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Qualitative analysis of pedestrians' perception of the urban environment when crossing streets

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# Qualitative analysis of pedestrians' perception of the urban environment when crossing streets

## Abstract

*Purpose:* Taking all users of the road system into account — notably those who use non-motorized modes of transportation — is a major challenge for urban engineers when designing roads and public spaces. And yet, although a body of knowledge exists concerning the effects of the environment on pedestrian accidentology, so far very little research has been carried out on the perception pedestrians have of the road environment (structure of buildings, vegetation, etc.) and its influence on decision-making when crossing. This exploratory research aims at studying this perception through a qualitative approach. *Methods:* We used the focus group method to study the perception of 20 two-way street environments with a certain level of diversity from the point of view of buildings (type, density, and heterogeneity), activities, position in relation to the city center, width of the sidewalks and type of traffic. The participants in the two focus groups were 11 regular or occasional pedestrians. *Results:* The verbal material obtained is analyzed in terms of perception of the environment, inferences about driver behavior (notably toward pedestrians), and influence on the pedestrian crossing behavior. Pedestrians prefer environments in which they have the “upper hand” or environments that are highly predictable. *Conclusions:* The results suggest a few tendencies or lines of approach concerning the design of spaces that make street crossing more comfortable for pedestrians. They also show that the focus group method is of great interest for studying the perception and interpretation of urban environments.

*Keywords:* Pedestrian – Environment – Perception – Focus group – Road crossing behavior – Road design

## 1. Introduction

One major challenge for urban engineers when designing roads and public spaces is to take all users into account, notably those who use non-motorized modes of transportation. Such approaches require thinking of urban spaces and their design from the point of view of these modes: what perception do users of non-motorized modes of transportation have of this? How do they understand it?

Concerning pedestrians, it has been established that the frequency and seriousness of their accidents vary with density, the function of the zone (residential, business activities), the presence of shops, or the location in the city (city center, suburbs) [1-4]. Of course, these differences come in part from the influences that the environment has on important parameters such as speed, increasing the risk and seriousness of accidents [5-8]. It is, however, plausible that the differentiated effects of urban spaces on pedestrian accidents are also, at least in part, due to pedestrians' perception and interpretation of the environment and their influence on crossing decisions, but this question remains poorly understood.

Pedestrians' perceptions of the road environment have been widely studied by psychologists, with a view to improving risk evaluation [9-11], and by urban planners, architects and geographers, with a view to making this environment more favorable to pedestrian [12-14] in terms of the feeling of comfort, safety and security. Some of these studies, such as the one by Ewing et al. [15] on “walkability” or “walking potential” – i.e. the way individuals perceive the street as a walking space – looked into the physical elements in the environment that determine pedestrians' reactions (feeling of safety or comfort, level of interest). For this, Ewing et al. identified the physical elements in the environment that determine the qualities of the urban design (recognizable, readable, open, on a human scale, transparent, unified, rich, coherent and in good upkeep) that have an influence on pedestrians' reactions. All these studies provide a better understanding of the determinants in pedestrian mobility, but not the way in which the built environment influences (or does not influence) pedestrian behavior in interactions with other types of users, notably when crossing a street.

These studies do not enable us to determine whether perception and interpretation of urban environments by pedestrians, when they are faced with a crossing task, lead them to develop expectations on how their situation evolves (notably in terms of foreseeing driver behavior) so as to be able to take faster, better suited decisions.

Recent work suggests that the environment influences the crossing task through its topographical, infrastructural and regulatory aspects [16]. Other physical elements in the environment, however, such as the nature and spatial distribution of buildings, pedestrian and traffic density, could influence the gathering of information on the crossing situation and its interpretation, notably concerning inferences on driver behavior [17], as well as decision-making when crossing. Empirical evidence on these subjects is limited, however. We therefore need to gain a better grasp of the nature of pedestrians' perceptions of the environment and their mobilization when crossing in order to act more effectively in terms of prevention, but also of road engineering.

## 2. Experimentation using the focus group method

The objective of this exploratory study is to identify the differentiations made by pedestrians between different urban environments, notably in terms of inferences on driver behavior. For this, we used the focus group method, applied to the perception of various environments by pedestrians (who walk occasionally or daily). A focus group consists of a group of people brought together for a discussion, in our case on their perceptions of a given object. It is set up by the researcher to provide access to a set of information shared by a relatively homogenous group of individuals. Exchanges of contradictory points of view and reciprocal influences are used to bring to light the coherency of the opinions expressed, consensuses and points of disagreement, and require the participants to develop and refine personal positions and arguments. The method of focus group leads participants to develop their arguments to defend their position against other participants. The material gathered in this way enables us to precisely understand the different participants' points of view. This method is often used in different disciplines to gain a better grasp of how various objects are perceived [18-20].

## 2.1 Population

The 11 participants (6 women and 5 men) were recruited through acquaintances and none of them was expert in pedestrian issues. They were divided into two discussion groups. The first included five experienced drivers who are also occasional pedestrians (35-50 years old). The second included three experienced drivers and three pedestrians (who do not own a vehicle and walk daily) (23-30 years old). In this last group, the aim was to share opinions among people with different travel experiences – in terms of mode, and so in terms of vulnerability, speed, travel constraints and the more or less habitual point of view from which they perceive visual crossing scenes – which could lead to divergences in their perception of the environment as pedestrians. Intra-group homogeneity in terms of age was used to facilitate interactions among participants, and not to compare the narratives obtained from the two groups.

## 2.2 Materials

The experimental material used as a support for the group discussions comprises 20 sets of four photographs, each of these sets presenting an urban environment (see an example in figure 1). The environments selected and represented in the pictures were from the different urban regions of the South East of France and were chosen to be unfamiliar to the participants. The sites are not situated in the living area of the participants and they are quite common places, not famous ones. Each set, presented in A4 format, shows left-hand, right-hand and central views of one site — providing a 180° view of a two-lane infrastructure environment (one lane in each direction). These photographs were taken from the pedestrian's point of view (height of the view and position on the sidewalk in a pre-crossing position). The environments have a certain degree of diversity from the viewpoint of the buildings (type, density, heterogeneity), neighborhood activities (housing, shops, services, industries, etc.), the site location within the city (central business district, center, suburbs, countryside) and how the road and its surroundings are organized (width of the sidewalks, whether there are pedestrian crossings, parked vehicles, nearby intersections, etc.). The sites were photographed under normal conditions of use (in terms of traffic, number of pedestrians, etc.). To control the situation presented and avoid overloaded situations that would overly focus the participants' attention (oncoming vehicles located right next to the viewer, for example) and may influence their perception more than environment, the photos were taken under normal and daily conditions of use, that is during working hours but outside rush hours .

----- insert here figure 1-----

### 2.3 Procedure

The objective of the experiment is to understand participants' reactions in terms of the crossing action when faced with the physical elements of the environments presented, not discussing it from the safety point of view as is usually the case, but rather from the viewpoint of comfort and difficulty. The objective is to understand which elements in the environment are used by pedestrians to define the difficulty of the crossing task. In fact, some studies have shown that the intention to cross is linked less to a risk evaluation than to an estimate of the difficulty of performing the task [21-23].

The focus groups took place during two consecutive afternoons in the research laboratory. All 20 of the photographic sets were presented to each participant individually and in isolation, 15 minutes before the group discussion. Among the 20 environments, they were asked to choose the most pleasant, the most unpleasant, the easiest and the most difficult for crossing. The participants had 5 minutes to make these choices.

The 20 sets of photographs were available to the participants during the group discussion. The discussion is initiated by using the choices asked of the participants individually before the group discussion. The objective of the discussion is to differentiate between the environments in terms of the crossing activity, notably for pleasantness and difficulty. The entire group was asked sub-questions for each environment selected, in order to lead the participants to compare the different environments by identifying environments similar to the one chosen, determining the main elements leading to the choice of this environment in particular, and what differentiates it from other environments that the group considered to be comparable. The objective of the discussion was not to obtain a consensus within the group, but rather to use potential disagreements among the participants to bring each of them to develop their arguments. At the end of the discussions, each group was asked two general questions concerning the elements in the environment usually taken into account when crossing a street and the type of information the environment can provide for making the decision to cross.

### 3. Results

The group discussions (more than 2 hours and 50 minutes each) were fully transcribed and provide very rich material (28,338 words for the first focus group and 19,088 words for the second). This was studied to understand key points of the narratives in response to the four questions asked to the participants. The usual qualitative methods for content analysis were applied to the transcriptions. The text of the discussions was analyzed to pinpoint elements in the narrative to understand the choices of environments in response to the four selections requested, but also the physical elements mentioned, the labels assigned to the environments and the inferences that the participants made.

#### 3.1 Pleasant environments for crossing

One environment where crossing was considered to be pleasant was chosen by most of the participants in the focus groups. It was a site located in a city center (figure 2). They would feel good here in general. It is an environment that appeared calm and pleasant for strolling (shade from large trees). This feeling was reinforced by the presence of cafés and shops, which make this street livelier and more "pedestrian". Some said that their feeling of safety was increased by the wide sidewalks, the narrow carriageway the same color as the sidewalks, the absence of road markings and no parking, which appeared to indicate to them that pedestrians have the right-of-way, that they have the "upper hand (G1)" and "here, the automobile driver is the one who has to pay attention to the pedestrian (G2)": "the fact that the sidewalk appears to be made of the same material, it really makes you think that it is a pedestrian zone or, at least that there are a lot of pedestrians crossing (G2)". Unorganized pedestrian crossing (no pedestrian crosswalks laid out) requires drivers to be more vigilant and to drive slowly: "I think vehicles will drive more slowly, because they expect regular pedestrian crossings and therefore, yes, I think they drive slower and so there is a feeling of safety (G2)".

----- insert here figure 2-----

Two residential environments were also selected as being pleasant for crossing (figure 3). Here, the calm, reassuring atmosphere (little apparent traffic) that is "pleasing to the eye (G1)" (low buildings, greenery) is what stands out. The sidewalks are clearly laid out, there is good visibility both for drivers and for the pedestrians themselves ("you have an unobstructed view (G1)") and the presence of pedestrian crosswalks make these

environments the sites that appear the least dangerous. Moreover, despite the presence of small buildings, a “nature, a little more like a village (G1)” atmosphere is felt on these sites, further reinforcing this reassuring aspect: “when you are in a village you’re calmer, there aren’t as many crazies (G1)”.

----- insert here figure 3-----

### 3.2 Unpleasant environments for crossing

The environments considered the most unpleasant for crossing are located more in the peripheral sections of urban areas. The participants often qualify these environments with labels such as “commercial zone”, “industrial park” (figure 4), “ghetto”, “housing project” (group of multistory, social housing buildings), “suburb” (figure 5), “motorway” (figure 8), etc.

----- insert here figure 4-----

More frequently, the participants point out that the environment appears to be dedicated to cars, that there appear to be high speeds, the traffic is dense, or there are many heavy goods vehicles: “It’s almost like a motorway... An expressway (G1)”; “They drive fast (G1)”; “It’s unpleasant, because it looks like there’s automobile traffic, but also trucks (G2)”. The participants often observe that pedestrians do not appear to have any place in such environments. Road markings are mentioned when they are deteriorated (faded pedestrian crosswalk) or when they stand out: “I found it unpleasant because the solid white center line and the straightaway let cars drive fast, and that’s scary (G2)”. These comments apply more to environments located in commercial or industrial areas on the edges of urban areas, pointed out as being the most unpleasant by the majority of participants. Furthermore, some participants said that the landscape was unattractive, not very reassuring or dehumanized in residential areas or certain industrial or commercial spaces on the outskirts (“It’s the ‘housing project’ side that I found ugly and not very reassuring (G1)”, “It really fits the cliché of the suburbs (G1)”; “It’s a [industrial] zone... I don’t like it... I think it’s inhuman (G1)”).

----- insert here figure 5-----

For some participants, the unpleasantness of some of the environments presented is due to the fact that, in their opinions, these are areas where people undertake many maneuvers for parking and at intersections, and where there are sometimes obstacles to visibility. Lastly, during the discussions concerning the environments considered to be unpleasant, the participants often pointed out that pedestrians are less expected by drivers and that pedestrians have to control their crossing by themselves (without being able to rely on drivers): “It [see figure 4] is unpleasant, because people don’t necessarily expect to see me there because, you know, it’s an industrial park...(G2)”; “It’s practically up to us pedestrians to pay attention even though it should be a concern for drivers too, so it adds more stress just when crossing(G2)”.

### 3.3 Easy environments for crossing

Most of the participants feel that it is easy to cross at sites that they situate “in the city” but not in the “city center”, often in residential neighborhoods (figure 6), or sometimes even at less urbanized sites that they situate on the city’s periphery, at the “entry to the urban area”, and even “somewhat countryside” (figure 7).

They mention the presence of houses or small residential buildings and little or no business activity. They notably emphasize the “unobstructed view”, “straightaway with good visibility” and sometimes how few parked vehicles there are. Some pointed out the presence of crosswalks or pedestrian crossing facilities; others spoke of an absence of intersections or a deteriorated roadway.

----- insert here figure 6 & 7-----

The environment, notably due to these elements, leads them to believe that automobile drivers drive slowly: "...it's a residential neighborhood [...] I think that here, cars don't go faster than 30/40 km/h, even with the straightaway (G2)", "...the roadway is in bad shape in many places, so I'd say that you wouldn't drive very fast, you know (G1)". Sometimes speeds are also considered to be a bit faster but without hindering crossing, the important thing being visibility: there is good reciprocal visibility between drivers and pedestrians, who can see vehicles coming from a long way off, and they can be seen by the drivers. There appears to be little traffic: "I think a lot fewer cars go by, so for me, that's why I think it's easy (G2)".

Thus, for the participants, the situation appears simple and easy to manage for pedestrians. Few events could take them by surprise: "...you know where you are, it's clear, you have a good view, so we have to be careful, too, but I get the impression that it's easier, that there are fewer hidden dangers (G1)". The pedestrian can find plenty of traffic gaps to cross without having to excessively mobilize attentional resources: "...you have time to cross calmly, I don't feel like there's really any danger, I get the impression that everything is OK, I'm at ease, I look to the right and to the left and it's cool. You don't need to be particularly attentive, that's it (G1)", "both are fairly easy to cross, short and simple, there's not much traffic (G2)".

The participants also think that, in these locations, automobile drivers pay attention to pedestrians, notably because drivers are thought to be in their own residential neighborhood. The environments considered as easy are often felt by the participants to be closed spaces, spaces of domestic life, a sort of bubble where only the locals move around: "I think that it's people who live there [...] in my opinion, the drivers pay attention to the pedestrians, they are in a neighborhood that they know well, so they pay attention (G2)".

The idea that drivers pay special attention to pedestrians in part led one participant, contrary to the others, to choose a very different environment located in the city center and which was quite often chosen as the most pleasant site (see figure 2).

In this environment, the less marked distinction between pedestrian spaces and vehicle spaces was emphasized, as well as the road treatment: "the fact that there are no defects on the ground, I don't have to worry about it, so it's easy to cross there [...] you get the impression that you're on a kind of terrace, with a step, stairs (G1)".

Above and beyond pedestrian attention, this group of elements suggests to the participant that cars drive relatively slowly. Although there are many interactions between drivers and pedestrians, they seem easier: "you can talk while crossing, I don't have to look out much, so it's fairly easy [...] I operate by ear in that kind of situation [...] 90% of the time he'll stop to let you cross (G1)".

### 3.4 Difficult environments for crossing

Environments considered hard to cross are, like the environments considered to be unpleasant, located more on the periphery of urban areas. The participants often label them as "countryside", "motorway", "highway environment", "conventional road, totally", or "industrial park" and, *a priori*, they are characterized by abundant road markings and narrow or non-existent sidewalks (see figures 8 and 9).

----- insert here figures 8 & 9 -----

Road markings are the element that comes up most frequently in explaining why crossing is difficult. As they give a feeling that the situation is complex, they make it hard for the pedestrian to understand: "As a pedestrian, you think, 'what's going on here?' I wouldn't get it. So I wouldn't really know what to expect (G2)". This feeling of complexity is notably related to the different possibilities for vehicle behaviors and trajectories suggested by the road markings and which are hard for the pedestrian to predict: "you'd better be really careful: they turn to the right, they turn to the left, there are two lanes (G1)". They feel that these markings make it harder for the pedestrian to make a decision: "it's more the fact that there are several pieces of information for possible orientations. So do you see everything you have to think about? It's not just the two directions: there are right-hand turns, left-hand turns, so you take more time to decide (G1)". The participants also infer that drivers pay less attention to pedestrians given the maneuvers they have to perform: "If a pedestrian suddenly appears when

the driver is already in the middle of his right-hand turn maneuver, he may be more concentrated on the road (G2)”.

Beyond the directional arrow, the difficulty in crossing is also related to the centerline markings (or edge markings) and the condition of the roadway, which are interpreted as indicating that the environment gives the right-of-way to vehicles: “a clearly distinct carriageway, with lines, all that... you are entering into an environment that is not your own. You are entering into a road environment (G1)”. This environment is perceived as being built to the detriment of pedestrians: “it looks like car territory. It’s new, it’s been redone and everything, so pedestrians, they didn’t even give them a sidewalk. So maybe it’s that effect that scares people (G2)”.

The lane configuration is used to infer the speeds driven: “it’s very straight, they must drive really fast (G1)”. Speeds are also inferred from the markings designed for vehicles combined with the absence of markings for pedestrians (regarding the environment presented in figure 8): “no pedestrian crosswalk and a white line, you really get the impression of enormous speed (G2)”.

The narrowness, or even absence, of sidewalks is used by the participants to estimate the potential pedestrian density. This pedestrian density is then used to infer how much attention is paid to them by drivers: “the sidewalks are pretty small. So, drivers don’t really expect to see pedestrians. I think they probably drive faster. It’s really deserted (G2)”.

The width of the roadway to be crossed, along with speeds that are high and hard to assess, are perceived as making the pedestrian’s task difficult due to the large amount of information to be taken into account, and extending the decision-making time: “The speed of the oncoming cars, on both sides, and the width of the road. You have to think about all that. You really have to think there, make a film in your head... (G2)”.

One participant chose an environment located in a city center as the most difficult (while this same site is chosen by the majority in terms of pleasantness and ease of crossing), on the grounds of the situation’s complexity, both for the pedestrian and for the driver, the sources of distraction for drivers and the possible misunderstandings between pedestrians and drivers.

Thus, the main elements used by the participants to judge the difficulty of crossing in the environments presented concern road markings – meaningful and complex – the dimensions of the roadway – wide – and sidewalks – narrow or absent – leading them to infer high speeds and a low pedestrian density, these two elements producing low attention to pedestrians. The difficulty for pedestrians therefore comes from the amount and complexity of the information to be gathered and processed, in addition to a feeling of imminent danger due to vehicle speeds: decision-making is long and complex in a situation where there is no room for error.

### 3.5 More general results

Beyond the results presented above, some more general lessons can be learned from the analysis of the discussions in the focus groups.

#### 3.5.1 Labels applied to the environments

Here we are interested in participant interventions in which they gave an overall qualification to the site photographed, applying a “label” such as *housing project* (group of multistory, social housing buildings), *industrial park*, *city center*, *pedestrian zone*, *motorway*, *countryside*, *commercial*, *residential neighborhood*, “*résidence*” (this French term generally stands for “group of multistory residential buildings”), etc. These qualifications can often be interpreted as references to categorical representations of the environment or public spaces present in the participants’ memory. For example, one member of a focus group said “that reminds me of a fairly quiet neighborhood, a little “résidence” (G2)”, and in the context it is clear that he was not referring to any particular neighborhood or particular “résidence” here, but rather to a more general representation.

Among all the participant interventions (in both focus groups) containing some form of analysis or description of the photographed sites, approximately 31% (87 out of 277) used such labels. In these 87 interventions, a total of 101 labels or general qualifications appear (54 for focus group 1 and 47 for focus group 2).

Diverse wordings were used by the subjects, corresponding to different ways of evoking these labels and general qualifications. Some wordings appear to identify or assign the site to an environment category: “it’s a residential neighborhood (G2)”, “I chose that one, the city center (G1)”, etc. Other wordings appear more to situate the site photographed in a certain category of environment: “it’s probably in the city center (G2)”, “here, this is [...] in a commercial zone (G1)”, etc.). Other expressions show a resemblance, an aspect, an impression (“it doesn’t look



like a national highway (G1)”, “it makes you think of a pedestrian zone (G2)”, “it’s more like an industrial park (G2)”) suggesting a proximity to a category. Rarely, there is a simple qualification, only concerning two wordings out of 101: “it’s not commercial (G1)”, “it’s residential (G2)”.

On the other hand, a notion of degree of belonging to the category, degree of resemblance, or at least a degree or intensity of the connection between the site examined and the category or label mentioned, appeared in approximately 40 of the 101 wordings used (approximately 40%). Here are a few examples: “it’s almost an industrial park (G1)”, “it’s more like a residential road, say (G2)”, “it’s really the city center (G1)”, “a bit [...] more like a village (G1)”, “it really fits the cliché of the suburb (G1)”.

The labels that the participants most frequently used are those given in table 1, by descending order of frequency.

----- insert here table 1 -----

These results obviously only make sense in reference to the 20 photographed sites presented to the participants.

Other labels only came up once or twice each in all the discussions in the two focus groups. They may, however, take on forms similar to some of the main labels and should therefore be taken into account to gain a better view of the results. Table 2 presents all the labels used, grouped together in a way that makes it easier to pool similar forms.

The first group of labels includes those using the idea of the city or different kinds of urban or non-urban environments with reference to the question of the urban landscape or a kind of gradient between the city center and the countryside. The second group includes labels concerning residential urban environments. The labels *family zone*, *quiet neighborhood*, applied to environments that the participants themselves qualify as residential, were added to this group. The notion of *housing project*, as well as the terms *suburb* and *ghetto*, also refer to residential areas. The third group comprises labels relative to commercial or industrial environments on the city’s periphery. The fourth brings together labels formulated in terms of the kinds of roadways (*motorway*, *national highway*, *road*, etc.), or the environment’s highway or automobile character (*automobile environment*, *road environment*). The fifth group includes labels referring to how pedestrians are accommodated in the environments in question.

----- insert here table 2 -----

Table 2 shows that, overall, labels referring to the environment’s urban character, the different degrees of proximity to the city center and the city-country gradient are those most used. Those relative to residential zones are also widely used.

With reference to research on cognitive categories and the notion of prototype [notably see 24, 25, 26] and their applications to road spaces [27, 28], the use of such labels by the participants could be interpreted as reflecting the use of knowledge in the individual’s memory, and more particularly of knowledge that is structured into mental categories formed in the context of a particular activity (here, travel and the use of public spaces). These categories meet a need for cognitive economy (by reducing the stimuli of the real world to behaviorally and cognitively usable proportions [29] and are inseparable from the context of their production and use, and notably from behavioral responses in the real world.

We cannot, however, exclude that the labels are actually just summaries, part of the narrative in communication between participants, and that they do not reflect the existence of categorical representations in their memory.

Further investigation is needed on the particular use of these labels during discussion within focus groups; it appears that they mainly serve as basis for inferences, with assignment to a category or label enabling the participant to make a statement on the amount of traffic, the number of pedestrians, speeds, whether drivers expect pedestrians, etc.: “It doesn’t look like there are very many pedestrians, but it’s a residential zone, so there may be a lot of pedestrians after all (G2)”.

### 3.5.2 Inferences produced from the material presented

Out of the totality of participant interventions (1,269), 14% (180) include at least one inference, defined, broadly speaking, as any information added and deduced from the information already given by the visual elements present in the photographs proposed. In all, 244 inferences were encoded. Table 3 presents the elements in the scene that are the subjects of inferences and the classification by descending frequency of the results of these inferences.

The results show that the vast majority of inferences concern traffic or vehicle drivers (191 inferences) much more than pedestrians (51 inferences).

Inferences mainly concern vehicle speeds (73 inferences) in the different environments (“I think that people drive a little faster than there, because they can; but not as fast as there, because there are pedestrian crosswalks, there are people (G1)”), vehicle density (39) and pedestrian density (29) (“looking at the pictures, it is true that you don’t expect to see a lot of active traffic, you know. Even if at some times of the day it probably happens (G1)”) and the attention paid to pedestrians by drivers (45) (“you can turn right there. I thought to myself that the car first pays attention not to collide with another car and then it pays attention to the pedestrians (G2)”).

----- insert here table 3 -----

The type of wording used in the inferences was also analyzed (table 4). The results show that nearly half (114) of the inferences are formulated as an affirmation, a logical connection that directly links a visible element in the scene to a non-visible result (“there aren’t many homes, so if there aren’t a lot of homes, that means there aren’t a lot of people walking to the bakery (G1)”; “there are trees, car drivers are afraid of trees! (G1)”). This type of wording is more prevalent among experienced drivers. A little more than one-third of the inferences are worded as simple hypotheses, a probable consequence of the visible situation (“it seemed to me that it was a little residential housing area, so normally there shouldn’t be a lot of cars driving around (G2)”); this wording was more common among less experienced drivers and pedestrians. Only 14% are formulated as personal opinions and less than 8% as foresight on the situation in the near future. The inferences are either produced directly from the labeling of the environment (“in residential housing areas, there are indeed more children who can play, who may be outside (G2)”; “it is the typical case of urban streets with moderate speeds (G1)”), or deduced from the presence of cues taken from the environment (“as it is a long straightaway, I think cars may drive fast (G2)”; “there are cars parked in front of the bakery, there are parking spots alongside, a bus stop, I think there’s a lot of movement (G2)”).

----- insert here table 4 -----

### 3.5.3. Effect of interactions on perceptions during the focus group discussions

The interactive dimension, specific to group discussions, is an important feature of this method. The use of focus groups is also of interest in that it provides participants with the possibility to discuss their points of view, to influence each other reciprocally and to develop their own points of view. These interactions thus may have led to the joint construction of an interpretation of the environment, as in this example of a discussion between 3 participants on the pleasantness of the city center environment:

N: The fact that there are terraces, wide sidewalks, that there aren’t any road markings, that it’s not very straight, that there are people, that the buildings are tall... all of that obstructs the perspective a bit...

[...]

M: so that leads to a certain recognition of a pedestrian space for, well... for drivers, and so there is respect... yes, without being imposed, but respect from drivers for this space where he recognizes that there are... yes, they take into account... that is induced...

N: Actually, in this kind of space we all share the space. So maybe what I was saying earlier about the pedestrian’s having the upper hand...it’s not that they have the upper hand, it’s just that they have the upper hand here more than elsewhere. That means that you can’t ignore the vehicles.

M: And cross any way you want...

N: Exactly...

S: Pedestrians are in a more favorable environment, let's say...

N: So their task is easier, so it's more pleasant."

The discussion also enables certain participants to understand the effect that the presence of certain elements in the environment has on their perceptions, as in this example of the effect of markings on the perception of pedestrians' place in the space:

"C: Earlier, N. said that he seemed to focus on road markings, and I hadn't ever thought about it but, yes, when you see that the road has good markings for cars, you think, "this is car territory". I had never realized that... but that seems pretty true to me. So you can see that there (19), there aren't any road markings, it looks more... shared. So when the lines are nice and white and all, you think, "whoa, they must go zoom!"

N: yeah, it's a track...

C: I had never noticed, but... I pretty much agree. So there (15), there are some markings, so you feel less at home, you know..."

The group dynamic and the interactions between the participants were not analyzed in depth, however, given our research objectives.

#### 4. Discussion and conclusion

In terms of road engineering, the results suggest a few tendencies or lines of approach concerning the design of spaces that make street crossing more comfortable for pedestrians. For most of the participants, the preferred environments for crossing a street are those which clearly give pedestrians the upper hand over automobiles (wide sidewalks, no parking, no markings, a lively context with cafés and shops). We have reasons to think that such environments are also, in general, safe environments: for instance, it has been established for a long time that safety is improved by public space treatments which, beyond traffic calming, make the local and non-motorized uses of the public space more salient to motorists [see for example 30].

Other participants appear to prefer environments that provide more organization and simplified use of the public space by pedestrians (presence of pedestrian crosswalks, well defined sidewalks and unobstructed visibility, in a rather calm context and with moderate traffic). Here again, these elements do not appear to be incompatible with a good level of safety, if we take the urban context into account. It is true that the scientific literature is sometimes critical of the safety provided by pedestrian crosswalks [31], but an in-depth examination of the research carried out on this point leads us to the more nuanced conclusion that pedestrian crosswalks reduce risk so long as they are installed in a clearly urban environment on roadways that are not too wide or fast [32, pp. 96-100].

In short, pedestrians prefer either environments that are complex but in which they have the "upper hand", or environments that are highly predictable and where it is easy to make decisions. This underlines that both of these organizations of the street can correspond to the pedestrians' needs. For a given place, the more appropriate choice depends on the surrounding area, the activities carried out and the other users of the place. This meets the principle of "complete street" that takes all the users into account but that is designed depending on surrounding [33]. This also provides food for thought on how to implement certain contemporary road engineering concepts such as the "zones de rencontre" used in Switzerland, Belgium and France, whose principle is based on total mixed use of spaces for all user categories and on priority given to pedestrians in relation to vehicles, including motor vehicles (most European countries have similar concepts: "verkehrsberuhigter Bereich", "erf", "living street", for example). An assessment of these layouts from the pedestrian point of view would be useful to determine how pedestrians perceive them and identify their territory, which is supposed to be shared by all travel modes, in this situation.

From a methodological point of view, the focus group method provides a wealth of verbal material and proved to be of great interest for studying the perception and interpretation of environments by the participants in the role of pedestrians. The analysis of the transcriptions shows that the exchanges between the participants and the discussions on their differences of opinion led them to express their points of view more than during individual interviews. The method also provides a more detailed access to the elements in the environment that pedestrians take into account and the inferences that they can lead to.

The results obtained here should not be taken at face value, however, given the small number of users questioned. Furthermore, given its qualitative nature and low degree of structure, this method is still rather informal, and the results should be taken with caution, as part of an exploratory process. These results therefore need to be confirmed using the same methodology on a larger sample of pedestrians.

Moreover, the results of this exploratory study did not show whether the inferences produced by pedestrians from the environment really influence their crossing decisions. This issue was the subject of a second study [34] which showed that elements of built environment and public space design are used by pedestrians to make inferences (about the pedestrian and traffic density, attention to pedestrian and vehicles speed) and to decide to cross or not.

Nevertheless, the results obtained in these two studies were the product of pedestrian analyses of static environments. We cannot be sure that people would be aware of or even produce the same analyses, inferences and assessments in a real-life situation. The environment's influence on the pedestrians' inferences and analyses of the general crossing situation needs to be confirmed using other, more ecological methods such as the commented route method which could be used to study the influence of the approach environment and the environment at the time of crossing.

Overall, the qualitative analysis presented in this article shows that pedestrians take into account many elements and cues relative to the road infrastructure and other users, but also the public space and the urban environment in a broader sense, when they have to assess the degree of difficulty or pleasantness of crossing a street. The results obtained, which need to be consolidated with other analyses, provide a better understanding of pedestrian perceptions and suggest possible improvement in infrastructure design to provide better ergonomics and a more pleasant walking experience on urban road systems.

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#### References

1. Dissanayake, D., Aryajja, J., and Wedagama, D.M.P., *Modelling the effects of land use and temporal factors on child pedestrian casualties*. Accident Analysis & Prevention, 2009. 41(5): p. 1016-1024.
2. Wedagama, D.M.P., Bird, R.N., and Metcalfe, A.V., *The influence of urban land-use on non-motorised transport casualties*. Accident Analysis and Prevention, 2006. 38 p. 1049-1057.
3. Graham, D.J. and Glaister, S., *Spatial Variation in Road Pedestrian Casualties: The Role of Urban Scale, Density and Land-use Mix* Urban Studies, 2003 40(8 ): p. 1591 - 1607.
4. Clifton, K.J., Burnier, C.V., and Akar, G., *Severity of injury resulting from pedestrian-vehicle crashes: What can we learn from examining the built environment?* Transportation Research Part D () 2009. 14 p. 425-436.
5. Aarts, L. and Van Schagen, I., *Driving speed and the risk of road crashes: A review*. Accident Analysis & Prevention, 2006. 38: p. 215-224.
6. Rosén, E., Stigson, H., and Sander, U., *Literature review of pedestrian fatality risk as a function of car impact speed*. Accident Analysis and Prevention, 2011. 43: p. 25-33.
7. Davis, G.A., *Relating severity of pedestrian injury to impact speed in vehicle-pedestrian crashes, simple threshold model*. Transportation Research Record, 2001. 1773: p. 108-113.
8. Pitt, R., et al., *The severity of pedestrian injury in children: an analysis of the pedestrian injury causation study*. Accident Analysis & Prevention, 1990. 22(6): p. 549-559.
9. Underwood, J., et al., *Reading the road: the influence of age and sex on child pedestrians' perceptions of road risk*. British Journal of Psychology, 2007. 98: p. 93-110.
10. Cho, G., Rodriguez, D.A., and Khattak, A.J., *The role of the built environment in explaining relationships between perceived and actual pedestrian and bicyclist safety*. Accident Analysis & Prevention, 2009. 41: p. 692-702.
11. Mullan, E., *Do you think that your local area is a good place for young people to grow up? The effects of traffic and car parking on young people's views*. Health & Place, 2003. 9(4): p. 351.
12. Foltête, J.-C. and Piombini, A., *Urban layout, landscape features and pedestrian usage*. Landscape and Urban Planning, 2007. 81(3): p. 225.
13. Livi Smith, A., *Contribution of Perceptions in Analysis of Walking Behavior*. Transportation Research Record: Journal of the Transportation Research Board, 2009. 2140: p. 128-136.
14. Hine, J., *Pedestrian travel experiences. Assessing the impact of traffic on behaviour and perceptions of safety using an in-depth interview technique*. Journal of Transport Geography, 1996. 4(3): p. 179-199.
15. Ewing, R., et al., *Identifying and measuring urban design qualities related to walkability*. Journal of Physical Activity and Health, 2006. 3(suppl. 1): p. S223-S240.
16. Bergeron, J., et al., *Effets des caractéristiques de l'environnement sur le comportement des piétons à des intersections urbaines*, in *Le piéton et son environnement. Quelles interactions ? Quelles adaptations ? Actes INRETS n°115*, M.A. Granié and J.M. Auberlet, Editors. 2008, Collection INRETS: Paris. p. 163-174.

17. Foot, H.C., et al., *Children's understanding of drivers' intentions*. British Journal of Developmental Psychology, 2006. 24: p. 681-700.
18. Bruseberg, A. and McDonagh-Philp, D., *Focus groups to support the industrial/product designer: a review based on current literature and designers' feedback*. Applied Ergonomics, 2001. 33(1): p. 27-38.
19. MacDougall, C., *Compétence, équité et représentations du lieu et de l'espace chez les enfants*, in *Enfants et jeunes dans les espaces du quotidien*, I. Danic, O. David, and S. Depeau, Editors. 2010, Presses Universitaires de Rennes: Rennes. p. 157-172.
20. Wibeck, V., Adelswärd, V., and Linell, P., *Comprendre la complexité : les focus groups comme espace de pensée et d'argumentation sur les aliments génétiquement modifiés*. Bulletin de psychologie, 2004. 57(3): p. 253-261.
21. Holland, C.A. and Hill, R., *The effects of age, gender and driver status on pedestrians' intentions to cross the road in risky situations*. Accident Analysis & Prevention, 2007. 39: p. 224-237.
22. Yagil, D., *Beliefs, motives and situational factors related to pedestrians' self-reported behavior at signal-controlled crossings*. Transportation Research Part F: Traffic Psychology and Behaviour, 2000. 3(1): p. 1-13.
23. Evans, D. and Norman, P., *Understanding pedestrians' road crossing decisions: an application of the theory of planned behaviour*. Health Education Research: Theory and Practice, 1998. 13(4): p. 481-489.
24. Rosch, E., *Principles of categorization*, in *Cognition and categorization*, E. Rosch and B.B. Lloyd, Editors. 1978, Erlbaum: Hillsdale (NJ). p. 27-48.
25. Rosch, E. and Mervis, C.B., *Family resemblances: studies in the internal structure of categories*. Cognitive Psychology, 1975. 7: p. 573-605.
26. Dubois, D., *Sémantique et cognition* 1991, Paris: Editions du CNRS.
27. Mazet, C., Dubois, D., and Fleury, D., *Catégorisation et interprétation des scènes visuelles: le cas de l'environnement urbain et routier*. Psychologie Française, 1987. 32(1/2): p. 85-95.
28. Montel, M.-C., Van Elslande, P., and Brenac, T., *Categorisation of streets by drivers and associated expectancies: a cognitive analysis of driving activity for safer urban design*. Advances in Transportation Studies, 2005. 7: p. 23-38.
29. Rosch, E., *Human categorization*, in *Studies in cross-cultural psychology*, N. Warren, Editor 1977, Academic Press: London. p. 1-49.
30. Faure, A. and de Neuville, A., *Safety in urban areas: the French program "Safer cities, accident-free districts"*. Accident Analysis and Prevention, 1992. 24(1): p. 39-44.
31. Elvik, R. and Vaa, T., *The handbook of road safety measures* 2004, Amsterdam Elsevier.
32. Brenac, T., Nachtergäële, C., and Reigner, H., *Scénarios types d'accidents impliquant des piétons et éléments pour leur prévention [Accident prototypical scenarios involving pedestrians and elements for their prevention]*. Rapport n°2562003, Arcueil: Les collections de l'INRETS.
33. Smith, R., Reed, S., and Baker, S., *Street design: Part 1 - Complete street*. Public Roads, 2010. 74(1): p. 12-17.
34. Montel, M.C., et al. *Urban environments, pedestrian-friendliness and crossing decisions*. in *Transportation Research Board 92nd Annual Meeting*. 2013. Washington, D.C.: Transportation Research Board.



Fig. 1 Example of a set of photographs presenting left-hand, central and right-hand views

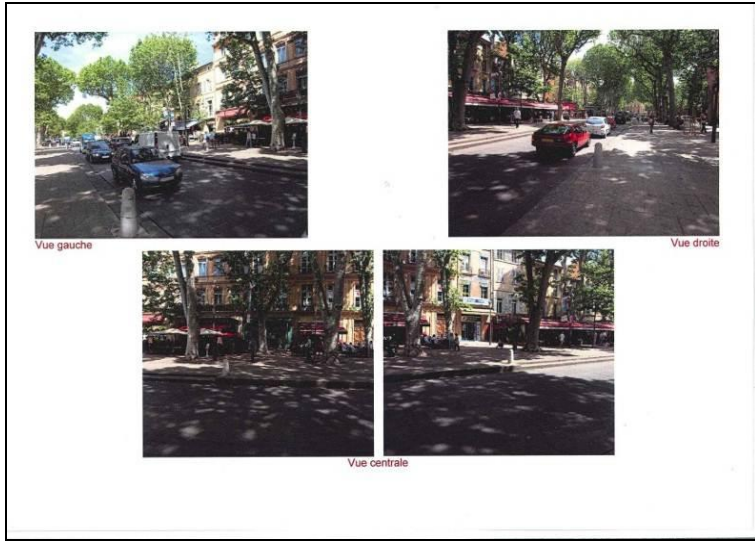


Fig. 2 City center environment

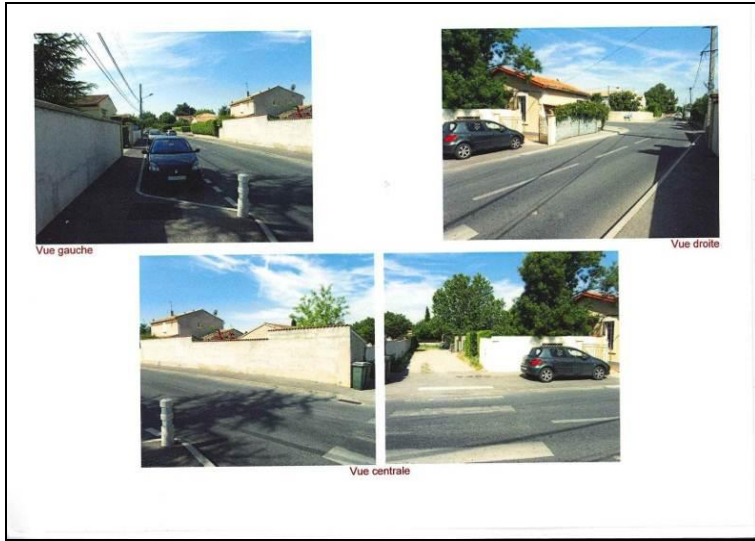


Fig. 3 Residential environment



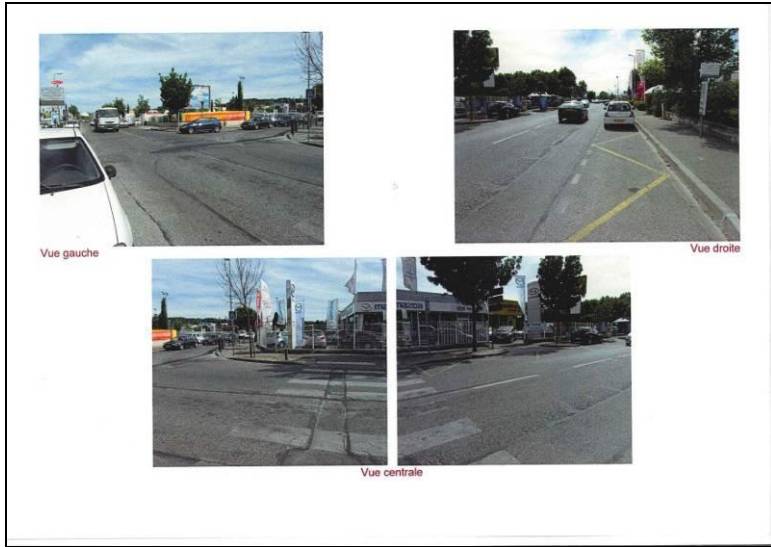


Fig. 4 Environment in a commercial zone



Fig. 5 Housing project environment

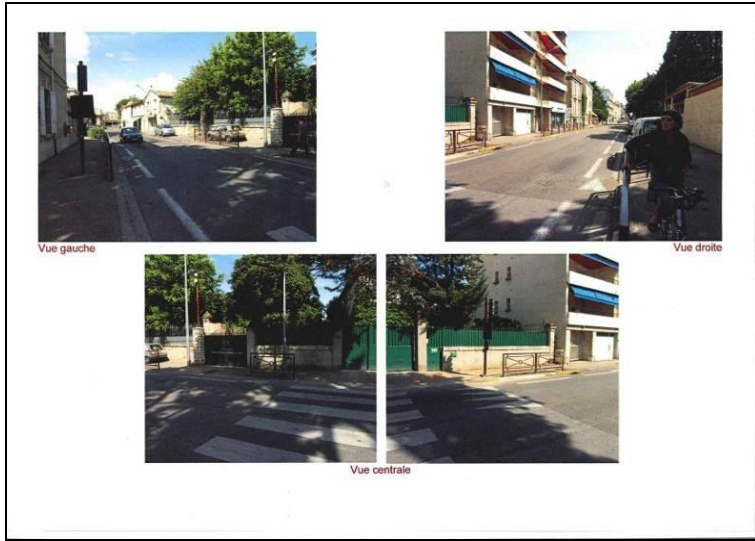


Fig. 6 Residential neighborhood environment

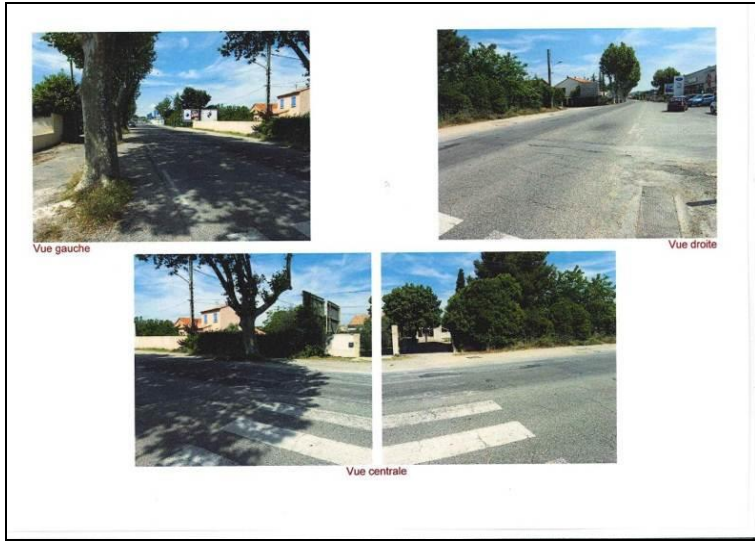


Fig. 7 Environment at the entry to an urban area



Fig. 8 Environment on the periphery of an urban area 1



Fig. 9 Environment on the periphery of an urban area 2

Table 1 The most frequently used labels

Label	Number of occurrences
City center	15
City	7
Pedestrian zone	7
“Résidence”	7
Residential neighborhood	5
Commercial zone	5
Industrial park	4
Housing project	4
Suburb	3
Countryside	3
Country	3
Motorway	3

Table 2 Groups of labels and corresponding numbers of occurrences in the focus group discussions

Group of labels	Labels (and number of occurrences)	Total number of occurrences
Urban character, nuances between city and country	City center (15), city (7), exit of the city (2), entry to the urban area (1), urban area (1), urban environment (2), urban street (1), village (1), city center environment (1), countryside (3), country (3), country road (1), nature (1)	39
Residential environments	“Résidence” (group of multistory residential buildings) (7), residential neighborhood (5), residential zone (1), residential (1), residential road (2), road in a residential neighborhood (1), housing project (4), suburb (3), ghetto (1), family zone (1), quiet neighborhood (1)	27
Commercial or industrial environments on the periphery	Commercial zone (5), commercial (1), zone (2), industrial park (4)	12
Nature of the roadways and road or automobile character	Motorway (3), expressway (2), high-speed road (1), national highway (1), road (1), conventional road (2), automobile environment (1), road environment (1), motorway entrance (1)	13
Environments qualified with reference to pedestrian accommodation	Pedestrian zone (7), pedestrian street (1), pedestrian environment (2)	10
Overall total		101



Table 3 Inferences, classified in relation to their subject and their result, and corresponding numbers of occurrences

Subject of the inference	Result of the inference	Number of occurrences
Traffic	Speed	73
	Density	39
	Attention to pedestrians	45
	Behavior	11
	Pedestrian right-of-way	6
	Diversity of traffic	6
	Transgression	5
	Vehicle right-of-way	4
	Traffic complexity (vehicle movement)	1
	Pedestrian visibility	1
	Total	191
Pedestrian	Density	29
	Travel	8
	Crossing	6
	Attention to traffic	3
	Perception of danger	3
	Right-of-way	1
	Behavior	1
	Total	51
Environment	Future condition	1
	Layout (presence of traffic lights)	1
	Total	2
Overall total		244

Table 4 Types of wording for inferences

Type of wording	Number of occurrences
Affirmation, logical connection	114
Probability, "they could, maybe"	75
Personal position, opinion, "I think"	36
Foresight; "you expect"	19
Total	244