

VR for Daily Life, for People with Specific Needs



Jérôme DINET

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Impairment, Disability, or Handicap ?



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~~Impairment, Disability, or Handicap ?~~



When the environment is not adapted

Theoretical and Applied Researches in the 2LPN Lab related to Digital and Virtual Reality :

Serious game

→ Surgery for burned children
(WINTER ISLES ; MIST STUDIO©)



Serious game social inclusion
→ Children with haemophilia
(HEMO-GAME)



VR

→ Young pedestrians
(TRAVERSER N'EST PAS JOUER ; Human Games©)



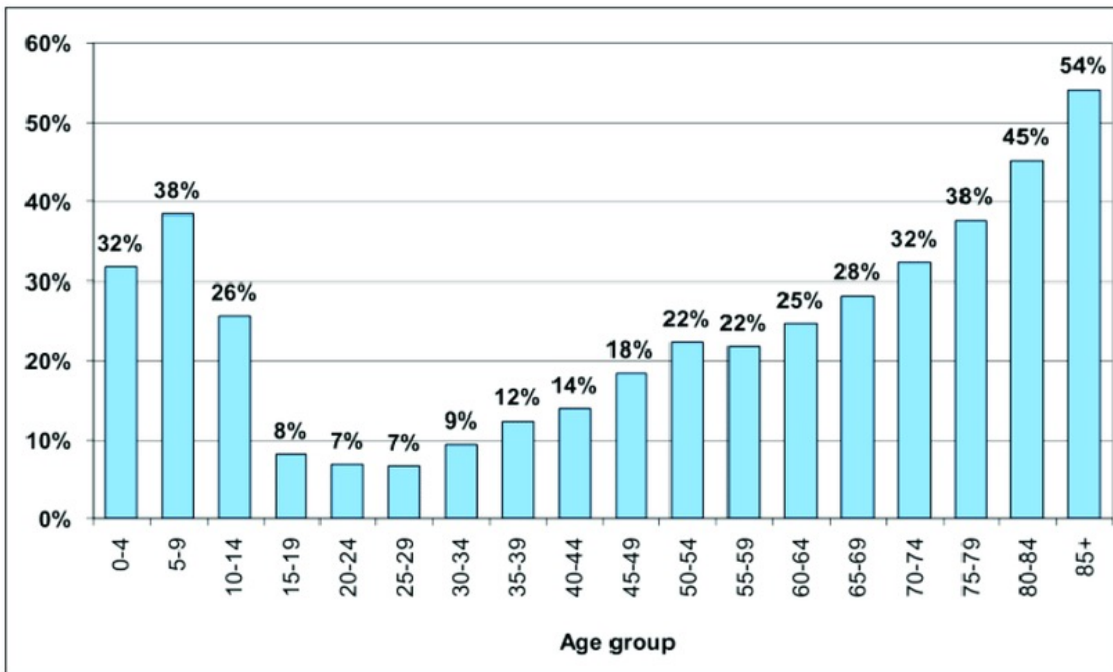
Family of Autism
→ Sisters and Brothers
(GROUPE FRATRIE)



« Histoire de frères et sœurs ... »
Créer des liens par-delà la différence
Traversées d'amour et de haine, de rivalités, parfois de sentiments d'injustice, les relations fraternelles ne sont jamais neutres. Quand s'ajoute la question de la différence, elles deviennent souvent plus complexes ...
Projet "groupe fratrie"
Initié par Stéphanie Claudel-Valentin (enseignant-chercheur en psychologie clinique à l'université de Lorraine), ce projet est mis en œuvre grâce à la collaboration du Centre Ressources Autisme de Lorraine.



Pedestrians and collision



Overrepresentation of

- **children** (< 5 years-old)

- **older people** (>70 years-old)
in pedestrian fatalities

Essentially in cities (more and more
« complex » for pedestrians)

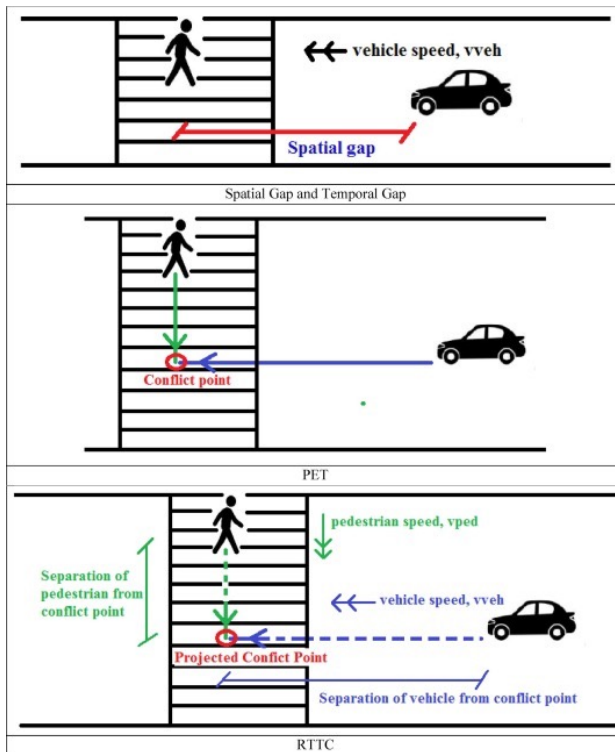
Specially for people with specific needs

Rem.: the pedestrian safety issue is often
neglected in reports on vehicular injuries.

Pedestrian fatalities as a percentage of total fatalities
by age group (Guo *et al.*, 2021)

Pedestrians and collision

Spatial and time gap selection between two vehicles
(Simpson, Johnston and Richardson, 2003)



Some factors before to cross ...
(Anwari *et al.*, 2023; Zang *et al.*, 2021)



PERCEPTION + COGNITION + EMOTION + ACTION

Example #1 – VR for Teaching Road Crossing Skills for Children with Autism

Benefits of using VR for children with ASD :

1. Controlled and safe learning environments
2. Generalization / Adaptation
3. A primarily visual/auditory world
4. Individualized Treatment
5. Preferred Computer Interactions
6. Embodied Interaction
7. Immersion



CONTEXT



Key challenges related to ASD and mental disabilities and crossing street:

- ✓ Promoting their **cognitive** autonomy
- ✓ Maintaining **social interaction**
- ✓ Prevent the **accidents** (social inclusion)



→ **walking** is one the best activities for children because it has positive effects on physical and mental health for them

Tzanavari, A., Charalambous-Darden, N., Herakleous, K., & Poullis, C. (2015, July). Effectiveness of an Immersive Virtual Environment (CAVE) for teaching pedestrian crossing to children with PDD-NOS. In *2015 IEEE 15th international conference on advanced learning technologies* (pp. 423-427).



Four children with ASD (mean age = 9:1 years-old)
with their educator in the VR CAVE

Procedure (6 steps) of safe crossing in the virtual environment:

1. *“Stop and wait on sidewalk”*
2. *“Press button and wait for green light”*
3. *“Look left and right when the light turns green, until all clear”*
4. *“Walk and continue looking”*
5. *“Use Cross Walk”*
6. *“Cross the road to reach the pavement”*

Data:

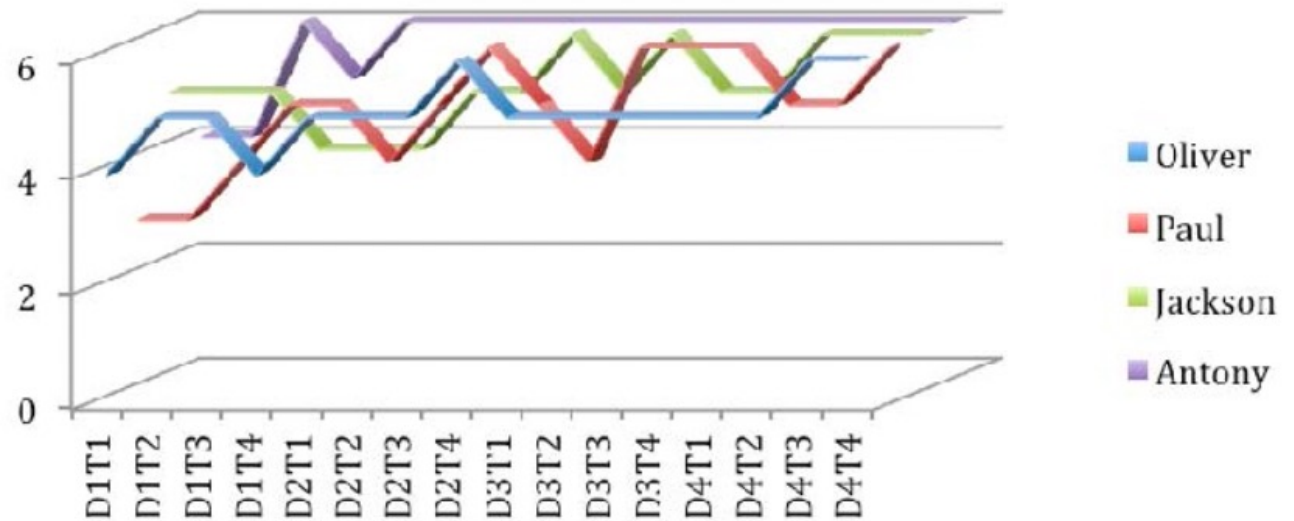
- Behaviours (posture, gait initiation, gaze exploration ...) ...
- ... for each step

Tzanavari, A., Charalambous-Darden, N., Herakleous, K., & Poullis, C. (2015, July). Effectiveness of an Immersive Virtual Environment (CAVE) for teaching pedestrian crossing to children with PDD-NOS. In *2015 IEEE 15th international conference on advanced learning technologies* (pp. 423-427).



Main results :

- More mistakes in the procedure during the first days and trials
 - Less and less mistakes
 - Positive learning specially for step #3 and #4
3. = "Look left and right when the light turns green, until all clear"
 4. "Walk and continue looking"



Kurtça, V. E., & Gezgin, D. M. (2023). Effectiveness of virtual reality technology in teaching pedestrian skills to children with intellectual disabilities. *e-Kafkas Journal of Educational Research*, 10(1), 118-138.

Angulo, A. V., Robartes, E., Guo, X., Chen, T. D., Heydarian, A., & Smith, B. L. (2023). Demonstration of virtual reality simulation as a tool for understanding and evaluating pedestrian safety and perception at midblock crossings. *Transportation research interdisciplinary perspectives*, 20, 100844.

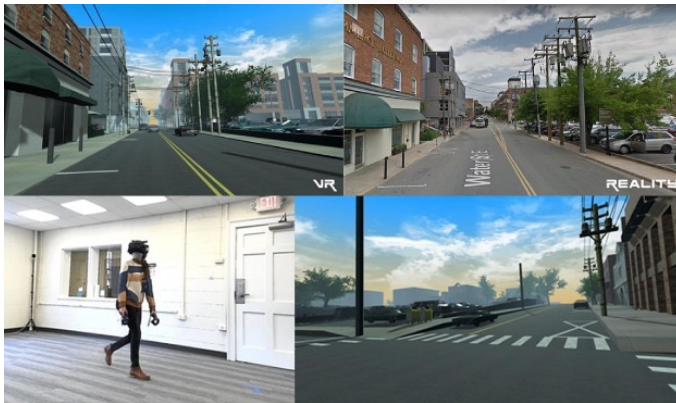


Children with mental disabilities

(mean age = 13 years-old)

Procedure (6 steps) of safe crossing in the virtual environment:

1. *“Stop and wait on sidewalk”*
2. *“Press button and wait for green light”*
3. *“Look left and right when the light turns green, until all clear”*
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Data:

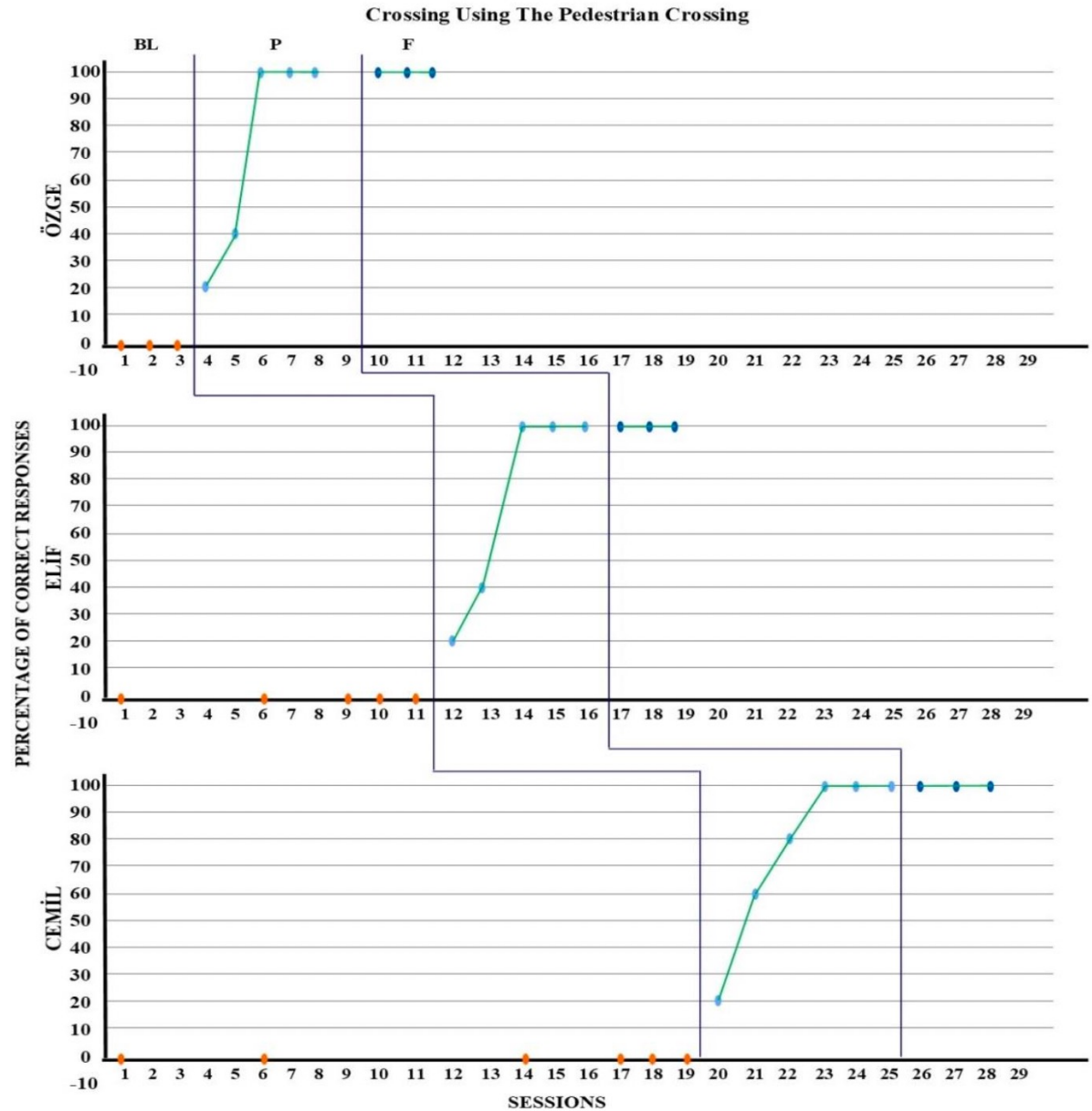
- Behaviours (posture, gait initiation, gaze exploration ...) ...
- Visual exploration

Main results :

The correct response percentages in Özge, Elif, and Cemil crossing using the pedestrian crossing

- in the beginning level (BL)
- probe (P)
- and follow-up session (F).

- More and more « right » behaviours
- Interindividual differences
- Stability during the time



Example #2 - Breaking Social Isolation for Older People



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CONTEXT

Key challenges related to aging:

- ✓ Maintaining **physical** and **cognitive** autonomy
- ✓ Maintaining their **independence**
- ✓ Maintaining **social interaction**
- ✓ Prevent the **loneliness** (social isolation)

→ **walking** is one the best activities for older adults because it has positive effects on physical and mental health for older adults



CONTEXT

But : walking can be particularly **complex** for older adults:

- ✓ **Sensory + Motor + Cognitive** changes
- ✓ Towns are more and more **complex for pedestrians** (real risks + perceived risk)
- ✓ Older adults are often **anxious** with outdoor activities (fear of falling ☐ restricted physical activity + COVID-19)



OUR QUESTIONS

Several digital tools/techniques to improve walking
(to motivate)

- 1) **Usability** and **acceptability** of different tools
(opinions? Attitudes? Feelings? ...) → **Study n°1**
- 2) Impact of the « most acceptable » on **effective behaviours** and **quantitative** indicators → **Study n°2**

STUDY 1

Usability ? Acceptability ? Attitudes ? **Focus group**

23 older people (aged from 65 to 93 years-old)




- 1.** Verbalization of their opinions and attitudes towards technology (freely, without support))
- 2.** Verbalizations and comments about three digital tools, their advantages and limits *a priori*
- 3.** Verbalization of their opinions and attitudes towards technology (utility, usability, acceptability).

Inductive content analysis
+ a SWOT analysis

(Strengths, Weaknesses, Opportunities, Threats)



STUDY 1

	UTILITY	USABILITY	ACCEPTABILITY
	<p>+/-</p> <p>e.g., "Useful for physicians", "Very small", "Not really useful for seniors"</p>	<p>++</p> <p>e.g., "Easy to use", "No action is required", "Not in my leg"</p>	<p>++</p> <p>e.g., "If invisible, I am OK to use it", "Only for a short period", "Not during the night"</p>
	<p>+++</p> <p>e.g., "Innovative", "Useful for physicians and for seniors", "Complementary"</p>	<p>++</p> <p>e.g., "With some help, easy to use", "I have just to walk"</p>	<p>+++</p> <p>e.g., "Really funny", "I would like to test that", "Very cool, like in movies"</p>
	<p>+/-</p> <p>e.g., "Funny", "Easy to wear", "Too much information"</p>	<p>+/-</p> <p>e.g., "Too complex to use", "Too more actions and buttons"</p>	<p>++</p> <p>e.g., "Useful for physicians", "I do not want to be constantly followed"</p>

STUDY 2

	IVR group (<i>n</i> = 21)	Control group (<i>n</i> = 21)	Total (<i>N</i> = 42)
SEX(<i>n</i>, %)			
Male	8 (38%)	7 (33.3%)	15 (35.7%)
Female	13 (61%)	14 (66.6%)	27 (64.21%)
AGE			
Mean (SD)	78.4 (6.7)	77.8 (6.9)	78.1 (6.8)
Min.-Max.	64-85	63-84	63-85
REASONS FOR LIVING ALONE (<i>n</i>, %)			
Never having married	2 (9.5%)	2 (9.5%)	4 (9.5%)
Divorced	3 (14.2%)	4 (19%)	7 (16.6%)
Separated	1 (4.7%)	0	1 (2.3%)
Widowed	14 (66.6%)	15 (71.4%)	29 (69%)
SCORE MMSE			
Normal (> 24)	17 (80.9%)	16 (76.1%)	33 (78.5%)
Mild (21-24)	4 (19%)	5 (23.8%)	9 (21.4%)
Moderate (10-20)	0	0	0
Severe (<10)	0	0	0
AIDS(<i>n</i>, %)			
Using glasses	19 (90%)	20 (95.2%)	39 (92.8%)
Hearing Diff.	5 (23.8%)	6 (28.5%)	11 (26.1%)
Limited mobility	2 (9.5%)	2 (9.5%)	4 (9.5%)

Impact on effective behaviour → **Experiment**

42 older people (aged from 63 to 85 years-old)

Impact of Immersive Virtual Reality (IVR) on **physical** and **mental** dimensions.

Two groups :

- ✓ **Experimental group** = to interact with a specific Immersive Virtual Reality (IVR) daily for 4 months in their homes, at least 15 minutes per day.
- ✓ **Control group** = No specific information (a standard-of-care control)



STUDY 2

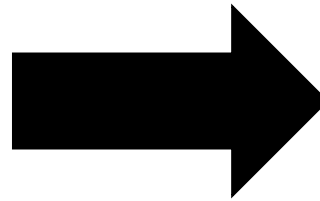
	First session (Week 1)	Last session (Week 10)	<i>p.</i>
WEIGHT (in kg.; Mean and SD)			
IVR group (<i>n</i> = 21)	66.8 (7.9)	63.7 (8.7)	.002
Control group (<i>n</i> = 21)	67.1 (9.1)	67 (8.8)	<i>ns</i>
WAIST CIRCUMFERENCE (in cm.; Mean and SD)			
IVR group (<i>n</i> = 21)	102 (12.3)	97.5 (14.2)	.003
Control group (<i>n</i> = 21)	101 (13.9)	100.5 (11.2)	<i>ns</i>
NUMBER OF STEPS OUTSIDE (Mean and SD)			
IVR group (<i>n</i> = 21)	3890 (878)	7604 (754)	<.001
Control group (<i>n</i> = 21)	4002 (652)	3791 (448)	<i>ns</i>
TIME OF USE OF IVR (in min. per day; Mean and SD)			
IVR group (<i>n</i> = 21)	15 (3.8)	12 (4.7)	.02
Control group (<i>n</i> = 21)	-	-	-
PERCEPTION OF INTENSITY OF ACTIVITY (from 0 to 7; Mean and SD)			
IVR group (<i>n</i> = 21)	1 (0.1)	5.5 (0.3)	<.001
Control group (<i>n</i> = 21)	0.8 (0.2)	1.3 (0.3)	<i>ns</i>
LONELINESS SCORE (Mean and SD)			
IVR group (<i>n</i> = 21)	37.06 (4.2)	21.43 (6.1)	<.001
Control group (<i>n</i> = 21)	37.02 (5.7)	36.71 (6.6)	<i>ns</i>

DISCUSSION

- ✓ An **Immersive Virtual Reality** (IVR) system can be a relevant digital tool for elderly people according to them, *i.e.*, a digital tool perceived as **useful, usable** and **acceptable to promote walking**
- ✓ Positive impacts on **physical** dimensions (weight, waist circumference) ...
- ✓ ... and on **mental** dimensions (loneliness score = perception of social isolation)
- ✓ + positive influence on the **number of steps performed outside.**
- ✓ Positive impacts **even if the time spent to use the IVR decreases**
- ✓ If the IVR led to reduced loneliness, it is probably because physical activity created **opportunities to meet people in the real/physical world**, that is being an indirect effect of the IVR.

DISCUSSION

- Impacts of an Immersive Virtual Reality can be positive because its use can help individuals (here, older adults) to **adopt new intentions** and **new positive behaviors in real and physical world**.



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chaire behaviour



Thank you for your attention ...