INTEGRATED STREET DESIGN IN HIGH-VOLUME JUNCTIONS: THE CASE STUDY OF LONDON'S OXFORD CIRCUS

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Abstract

While traditional street design relied upon segregating vehicles and pedestrians in urban areas to ensure smooth traffic flow, urban planners and traffic engineers are gradually moving away from it. Instead, under the more modern concept of integrated street design, more space and freedom of action is provided to pedestrians, the needs of whom were previously omitted. An example space to have undergone redevelopment to a more pedestrian-oriented design is London's Oxford Circus junction. Comparing with the results of a study pre-redevelopment, the present study aims at identifying the shift in the perceptions of the pedestrians when using the space post-implementation of the new design at Oxford Circus, but also at drawing generic conclusions on the perceptions of the pedestrians towards such schemes. A questionnaire is developed and data is collected through on-street interviews with pedestrians at Oxford Circus. The results show that integrated street design offers improved way-finding, better perceived safety and more pleasant environments for pedestrians.

1. Introduction

Traditionally, street design has been driven by the concept of segregation of pedestrians and vehicles. As such, the priority has been to allow for quicker access and movement of the vehicular traffic by limiting conflicts and human-dependent decisions and by designing streets according to the desire lines of vehicle drivers. As opposed to that, the desire paths of pedestrians have often been neglected, with structures such as pedestrian subways, bridges, guardrails and walls restricting their movement with the objective of protecting them and preventing their involvement in road accidents. The concept of segregation is set out most lucidly in Buchanan's 'Traffic in Towns' report (*1*) which has served as a street design manual in the UK for many decades.

In recent years, however, there has been a trend away from traffic segregation, driven by developments in architecture and urban planning. Segregation has been deemed by some detrimental for urban environments due to its perception as resulting in "the domination of vehicular traffic and associated noise and air pollution alongside street clutter and ugly surroundings" (*2*). Instead, street design has shifted gradually towards the concept of integration and space sharing as a means of creating a better environment, mainly by introducing single surfaces and removing features such as street furniture, signage, delineation and kerbs. While early examples of integrated street design included the "woonerf" and "home zone" principles for residential areas in the Netherlands and the UK respectively, more recent examples are not confined to residential environments and are gradually being introduced at several locations worldwide.

One space to have undergone such a transformation is Oxford Circus in London (Figure 1). From what was previously a segregated junction with barriers limiting the overflow of pedestrians onto the street level, this space has been "opened up" to allow for diagonal crossing and for pedestrian movement to follow the main desire lines. Theoretical (computer) modelling and on-site analyses have determined the new design has resulted in faster pedestrian movement across the area without any negative impact on the vehicular traffic volumes. However, a fundamental question of such a change is how the perceptions of the pedestrians themselves may have changed. A before-implementation study attracted fairly negative comments about the original layout, mainly due to overcrowding in the area (*3*).

This study, therefore, assesses the pedestrians' perceptions post-implementation and draws generic conclusions on the perception-related impacts of integrated street design, both in terms of a holistic experience as well as with respect to individual factors, such as comfort and safety. Building on the before-study and adopting a similar approach, a questionnaire is developed for the conduct of on-street surveys with pedestrians. The results of the survey are then compared with the results of the

before-implementation survey exercise, and the change in the perceptions of the pedestrians as a result of the redevelopment is measured.

Figure 1: Oxford Circus redevelopment

The paper is structured as follows: Section 2 sets the background of the study, which includes a review of methods assessing the impacts of urban street design on the perceptions of the pedestrians. Section 3 presents the survey design methodology and the results obtained. Section 4 describes the analysis and draws conclusions. Finally, Section 5 draws some generic conclusions and identifies areas of future research.

2. Background

Street environments consist of a large variety of elements and the development of a road space to suit the local needs is essential for it to function appropriately. Therefore, the questions that urban planners and traffic engineers are required to address are how to exploit the space for as many user categories as possible, how to cater for all users' needs, and how to ensure that the users will feel comfortable in the space and use it as intended by the design. For example, a good space can be designed by making walking and strolling around easier, or through promoting vitality across the surrounding areas, in order to encourage pedestrians to use is more, as opposed to traditional designs. A place may be more comfortable for its users by offering a better accessibility to a larger variety of services, or by making this quicker to walk in and easier to get to, for instance. However, such cases do not apply to every public space, as each particular area has its own characteristics and requirements.

Since pedestrians have often been omitted from the largely car-oriented street designs of the 1960s and 1970s, the issue of providing an adequate pedestrian experience is becoming more and more important in traffic engineering and urban planning. A variety of methods have been developed with the aim of assessing the street environment from the pedestrians' point of view in order to be able to address their needs. These methods usually involve the conduct of surveys with pedestrians, covering aspects such as the accessibility of the area, the availability of the required street furniture, the availability of the required services, the aesthetic appearance and the cleanliness of the space. Such an approach is adopted, for example, in a study by Jones et al (*2*), who analyse a street space in London by asking users about their levels of satisfaction when using the space. However, since external environments are subject to users who have different tastes and needs, what is important for one user may be less important for another, thus making it a necessity to find a common standard for the comparison. Also, as it is very common that pedestrian surveys are carried out on a before- and after- basis (in the case, for example, of the investigation of the perceptions of pedestrians following the implementation of a new traffic engineering scheme), it is essential to have a common standard so as to enable the comparison of the responses.

An example of a generic model for analysing pedestrian environments is the "Pedestrian Environment Review System" (PERS), which has been developed by the Transport Research Laboratory (TRL) (*4*). Implementing a three-tier system, where each level offers a more detailed assessment of the previous level (Tier 1: Public space -> Tier 2: Route -> Tier 3: Link, Crossing), PERS is based on the

completion of a series of separate independent review forms. A wide range of parameters are covered by the review framework, relating to different aspects of urban design features, such as safety, legibility of space, user conflicts, and walking surface quality. Respondents are required to assign scores between -3 and +3 to each of the parameters, which can be subsequently weighted according to their importance (*5*) in the pedestrians' perceived utility. Overlaying the results from PERS on a map enables their visualisation, which offers a quick insight into the street space under analysis.

While PERS is a fairly comprehensive analysis tool for pedestrian environments and offers a standardised method of measuring pedestrian views, it is mainly intended for comprehensive interviews with experts. In fact, the completion of the numerous review forms is time-consuming and not suited for the conduct of on-street surveys with pedestrians. What is more, it requires very detailed information from the respondent about all parameters, which is mostly not noticed by "simple" pedestrians. As such, shorter pedestrian surveys are a simpler way of analysing street spaces and defining of the overall opinion through focus groups and on-street surveys. Despite the fact that less detailed information is collected from the respondents, the ease of conducting shorter interviews puts the latter method in a prominent position for broadly understanding the perceptions of pedestrians. Hence, depending on the characteristics of the space in question, surveys have been generally designed for the purposes of specific case studies.

A study of particular relevance to the present work is a 2007 assessment of the pedestrian perceptions at London's Oxford Circus site. For the purposes of the study an on-site questionnaire was designed and implemented with the prospect of identifying the issues relating to movement within and around the space. Surveys were held on two different study days: one during a specially organised pedestrianised day (called Very Important Pedestrians (VIP) day, held on 1 December 2007), on which vehicles were severely limited from passing through the area; and one on a "normal" day, held a week later, so as to compare the results with everyday conditions. The study was commissioned by Transport for London and was carried out by Atkins' Intelligent Space (*3*). The surveys enquired visitors to the area about their perception of public transport services, way-finding into and around the area, the ease of moving around the space and their perceived safety. A demographic dataset describing the respondents was also collated in the process. The study eventually helped clarify important problems relating to the pedestrian environment, in light of the subsequent redevelopment of the space in 2010.

3. Methodology and results

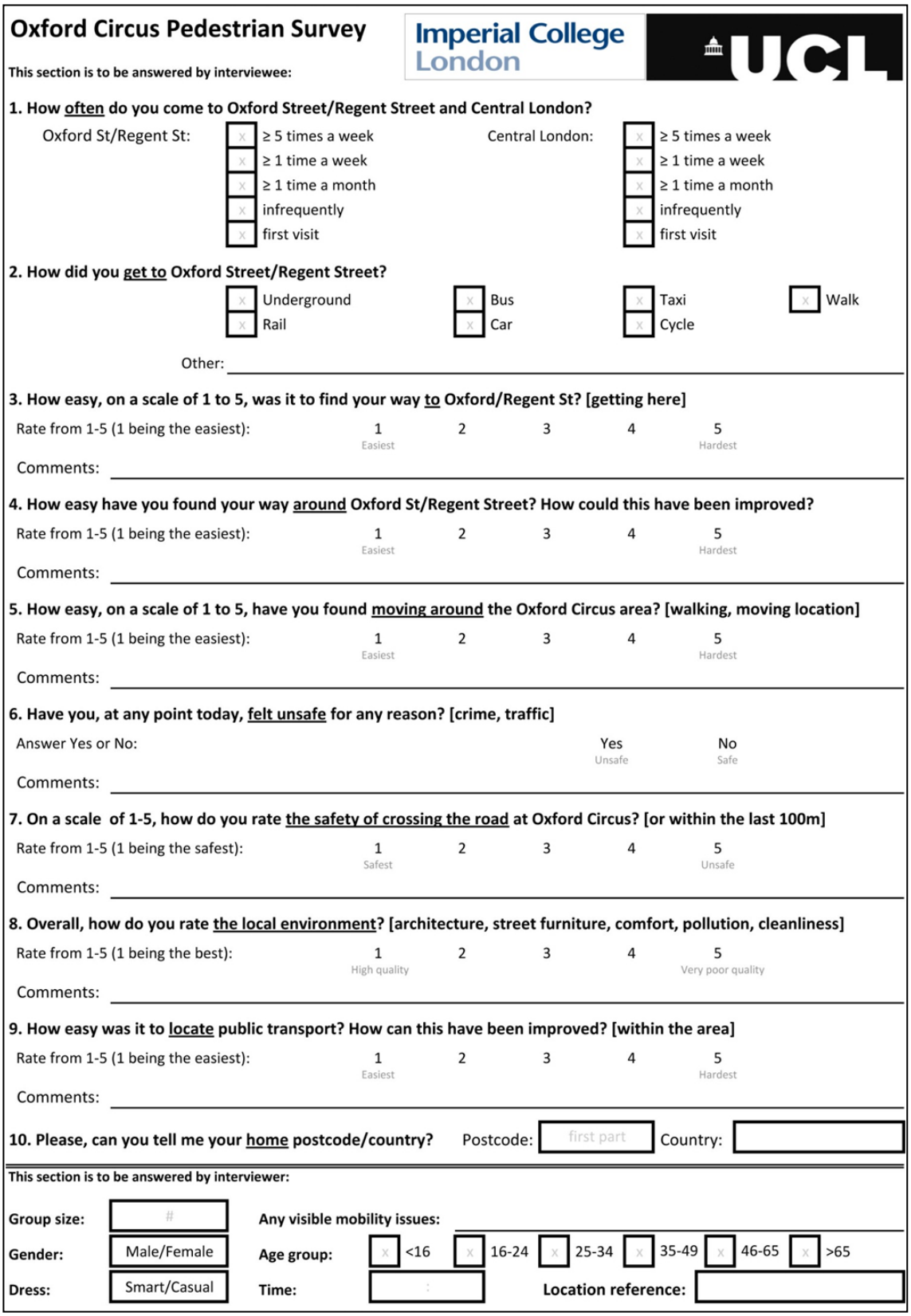
The present study has the aim of comparing everyday usage of Oxford Circus, relating the before- and after-redevelopment scenarios. For this purpose, a new questionnaire has been developed and a number of the questions from the original survey have been transferred intact in order to maximise the comparability of the results; however, some questions from the original survey have been dropped and new ones have been added, so as to reflect the purpose of the study. The questionnaire developed in the present study is shown in Figure 2.

The questionnaire was aimed at determining variations in the general ease of way-finding, perceived safety and demographics of the user population. The introduction of new questions enquiring about the perceived safety at crossings in the redesigned Oxford Circus and the overall perception of the environment were deemed as newly interesting points of inquiry. A number of changes in the stated forms of the questions were carried out so as to allow for a more concise questionnaire, as required for the comparison study, and also to make a more efficient transmission of the answers from the user. The individual questions, along with the responses obtained, are discussed in Section 4.

In order to allow for a better flow of the survey for the respondent, the questions were ordered by subject, starting with the questions on way-finding and followed by those on safety and environmental perceptions. Also, compared with the questions of the original surveys, several questions were rephrased to prevent the interviewees' confusion. Demographic information was collected implicitly from the respondent through the subsequent completion of the respective section by the surveyor based on his/her judgement. The complete questionnaire was tested through two pilot surveys, which were undertaken before the conduct of the full survey.

The full survey was held on Thursday 29th July 2010 between 10am and 7pm. The turnout of

pedestrians along the Oxford Circus area was normal, with the usual slower start in the morning hours increasing in volume in the afternoon and evening rush hour periods. Movement along the footpath was generally unhindered. A closure of the north-easterly entrance to the Oxford Circus Underground station created an increased demand on the other points of entry, especially on the south-western entrance point, which at times during peak hours suffered from a slight overspill of pedestrian activity on the road.



Oxford Circus Pedestrian Survey

Imperial College London

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This section is to be answered by interviewee:

1. How often do you come to Oxford Street/Regent Street and Central London?

	Oxford St/Regent St:	Central London:
☐	≥ 5 times a week	≥ 5 times a week
☐	≥ 1 time a week	≥ 1 time a week
☐	≥ 1 time a month	≥ 1 time a month
☐	infrequently	infrequently
☐	first visit	first visit

2. How did you get to Oxford Street/Regent Street?

☐ Underground ☐ Rail ☐ Bus ☐ Car ☐ Taxi ☐ Cycle ☐ Walk

Other: _____

3. How easy, on a scale of 1 to 5, was it to find your way to Oxford/Regent St? [getting here]

Rate from 1-5 (1 being the easiest): 1 (Easiest) 2 3 4 5 (Hardest)

Comments: _____

4. How easy have you found your way around Oxford St/Regent Street? How could this have been improved?

Rate from 1-5 (1 being the easiest): 1 (Easiest) 2 3 4 5 (Hardest)

Comments: _____

5. How easy, on a scale of 1 to 5, have you found moving around the Oxford Circus area? [walking, moving location]

Rate from 1-5 (1 being the easiest): 1 (Easiest) 2 3 4 5 (Hardest)

Comments: _____

6. Have you, at any point today, felt unsafe for any reason? [crime, traffic]

Answer Yes or No: Yes (Unsafe) No (Safe)

Comments: _____

7. On a scale of 1-5, how do you rate the safety of crossing the road at Oxford Circus? [or within the last 100m]

Rate from 1-5 (1 being the safest): 1 (Safest) 2 3 4 5 (Unsafe)

Comments: _____

8. Overall, how do you rate the local environment? [architecture, street furniture, comfort, pollution, cleanliness]

Rate from 1-5 (1 being the best): 1 (High quality) 2 3 4 5 (Very poor quality)

Comments: _____

9. How easy was it to locate public transport? How can this have been improved? [within the area]

Rate from 1-5 (1 being the easiest): 1 (Easiest) 2 3 4 5 (Hardest)

Comments: _____

10. Please, can you tell me your home postcode/country? Postcode: [first part] Country: [ ]

This section is to be answered by interviewer:

Group size: [#] **Any visible mobility issues:** _____

Gender: [Male/Female] **Age group:** ☐ <16 ☐ 16-24 ☐ 25-34 ☐ 35-49 ☐ 46-65 ☐ >65

Dress: [Smart/Casual] **Time:** [:] **Location reference:** [ ]

Figure 2: The full questionnaire

A total of 114 questionnaires were completed, compared with 110 in the 2007 VIP day and 39 on the 2007 comparison day surveys. Slightly more than half of the surveys (68) were held at Oxford Circus itself, while the rest were carried out within 100 metres from the junction into Oxford Street and Regent Street. In general the targeted respondents were fairly cooperative, with low refusal rates being observed. The interviews' duration ranged between two and five minutes, depending on the interviewee's responsiveness. 66 respondents were female (57%), thus offering a fairly well-balanced sample gender-wise. In comparison, similar ratios were achieved both at the 2007 VIP day and at the 2007 comparison studies, though the samples were slightly male-skewed: the VIP day sample's ratio was 59:41%, while the 2007 comparison ratio was 52:48%.

The sample, however, was fairly skewed towards younger ages, with 83 respondents (73%) being under 34 years of age and another 28 (25%) being between 34 and 65. In contrast, the age distributions for the VIP day and the 2007 comparison samples were more skewed towards the middle-age category. A very good spread was achieved, however, in the origin of the respondents, with 32 respondents (28%) being London-based, 37 (33%) being UK- but not London-based and 45 (39%) being non-UK-based. As opposed to that, the 2007 surveys' samples were strongly London-biased, with over 50% of the respondents being London-based.

Looking at the frequency of visit to the area, the vast majority of the respondents (35%) stated that they visit Oxford Circus infrequently, and another 29% said that that was their first visit. Only 10% of the respondents were regular visitors to the area (more than five times per week), with similar percentages being encountered in the weekly (more than once a week) and monthly (more than once a month) categories (13% and 12% respectively). Similar trends were found with respect to the respondents' visiting frequencies to Central London (36% infrequently, 22% first visit), though regular Central London visitors (more than five times per week) were well-represented in the sample (21%). In comparison, the samples of the 2007 surveys had similar representations of infrequent visitors to Oxford Circus (30-40%), but the amount of first-time visitors was much lower (less than 10% in both surveys); instead, higher percentages of regular, weekly and monthly visitors were recorded (10-25%). As for the visits to Central London, the 2007 samples had a considerably higher representation of regular visitors, with 60-70% of the respondents visiting Central London at least once a month.

As concerns the means of travel to access the Oxford Circus site, the Underground was by far the most common mode of travel, followed by the bus and the train. 70% of the respondents stated that they used the Underground at some segment of their trip to the area, another 18% used the bus and another 14% used the train. 11% of the respondents also mentioned walking, while very few respondents appeared to have used the other modes (car, taxi, cycle). Similar trends were recorded in the 2007 surveys. It should be noted, however, that these percentages included the fact that travellers used more than one mode to reach the area on the day of the survey.

In order to draw conclusions a full comparison was carried out between the results of the different surveys. Direct percentage comparison was used in order to identify changes in the perceptions of the pedestrians as a result of the new design with respect to each of the survey's questions. The additional questions of the survey (i.e. the ones that were not included in the original surveys) also offered an insight into previously unexplored areas of pedestrian perceptions in the space.

The results were also tested for association to the results of the original surveys using contingency tables, as documented in Statistics textbooks, such as (*6*), along with Chi-square tests to the 1% and 5% significance levels.

4. Analysis and discussion

The results were analysed and discussed by investigating the responses given to each of the survey's questions individually. The analysis focused on the questions relating to the perception of pedestrians (Questions 3-9) and is presented here in three parts: way-finding, safety and overall perception.

4.1 Way-finding

The investigation of the way-finding perception and the ease of walking around were the main topics

of investigation of this study. These were covered in four questions enquiring about the ease of the various levels of movement required in and around the area. The next few answers were coded into a scale of 1 to 5 to allow for a quicker and more understandable response by the interviewee.

Q3: How easy, on a scale of 1 to 5, was it to find your way to Oxford Circus?

In this question a shift of responses from the "Easiest" to the "Easy" category was noted from the VIP day survey (Table 1 and Figure 3). However, if the "Easiest" and "Easy" categories were to be considered together, such variation would be less apparent between the 2007 VIP day and the survey of the present study (87% to 84%). Otherwise, responses appeared to be more positive in the post-redevelopment survey, with a lower ratio of negative ("Hard" and "Hardest") responses than the 2007 Comparison day survey, when only 49% of the interviewees replied positively to this question. As such, based on the responses, it can be concluded that way-finding to the Oxford Circus has improved since the new street design has been introduced. Through contingency testing at both the 1% and 5% levels it was found that an association exists between the responses to the three surveys, thus making this finding statistically significant.

Table 1: Ease of way-finding when accessing Oxford Circus

Response category	2007 VIP day	2007 comparison	Current survey
Easiest	76	15	50
Easy	18	4	46
Neutral	5	4	12
Hard	5	7	6
Hardest	3	9	0

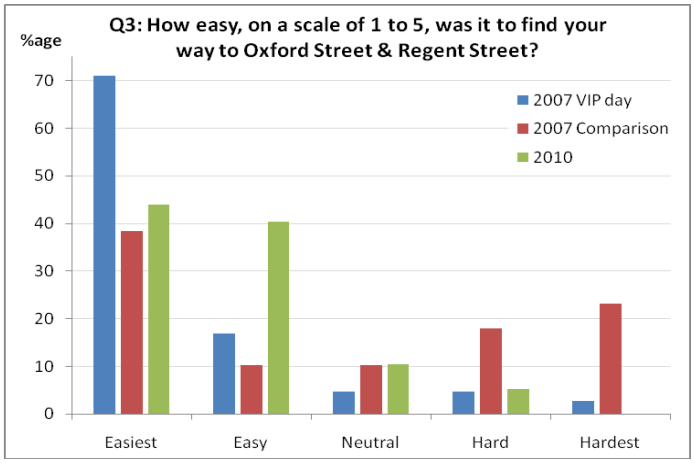

Figure 3: Ease of way-finding when accessing Oxford Circus

Q4: How easy have you found your way around Oxford Sreet / Regent Street?

With respect to way-finding around the streets leading to Oxford Circus (Table 2 and Figure 4), the limited pedestrian space in the original layout had resulted in negative scores in the 2007 comparison survey. However, a significantly lower amount of "Hardest" responses was recorded in the present study's survey. Additionally, a shift of responses was noted from the "Easiest" to the "Easy" category compared with the results of the original VIP day survey, which may have been due to the effect of the presence of vehicles in the area on the pedestrian. The strong reduction in "Hardest" responses can only be linked to the changes in the urban layout, as no other major changes to way-finding were made in the area. The effects of improved signage (such as the "Legible London" scheme) may also play a role in this. Through contingency testing at both the 1% and 5% levels it was found that an association exists between the responses to the three surveys, thus making the findings statistically significant.

Table 2: Ease of way-finding around Oxford Street / Regent's Street

Response category	2007 VIP day	2007 comparison	Current survey
Easiest	56	14	23
Easy	19	2	49
Neutral	11	4	27
Hard	14	4	9
Hardest	7	15	5

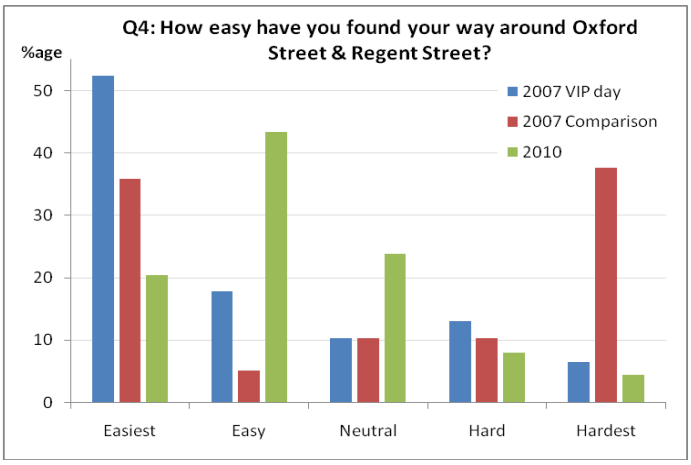

Figure 4: Ease of way-finding around Oxford Street / Regent's Street

Q5: How easy have you found moving around the Oxford Circus area?

To allow for a better flow of the survey for the interviewee a change was made to this question with respect to the 2007 surveys, altering the response categories from "Positive"-"Reasonable"-"Negative" to "Easiest"-"Easy"-"Neutral"-"Hard"-"Hardest", in line with the previous questions. The latter results were therefore grouped together to enable a comparison; this was done by grouping the "Easiest" and "Easy" responses into the "Positive" category and the "Hard" and "Hardest" responses into the "Negative" category, and by attributing the "Neutral" responses to the "Reasonable" category. Again, a significantly lower percentage of "Negative" responses (Table 3 and Figure 5) were recorded compared with the 2007 comparison survey. This could be mainly attributed to the increased availability of walking space following the redevelopments, but also to the resulting reduction in congestion in the area. In fact, the ease of moving around the area in the present study's survey was perceived to be as good as in the 2007 VIP day survey, when larger numbers of pedestrians were able to use the street pavement to move around. Through contingency testing at both the 1% and 5% levels it was found that an association exists between the responses to the three surveys with respect to way-finding around Oxford Circus, thus making the findings statistically significant.

Table 2: Ease of way-finding around Oxford Circus

Response category	2007 VIP day	2007 comparison	Current survey
Positive	31	2	34
Reasonable	19	3	37
Negative	32	34	42

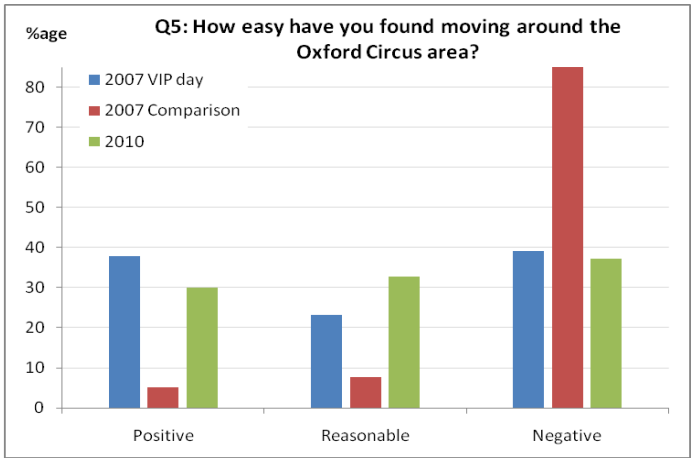

Figure 5: Ease of way-finding around Oxford Circus

Q9: How easy was it to locate public transport?

The access of public transport in the area has not changed following the redevelopment and the majority of the users followed the same modes of travel in all three surveys, as mentioned in Section 3. However, increased pedestrian signage and better waiting facilities have been introduced recently.

Hence, a shift of responses in the present study's survey was duly noted from the "Easy" to the "Easiest" category when comparing with the two 2007 surveys (Table 3 and Figure 6). Little variation was observed in the other three responses. Through contingency testing at both the 1% and 5% levels it was found that an association exists between the responses to the three surveys with respect to the locating public transport around Oxford Circus, thus making the findings statistically significant.

Table 3: Ease of locating public transport

Response category	2007 VIP day	2007 comparison	Current survey
Easiest	27	1	50
Easy	57	27	39
Neutral	10	2	15
Hard	7	3	5
Hardest	4	3	2

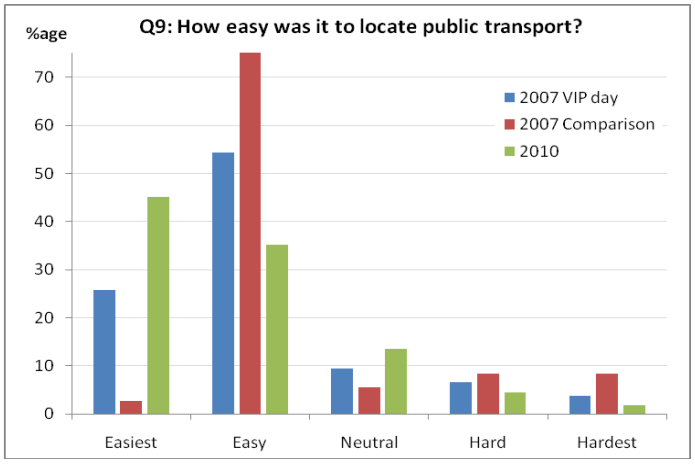

Figure 6: Ease of locating public transport

4.2 Perceived safety

The safety of the diagonal crossing was questioned in the local media, and given that this was locally a relatively new concept in the UK, its understanding by the users remained unproven. The safety category in the analysis included both safety from traffic accidents and from crime, and was the result of what the users perceive when being in the space.

Q6: Have you, at any point today, felt unsafe for any reason?

The reduced segregation in the new layout of Oxford Circus may have increased the sense of perceived danger. A small but significant change was noted between the three surveys: while only 11% had answered "Yes" about feeling unsafe in the area in VIP day survey, this increased to 23% in the 2007 comparison day survey (Table 4 and Figure 7). In the present study's survey only 16% "Yes" responses were recorded, implying that users feel safer in the new design. The reduced crowding may have had an influence on this, with reduced potential for theft (such as pickpockets) in less crowded situations. Through contingency testing at both the 1% and 5% levels it was found that an association exists between the responses to the three surveys with respect to the perceived safety around Oxford Circus, thus making the findings statistically significant.

Table 4: Perceived safety

Response category	2007 VIP day	2007 comparison	Current survey
Yes	12	9	18
No	93	30	95

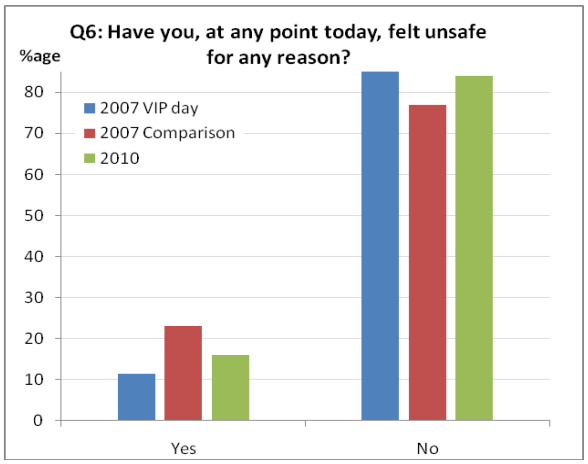

Figure 7: Perceived safety

Q7: How do you rate the safety of crossing the road at Oxford Circus?

This question was introduced in the survey to provide a better insight of the overall perceived safety in the redesigned space and no data from the 2007 surveys were available for comparison. The reservations of certain users in using the diagonal crossing were highlighted. One particular user who tried crossing diagonally claimed to have panicked when hearing an emergency vehicle siren approaching from Regent Street. Others claimed that vehicular traffic is too fast coming into the crossing space on a green light, giving the pedestrian little time to finish the crossing. In over half of the responses gathered, however, interviewees rated the crossing as "Safest" or "Safe"; the remaining responses were split equally into neutral and negative responses (Figure 8). A point of concern remain the fairly high percentage of the respondents (25%) who claimed that crossing the road was "Unsafe" or "Not very safe", and it would be interesting to analyse this finding further through a future survey, when pedestrians will be more accustomed to similar diagonal crossing arrangements being implemented in the UK and in Europe.

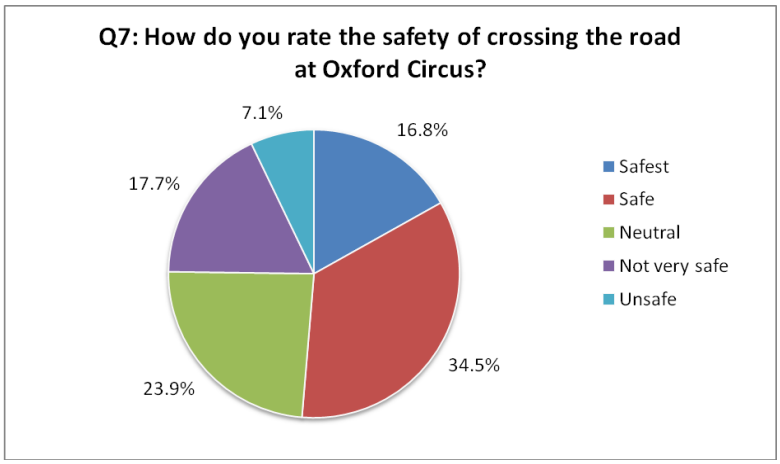

Figure 8: Perceived safety of crossing

4.3 Overall perception

The effect of the quality of the overall environment on the pedestrian after the redesign was also enquired upon to understand the degree to which the users enjoyed their sojourn in the space.

Q8: Overall, how do you rate the local environment?

In general respondents rated the local environment highly, with more than half of them answering "High quality" and "Good quality" to the question (Figure 9). However, 17% gave negative answers ("Poor quality" and "Very poor quality"). Pollution from vehicles was one of the reasons mentioned for such ratings. No data from previous studies exist so as to be able to derive any effects that the new design may have had on the overall perception of the pedestrians; nevertheless, it should be pointed out that the space is in an inner city area, which is likely to attract a number of negative comments irrespective of the street design.

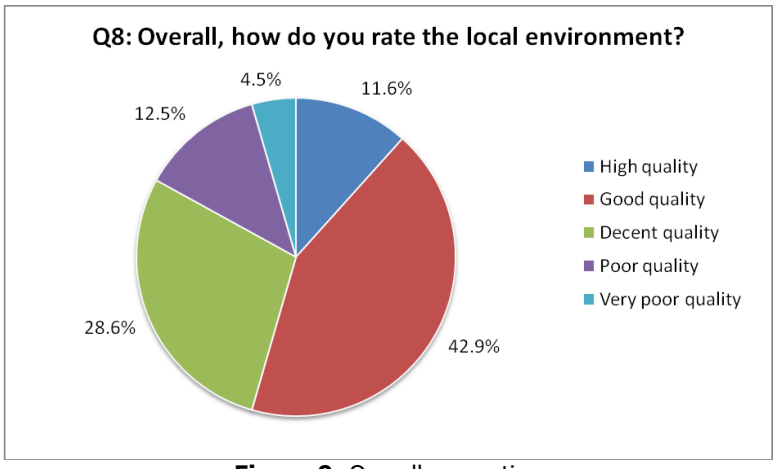

Figure 9: Overall perception

5. Conclusions

The results of the survey indicated an overall positive reaction in the perceptions of pedestrians to the redevelopment of Oxford Circus to an integrated street design. These results also indicated that pedestrians enjoy the increased freedom of movement in space sharing in popular inner city areas. The questions relating directly to pedestrian movement around the area all demonstrated positive improvements when compared to the 2007 comparison day surveys, and some of the questions scored even higher than the 2007 VIP day itself, when no vehicles were present in the street.

The findings point to a number of generic conclusions:

- simpler walking routes allow for better way-finding;
- more "walkable" spaces make it easier to locate public transport;
- reduced pedestrian congestion improves perceived safety;
- not all users adjust to the new designs immediately, and appropriate education is needed.

The study analysed the before- and after-scenarios of the Oxford Circus case-study. However, further conclusions could be drawn from carrying out similar surveys at different sites in the UK, but also in different countries. Comparing the results of different case-studies is likely to provide interesting findings, particularly with respect to the individuality of the sites, which would highlight previously unidentified issues. Further work will thus primarily concentrate on other schemes under implementation around London, such as the Piccadilly Circus and the Exhibition Road redevelopments.

Further work will also concentrate on investigating the perceptions of other road users towards similar schemes, such as drivers and cyclists.

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