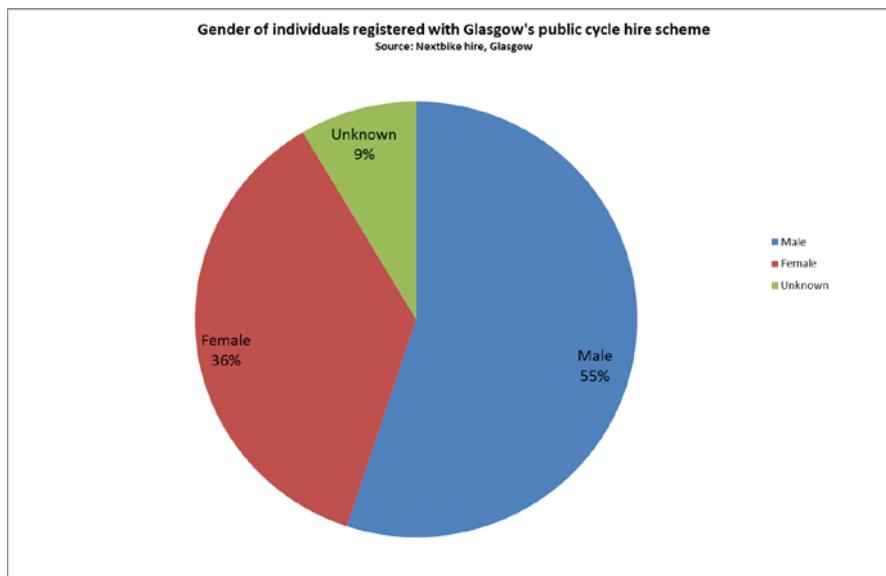


2.5 Demographic aspects of the scheme

2.5.1 Gender

Nextbike supplied records of the first names of individuals registered with the bike hire scheme during the period since its inception. Using tables of both Scottish and USA birth name records as a reference, a gender was assigned to the name whenever possible. Of the 16,122 records provided, 8,878 were assigned as male and 5,863 as female. As such, approximately 36% of users of the scheme were female and 55% male; for 9% of users, gender could not be assigned automatically using this method (Figure 14).

Figure 14: Gender of individuals registered with Glasgow's public cycle hire scheme.



2.5.2 Home postcode

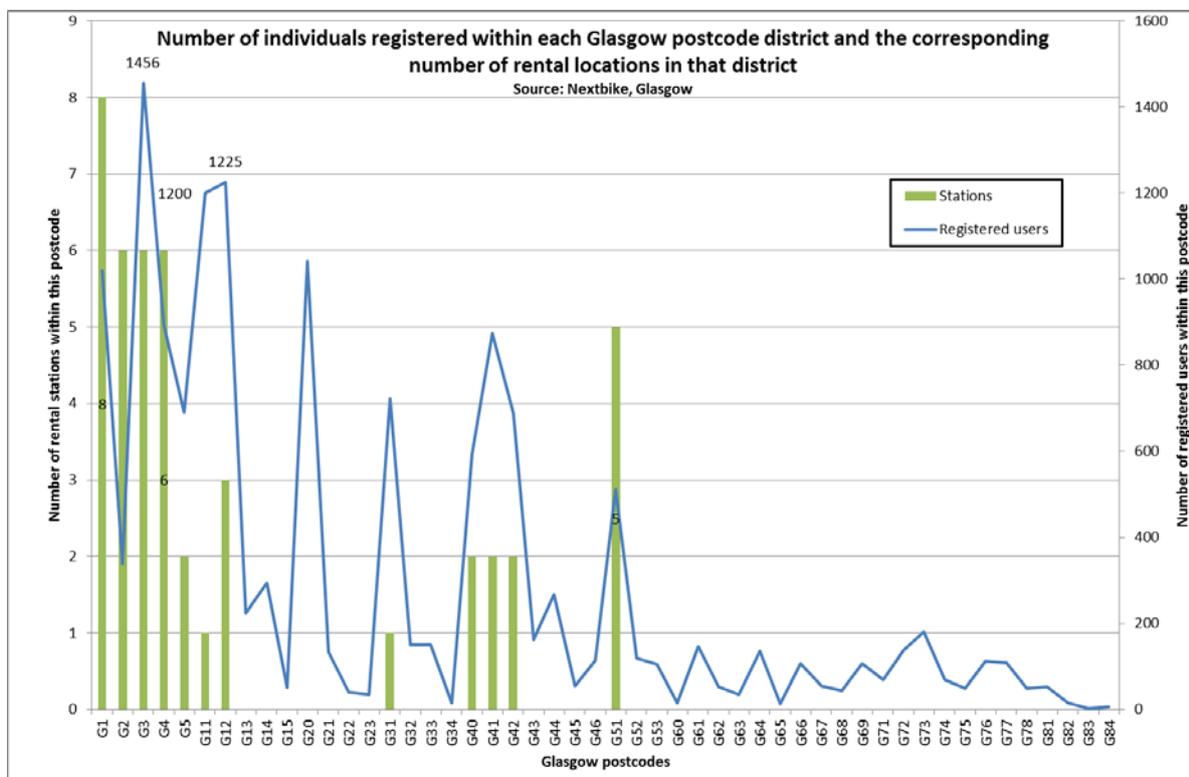
District level postcodes were also available for most of these 16,122 records. Over 90% of those registered with the bike hire scheme had home postcodes within the Glasgow postcode area. This covers Glasgow City and neighbouring parts of East Renfrewshire, East and West Dunbartonshire, Lanarkshire, Argyle and Bute and Stirling council areas, as shown in Figure 15. Only around 1% of users had a home postcode outwith the Glasgow postcode area. Just under 8% of records did not have a valid postcode.

Figure 15: Glasgow postcode area.



The distribution of registered individuals within each of the 57 postcode districts within the Glasgow area is shown in Figure 16 (line chart). The highest percentage of those registered (almost 10%) had postcodes within the G3 area. This includes the areas of Anderston, Finnieston, Garnethill, Park, Woodlands and Yorkhill. The adjacent areas to the west, G11 and G12, also had high levels of individuals registered, around 8% in each case. These areas encompass the University of Glasgow and have a high student population. As can be seen in Figure 16, registration roughly tends to fall with increasing distances of home addresses from the city centre (i.e. increasing postcode number). The distribution observed has similarities to the distribution of rental locations, which is also shown in Figure 16 (bar chart). This suggests that there are more people registered for the scheme in areas where rental stations are located.

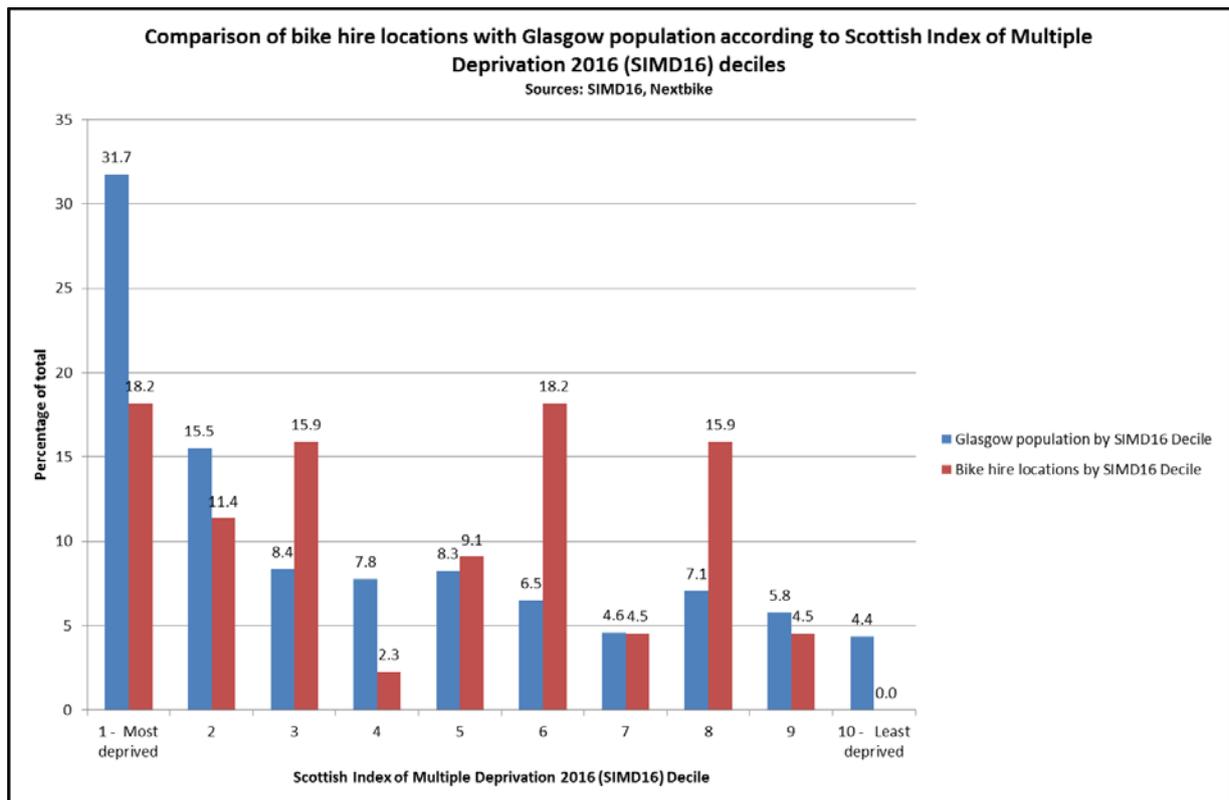
Figure 16: Number of individuals registered within each Glasgow postcode district and the corresponding number of rental locations in that district.



2.5.3 Socioeconomic factors

Analysis of the full postcode of residence of those registered with Glasgow’s public bike hire scheme, would enable an assessment of whether individuals from the more deprived areas of the cities were potentially accessing the scheme to a similar extent to those from less deprived areas. However, due to data confidentiality issues, the full postcode of users was not available for analysis. Full postcodes are of course available for the locations of the bike hire rental stations and so their distribution according to their Scottish Index of Multiple Deprivation 2016 (SIMD16) category can be studied. This gives some indication of the extent to which the scheme may be serving areas with greater or lesser levels of deprivation. Figure 17 compares the distributions of the hire locations and population of Glasgow across the SIMD16 deciles of deprivation. There are more people in Glasgow living in areas of high deprivation than there are in more affluent areas – for example, around half of Glasgow’s population live in the most deprived 20% of communities across Scotland. However, the current distribution of the bike hire locations does not follow this same pattern with bike hire locations being relatively evenly distributed across deciles of deprivation in the city.

Figure 17: Comparison of bike hire locations with Glasgow population according to SIMD16 deciles.



2.6 CO₂ emissions

There is not currently data available to examine the extent to which Glasgow's public bike hire scheme is replacing other transport modes. It is hoped to conduct qualitative research with users of the scheme during 2017 to investigate this. Substitution of a variety of modes of travel is likely to be occurring and research² suggests that the substitution of private car journeys by bike hires may be very small. However it is worth considering the potential impact on reducing CO₂ emissions of the scheme if it were to be replacing car travel.

Each mile driven by the average passenger vehicle results in emissions of 0.417kg of CO₂³

As discussed earlier in this report, it is not possible to determine from the data the length of each journey made using the cycle hire scheme. However taking the average distance between rental and return locations of 1.6km (approximately 1 mile), which will of course be an underestimate of actual distance travelled, and based upon 191,874 hires over a two year period (so also including journeys starting and finishing in the same place), the scheme if it was to have substitute vehicle journeys could potentially have reduced CO₂ emissions in Glasgow by approximately 80 tonnes.

3. Discussion

3.1 Usage

It is interesting to compare usage of the Glasgow bike hire scheme with other schemes around the world. Fishman *et al.*⁴ notes that the reporting of metrics varies considerably between schemes and obtaining accurate trip frequency data from operators can be problematic. The most commonly used metrics are usage per day per bike and usage per 1,000 population. Over the two-year period studied in Glasgow there were approximately 192,000 rentals made using the scheme. With around 400 hire bikes available in Glasgow, this means that there were approximately 0.65 journeys per bike per day. Working out market penetration is more difficult as it requires defining the size of the target population. A very crude approximation can be obtained by taking the total population of Glasgow, which is approximately 606,000. This gives a usage of 158 journeys per 1,000 residents per year.

In the Bike Share Planning Guide³, published by the Institute for Transportation and Development Policy, metrics for a number of bike hire schemes across the world are given, with trips per bike per day ranging from 0.4 in San Antonio, USA, to 10.8 in Barcelona. Trips per 1,000 residents per year ranges from 4 in San Antonio to 187 in Mexico City.

3.2 Duration and distance

Four-fifths of all bike rentals are for less than half an hour. For users with an annual subscription, the first 30 minutes of any hire is free and other users pay for hire in 30 minute blocks. As the Bike-share planning guide⁵ points out, incentivising short trips maximises the number of trips per bike per day. Given the location of the bike rental stations predominantly within the city centre, close by amenities, and the nature of

the bikes themselves as sturdy city bikes, it is likely that most users will wish to hire them for only relative short periods of time. This is certainly likely to be the case with the commuting usage. However it would be interesting to know to what extent the pricing structure is driving the hire lengths. Carrying out survey work with users would be required to clarify this. Distances between rental and return locations are generally very small, and of the order of several kilometres. Some users may be covering large distances between locations during the hires, but this seems unlikely given the short duration of most hires.

3.3 Route choice

Glasgow Green, Broomielaw, St Enoch Square, Partick Interchange and journeys around and between them stand out as the most popular rental locations and routes for the scheme. This may reflect the availability of public transport connections with subway, trains and buses at both Partick and St Enoch Square, but also the availability of a dedicated cycle corridor between Glasgow Green, Broomielaw, St Enoch Square and Partick in the form of Sustrans National Cycle Routes 7 & 75⁶. Serving other such cycle corridors such as the Forth and Clyde Canal, South West City Way, West City Way and forthcoming South City Way is being taken into account in proposals to expand the scheme by Glasgow City Council. Proposed additional stations were listed in Glasgow City Council committee papers in August 2016⁷.

3.4 Impact of weather

As expected, weather does appear to exert an influence on usage of the scheme. In less favourable weather conditions, particularly lower temperatures and rain, usage falls. It would be interesting to compare whether this impact is similar to that on cycling within the city in general, or whether there may be a larger effect on users of the hire scheme. Hire scheme users may be more casual cyclists and not possess or be carrying wet and cold weather clothing to the same extent as individuals riding their own bikes. Also, given the position of the current rental locations around town, there may be more readily accessible alternative public transport options available than there would be for journeys starting and finishing elsewhere. The impact of weather could be further explored in qualitative research with users.

3.5 Characteristics of users

A predominance of males compared with females cycling is commonly observed when cycling data is considered. For example the Scottish Household Survey for 2015, which asks a series of questions of a sample of approximately 11,000 people across Scotland, indicated that approximately 16% of men and 8% of women had participated in at least 30 minutes of cycling in the last four weeks. The 2011 census⁸ found that 2.1% of male workers in Scotland cycled to work compared with 0.6% of female workers. Fishman *et al.* (2013)⁴ suggest that the gender divide is often less marked in cycle hire schemes than in participation in cycling as a whole. For the cycle hire scheme in Glasgow, the ratio of female to male registered users is approximately 2:5. A comparison with other Glasgow data on cycling would allow exploration of whether this level of female participation is higher than that in other cycling activity within the city. It may be that a normalisation of cycling as an urban travel behaviour is taking place as a result of the introduction of the scheme, and this is making more women feel able to participate.

It is interesting to note that most users of the scheme live within Glasgow, with the figures suggesting little use of the bikes by tourists from elsewhere or as part of a multi-modal trip by people coming into the city from other parts of Scotland. It could be that the need to register is a deterrent to one-off users of the scheme, or perhaps a perceived lack of easily accessible information on suitable cycle routes. Again, this could be explored in qualitative research. Users who subscribe to a Nextbike scheme in one city are able to use schemes in any other cities which are also operated by Nextbike.

Usage of the scheme appears to decrease among those living in outer parts of Glasgow. The reasons for this could be many, including less need to be in the areas of town in which the rental locations are located, greater availability of alternative means of personal transport and a lack of rental stations and return options further out of town precluding local travel. Having a rental station close to your home does seem to be associated with a greater likelihood to register for the scheme, and it would be interesting to further explore this in qualitative research. The review by Fishman *et al.* (2013)⁴ reports research indicating that proximity of residence to rental location does have a strong influence on the likelihood of use of the scheme.

Given the relatively small number of bike hire stations at this stage, and the placing of initial stations in areas with anticipated high usage such as the city centre and around the universities, it is not surprising that the distribution of hire locations according to deprivation category does not match the deprivation profile across the city. As the scheme develops however it would be hoped that the distribution would alter. Access to the full postcodes of users would allow a more in depth study of the reach of the scheme to residents in areas of high deprivation. Concerns⁹ have been raised in some cities e.g. Baltimore and New York, that the location of bike hire stations has been in more affluent areas and usage has been greater among the better-off. However Fishman *et al.*⁴ noted research indicating that after adjusting for the location of bike hire stations, users in the most deprived areas of London actually made slightly more trips than users in the least deprived areas. Concessionary fares are available for bus and train travel within Glasgow for certain population groups and similar approaches may need to be considered for bike hire schemes in future to assist with accessibility.

Survey work with registered individuals and non-users of the Glasgow scheme would enable exploration of the relationship between deprivation and usage and also examination of uptake among equality group.

4. Summary

During the first two years of operation of the Glasgow public bike hire scheme, there were around 200,000 bike hires made and 16,000 people registered to use the scheme. The number of hires varied seasonally, and according to the day of the week. The number of hires in the summer were three to five times higher than those in the winter. Most hires took place on weekdays and during the periods 7.30am to 9.30am and 4.30pm to 6.30pm, suggesting the scheme is being used for commuting. There was a steady growth in usage during the two-year period, which may partly be associated with the increase in the number of hire locations. Most hires were for less than 30 minutes and the most popular rental location was Glasgow Green. Sunshine

and higher temperatures were associated with a greater number of hires, whereas increasing wind speeds and rain were associated with fewer hires. Most people registered to use the scheme live within Glasgow or the surrounding area, and a higher proportion of women than seen in other cycling activities have registered. Qualitative research is now required to understand users' and non-users' views and perspectives of the schemes and to find out more about the reasons for journeys being made, and the actual routes taken.

This report forms part of a series of reports detailing descriptive analyses of data relating to cycling in Glasgow. These reports provide a picture of aspects of current cycling activity within the city. The other three reports cover [cycle journeys on the Anderston-Argyle Street Bridge](#); [cycle journeys on the South West City Way](#); and [analysis of the Hands Up Survey of methods of travel to school for Glasgow school pupils](#).

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