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"I Don't Care About Social Control": Watching-Eye Effect Does Not Reduce Illegal Pedestrian Behaviour in France

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Pedestrians often risk accidents by crossing at red lights. This study examines whether this behavior stems from risk awareness and tests the effectiveness of visual "nudges" using eye images. Conducted in Strasbourg with 2967 pedestrians, the study compared 'child's eyes', 'woman's eyes', flower images, and no signs. Results showed that eye images did not significantly reduce red-light crossings. Unexpectedly, the 'child's eyes' sign decreased waiting time, while the flower sign increased risky behavior. Jaywalking was influenced by gender, age, distraction, peer presence, and location. Unlike previous research, this study specifically examines pedestrian crossings, highlighting the limited impact of visual nudges and the need for further research into urban pedestrian decision-making and safety measures.

Keywords: Nudge, illegal crossing, social control, waiting time, risk taking

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Declaration of informed consent: No identifying information was collected from the pedestrians. The data is anonymous, the focal pedestrians were only coded by their location, day, and time of crossing the street. The Bas-Rhin Prefecture was informed about the experiment and the General Data Protection Regulation (GDPR) was respected. The experiment was approved by the ONISR and SIRAC. During recordings, pedestrians had the opportunity to be informed about the study if they requested it. They could also have access to the contact information of the authors.

The dynamics of urban mobility, particularly for pedestrians, are becoming increasingly important as urban populations continue to grow, with estimates suggesting that 68% of the world's population will live in cities by 2050. Contemporary urban environments were originally designed with vehicular traffic in mind. They are now rapidly evolving to accommodate and encourage pedestrian movement, partly driven by health and environmental considerations. However, this transition often outpaces the change in urban infrastructure, leading to frequent conflicts between pedestrians and motorists. This is particularly evident in French big city areas, where the number of pedestrian deaths and injuries is significantly higher than in rural areas (Carnis et al., 2019). In 2018, for example, pedestrians accounted for 15% of road deaths and 14% of injuries. This corresponds to 470 deaths and 9,805 injuries (both minor and serious). These figures have remained stagnant since 2010, having started to decline in the 2000's (Carnis et al., 2019); and interestingly, 21% of these accidents were attributed to the behaviour of the pedestrians themselves (Carnis et al., 2019). In 2023, approximately 425 pedestrians died, marking a decrease of 12% compared to 2022 and a 12% drop relative to 2019. This reduction aligns with an overall downward trend in road fatalities across various user groups since the pandemic, though pedestrians, cyclists, and motorized two-wheeler users still represent a significant portion of road casualties. Pedestrians accounted for around 16% of those killed or seriously injured on French roads in the past year, underscoring their vulnerability despite recent safety improvements (Carnis, 2023). Regarding injuries, an estimated 1,900 pedestrians sustained serious injuries over the past year, showing a steady reduction of about 16% compared to 2019 levels, although there has been less significant change compared to the previous year. In addition to the overall number of casualties, demographic patterns provide important insights into risk exposure. Studies show that men are consistently more represented among pedestrian fatalities and violations than women, often displaying greater risk-taking and lower compliance with traffic lights (Pelé et al., 2017; Sueur et al., 2013). Older pedestrians, conversely, are more vulnerable due to slower walking speeds and reduced perceptual capacities, which increase the likelihood of being struck when crossing (Carnis et al., 2019). Younger individuals and adolescents may also take more impulsive decisions when facing traffic, particularly in dense urban environments or in groups. These sex- and age-related tendencies are essential to consider when designing interventions such as nudges, which may not affect all categories of pedestrians in the same way. Moreover, pedestrian behaviour often varies according to familiarity with the environment. Regular users of a given intersection tend to develop routine strategies adapted to local traffic rhythms and perceived risks, which can lead either to safer practices through experience or to complacency and habitual rule-breaking. Conversely, occasional pedestrians—such as visitors or commuters in unfamiliar districts—are generally more cautious and more compliant with signals, relying more on visual cues and the behaviour of others (Pelé et al., 2017; Sueur et al., 2013). Such differences in spatial habituation highlight the need to consider local context when evaluating interventions aimed at improving pedestrian safety.

The unique characteristics of pedestrians as road users—their unpredictability and tendency to optimise time and distance—can lead to unsafe behaviour (Bergeron et al., 2008; Thompson et al., 1985). These include crossing outside of designated areas, ignoring traffic signals, and not crossing at right angles to the pavement. These behaviours are influenced by several factors, including the pedestrian's social and physical environment, but also his or her decision making. For example, the frequency of rule-breaking decreases as the number of traffic lanes increases (Pelé et al., 2017). Also, a false sense of safety in groups can lead to increased risk-taking (Wang et al., 2011). Adolescents are particularly susceptible to social influences and often put themselves in dangerous situations on the road when crossing (Granié & Espiau-Nordin, 2008).

Risk perception strongly influences pedestrian behaviour, and different pedestrian profiles have been identified at signalised crossings and categorised according to their intention to cross at a red light (Pelé et al., 2019a, 2019b). Some cross intentionally after assessing the situation. Others cross unintentionally, often due to distractions or following a group (Nasar et al., 2008). Distractions, whether auditory, visual or cognitive, such as mobile phones and headsets, also interfere with gathering the information needed to cross safely (Bungum et al., 2005). In addition, some pedestrians choose to cross at the beginning or end of a red light, using vehicle traffic signals to time their movement. This behaviour contributes to a significant proportion of illegal crossings (Lipovac et al., 2013). Considering the gender of pedestrians, men tend to display riskier behaviour and commit more violations than women (Lipovac et al., 2013; Pelé et al., 2017; Rosenbloom, 2009; Tom & Granié, 2011; Vujanić et al., 2014). Age is another determinant, with young adults (15–30 years old) tending to take greater risks, often crossing closer to the arrival time of the next vehicle (Giuffrè et al., 2016). Conversely, older people may unintentionally engage in risky crossing behaviours, often due to diminished physical or cognitive abilities (Zhang et al., 2017).

Social factors also play a role in pedestrian behaviour at red lights. For example, pedestrians crossing alone behave differently than those in groups. Group dynamics typically divide individuals into initiators, who cross after making an informed decision, and followers, who cross by imitation, potentially exposing themselves to danger (Faria et al., 2010; Pelé et al., 2019a, 2019b). Although crossing in groups may be perceived as safer due to increased visibility to drivers, this hypothesis requires further empirical support for validation (Pelé et al., 2019b; Rosenbloom, 2009; Zhang et al., 2017). Environmental factors also play an important role. For example, the design of roads affects pedestrian risk behaviour. Increasing the number of lanes and traffic density, or reducing lane visibility, increases perceived risk and leads to more cautious behaviour (Mueller et al., 1990; Pelé et al., 2017; Wang et al., 2011; Zhang et al., 2017, 2019). The design of pedestrian facilities also influences behaviour. For example, the duration of pedestrian red lights is positively correlated with the number of illegal crossings (Keegan & O'Mahony, 2003; Pelé et al., 2019a; Wang et al., 2011). Lights with irregular cycles tend to generate more illegal crossings than those with regular cycles (Giuffrè et al., 2016). Well-designed pedestrian environments can lead to a reduction in rule violation (Greenwald & Boarnet, 2001). All these factors, combined with the high level of vulnerability of pedestrians, make them an important population to protect. It seems crucial to reduce their exposure to the risk of collision with a vehicle, and the use of nudges seems to be an interesting avenue to explore.

Nudges can take many forms, but they always offer a choice without restricting freedom, subtly steering human decision-making in a beneficial direction (Thaler & Sunstein, 2009). The concept of nudging has been explored in several contexts. Bateson and collaborators (Bateson et al., 2006) conducted an experiment using eye pictures as a form of social control and observed increased cooperative behaviour, such as higher donations, in the presence of eye pictures compared to flower pictures. Similar positive effects of eye images have been observed in different settings, including tray clearing in university canteens (Ernest-Jones et al., 2011), litter sorting at bus stops (Francey & Bergmüller, 2012), generosity in stores (Powell et al., 2012), voter turnout (Panagopoulos, 2014), and blood donations (Sénémeaud et al., 2017). This groundbreaking approach is based on the 'watching-eye effect,' a now well-documented psychological phenomenon in which the mere perception of being watched can significantly influence individual behaviour. In controlled or simulated environments, eye-like symbols can subconsciously motivate people to adhere more closely to social norms and rules, presumably due to an increased sense of being watched (Bateson et al., 2006; Ernest-Jones et al., 2011; Francey & Bergmüller, 2012; Lv et al., 2024; Panagopoulos, 2014; Powell et al., 2012). Nudges in the form of eye images seem interesting to test to reduce risky crossing behaviours, as non-verbal cues, such as eye contact, play an important role in road safety. For example, drivers are more likely to stop and allow a pedestrian to cross at an unsignalled crosswalk if the pedestrian looks at them (Guéguen et al., 2015). However, the effect of such cues can be transient, as observed with road signs depicting children's book illustrations, which only temporarily reduce vehicle speed (Vlakveld et al., 2022).

In the context of urban traffic, where non-compliance with traffic signals is a common problem, harnessing this subconscious influence represents an innovative and potentially transformative method of improving pedestrian safety. The rationale behind the use of eye imagery adjacent to pedestrian signals is that these visual cues could subconsciously create a sense of vigilance and encourage pedestrians to obey traffic rules. By creating the illusion of social surveillance, these eye images are thought to act as a subtle but effective deterrent to risky behaviours. This study is the first of its kind to empirically test this hypothesis in real urban settings, deploying eye images with different emotional expressions at pedestrian crossings and assessing their real-world impact on pedestrian behaviour. We aim not only to determine the effectiveness of these visual nudges in reducing illegal pedestrian crossings, but also to contribute to a broader understanding of how small environmental changes can significantly influence complex human behaviours in urban landscapes. The expected outcome is a significant reduction in illegal crossings, driven by the innate human response to perceived observation, marking a significant step forward in the application of psychological principles to urban road safety.

Materials and Methods

Image Selection

Sueur and collaborators (Sueur et al., 2022) conducted a preliminary study to select the eye image for the present experiment. A total of 1,447 French individuals participated in the survey, of which 610 completed the full set of 20 questions focusing on pedestrian behaviour (Pedestrian Behaviour Questionnaire, PBQ, (Granié et al., 2013; Vandroux et al., 2022)). The demographic breakdown of the respondents included 71% females with an average age of 35 (± 14 years). Analysis of the responses showed that 33% of participants felt observed, 5% felt fear and 26% expressed surprise when viewing the eye images, indicating mixed effects on their tendency to avoid crossing at red lights. In particular, perceptions of being observed increased by about 10–15% and feelings of fear or inhibition increased by about 5% as the eye expressions changed from neutral to friendly and then to angry. However, no significant correlation was found between these findings and the PBQ responses. These results suggest that eye gaze could potentially reduce illegal pedestrian crossings, highlighting its relevance as a road safety tool (Sueur et al., 2022).

The selection of the two eye images (angry woman and neutral child) was guided by both theoretical and practical considerations from this preliminary questionnaire study. Although the angry man and angry child elicited the strongest emotional reactions (higher reported feelings of fear and observation), they were also perceived as excessively intimidating or socially unrealistic for a public safety device, which could provoke avoidance or reactance effects. Conversely, the angry woman image maintained an expressive yet socially acceptable intensity, while the neutral child image represented an innocent and prosocial cue, consistent with emotional contagion and empathy models. These choices aimed to balance salience and acceptability in real traffic contexts, while maintaining comparability with prior "watching-eyes" studies using neutral or mildly expressive stimuli. In the original questionnaire, participants rated 16 stimuli (five faces × three expressions + one floral control) on perceived observation, fear, inhibition, and surprise. Mean ratings were then used to select the two images representing distinct yet moderate emotional intensities. Both images were standardised (grayscale, same luminance and resolution) to prevent colour bias and validated by the local road authority before field installation.

Based on Sueur et al. (2022), three images were selected for this experiment. The first shows a woman with an angry expression (Figure 1a) and the second shows a child with a neutral expression (Figure 1b). The third is a control image, and shows flowers (Figure 1c). All three images are in shades of grey (Figure 1) to avoid colour-related decision bias (Elliot & Maier, 2007; Yüksel, 2009). Dataset is available here: https://doi.org/10.5281/zenodo.5898591

(a) Woman's eyes with angry expression *(b) Child's eyes with neutral expression* *(c) Flowers*

Figure 1. Images selected during the preliminary study (Sueur et al., 2022). The two test photos represent eyes sign (a) and (b), and the control photo flowers (c).

Set-up for the Experiment

These images were printed on traffic signs (50 × 20 cm, standard French sign) and hung just above the pedestrian lights (Figure 2a). We did this to be sure that pedestrians saw the images when they looked at the light. We made sure that pedestrians saw the sign by checking it ourselves, but also by looking at pedestrians' gazes. Some pedestrians even pointed out the sign to their friends or family. The size of the sign (20 × 50 cm) was selected according to the standard supplementary panel format defined by the French Highway Code for additional information signs. This dimension corresponds to the usual format authorised for complementary signage in urban areas and was validated by the local road authorities (SIRAC, Eurométropole de Strasbourg) prior to installation. The use of this format ensured that the device conformed to national traffic regulations while remaining visible to pedestrians without obstructing other road users' signals or signage. The study comprises four experimental conditions:

- Two test conditions: 'woman's eyes' photo (Figure 1a) and 'child's eyes' photo (Figure 1b).
- Two control conditions: 'flowers' photo (Figure 1c) and no sign at all.

All observations were filmed using a Canon EOS60D camera mounted on a tripod at a height of approximately 1.70 metres above the ground. The observer was positioned offset from the pedestrian crossing to be hidden from pedestrians and thus avoid influencing their behaviour (Figure 2b), as discussed in previous studies (Pelé et al., 2017, 2019a, 2019b).

Observation of Pedestrians

The study focuses on pedestrians in Strasbourg, a city with a population of 282,649 in 2019. We followed previous study protocols for observations and data collection (Pelé et al., 2017, 2019a, 2019b). Observations targeted residents of Strasbourg, excluding tourists (who were identified by their equipment, cameras or maps, or by the presence of guides). Groups of pedestrians, such as children on school trips, were also excluded. Individuals travelling on wheeled vehicles, such as skateboards or bicycles, were not included due to their higher speed.

Three signalised pedestrian crossings were observed in the centre of Strasbourg: Quai de Paris, Nuée Bleue and Université (Table 1). The choice of these sites was made in agreement with the Service de l'Information et de la Régulation Automatique de la Circulation (SIRAC) of the Euro-Metropole of Strasbourg (Strasbourg.eu eurométropole, 2015). These locations were deliberately selected because they presented moderate traffic density and controlled pedestrian flows, allowing safe observation and camera installation without endangering participants or researchers. The aim was to test the effect of the nudge under real but low-risk urban conditions, consistent with ethical and safety requirements for field studies involving public road users. Although the relatively low number of vehicles may have reduced the occurrence of transgressive crossings, it ensured a reliable and safe experimental setup while maintaining the ecological validity of the observations. These sites were at least 400 metres away from schools and avoided the main tourist routes. If a cycle path was present, it was parallel to the pedestrian crossing and did not need

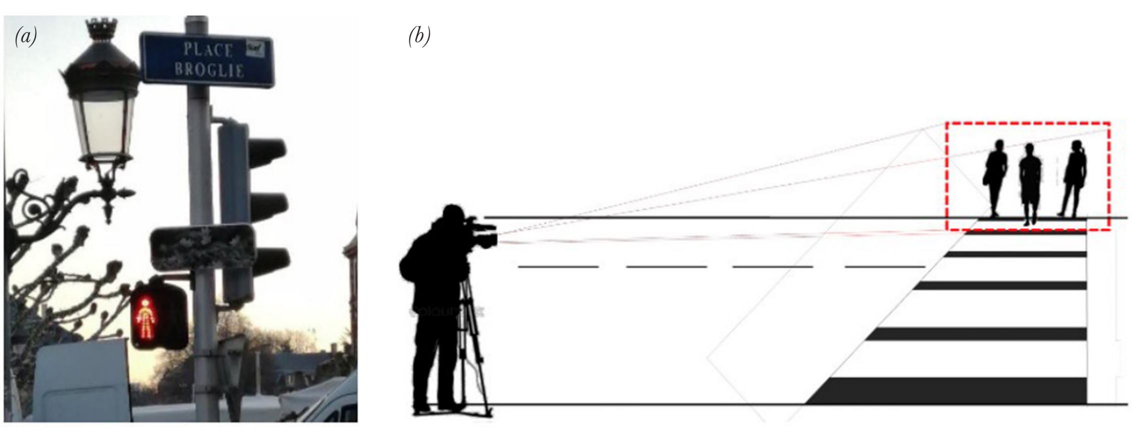

Figure 2. Photo showing the flower sign at an observation site. The signs should be installed next to the pedestrian light, ideally above but not below (a). Diagram of the observer's and camera's angle of view on the targeted pedestrians (b).

Table 1. Information on observation sites

Site	Quai de Paris	Nuée Bleue	Université
Geographical coordinates	48.584250, 7.741250	48.584472, 7.748806	48.577667, 7.764472
Number of lanes	One lane (one way)	Two lanes	Four lanes (with one for the bus)
Tramway*	Yes	Yes	No
Cycle path	Yes	No	Yes
Average number of cars per hour (one way)	50	111	136
Average pedestrian frequency per hour	110	154	148
Mean road crossing speed	1.06 ± 0.27	1.01 ± 0.16	0.98 ± 0.06

**Unlike cars, the tram runs parallel to the pedestrian crossing and temporarily blocks vehicle movement when approaching the intersection. This configuration may lead pedestrians to perceive the situation as safer and thus to cross at a red light, even though the pedestrian signal is still prohibitive.*

to be crossed. All observation sites were located within urban areas of Strasbourg, where the maximum authorised vehicle speed was 50 km hr^{1}, consistent with the limits reported in previous studies on the same intersections (Sueur et al., 2013; Pelé et al., 2017, 2019a).

The observations took place over two periods. The first was from 13 September to 15 October 2019 for the control condition with no sign. The second was from 16 January to 2 March 2020 to observe both the test conditions (children and woman's eyes signs) and the control condition with the flower sign. Observations took place from Monday to Friday, between 8am and 12pm (excluding school holidays), only in acceptable weather conditions (i.e., outside rain or snow) and when there were no obstacles for pedestrians (e.g., roadworks).

Three hours of observation per site and experimental condition were analysed, for a total of 36 hours of recordings. Semi-randomisation was used to maintain an equal distribution of day and time of observation by experimental condition and site.

Only pedestrians crossing in the direction of the observer were included in the study, as their behaviour could be recorded. Direct observation allowed us to count the number of pedestrians crossing at green and red lights, the number of vehicles, and the number of hesitant pedestrians using behavioural sampling (Altmann, 1974). This was done using a five-entry mechanical counter (Clay Adams brand). Video analysis (indirect observation) was then used to record each pedestrian using focal sampling (Altmann, 1974). The pedestrians selected for this study were those who arrived at the crossing when the pedestrian signal was red (i.e. those who crossed at the red signal or those who waited at the red signal and crossed at the green signal). Pedestrians arriving and crossing at green were not included in the current study as the effect of the nudges could not be concluded. In addition, data were only collected when pedestrian visibility was optimal (i.e. without a permanent obstacle such as a lorry parked between the camera and the pedestrian). Thus, of the 3,071 pedestrians observed crossing the road by video analysis, 104 (3.4%) were excluded.

Ethics and Data Protection

No identifying information was collected from the pedestrians. The data is anonymous, the focal pedestrians were only coded by their location, the day and the time they crossed the street. The Bas-Rhin prefecture was informed about the experiment and the General Data Protection Regulation (GDPR) was respected. The experiment was approved by ONISR and SIRAC. During the recordings, pedestrians had the opportunity to be informed about the study if they wished. They also had access to the authors' contact information. We could not choose sites with recorded accident events in order not to disrupt crossing behaviour and cause more accidents. We did not observe any accidents at our experimental sites.

Variables

Several variables were collected for each focal pedestrian.

Behavioural Variables

[Waiting time] corresponds to the waiting time (in seconds) of the pedestrian before crossing the road. It is calculated by subtracting the pedestrian's arrival time, when he puts his foot down to stop on the pavement, from the departure time, when he lifts his foot to start walking. The waiting time is zero if the pedestrian crosses without stopping at the pavement (Figure 3).

[Stop]: each pedestrian is coded as 1 if they have a waiting time greater than zero and 0 if they cross directly (waiting time = 0).

[Hesitation] corresponds to an interruption of the committed movement. The pedestrian can then decide to reverse and interrupt the crossing, or accelerate to continue crossing (Jay et al., 2020). Pedestrians were coded 1 if they exhibited a hesitation behaviour and 0 if they did not.

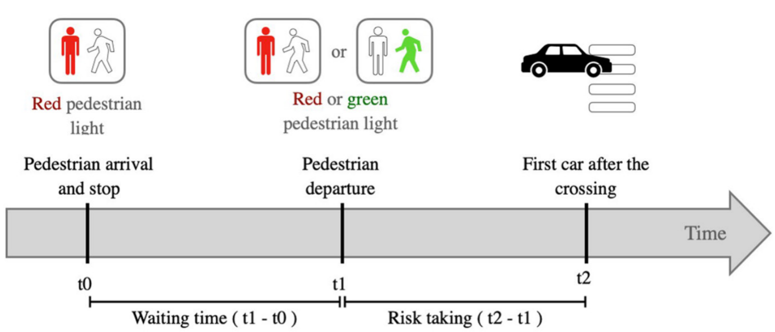

Figure 3. Diagram of the time variables recorded and calculated for each pedestrian (based on Sueur et al., 2013).

[Pedestrian glances] is the number of times the pedestrian glanced in the direction of the pedestrian signal and thus in the direction of the device for the experimental conditions with signs. In total, 81% of pedestrians directed at least one glance toward the device, with a mean frequency of 1.96 ± 1.92 observations per person, which indicates a generally good level of visual attention toward the nudge. Moreover, several pedestrians explicitly pointed toward the device or showed it to accompanying individuals, suggesting that it was not only noticed but also became a salient element in their interaction and communication during the crossing. Interobserver and intraobserver agreement for this variable often appeared to be insufficient, varying between 60% and 80%. Indeed, the observation method and the quality of the videos did not allow us to obtain a sufficient percentage of agreement for the variable pedestrian gaze (pedestrians looking at the signal). The visibility of the faces in the videos was not precise enough to correctly identify eye movements and directions suggesting a not reliable variable. Gaze data from pedestrians were not considered reliable enough and were not used in this study.

Environmental Variables

[Sign]: for test condition: woman's eyes sign or child's eyes sign; for control condition: flowers sign or no sign.

[Site]: Quai de Paris / Université / Nuée Bleue.

[Crossing light] corresponds to the colour of the pedestrian signal light at the moment of crossing. Each pedestrian is coded 1 if they cross on a green light and 0 if they cross on a red light.

[Risk-taking] is the time (in seconds) between the pedestrian's departure and the arrival of the first car (or bus or motorcycle) after them at the crossing (Figure 3).

[Distractors] corresponds to the number of distractors, such as headphones or mobile phones, by distinguishing between the actions of talking on the phone and looking at it.

[Speed] was not considered as quite constant between the different vehicles.

[Number of passing cars] corresponds to the number of vehicles (cars, buses, motorcycles) passing through the intersection per minute during each observation sequence. This variable provides an index of traffic density at the time of the pedestrian's crossing. Vehicle counts were obtained from direct observation.

Social Variables

[Group] corresponds to the number of pedestrians that constitute the group of the focal individual if there are other pedestrians waiting at the same time. A pedestrian belongs to a group if s/he is separated from the next pedestrian by less than 4.10 seconds for Quai de Paris, 5.26 seconds for Nuée Bleue, and 7.00 seconds for Université. These times correspond to the average time taken by a pedestrian to cross. They are based on 20 crossings per site. It is considered that a pedestrian does not influence the next one if s/he has arrived at the other side of the road. The notion of a group does not include familiarity between pedestrians.

[Order of departure] is the order of departure within a traffic light cycle based on the departure time of each pedestrian. The individual who departs first (shortest time) is ranked as rank 1, the individual who departs second is ranked as rank 2, and so on. For a better understanding, a figure is provided in Pelé et al. (2017).

[Accompanied] whether the pedestrian is accompanied by a known person ('Yes' or 'No'). A pedestrian is accompanied if they talk or walk in sync with another pedestrian.

[Children] is the number of children present at the crossing, including those in pushchairs.

Individual variables

[Gender]: male (M) or female (F). Estimated visually.

[Age] is estimated in 10-year increments. For example, a person who physically appears to be 45 years old is placed in the 40 categories. The possible categories range from 0 for children aged 0 to 9, then [10–19], [20–29], etc. to [80 and over] for those aged 80 and over. To ensure accuracy and reliability in the estimation of age categories, the age of each individual was independently estimated and double-checked by a second observer.

All these variables were extracted from the videos thanks to the free software BORIS (Behavioural Observation Research Interactive Software v 7.9.24) (Friard & Gamba, 2019), which allows temporal precision to the nearest centi-second.

Inter-Observer Agreement

The video analyses were performed over two consecutive periods by two different observers (LL and MJ). Thus, the same video was observed several times in order to adjust the results between and within observers. Agreement was checked 3 times: before, during and after the end of the observations for each variable. An agreement rate (Elie & Colombet, 2011) of at least 80% validated the observations for the variables sex, hesitation, distractors, group, children, order of departure and accompanied. The age estimate was validated using Kendall's coefficient ($W > 0.8$; p-value < 0.05) (Abdi, 2007). For the different durations, a maximum difference of 500 centi-seconds was tolerated. In fact, the frame-by-frame analysis on the BORIS software could produce discrepancies in the order of one centi-second, making it difficult to achieve 100% reproducibility for the time variables (i.e., waiting time and unsafety margin).

Statistical Analysis

We used generalised linear mixed models (GLMM) to analyse the impact of different explanatory variables on our response variables, in particular the red traffic light crossing rate (PR ratio). GLMM is a flexible statistical model that includes both fixed and random effects, allowing us to account for the complex structure of our data, such as variation between sites (treated as random effects). This model is particularly useful for dealing with non-normal data distributions and can handle different types of response variables, so we selected different statistical families—quasi-Poisson, gamma or binomial—depending on the specific response variable being analysed.

In order to ensure that our analysis was comprehensive, we decided to use the full model approach rather than model selection. This decision was made to avoid the potential pitfalls of model selection, such as overfitting or missing important variables, and to provide a more holistic understanding of the data. In our full model, we included a number of explanatory variables: experimental condition, number of passing cars, and presence or absence of the tram for the red traffic light crossing rate (PR ratio); and additional variables such as age, gender, whether the pedestrian was accompanied, distractors, group dynamics, order of departure, and presence of children for other response variables such as unsafety margin and hesitation.

For readers unfamiliar with GLMM, it is important to understand that this approach allows us to examine the influence of specific variables on an outcome while accounting for the inherent randomness in real-world data. We modified some of the data to meet the requirements of the model, as detailed in Table 2, and included site as a random effect to account for variability between sites.

To verify that the observation period (September–October vs. January–March) did not influence pedestrian behaviour, we combined the results of individual tests using Stouffer's Z-method. The combined analysis revealed no significant effect of the period on any behavioural variable, including red-light crossing rate (p = 0.9828), light colour at crossing (p = 0.164), presence or absence of waiting time (p = 0.866), waiting duration (p = 0.284), unsafety margin (p = 0.092), and hesitation (p = 0.106). These results confirm that seasonal or contextual differences between the two observation periods did not affect the studied behaviours.

Results were further refined using pairwise *t*-tests with Benjamini-Hochberg correction or pairwise Wilcoxon tests when significant effects of variables were observed. All statistical analyses were performed in R Studio (© 2009–2021 RStudio, PBC, version 1.4.1717) (Allaire, 2012; Racine, 2012) with a statistical significance level set at α = 0.05.

Results

A total of 2967 pedestrians (1673 females and 1294 males) were observed arriving at the red traffic light (Table A.1); 2335 crossed at the red traffic light (79%) and 632 crossed at the green traffic light (21.3%), which is the rate found in France (Pelé et al., 2017). There were 102 hesitations observed (3% of pedestrians) and 67 crossings with at least one child under 10 years of age.

Rate of Pedestrians Crossing at a Red Light (PR ratio)

During the extensive observation period at all study sites, we recorded the red traffic light crossing rate (PR ratio) under different conditions: 0.76 ± 0.14 for no sign, 0.78 ± 0.11 for the flower sign, 0.81 ± 0.16 for the child's eyes sign, and 0.80 ± 0.13 for the woman's eyes sign. When these rates were analysed using the first generalised linear model (GLM), we found no statistically significant effect of the different signs on the PR ratio. Specifically, the presence of the child's eyes sign (estimate = 0.014, t-value = 0.420, p = 0.678) and the woman's eyes sign (estimate = 0.007, *t*-value = 0.201, p = 0.842) did not lead to a significant change in pedestrian behaviour at red traffic lights, as shown in Table A.2.

However, our analysis revealed significant effects of external factors. The presence of a tram was positively correlated with the PR ratio ($p < 0.001$), suggesting that pedestrians may be more likely to cross against red traffic lights when a tram is nearby. Conversely, an increase in the number of cars was associated with a decrease of the PR ratio ($p < 0.001$), suggesting that more vehicle traffic may deter pedestrians from crossing during the red-light phase. These results are detailed in Table A.2.

Effect of Variables on the Colour of the Traffic Light When Crossing

Table 2. Laws and variables used in each model

Model	Family used	Response variables	Explanatory variables
(1)	Quasi-Poisson	Ratio PR	Sign + Tram + Car
(2)	Binomial	Crossing light (green or red)	Sign + Age + Sex + Accompanied + Distractors + Group + Order of departure + Children
(3)	Binomial	Stop (absence/presence of waiting behaviour)	Sign + Age + Sex + Accompanied + Distractors + Group + Order of departure + Children
(4)	Gamma	Waiting time (pedestrians who have waited only)	Sign + Age + Sex + Accompanied + Distractors + Group + Order of departure + Children
(5)	Quasi-Poisson	Unsafety margin (pedestrians who crossed at red light only)	Sign + Age + Sex + Accompanied + Distractors + Group + Order of departure + children + Interaction Group: Order
(6)	Binomial	Hesitation (absence/presence)	Sign + Age + Sex + Accompanied + Distractors + Group + Order of departure + Children

The second generalised linear model (GLM 2) reveals interesting findings regarding the effect of our visual nudges on pedestrian behaviour at traffic lights. Specifically, the presence of the child's eyes sign had a statistically significant effect on the likelihood of crossing at a red light compared to the no-sign condition (estimate = −0.311, z-value = −2.396, p = 0.017, as shown in Table A.3). Nevertheless, the rate of red traffic light crossing was still high in all conditions: 81% with the child's eyes sign, 80% with the woman's eyes sign, 78% with the flower sign, and 76% with no sign. Interestingly, pairwise *t*-tests did not reveal a statistically significant difference between crossings in the presence of the child's eyes sign and no sign conditions (pairwise *t*-test, $p = 0.11$).

Age emerged as a significant factor influencing the likelihood of crossing at the red traffic lights. Children under 10 years of age, usually accompanied by adults, had a lower red-light crossing rate of 25% (paired *t*-test $p < 0.05$). In contrast, people in their 40s had the highest red-light crossing rate at 86%, significantly higher than those in their 20s and 30s (77% and 76% respectively; pairwise *t*-test $p < 0.05$). About 81% of adults over 50 crossed at red lights.

Gender also played a crucial role, with 84% of men crossing at red lights compared to 75% of women, indicating a significant gender difference in crossing behaviour (estimate = −0.474, *z*-value = −4.833, $p < 0.001$, Table A.3). Being accompanied also influenced pedestrian behaviour, with 83% of those who were accompanied crossing at red lights compared to 78% of those who were alone (estimate = −0.452, *z*-value = −3.444, $p < 0.001$, Table A.3).

Distractors appeared to have a deterrent effect on red light crossing. The presence of distractors reduced the likelihood of crossing at red lights: 80% without distractors, 77% with one distractor and 69% with two distractors (pairwise *t*-test $p < 0.05$). The GLM 2 also shows the significant influence of group size (estimate = 0.200, *z*-value = 10.280, $p < 0.001$) and order of departure (estimate = −0.313, *z*-value = −8.752, $p < 0.001$, Table A.3) on pedestrian behaviour. The larger the group, the less likely individuals were to cross at red, but the likelihood increased with order of departure, suggesting a mimicry effect among pedestrians.

Finally, the presence of at least one child significantly reduced the rate of red light crossing to 58% compared to 79% in the absence of children (estimate = 1.066, *z*-value = 5.168, $p < 0.001$, Table A.3). This finding highlights the potential influence of children in promoting safer pedestrian behaviour.

Stop or Not Before Crossing

In our analysis, the visual nudges represented by the child's eyes and woman's eyes signs did not show a significant effect on increasing waiting time at pedestrian crossings. The GLM 3 results indicate that these visual cues did not significantly alter waiting times (child's eyes sign: estimate = −0.093, *z*-value = −0.890, $p = 0.373$; woman's eyes sign: estimate = −0.132, z-value = 1.235, $p = 0.217$, as shown in Table A.4). This finding suggests that the presence of these signs alone may not be a strong enough stimulus to change waiting behaviour at red lights.

However, there was a notable gender difference in waiting behaviour. Female pedestrians were more likely to wait at red traffic lights than male pedestrians, with 58% of women waiting compared to 45% of men (estimate = −0.475, z-value = −6.145, $p < 0.001$, Table A.4). Being accompanied also influenced pedestrian behaviour, with only 49% of accompanied pedestrians stopping at traffic lights compared to 53% of those walking alone (estimate = −0.280, *z*-value = −2.818, $p = 0.005$, Table A.4). Age also played a significant role, especially for younger pedestrians. Children under 10 always stopped at traffic lights (100%), while older age groups showed different rates of stopping, with the 40-year-old category stopping the least (34%) (pairwise *t*-test $p < 0.05$). Interestingly, there was a tendency for pedestrians' waiting behaviour to decrease until the age of 40 and then to increase again in older age groups.

Surprisingly, the distractors had a counter-intuitive effect, encouraging pedestrians to stop more often at traffic lights. The more distractors pedestrians had, the more likely they were to stop (49% with no distractors, 56% with one distractor, 73% with two distractors, pairwise *t*-test $p < 0.05$).

Group size also influenced stopping behaviour at pedestrian lights, with a larger group size correlating with a higher likelihood of stopping. A single pedestrian stopped only 39% of the time, whereas those in larger groups of 7–8 pedestrians stopped 80-100% of the time (pairwise *t*-test $p < 0.05$). The GLM 3 also showed an effect of the order of departure on waiting behaviour, with the percentage of waiting pedestrians peaking at around 50% up to the 15th pedestrian in the sequence and then falling to 19% (pairwise *t*-test $p < 0.05$).

Finally, the presence of children on the pavement significantly influenced stopping behaviour, with pedestrians stopping 61% of the time when a child was present, compared to 52% when no child was present (estimate = 0.470, *z*-value = 2.360, $p = 0.018$, Table A.4).

These findings highlight the complexity of factors influencing pedestrian waiting behaviour at traffic lights. They suggest that while visual nudges may not directly influence waiting times, other variables such as gender, age, company, distractions, group dynamics and the presence of children play an important role.

When Stopping: Waiting Time Before Crossing

In our study, of the 2967 pedestrian crossings analysed, 1556 (52.4%) showed waiting behaviour before crossing. For these cases, the average waiting time was 15.71 ± 13.79 seconds, with observed waiting times ranging from a minimum of 0.170 seconds to a maximum of 81.670 seconds.

Analysing these data using the fourth generalised linear model (GLM), we found that the presence of the eye signs (child's eyes and woman's eyes) did not significantly affect waiting times (child's eyes sign: estimate = 0.006, *t*-value = 1.683, $p = 0.093$; woman's eyes sign: estimate = −0.001, *t*-value = −0.142, $p = 0.887$, as detailed in Table A.5). This result suggests that these visual nudges, in their current form, do not have a significant effect on the length of time pedestrians wait at red lights.

However, other variables showed a significant effect on waiting behaviour. Age was a significant factor, with younger people aged 10 to 30 waiting longer at red lights than adults aged 40 to 60 (pairwise *t*-test $p < 0.05$). This finding is consistent with our previous observation of age-related differences in crossing behaviour.

Interestingly, pedestrians who were distracted tended to wait longer (estimate = −0.011, *t*-value = −5.377, $p < 0.001$, Table A.5). A further pairwise *t*-test showed a correlation between the number of distractors and increased waiting time ($p < 0.05$). This result may indicate that distractions, although often perceived as a risk factor, may in some contexts lead to more cautious behaviour at intersections.

Group size also influenced waiting times. Lone pedestrians waited an average of 13 seconds, while those in the presence of others waited 3 to 12 seconds longer. This effect may be due to group dynamics, where the presence of multiple pedestrians naturally reduces the likelihood that any one individual will start crossing quickly (Pelé et al., 2019a, 2019b). Notably, groups of seven waited the longest, with an average waiting time of 23 seconds (pairwise *t*-test $p < 0.05$).

Unsafety Margin

Our study looked specifically at the unsafety margin behaviour of the 2335 pedestrians who crossed at a red pedestrian light. We defined unsafety margin in terms of the interval between a pedestrian's departure and the arrival of the next car. The average risk time recorded was 27.46 ± 20.7 seconds, with a maximum of 80.781 seconds and a minimum of 0.153 seconds.

Interestingly, the presence of the control sign with flowers was found to influence risk-taking behaviour in comparison with no sign. According to Table A.6, this sign correlated with a decrease in risk time (estimate = −0.056, *t*-value = −2.201, *p*-value = 0.028), indicating an increase in unsafety margin. Pedestrians left less time before the arrival of the next car when the flower sign was present compared to no sign but also to the woman's eye sign, as shown by a pairwise comparison *t*-test (*p*-value = 0.008).

Our analysis also revealed significant age and gender effects on risk-taking. The younger age groups, particularly those between 10 and 30 years old, had shorter risk times of 26.392 seconds and 25.286 seconds respectively. In contrast, older age groups, such as those in their 30s and 50s, showed longer risk times (29.888 seconds and 33.389 seconds, respectively), with a notable difference of 9 seconds in risk time between 20-year-olds and 70-year-olds.

Looking at the gender effect, women on average left a longer interval of 28.558 seconds between crossing and the next car, compared to 26.194 seconds for men, indicating less risk-taking by women (Table A.6).

In addition, the order of starting influenced the risk time (estimate = 0.014, *t*-value = 2.539, $p = 0.011$, Table A.6). The first pedestrian to cross tended to take more risks than those who followed, although this effect was only a weak tendency, as shown by a pairwise *t*-test ($p = 0.051$). There was also a significant interaction between group size and starting order (estimate = −0.003, *t*-value = −3.542, $p < 0.001$, Table A.6), suggesting that the dynamics of group behaviour strongly influence individual risk-taking decisions.

Hesitation Behaviour

In our analysis using Generalised Linear Model 6 (GLM 6), we focused on understanding the factors influencing the hesitation behaviour of pedestrians crossing at red lights. This model included data from 2335 pedestrians, among whom 87 instances of hesitation were recorded.

Our results show a nuanced picture of hesitation in different sign conditions. In particular, hesitation was less frequent in the presence of the woman's eyes sign, with only 2% of hesitations observed in this condition. This was significantly lower than the other conditions: 4% for no sign, 5% for the flower sign and 4% for the child's eyes sign (estimate = −9.930, *z*-value = −2.470, $p = 0.013$, as shown in Table A.7). However, it is important to note that pairwise *t*-tests did not show a statistically significant difference between these conditions ($p > 0.05$). Another interesting aspect of hesitation behaviour was its correlation with whether pedestrians were accompanied. Those who were accompanied hesitated more (6%) than those who were alone (3%). This result (estimate = 0.732, *z*-value = 2.928, $p = 0.003$, Table A.7) suggests that the presence of an escort influences an individual's decision-making process at traffic lights. The other variables included in the GLM 6 did not show a significant influence on hesitation behaviour, as detailed in Table A.7.

Discussion

The primary objective of this study was to evaluate the effectiveness of visual nudges in influencing pedestrian behaviour, particularly in promoting crossing safety. Contrary to initial expectations, our results showed that eye images used as nudges did not significantly affect pedestrian crossing behaviour at red traffic lights. In fact, neither the child's eyes nor the woman's eyes sign significantly changed the rate of red light crossings (PR ratio), the level of unsafety margin, or the likelihood of pedestrians stopping before crossing. This contrasts with the expected outcomes suggested by our questionnaire study (Sueur et al., 2022) and the immediate impact theory supported by other research in different contexts (Bateson et al., 2006; Ernest-Jones et al., 2011; Francey & Bergmüller, 2012; Lv et al., 2024; Panagopoulos, 2014; Powell et al., 2012). These findings suggest that the influence of such visual nudges may not be as straightforward or universally effective in traffic environments where rapid decision-making is critical.

However, an interesting observation was that the child's eye sign slightly reduced the time spent waiting at the crosswalk. This result was unexpected, especially as the presence of children would normally encourage safer crossing behaviour. Similarly, the control flower sign unexpectedly appeared to reduce the time pedestrians waited before crossing at a red light, suggesting an increase in unsafety margin. These findings suggest that pedestrians may have misinterpreted the nudges or found the signs next to the traffic lights distracting or alarming. Literature reviews suggest that appeals to fear in road safety campaigns can have mixed results, sometimes leading to counterproductive behaviour (Elliott, 2003; Wundersitz & Hutchinson, 2011). The flower sign was initially designed as a neutral control condition, intended to test whether the mere presence of a visual stimulus near the traffic light could influence pedestrian behaviour. However, its apparent effect suggests that the sign may not have been perceived as entirely neutral. Similar to other visual cues, it may have introduced a form of instrumentation effect, subtly altering attention or emotional state. Flowers can evoke positive emotions or aesthetic appeal, potentially creating a sense of reassurance or distraction that encourages pedestrians to cross more quickly. This finding highlights the importance of verifying the neutrality of control stimuli in field experiments involving affective or attentional cues (see e.g., Fessler & Holbrook, 2013).

Visual nudges such as the eye sign have been shown to influence behaviour in a variety of settings (Bateson et al., 2006; Ernest-Jones et al., 2011; Francey & Bergmüller, 2012; Lv et al., 2024; Panagopoulos, 2014; Powell et al., 2012), and their effectiveness varies greatly depending on the social context in which they are deployed (Northover et al., 2017). For example, their impact is more pronounced in academic and quiet environments or less crowded places.

The effectiveness of nudges also varies across cultures, demonstrating that cultural context is crucial in determining the most effective road safety strategies (Hoekstra & Wegman, 2011; Shiwakoti et al., 2020). Our study, based on a French sample, reflects such cultural nuances in pedestrian behaviour. French pedestrians, known for their individualistic tendencies and low adherence to road safety rules, contrast sharply with Japanese pedestrians, who show much lower rates of illegal crossings (Pelé et al., 2017; Sueur et al., 2013). This cultural difference suggests that the effectiveness of eye nudges may vary significantly depending on the cultural background of the target population.

Finally, the meta-analysis by Northover and collaborators (2017) highlights the wide range of behaviours targeted by gaze impact studies. These studies typically focus on altruistic behaviours, such as giving or performing good deeds, rather than risky behaviours such as those observed in our study. The diversity of social contexts, target populations, proximity between the nudge and the subjects, and the behaviours targeted contribute to the variable effectiveness of these nudges. While numerous studies have demonstrated the impact of artificial eyes in simulating the presence of an observer, there are also cases where these nudges did not significantly change behaviour. This finding suggests a need for caution in interpreting the effectiveness of visual nudges and highlights the importance of considering the specific context and target behaviour when designing and implementing such interventions.

Nonetheless, we identified several factors that influence pedestrian crossing behaviour. Age first emerged as a key variable; in particular, children under 10, usually accompanied by adults, were less likely to cross at red lights and always stopped before crossing. The presence of a child often leads to safer crossing practices, with an increase in crossing at green lights and a greater tendency to stop at red lights. Interestingly, adults, especially those aged around 40, showed riskier behaviour than younger people. Indeed, young adults were less likely to cross at red lights and tended to wait longer than those aged 40 and over, with those aged 40 and over stopping the least. However, when crossing at red lights, young people aged 10–30 showed more risk-taking behaviour than those aged 30–50, such as getting too close to moving vehicles. This suggests that awareness and types of risk-taking vary with age, with younger adults potentially being more aware of their risks than older adults, who may inadvertently place themselves in dangerous situations (Daamen & Hoogendoorn, 2003; Giuffrè et al., 2016; Holland & Hill, 2007; Zhang et al., 2019).

Our results are also in line with the existing literature, confirming that gender has a significant impact on crossing behaviour. Consistent with previous research, we found that males generally displayed riskier behaviours compared to females, especially in their interactions with vehicles (Di Stasi et al., 2014; Pelé et al., 2017; Tom & Granié, 2011; Vujanić et al., 2014; Wang et al., 2011). Males generally exhibited a higher frequency of crossing at red lights, less frequent stopping, and shorter intervals between their crossing and approaching cars.

Contrary to the findings of Nasar and collaborators (Nasar et al., 2008), our study found that pedestrians with potential distractions, such as mobile phones or headsets, showed safer crossing behaviour. These effects were more pronounced with an accumulation of distractions which may suggest a strategy whereby pedestrians use their phones while waiting and then gather information before crossing. This apparently paradoxical result may be explained by the adoption of compensatory behaviours by some pedestrians when using distractors such as mobile phones or headphones; they may become more cautious, slow their walking pace, or increase their visual scanning of the environment, thereby mitigating the expected loss of attention (Jiang et al., 2018; Neider et al., 2011).

Social context also seems to play an important role. Pedestrians who were accompanied by someone were more likely to cross at red lights than those who were alone, and were less likely to stop but more likely to hesitate. This result contrasts with the findings of Pelé and collaborators (Pelé et al., 2017), who suggested greater compliance when crossing with others. In addition, the rate of crossing at red lights decreased with the size of the group, while stopping at crossings and waiting times increased. The larger groups tended to wait longer before crossing and were more likely to cross at green lights, conforming to group norms and pressures to maintain social credibility (Osman, 1982).

The order of departure within a group also influenced crossing behaviour. The likelihood of crossing at a red light increased after the first pedestrian started, with the last pedestrian in a large group often taking the greatest risks. In fact, the first pedestrian in a group often showed the least risk-taking behaviour, as they crossed deliberately after assessing the situation. Conversely, the last pedestrian to cross showed the least tendency to stop, possibly due to imitation or following behaviour, which can lead to increased unsafety margin. However, as group size increases, the risk to individual pedestrians decreases due to increased visibility (Leden, 2002).

Finally, the study highlighted the importance of road and sign configuration in influencing risky behaviour, with pedestrian decisions influenced by traffic density and traffic signal cycles. The number of lanes at each site varied, affecting the volume of vehicular traffic and consequently pedestrian crossing decisions (Pelé et al., 2017). While an increase in traffic tends to reduce red light crossings, this is not always consistent across studies (Dommes et al., 2015). Pedestrian behaviour is influenced by different environmental parameters such as vehicle speed (Zhang et al., 2017) and the number of parked vehicles (Tezcan et al., 2019). In addition, the presence of a tram line can disrupt regular traffic light cycles and influence pedestrian crossing decisions (Keegan & O'Mahony, 2003; Wang et al., 2011). To mitigate site-specific effects, conducting observations at multiple sites could provide more generalised insights into pedestrian behaviour. This comprehensive analysis highlights the complex interplay of individual, social and environmental factors in pedestrian behaviour at traffic signals.

This study presents several methodological limitations that should be acknowledged. First, although 81 % of pedestrians looked at the device, the exact level of visual perception could not be systematically verified, and the absence of a significant effect may partly result from variable awareness of the sign. The size (20 × 50 cm) and position of the signs—placed above the pedestrian lights due to space and safety constraints defined with the SIRAC—were chosen to comply with local regulations but may have reduced their salience compared with more conventional placements. In addition, data were collected at intersections characterised by low to moderate traffic density (fewer than three vehicles per minute) and a speed limit of 50 kmhr. These sites were selected to ensure participant safety, but such low-risk environments may have decreased the likelihood of observing transgressive crossings and limited the nudge's measurable impact.

While our findings provide valuable insights into how pedestrians respond to visual cues at crossings, they do not allow for a definitive conclusion regarding the effectiveness or ineffectiveness of the nudge itself. The relatively small size of the signs and their placement above the pedestrian light may have limited their visual salience, and we could not verify whether each pedestrian actually noticed them. Consequently, the observed effects might reflect differences in perception or attention rather than the intrinsic persuasive power of the images. Future studies should therefore assess sign visibility and attention capture directly, for instance through eye-tracking or on-site questionnaires, to better isolate perceptual factors from behavioural responses. The complex nature of pedestrian decision-making, often made in a matter of seconds, highlights the need for a nuanced approach. Future research could explore the use of different visual cues, perhaps with varying levels of visibility or incorporating audible warnings, to better suit the context and culture of the target population. Such interventions, including those that are harder to ignore and may influence a wider range of pedestrian behaviours, may provide a more comprehensive understanding of how to improve pedestrian crossing safety.

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Appendix

Tables:

Table A.1. Number of pedestrians observed per site and condition to number of hesitations (H) and crossings with at least one child (C).

Site	Nuée Bleue			Quai de Paris			Université		
	Pedestrians	H	C	Pedestrians	H	C	Pedestrians	H	C
Control condition (no sign)	257	14	2	129	1	5	437	19	4
Control condition (flowers)	223	15	8	105	0	9	324	13	2
Nudge (child's eyes)	369	18	11	98	3	5	322	6	3
Nudge (woman's eyes)	329	7	13	108	1	2	266	5	3
Total:	1178	54	34	440	5	21	1349	43	12

Table A.2: Results of the Generalised Linear Model 1 (quasi-Poisson law) for testing the red-light crossing rate

	Estimate	Std. Error	t-value	Pr(>|t|)	
(Intercept)	−0.174	0.061	−2.866	0.008	**
Sign: Flowers	0.001	0.034	0.017	0.986	
Sign: Child's eyes	0.014	0.034	0.420	0.678	
Sign: Woman's eyes	0.007	0.034	0.201	0.842	
Tram: Yes	0.194	0.034	5.642	< 0.001	***
Number of cars	−0.002	< 0.001	−4.297	< 0.001	***

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

(PRRatio).

Table A.3: Results of the Generalised Linear Model 2 (binomial law) for testing the light's colour when pedestrians are crossing (green or red).

	Estimate	Std. Error	z-value	Pr(>|z|)	
(Intercept)	−0.534	0.147	−3.619	< 0.001	***
Sign: Flowers	−0.108	0.131	−0.822	0.411	
Sign: Child's eyes	−0.312	0.130	−2.396	0.017	*
Sign: Woman's eyes	−0.140	0.130	−1.081	0.280	
Age	−0.009	0.003	−2.626	0.009	**
Sex (man)	−0.474	0.098	−4.833	< 0.001	***
Accompanied: Yes	−0.452	0.131	−3.444	0.001	***
Distractors	0.164	0.078	2.111	0.035	*
Group	0.200	0.019	10.280	< 0.001	***
Order of departure	−0.313	0.036	−8.752	< 0.001	***
Children	1.066	0.206	5.168	< 0.001	***

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Table A.4. Results of the Generalised Linear Model 3 (binomial law) for testing the presence or absence of waiting time

	Estimate	Std. Error	z-value	Pr(>|z|)	
(Intercept)	0.428	0.119	3.596	0.000	***
Sign: Flowers	–0.029	0.109	–0.263	0.792	
Sign: Child's eyes	–0.093	0.105	–0.890	0.373	
Sign: Woman's eyes	–0.132	0.107	–1.235	0.217	
Age	–0.007	0.003	–2.642	0.008	**
Sex (man)	–0.475	0.077	–6.145	< 0.001	***
Accompanied: Yes	–0.280	0.099	–2.818	0.005	**
Distractors	0.305	0.068	4.469	< 0.001	***
Group	0.199	0.021	9.679	< 0.001	***
Order of departure	–0.145	0.021	–6.761	< 0.001	***
Children	0.470	0.199	2.360	0.018	*

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

for all pedestrians.

Table A.5. Results of Generalised Linear Model 4 (gamma law) for testing the waiting time of pedestrians.

	Estimate	Std. Error	t-value	Pr(>|t|)	
(Intercept)	0.064	0.004	14.867	< 0.001	***
Sign: Flowers	0.005	0.004	1.297	0.195	
Sign: Child's eyes	0.006	0.004	1.683	0.093	.
Sign: Woman's eyes	–0.001	0.004	–0.142	0.887	
Age	< 0.001	< 0.001	2.168	0.030	*
Sex (man)	0.001	0.003	0.466	0.641	
Accompanied: Yes	–0.004	0.004	–1.136	0.256	
Distractors	–0.011	0.002	–5.377	< 0.001	***
Group	–0.002	< 0.001	–3.404	0.001	***
Order of departure	0.001	0.001	1.233	0.218	
Children	–0.006	0.004	–1.662	0.097	.

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Table A.6. Results of the Generalised Linear Model 5 (quasi-Poisson law) for testing the time between the first car and pedestrian crossing for pedestrians who have crossed at a red light (unsafety margin).

	Estimate	Std. Error	t-value	Pr(>|t|)	
(Intercept)	1.521	0.029	52.745	< 0.001	***
Sign: Flowers	–0.056	0.025	–2.201	0.028	*
Sign: Child's eyes	–0.019	0.024	–0.796	0.426	
Sign: Woman's eyes	0.020	0.024	0.812	0.417	
Age	0.002	0.001	3.655	< 0.001	***
Sex (man)	–0.052	0.017	–2.989	0.003	**
Accompanied: Yes	0.011	0.022	0.499	0.618	
Distractors	0.014	0.016	0.906	0.365	
Group	0.009	0.005	1.896	0.058	.
Order of departure	0.014	0.006	2.539	0.011	*
Children	–0.076	0.069	–1.100	0.271	
Interaction group: Order	–0.003	0.001	–3.542	< 0.001	***

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Table A.7. Results of the Generalised Linear Model 6 (binomial law) for testing the presence or absence of pedestrian hesitation for those who have crossed at a red light.

	Estimate	**Std. Error**	**z-value**	**Pr(>|z|)**	
(Intercept)	−3.179	0.346	−9.183	< 0.001	***
Sign: Flowers	0.196	0.283	0.693	0.488	
Sign: Child's eyes	−0.181	0.291	−0.622	0.534	
Sign: Woman's eyes	−0.930	0.376	−2.470	0.013	*
Sex (man)	0.051	0.221	0.230	0.818	
Age	0.002	0.007	0.286	0.775	
Accompanied: Yes	0.732	0.250	2.928	0.003	**
Distractors	−0.005	0.212	−0.026	0.979	
Group	0.052	0.037	1.429	0.153	
Order of departure	−0.121	0.067	−1.819	0.069	.
Children	−0.688	1.005	−0.685	0.493	

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Figure:

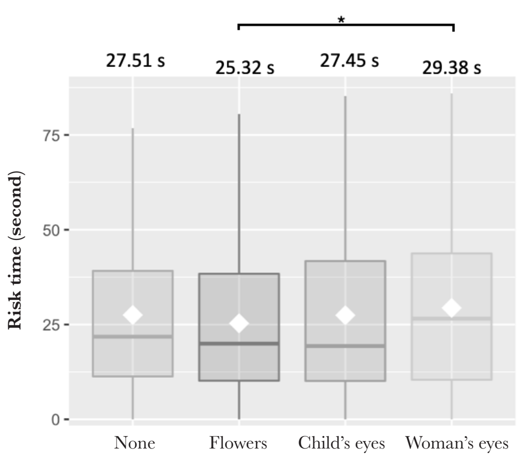

Figure A.1. Risk time according to the experimental condition (GLM 5, quasi-Poisson law); pairwise *t*-test, *p*-value < 0.05.

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