

# The role of context and perception of road rules in the pedestrian crossing decision: a challenge for the autonomous vehicle

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# Highlights

Pedestrian behavior : based on social knowledge and representations

Varies with crossing regulation, built environment, gender and age

Socialization and conventional rules

Internalization and effect of social norms

Knowledge of social norms as challenge for the autonomous vehicle

# Context

Better understanding pedestrian behaviors and crossing decision: a stake for the autonomous vehicles

Taking into account cognitive process is not sufficient: knowing the rules do not guarantee their applications

Presentation of the results of various studies we conducted

- Variation in crossing decision according to environment and individual factors
- Informal learning of pedestrian rules
  - Rule perception
  - Contextual compliance

# Effect of crossing site on compliance



Tom & Granié (2011)

Observation of 400 adult pedestrians on intersections with/without traffic lights

Dommes *et al.* (2015)

Observation of 422 adult pedestrians on intersections with traffic lights

- Spatial violation lower on intersections with traffic lights
- Crossing regulation as an indicator of significant dangerousness

- Temporal violation: looks only on traffic condition
- Eyes on traffic and light before crossing as indicators of intent to transgress



# Individual variations in compliance



Tom & Granié  
(2011)

Observation of 400 adult  
pedestrians on intersections  
with/without traffic lights

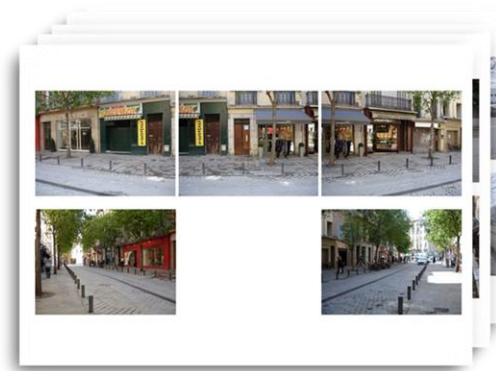
- Males: dynamic elements of environment in all crossing configurations
- Women: static elements + social environment when the crossing is not regulated
- Stronger social influence and normativity on decision-making among women

Granié *et al.* (2014)

Observation of 682 adult  
pedestrians (375 females)  
on intersections  
with/without traffic lights

- Older pedestrians display safer behaviors but explore less dynamic elements than middle-aged pedestrians do
- Delegation of responsibility to the regulatory system: more compliance but less monitoring

# Influence of built environment



Granié et al. (2013)

Focus groups with pedestrians on the pleasantness and crossing easiness about 20 crossing sites

Granié et al. (2014)

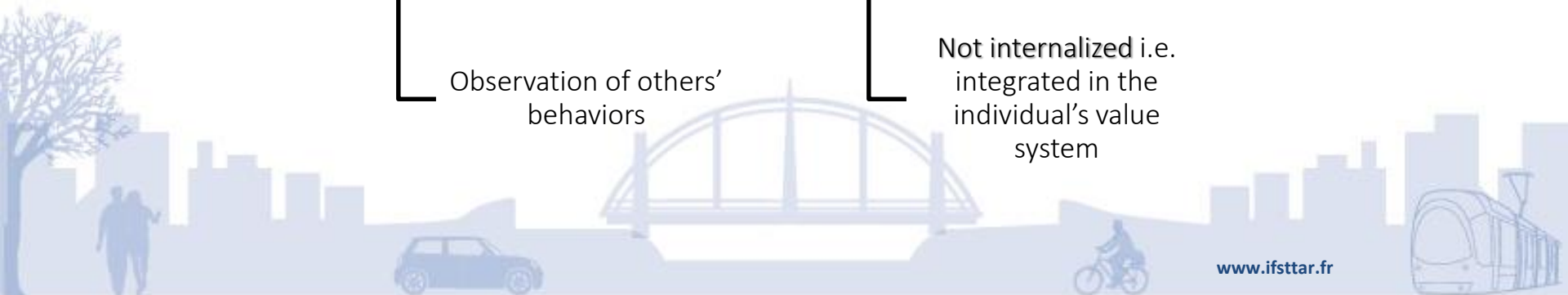
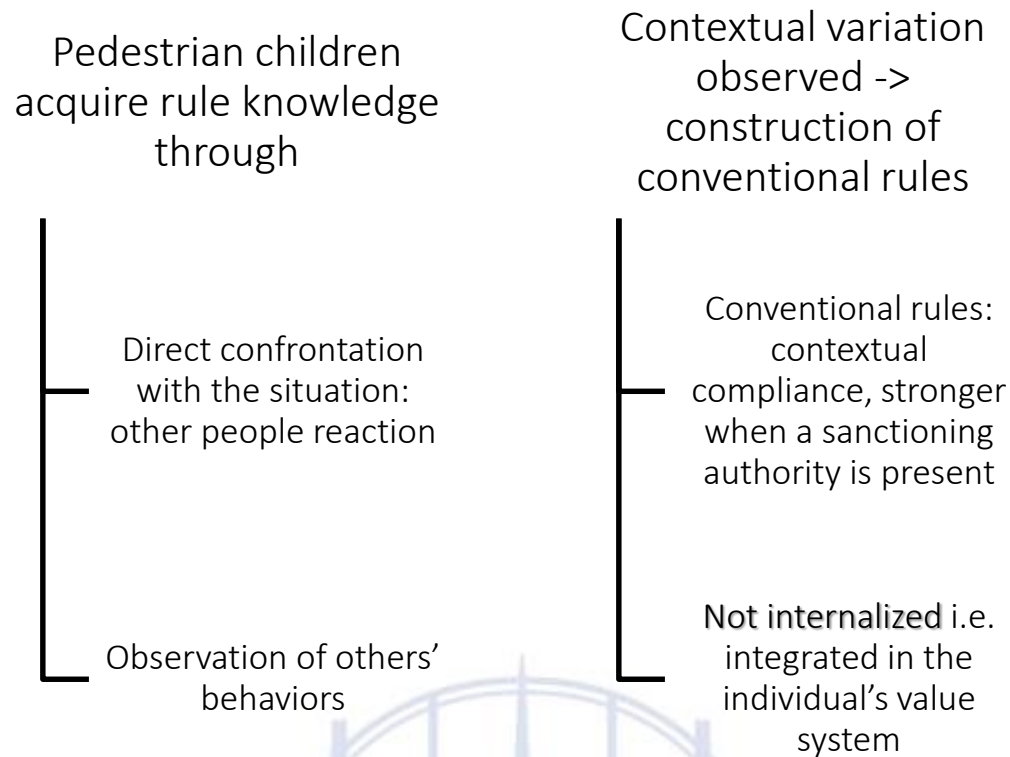
Experimental study among on crossing decision in 5 photographs of crossings sites

- Pedestrians preferred:
  - Organized environment with legibility and predictability for the pedestrian -> facilitating decision-making for the pedestrian
  - Complex environment with ambiguity and uncertainty for the driver -> increasing attention to the pedestrian

- Pedestrians use key indicators:
  - presence and function of buildings,
  - quality of sidewalks
  - presence of marked parking spaces
- To make inferences concerning
  - pedestrian and traffic density
  - vehicle speed
- Used to assess the driver-pedestrian balance of power

# Socialization to pedestrian rules

Compliance with traffic rules vary according to the context



# Effect of internalization



Granié (2007)

Observation and interview of 162 children aged 5-6

Granié (2009)

Survey on 278 adolescents aged 11-15

- Greater rule internalization leads to more prudent and better controlled behavior

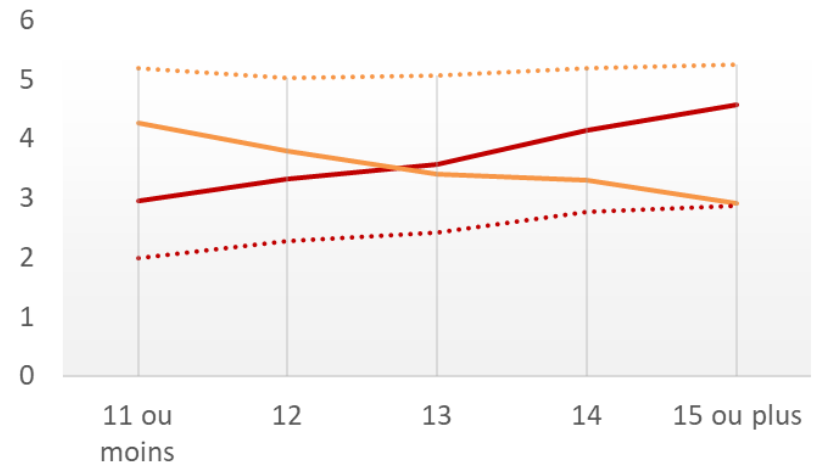
- Rule internalization inhibits risky behaviors
- But risky behaviors increase with age, as internalization decrease





# Effect of social norms

Granié & Apostolodis (2017)	Survey among 2,473 children aged 10-16	
Perceptions of the frequency of risky behaviors as pedestrians	Intentional or unintentional behaviors	For themselves, their parents and their peers



Children assess their pedestrian behaviors as always

- More risky than those of their parents
- Less risky than those of their peers
- Perceived social norm riskier than actual social norm: perceived peer pressure



Only for intentional risky behaviors

- gap Self – parents increases with age and gap Self – peers decreases with age
- gap Self - parents is greater for boys; gap Self - peers is greater for girls
- Boys gradually conform to perceived peer norms on intentional risk to comply with their gender group



# Challenges for autonomous vehicles

Pedestrian behaviors is based on social norms

- Varying according situations, gender and age
- Valorizing intentional risky behaviors in some social groups

Social norms govern interactions in road space, more than legal rules

- To be predictable by other road users
- To anticipate others' behaviors

Individuals observe social norms, before learning legal rules

- Important to understand what they learn
- Important to understand how and when they use them

Important to understand these different social norms

- For the pedestrian models implemented in the autonomous vehicle
- For the driver models implemented in the autonomous vehicles

# Challenges for autonomous vehicle

## For the pedestrian behavior models

- Taking account pedestrian social norm to better anticipate their behavior
- How behaviors vary across contexts
  - Pedestrian perception of car-pedestrian balance of power
- How pedestrian perceived autonomous vehicle
  - More attentive? More compliant with rules?
  - Adapt their behaviors to these beliefs (can vary according to gender and age)

## For the driver behavior model

- Autonomous vehicle should take into account the social norms used by the drivers
  - Varying across situations
  - Varying across cultures/countries
- Autonomous vehicle should be understandable and predictable
  - By other drivers (transition phase)
  - By non-autonomous users (vulnerable users)

# Thank you for your attention

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