Exploration of Virtual Reality for Road Safety Awareness in Morocco

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MEET THE **TEAM**!

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OUR **SPONSORS**

Dr. Mounir Ghogho
Dean of the College of Doctoral Studies

Dr. Ouassim Karrakchou
School of Computer Science

PROJECT OBJECTIVES

1 Understand existing road safety programs and driver history

2 Test the feasibility of realistic VR within road safety

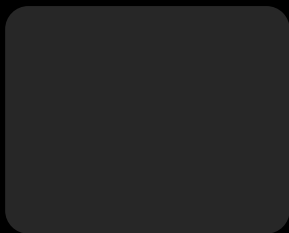**3** Evaluate the effectiveness of VR as a learning tool
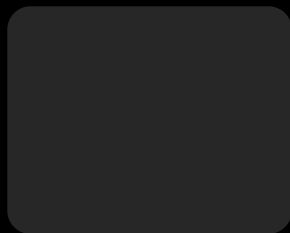
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01 *

BACKGROUND

# Geographical Distribution Road Accident Fatalities in Morocco

LESS THAN 25 KILLS
FROM 26 TO 50 KILLED
FROM 51 TO 75 KILLED
FROM 76 TO 100 KILLED
OVER 100 KILLS

Tangier

Fez

Rabat

Casablanca

Marrakech
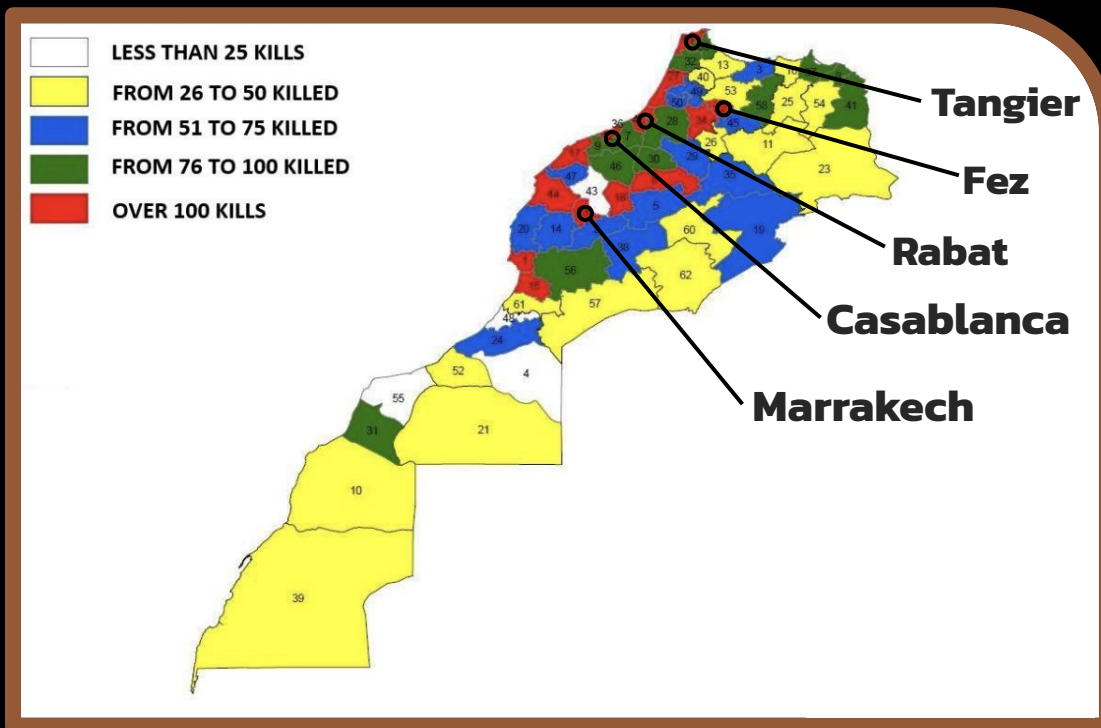
- Over **80,000 accidents** occur annually in Morocco

- Projections indicating an increase in accidents as the population continues to grow

- Lack of infrastructure in urban areas heavily contributes to road accidents, with over **71%** of all accidents occurring in agglomeration

- Most densely populated cities in Morocco have each averaged over **100 fatal road accidents per year** (on left)

Cluster Analysis With Reference to Road Safety
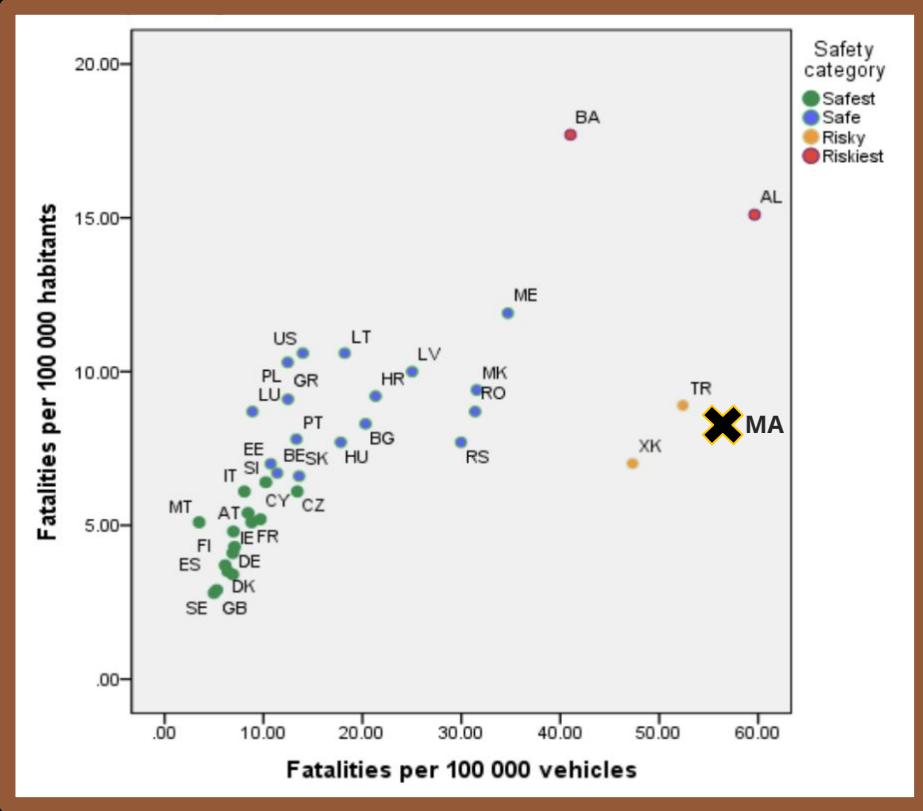
- When compared to other countries, Morocco's driving is categorized as "**risky**" (on left), similar to countries like Turkey and Kosovo

- Due to mix of traditional and modern vehicles with diverse risks and challenges:

  - Cars

  - Motorcycles

  - Buses

  - Trucks

  - Bicycles

BACKGROUND
COMPOSITION

Driver Behavior

Virtual Reality

Belief System
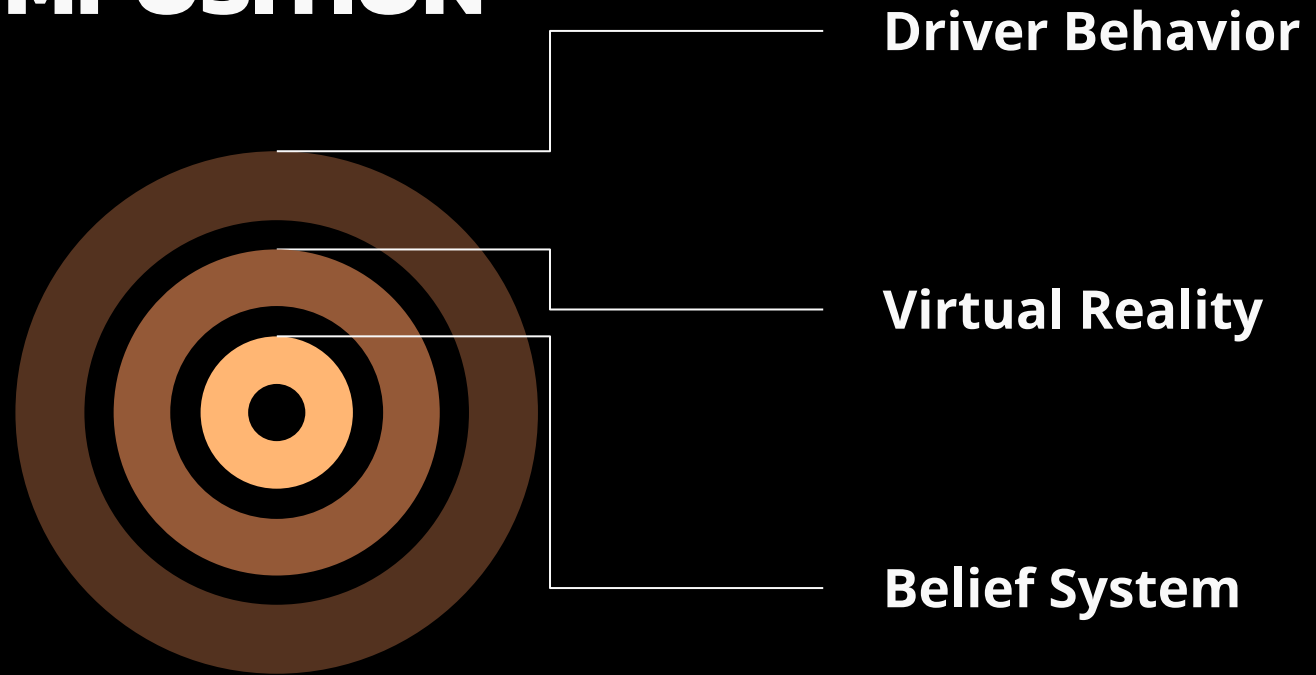
DRIVER BEHAVIOR

- Physical factors such as road conditions, vehicle type, and weather play a role in accidents
- Irresponsible driver behavior is the most significant factor
  - Behaviors include speeding, failure to give right-of-way, disregarding traffic signs, and using a mobile phone while driving
- Failure to implement specific safety measures can result in consequences
  - For example, cyclist accidents increase when one fails to equip proper gear such as a helmet or reflective vest

VIRTUAL REALITY

- Virtual reality (VR) is a technology that represents a computer-generated simulation within one's vision
- VR is starting to be developed within education due to increased funding
- While some are worried about the possible barriers of cost and technological distractions, we investigated how VR could be used within driving programs

CONTROL BELIEF

- Theory of Planned Behavior highlights three components involved in a person's belief system
  - behavioral beliefs
  - normative beliefs
  - control beliefs

- Control Belief refers to the way that an individual believes certain events and actions are within their control
- We investigated what our participants thought about their driving and fellow drivers
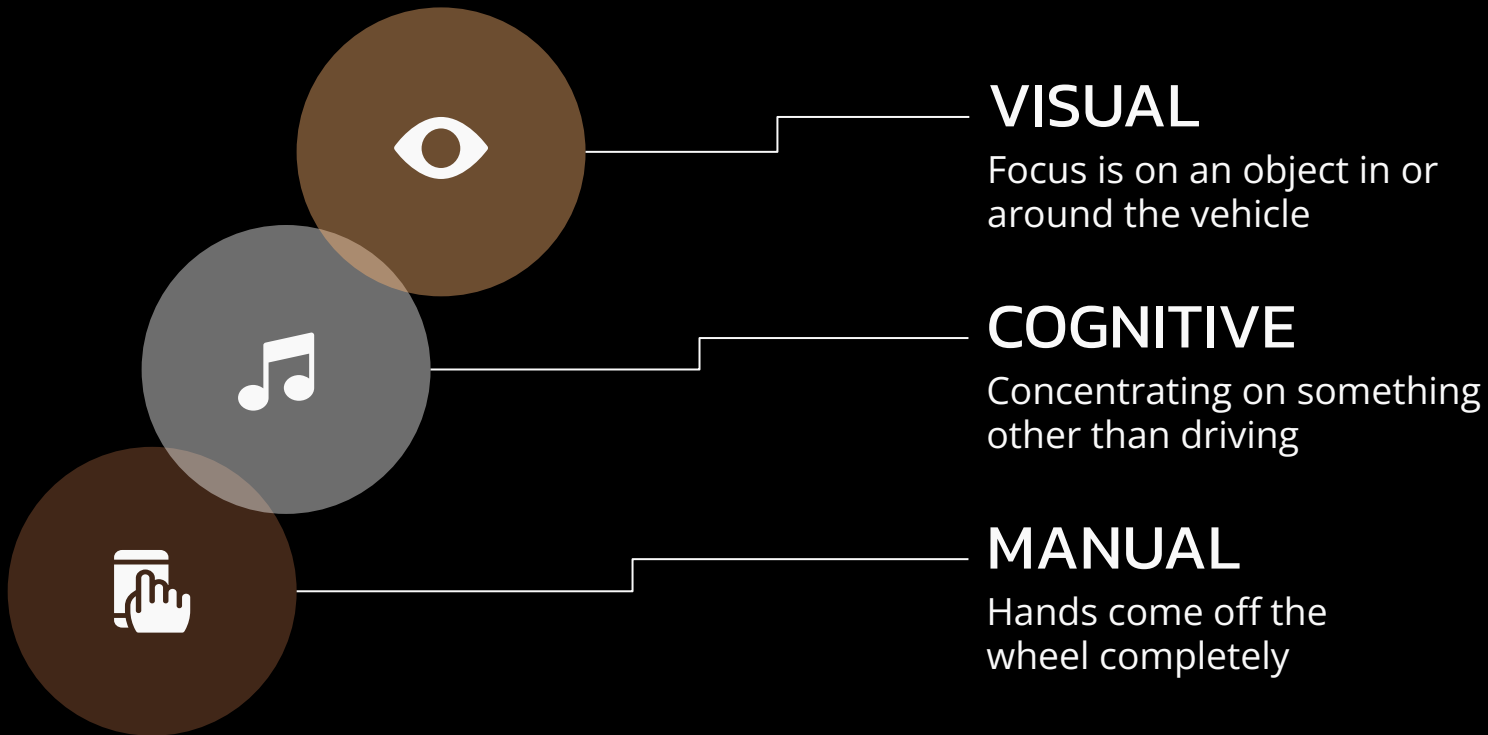
TEXTING & DRIVING

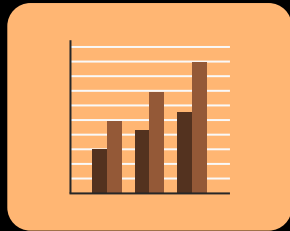**47%**

UIR Students admitted to sending a text
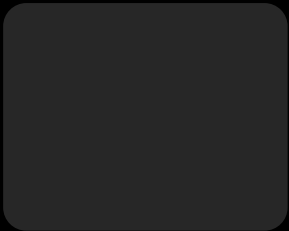
- Survey administered by the International University of Rabat (UIR) in 2019 found that **47%** of UIR students admitted to sending a text message while driving
- If a person looks away from the road for **three seconds** at **120 kilometers per hour,** they will travel roughly **100 meters**
- A person is **two times more likely** to cause an accident when using a device and driving

TYPES OF **DISTRACTIONS**

VISUAL

Focus is on an object in or around the vehicle

COGNITIVE

Concentrating on something other than driving

MANUAL
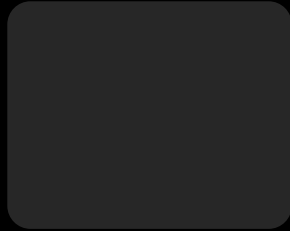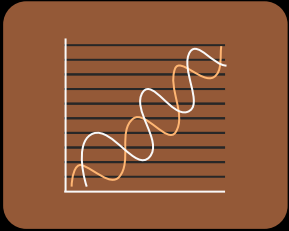
Hands come off the wheel completely

SETTING & **PARTICIPANTS**

- Conducted study at the International University of Rabat (UIR)

- With help of sponsors, sent email to Ph.D. students with sign-up form

  - Fast turnaround time made it hard to find participants

- Participants were required to complete medical screening process

  - Asked about daily health concerns (i.e. excessive tiredness, migraines, recent headaches)

  - If any health complications, participants were dismissed from study

- 21 Ph.D. students signed up, 7 voided due to medical screening, 14 participated, only 11 had driven before

PRE ASSESSMENT

01 CONTROL BELIEF

Participants were asked several questions about how they viewed themselves as drivers and how they viewed the behavior of other drivers on the road

02 VR EXPERIENCE

Participants were also asked about any prior VR experience to gauge familiarity with VR technology

SIMULATION

- Simulation was made via the game design program **Unity**
- Featured a real steering wheel and pedal setup that would be reflected within the simulation
- Featured a city landscape with buildings, trees, sidewalks, and two main roads
- Participants were instructed to look around the car, where a phone lies in the front passenger seat
- After driver starts going forward, the phone will ring and display a notification
- Shortly after the notification, a car will come from a side road and move in front of the driver's vehicle
- A distracted driver will not notice the car and will crash
- A video of the simulation is featured on the next slide

SIMULATION VIDEO

SUMMATIVE ASSESSMENT

Learning Curve

Intuitiveness

Pace of Understanding

Response Time

- **Learning Curve:** Depended whether a participant had used VR before. Participant's ability to overcome a learning curve is influenced by guidance given by the instructor
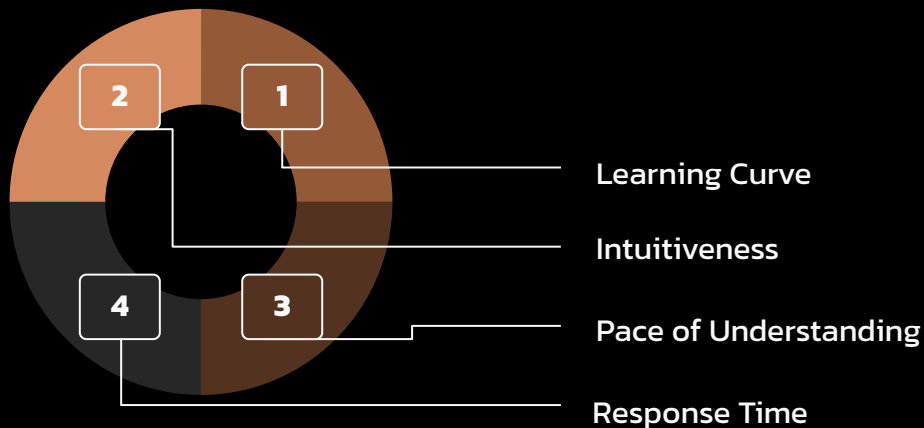
- **Intuitiveness**: Participant's ability to use and understand VR. Participants were Ph.D. students at UIR, so we anticipated they would have proficient technology skills
- **Pace of Understanding**: Asked students to assess how well they learned the material when using VR compared to other methods of learning, concerning visual, auditory, or hands-on factors
- **Response Time**: Asked participants to evaluate how their response time was affected by the technology

03*

FINDINGS

EDWARD TUFTE **COLOR THEORY**

- Data was represented using a neutral color set that would allow the results to be accessible for all viewers

Set of colors that is unambiguous both to colorblinds and non-colorblinds

| | Original | Simulation | | | | Hue | for Photoshop, Illustrator, Freehand, etc. | | for Word, Power Point, Canvas, etc. |
		Protan	Deutan	Tritan			C,M,Y,K (%)	R,G,B (0-255)	R,G,B (%)
1					Black	—°	(0,0,0,100)	(0,0,0)	(0,0,0)
2					Orange	41°	(0,50,100,0)	(230,159,0)	(90,60,0)
3					Sky Blue	202°	(80,0,0,0)	(86,180,233)	(35,70,90)
4					bluish Green	164°	(97,0,75,0)	(0,158,115)	(0,60,50)
5					Yellow	56°	(10,5,90,0)	(240,228,66)	(95,90,25)
6					Blue	202°	(100,50,0,0)	(0,114,178)	(0,45,70)
7					Vermilion	27°	(0,80,100,0)	(213,94,0)	(80,40,0)
8					reddish Purple	326°	(10,70,0,0)	(204,121,167)	(80,60,70)

Personal Driver Safety

How would you describe yourself as a driver? — 0 | 0 | 54.5% (6) | 45.4% (5) — n = 11

Risky | Moderately Risky | Moderately Safe | Extremely Safe
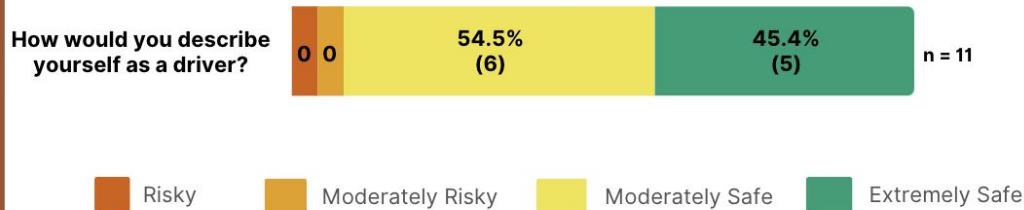
Personal Driver Confidence

How confident are you in your ability to maintain control of your vehicle in various driving conditions? Examples could be adverse weather and heavy traffic. — 0 | 18.2% (2) | 45.4% (5) | 36.4% (4) — n = 11

Not Confident | Slightly Confident | Moderately Confident | Extremely Confident
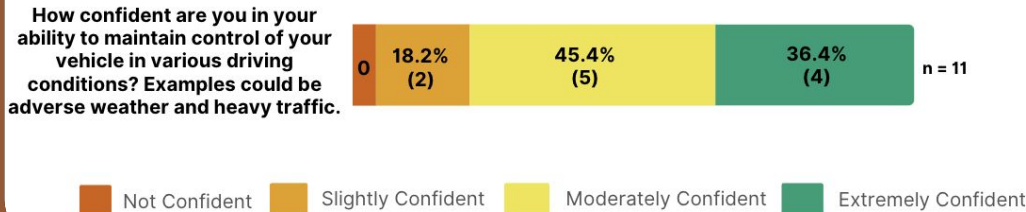
- Participants were asked to answer a series of questions that gauged personal beliefs about their driving history
- Personal driving safety was a common theme among all participants
- Many participants viewed themselves as safe and confident drivers even in difficult-to-navigate scenarios such as heavy traffic

- No participants often or always trusted the driving skills and behaviors of other road users

- No participants believed that they never contributed to the overall safety of the road environment
- Participants trust themselves more than they trust other road users

Road Safety Beliefs

To what extent do you trust the driving skills and behaviors of other road users?
- 18.2% (2) | 27.3% (3) | 54.5% (6) | 0 | 0 | n = 11

How much do you believe that your actions as a driver contribute to the overall safety of the road environment?
- 0 | 9% (1) | 9% (1) | 36.4% (4) | 45.4% (5) | n = 11

Legend: Never | Rarely | Sometimes | Often | Always
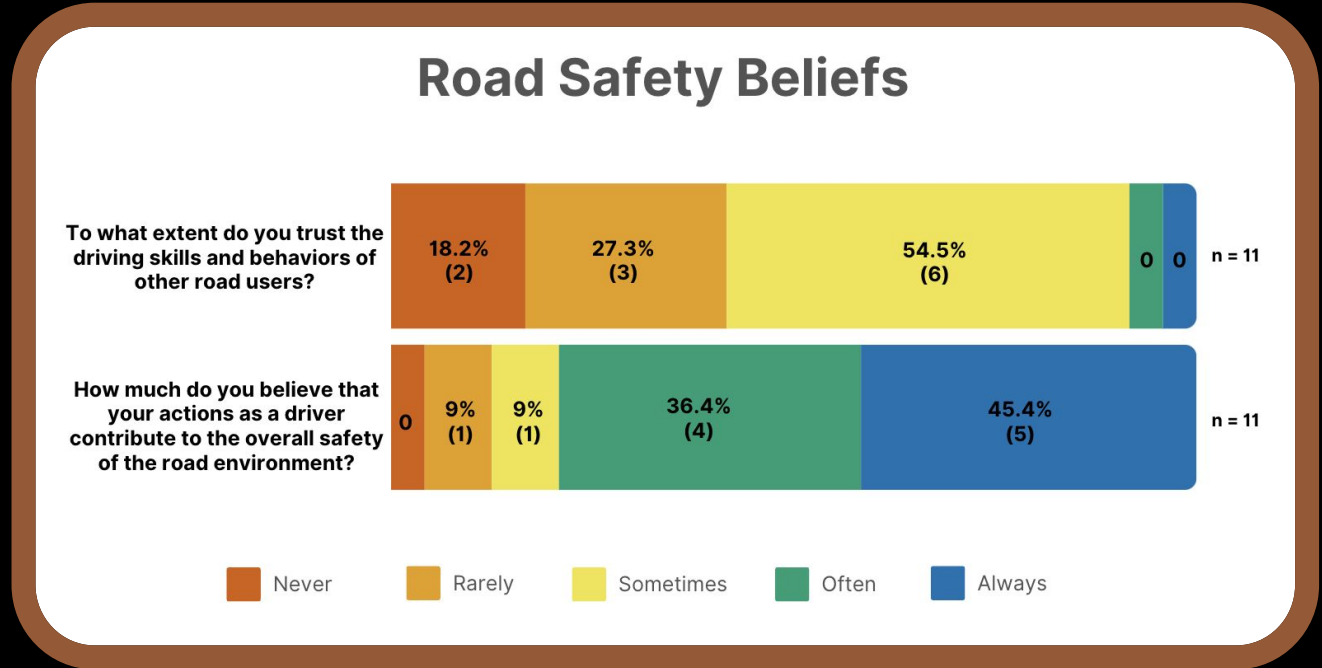
- No participants said that they often or always engage in these behaviors

- Participants still sometimes engage in distracted driving behaviors
- Even being distracted once is enough to cause an accident

Distractions While Driving

How likely are you to look at your phone while driving?
| 45.4% (5) | 27.3% (3) | 27.3% (3) | 0 | 0 | n = 11 |

How likely are you to send a text message while driving?
| 81.8% (9) | 0 | 18.2% (2) | 0 | 0 | n = 11 |

How likely are you to eat or drink while driving?
| 36.4% (4) | 36.4% (4) | 27.3% (3) | 0 | 0 | n = 11 |

How often do you do personal grooming, such as putting on make-up, shaving, or looking at yourself in the mirror while driving?
| 63.7% (7) | 27.3% (3) | 9% (1) | 0 | 0 | n = 11 |

Never   Rarely   Sometimes   Often   Always

Prior Use of VR

Yes (5)

35.7%

**No (9)**

64.3%

35.7%

64.3%

- Participants were asked to indicate their previous experience with VR and reason for using the technology

- Allowed us to understand popularity of VR in Morocco and determine whether it was a tool people could become familiar with in the future for education and awareness

- Participants were asked after the simulation if they believed that virtual reality had a positive effect on learning better road safety

- Since the vast majority of students (**92.9%**) expressed a positive outlook, it suggested a significant potential for VR interventions to impact road safety beliefs

- However, since majority of the participants had no prior VR experience, it would take time for participants to familiarize themselves with the technology
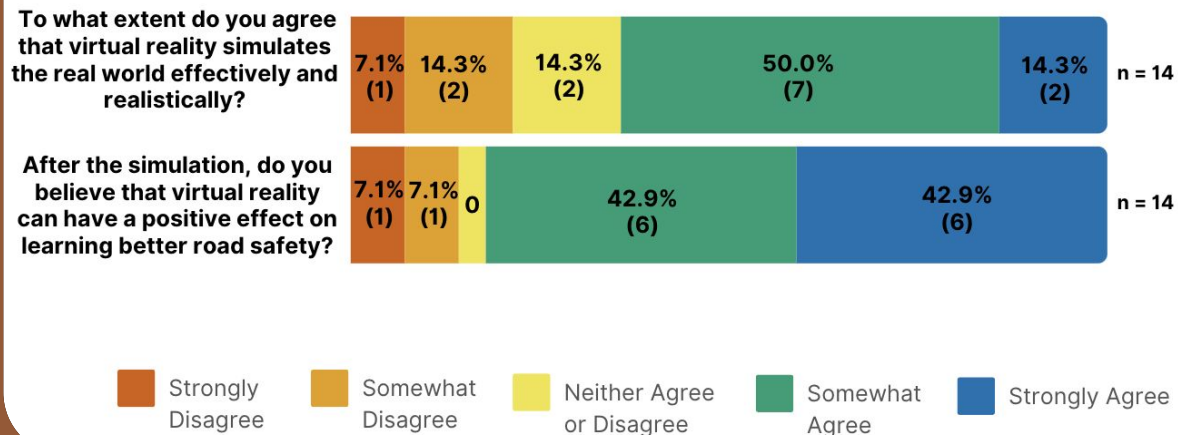
Ability of VR to Positively Alter Perception of Road Safety

7.1%

Yes (13)
92.9%

No (1)
7.1%

92.9%
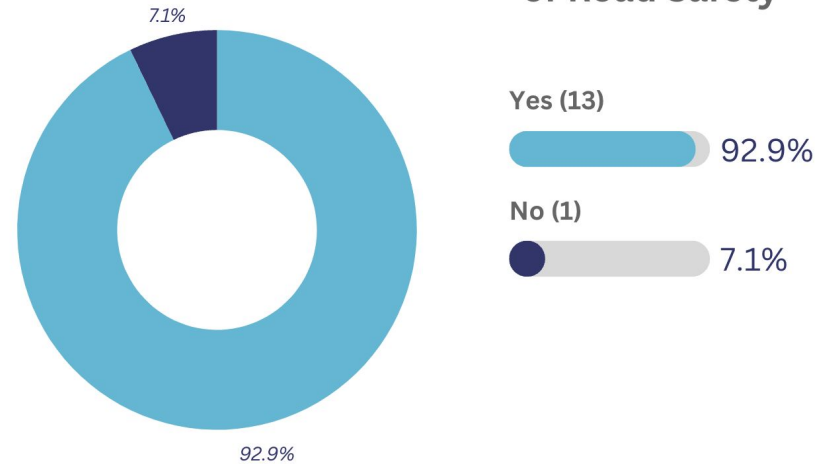
- 9/14 participants somewhat or strongly agreed that VR simulated the real world effectively and realistically

- 12/14 participants somewhat or strongly agreed that VR could have a positive effect on learning better road safety

- The data shows that good results could come from VR as a road safety awareness tool

Effectiveness of VR

To what extent do you agree that virtual reality simulates the real world effectively and realistically?
7.1% (1) | 14.3% (2) | 14.3% (2) | 50.0% (7) | 14.3% (2) | n = 14

After the simulation, do you believe that virtual reality can have a positive effect on learning better road safety?
7.1% (1) | 7.1% (1) | 0 | 42.9% (6) | 42.9% (6) | n = 14

Strongly Disagree | Somewhat Disagree | Neither Agree or Disagree | Somewhat Agree | Strongly Agree

* 9/14 participants stated that they would be less likely to use their phone after participating in the simulation

Less Likely to Use Phone After Simulation

35.7%

64.3%

Yes (9)
64.3%

No (5)
35.7%
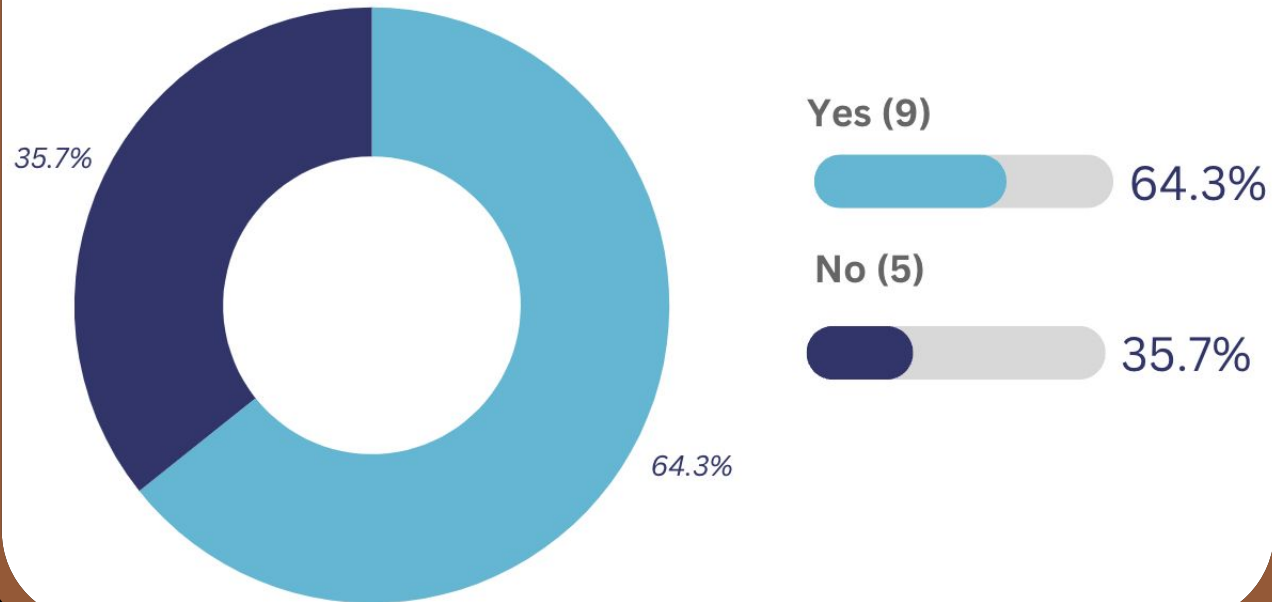
DATA COLLECTION **LIMITATIONS**

SAMPLE SIZE

- Only had two days on the project site to work with participants and gather feedback on their experience in the study
- Quick turnaround time made it difficult to survey a large number of participants, which could have had an impact on our results

BIAS

- **Sampling bias:** If the sample lacked diversity (e.g. age, gender, VR experience) and was not well distributed, then the findings would have lacked validity of the results
- **Self-report bias:** the veracity between self-reported and true values of the same measure
- **Recall bias:** participants may have struggled to accurately recall their driving experience

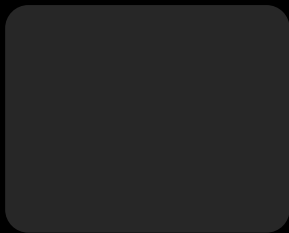# DATA COLLECTION **LIMITATIONS**

HAWTHORNE EFFECT

- Participants' behavior and responses to VR technology could be influenced by the fact that they are being observed for a study
- Their answers might exhibit a bias toward a particular direction, overemphasizing the actual effectiveness of VR
- Creating a comfortable and consistent research environment helped mitigate this bias

REALISM

- Fidelity in simulation is the concept where the virtual environment may be compromised by the realism of the technology
- This brought up concerns about using lower-quality VR. Factors such as graphic quality, sensory feedback, and motion tracking accuracy may have impacted perceptions of the immersive world, questioning the validity of responses

04*
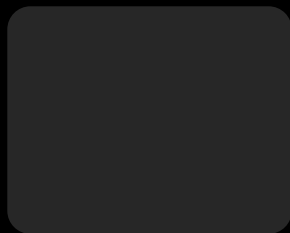
RECOMMENDATIONS

RECOMMENDATIONS FOR THE **FUTURE**

1 Increase Duration and Realism

2 Schedule More Time for Data Collection

3 Observe Participants' Headset View

4 Place Phone in Driver's Line of View

5 Interviews Following Simulation

RECOMMENDATIONS FOR **NARSA**

Concluded that VR **would** be an effective tool for drivers 21 and under

- **92.9%** of participants believed that VR had the ability to alter their perception of road safety, indicating that it can be an effective tool to raise awareness in the future

- Using the VR as part of road safety education before someone is granted their license can help foster safe driving habits beforehand

- We recommend avoiding using VR during Ramadan to avoid any potential health complications due to fasting, including dizziness that can come with using VR

THANK YOU FOR READING!

A special thank you to our sponsors and our advisors!
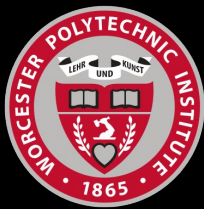
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