



**Westsächsische Hochschule Zwickau**  
University of Applied Sciences  
HOCHSCHULE FÜR MOBILITÄT | UNIVERSITY FOR MOBILITY

# User Experience of Elderly People in a Highly Automated Shuttle

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# Introduction

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- The increase in popularity of the concept of smart cities has promoted several efficient and clean modes of mobility such as cycling, public transport, electric vehicles and walking.
- Several cities are shifting their citizens dependence from private vehicles to public transport.
- Due to several advantages, Autonomous Vehicles (AV) as a means of public transport is gaining popularity among city administration, transport providers and the automobil manufacturing industry.
- Autonomous Shuttles (AS) is a kind of AV which is currently being widely tested across the globe as a future means for public transport.

# Level of Autonomy



# SAE J3016™ LEVELS OF DRIVING AUTOMATION

What does the human in the driver's seat have to do?

SAE LEVEL 0	SAE LEVEL 1	SAE LEVEL 2	SAE LEVEL 3	SAE LEVEL 4	SAE LEVEL 5
You are driving whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			You are not driving when these automated driving features are engaged – even if you are seated in “the driver's seat”		
You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	

What do these features do?

These are driver support features	These are automated driving features
These features are limited to providing warnings and momentary assistance	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met
These features provide steering OR brake/acceleration support to the driver	This feature can drive the vehicle under all conditions
These features provide steering AND brake/acceleration support to the driver	

Example Features

<ul style="list-style-type: none"> <li>• automatic emergency braking</li> <li>• blind spot warning</li> <li>• lane departure warning</li> </ul>	<ul style="list-style-type: none"> <li>• lane centering OR</li> <li>• adaptive cruise control</li> </ul>	<ul style="list-style-type: none"> <li>• lane centering AND</li> <li>• adaptive cruise control at the same time</li> </ul>	<ul style="list-style-type: none"> <li>• traffic jam chauffeur</li> </ul>	<ul style="list-style-type: none"> <li>• local driverless taxi</li> <li>• pedals/steering wheel may or may not be installed</li> </ul>	<ul style="list-style-type: none"> <li>• same as level 4, but feature can drive everywhere in all conditions</li> </ul>
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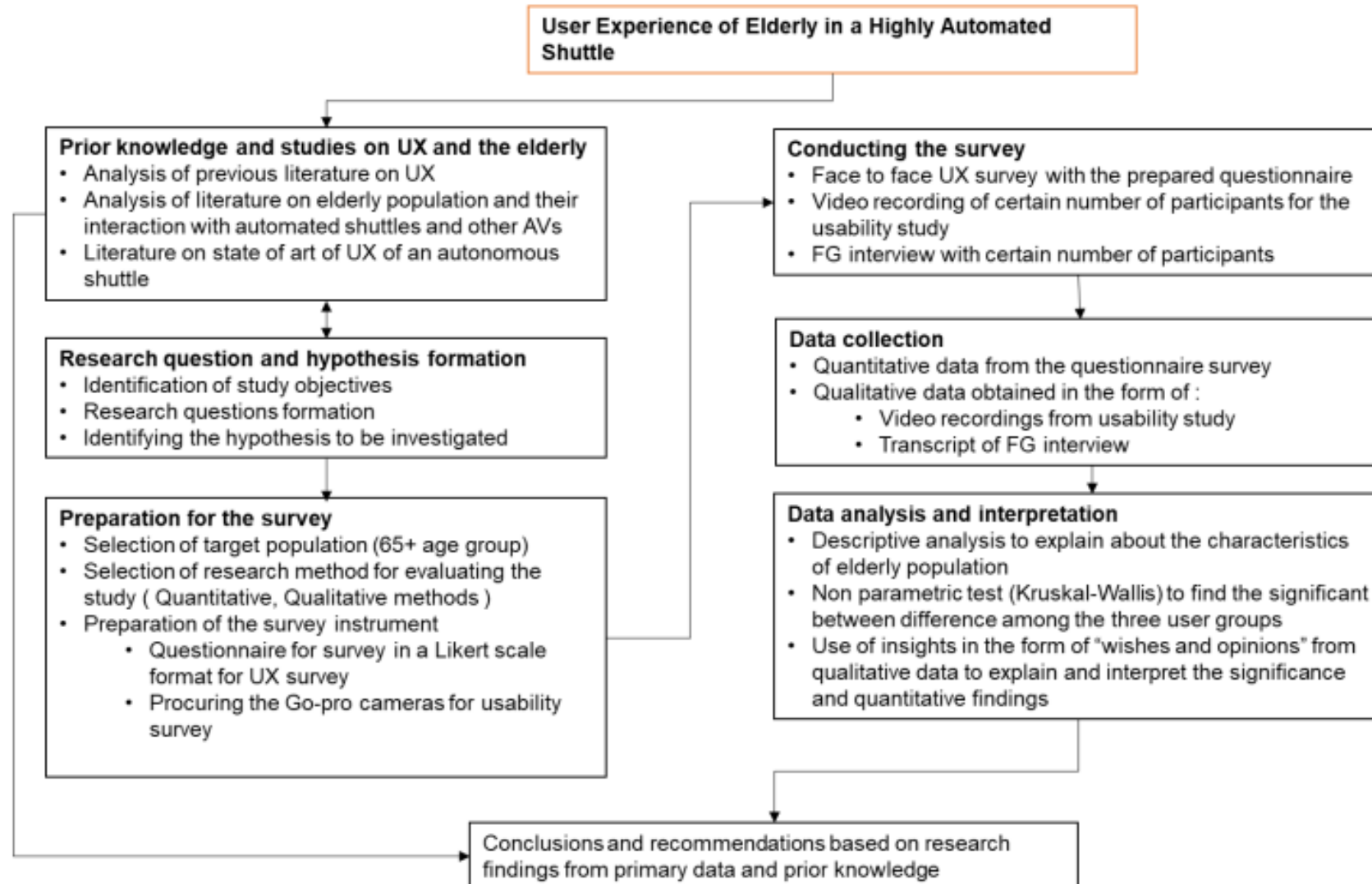


# Study Area



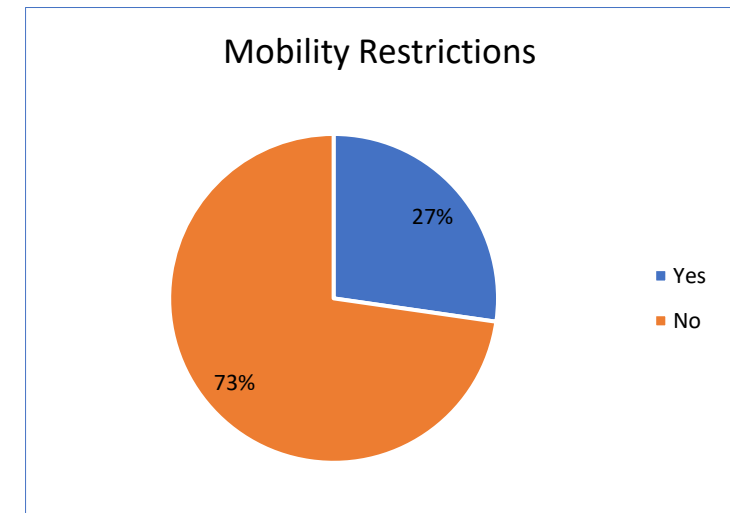
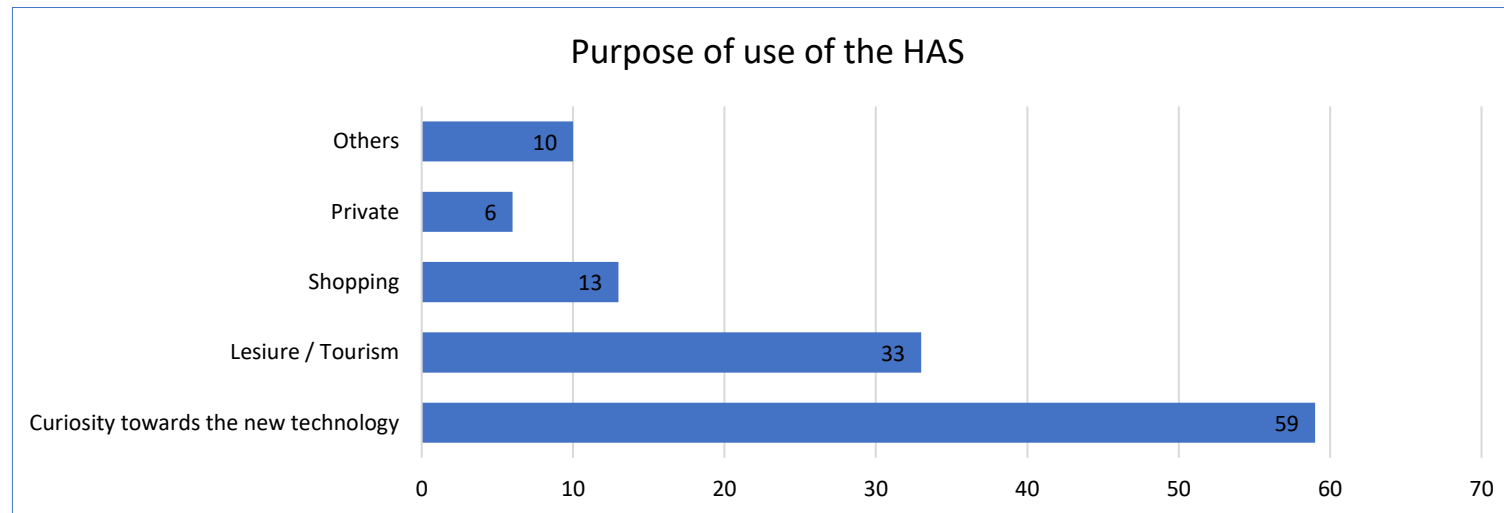
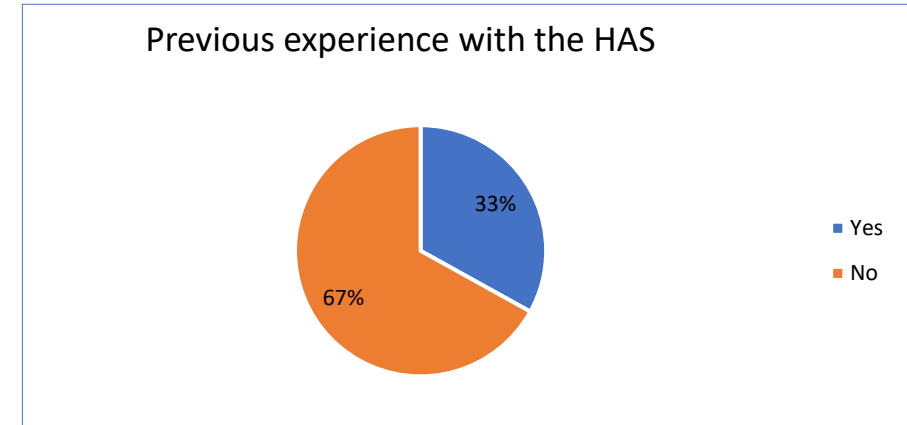
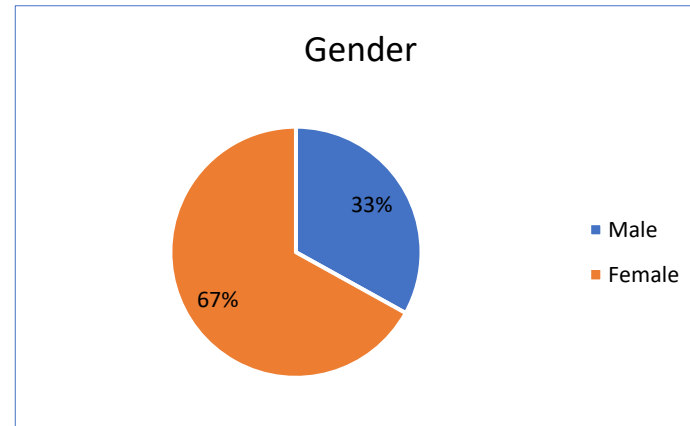
- Alt-Tegel lies in the Reinickendorf district of Berlin
- Area : 33.7 Km<sup>2</sup>
- Population : 36,986

# Research Design



# Sample Size Description

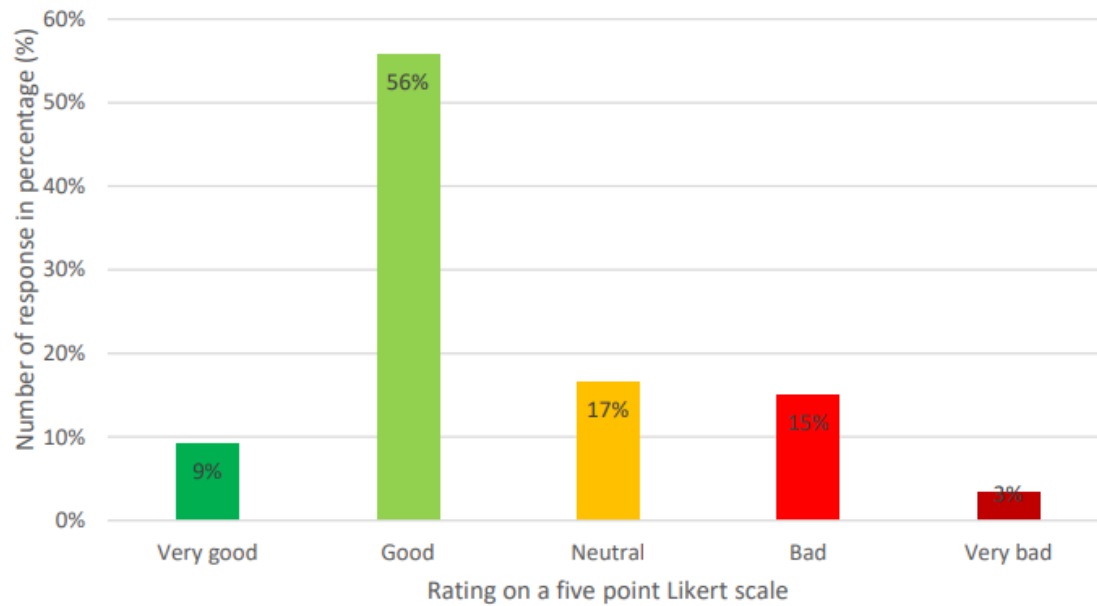
Elderly population  
(65+), n = 121



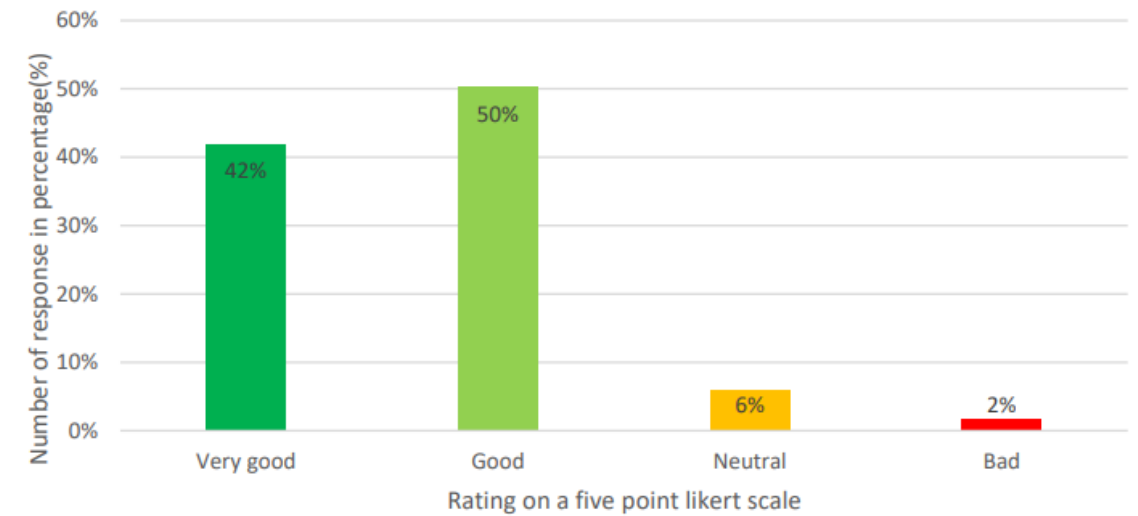
# Attractiveness & Comfort

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How would you rate the speed of the HAS?

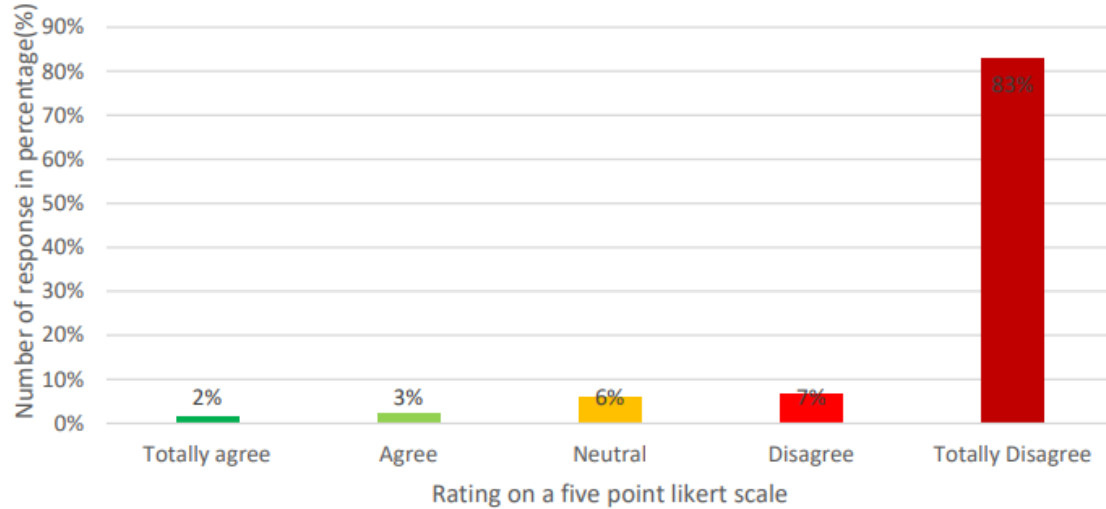


How would you rate the appearance and design of the HAS?

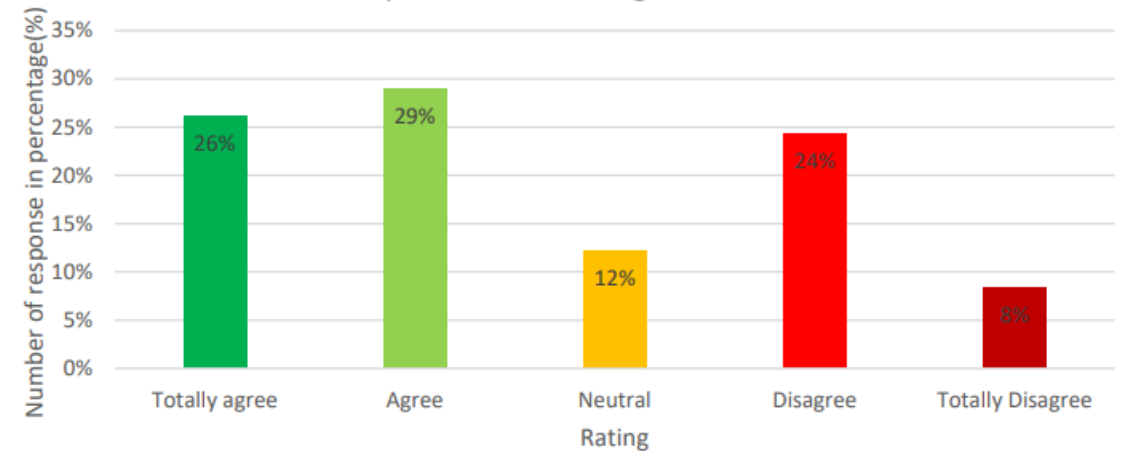


# Attractiveness & Comfort

How would you rate the statement: I feel cramped inside the HAS



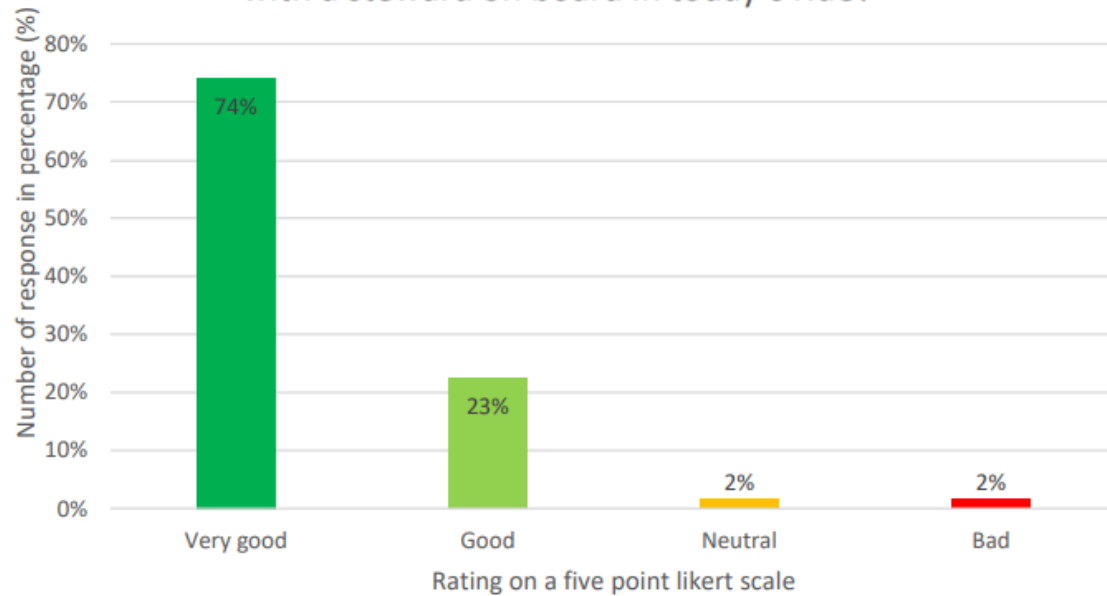
How would you rate the statement: Six seats in this HAS is adequate for this neighbourhood



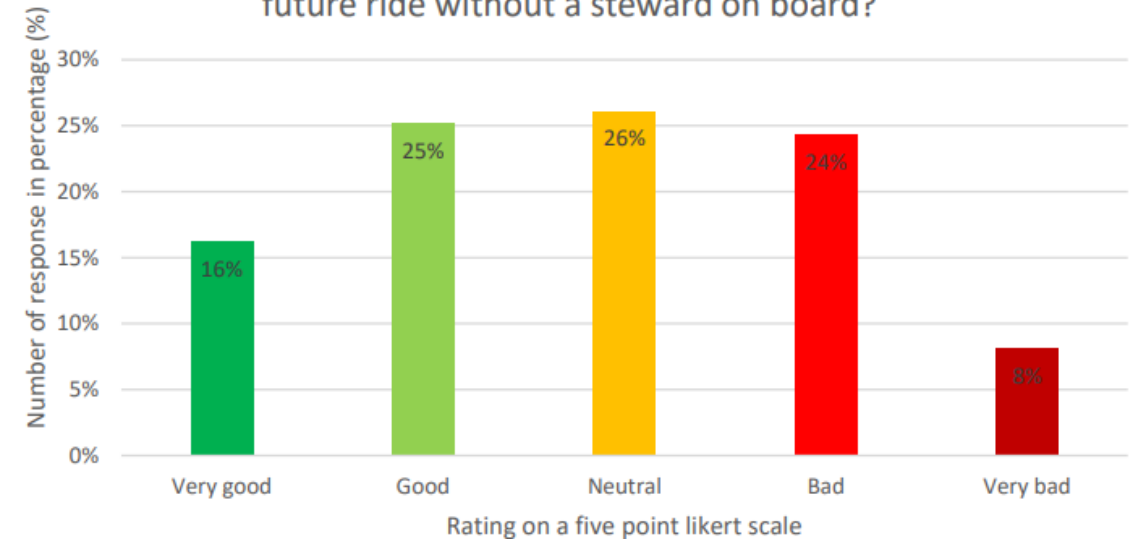


# Trust & Security

How did you find the driving safety and driving behavior with a steward on board in today's ride?

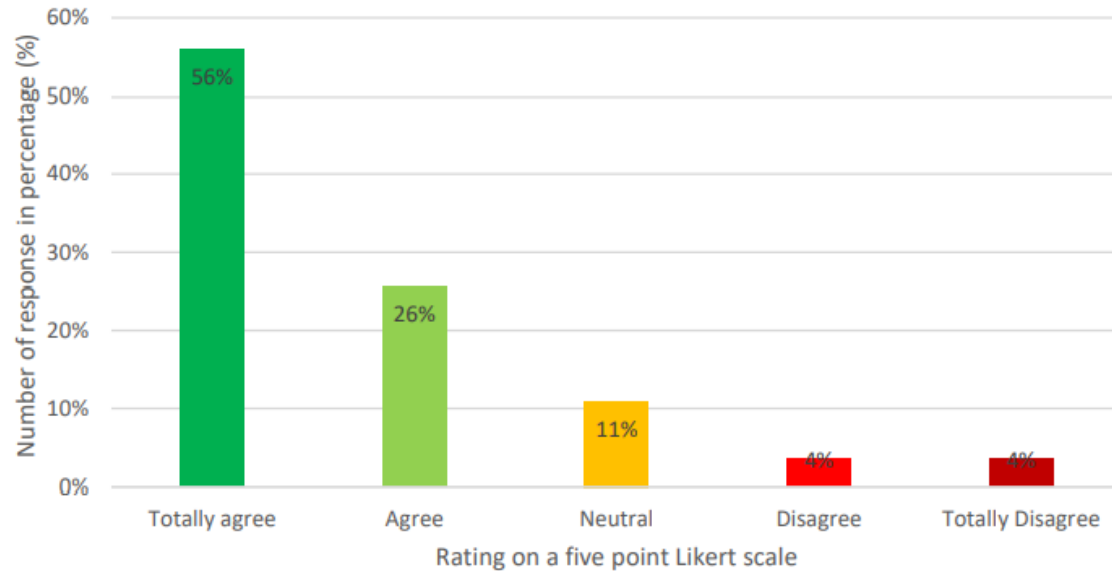


How would you rate driving safety and driving behavior on a future ride without a steward on board?

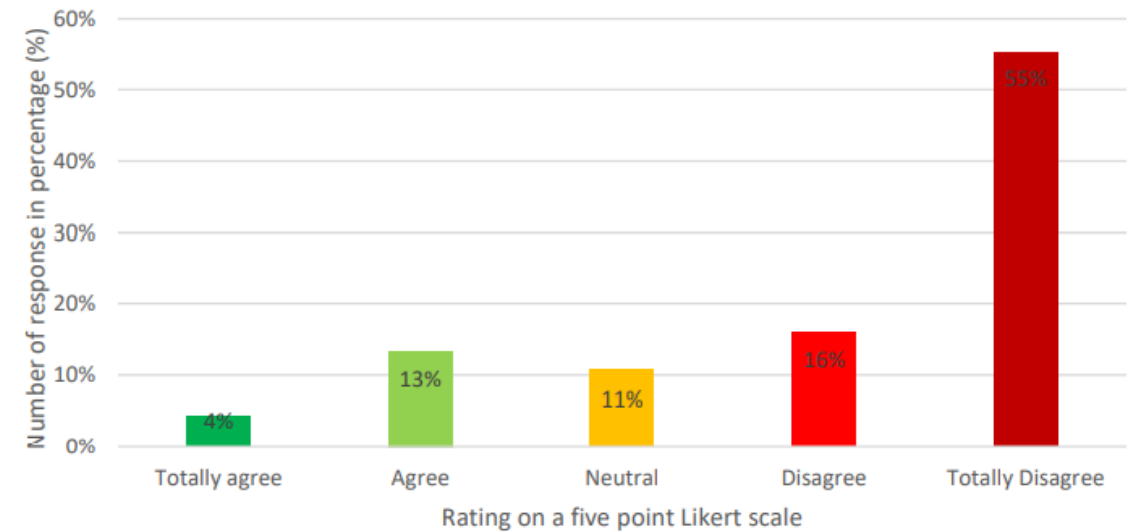


# Trust & Security

I would be happy to see the widespread introduction of HAS as an addition to Berlin's public transportation system

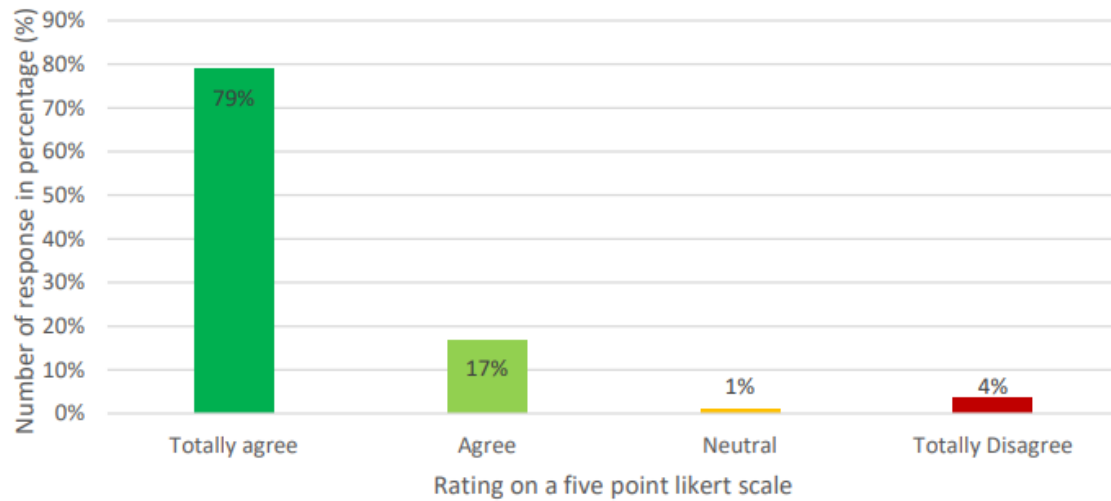


In future Berlin's public transport system, the well known large busses should be driverless

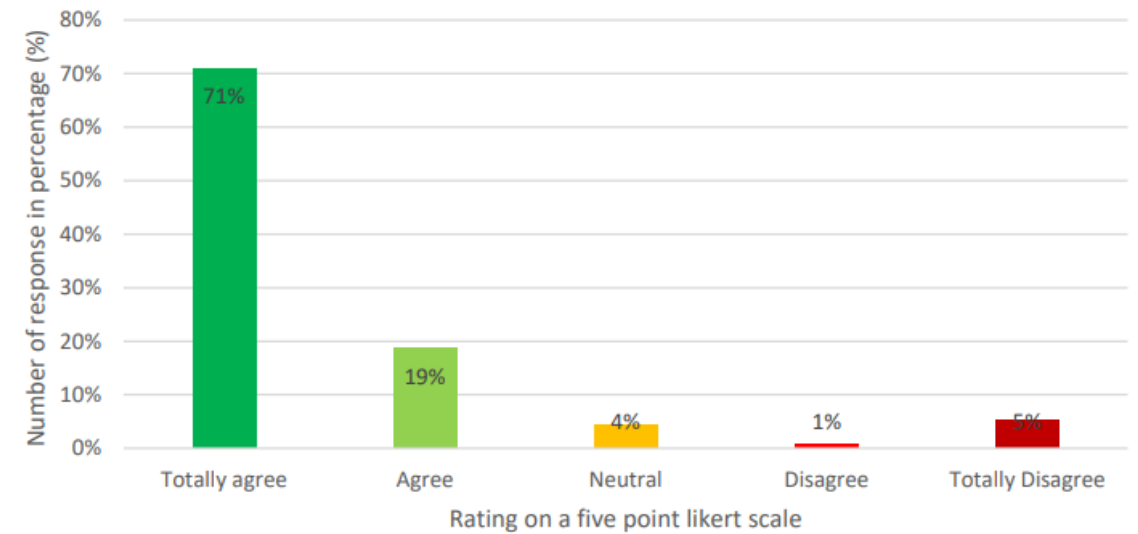


# For First and Last Mile .....

We need such HAS to improve the social participation of people with limited mobility



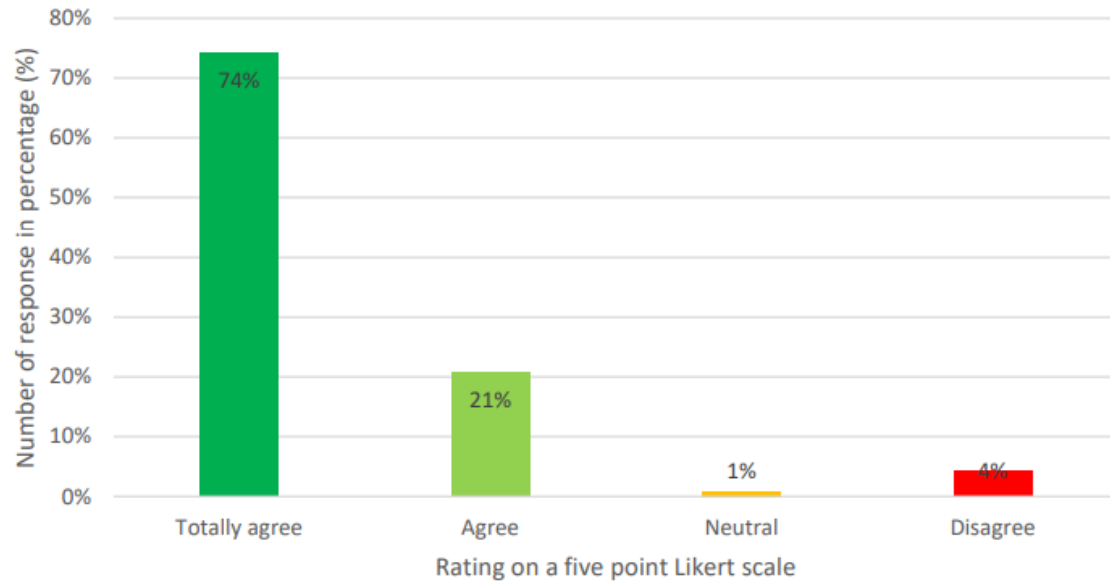
This HAS is good for coping with my first and last mile of journey



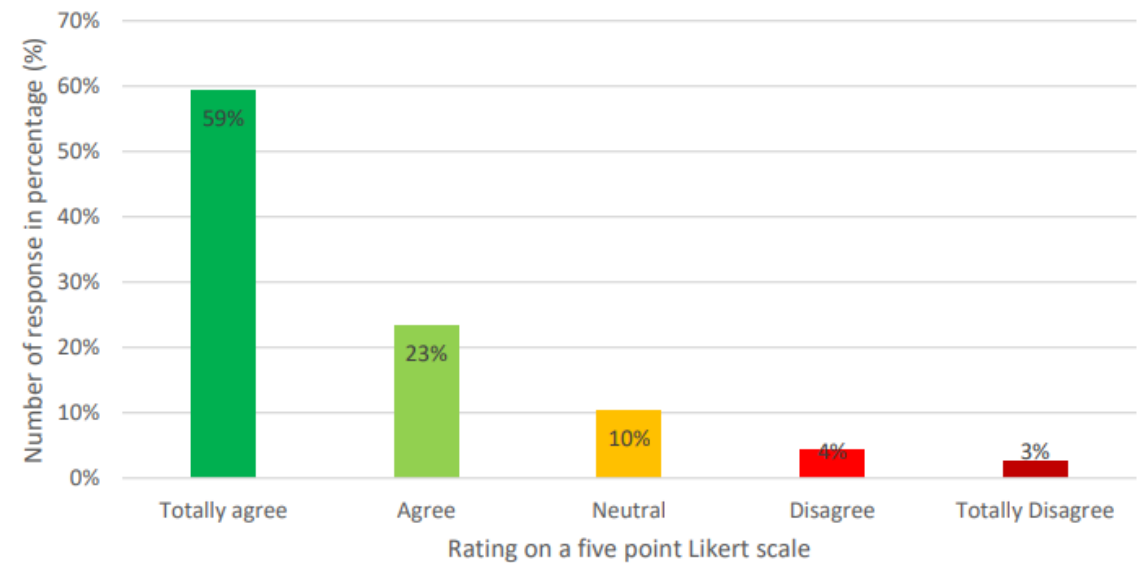
# Environment friendliness

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The use of shuttles is an opportunity to make a contribution to climate protection



I would like to contribute to climate protection with my own traffic behavior





# Inference Among the three age groups

Items	Respondents (n)	H	Significance	Effect size
Comfort				
How would you rate the level of convenience in the shuttle?	237	15.428	<0.01	0.06 (Moderate)
How would you rate this statement: I feel cramped inside the shuttle	237	6.128	0.047	0.02 (Small)
Trust and Security				
How would you rate the driving safety and driving behavior in the highly automatic shuttle in future ride without a steward onboard?	225	11.018	0.004	0.04 (Small)
Driverless vehicles in Berlin's public transportation system should get along without a steward on board	228	7.697	0.021	0.03 (Small)
I would be happy to see the widespread introduction of driverless shuttles as an addition to Berlin's public transportation system	225	9.71	0.008	0.03 (Small)
In future Berlin's public transport system, the well-known large busses should be driverless	227	35.102	<0.01	0.15 (Large)
Perception towards the autonomous shuttle				
This shuttle is good for coping up with my first and last mile of journey across	228	18.871	<0.01	0.07 (Moderate)
We need such shuttles to improve the social participation of people with limited mobility across	227	7.515	0.023	0.02 (Small)
The use of shuttles is an opportunity to make a contribution to climate protection	231	8.318	0.016	0.03 (Small)



# Recommendations

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- The innerdesign elements such as **seats**, **holding bars**, and small **size** of the shuttle should be adressed
- The design elements which directly affect the mobility restricted people such as **seat belts**, **control buttons** and **information screen** should be made easily acessible
- looking at the physical condition of the elderly **height of seats** should be raised by some centimeters so that they do not have to be seated low, which causes pain to the knee joints.
- The **control buttons** should be provided on both the extreme seats so that a person does not have to get up and press the button before arriving at the stop.
- Feeling of security and trust could be increased by providing a **drivers view** to the passenger, **dedicated communication line** with a **remote safety personnel** and encouraging more **public participation** during test trails of these shuttles



# Conclusion

- Overall, the elderlies found the HAS **comfortable, attractive, easy** and **useful**.
- A few design issues were raised by the elderly, which, if addressed with care, could increase the level of convenience of the HAS.
- The elderlies showed comparatively high level of **trust** and **security** towards the HAS with a steward on board than **without** an onboard **steward**.
- The elderlies are still not ready to embrace a fully autonomous vehicle as public transport.
- The elderlies find HAS to be a good means of transport for their **first and last mile** journey and a means of social inclusion for mobility restricted in the society (with the steward onboard).



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# Thank you



## Kontakt :

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