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A SERIOUS GAME AS A TOOL FOR USER-CENTERED DESIGN OF MOBILITY SOLUTIONS

Image: DLR

Background & Motivation



- **Challenges of user participation in early design phases:**
 - To **encourage** and **enable** potential users **to participate** in the design process
 - To **predict acceptance**
 - To **determine** the **influence of individual design parameters** on use intentions
- **Goal: To design for attractiveness of intermodal transport links**
 - **understand** users' **pain points** and **requirements**
 - **Create a virtual test environment** by which the effects of changes in the transport system on user acceptance can be studied without the need to implement them in the real world

Serious Game

- **Context:**
 - **DLR project Connected Mobility for Livable Places**
<https://verkehrsforchung.dlr.de/en/projects/vmo4orte>



Serious Games as a research tool

“games for purposes other than entertainment”

Michael and Chen, 2006

- **Of interest to our research:**

- possibility to **depict a complex world** with its relevant elements and effective relations
- allow **users to interact with this world** and **experience** the **consequences** of this interaction
- **features of elements and relations** in the game world **can be changed systematically** and **with** relatively **little effort**
- allow for **experimentation in context** and the analysis of how **user preferences and behaviour** change depending on the design of the world
- users have an **intrinsic motivation** to engage in the interaction

- **Applied** with **various objectives** and **heterogeneous approaches** across **multiple disciplines**

- **Healthcare**
- **Public policy**
- **Strategic communication**
- **Defence**
- **Training and education**
- **Stealth assessment**
- **Citizen science**
- **[...]**

Methodological aspects

- **Purpose:**
Twofold

research tool

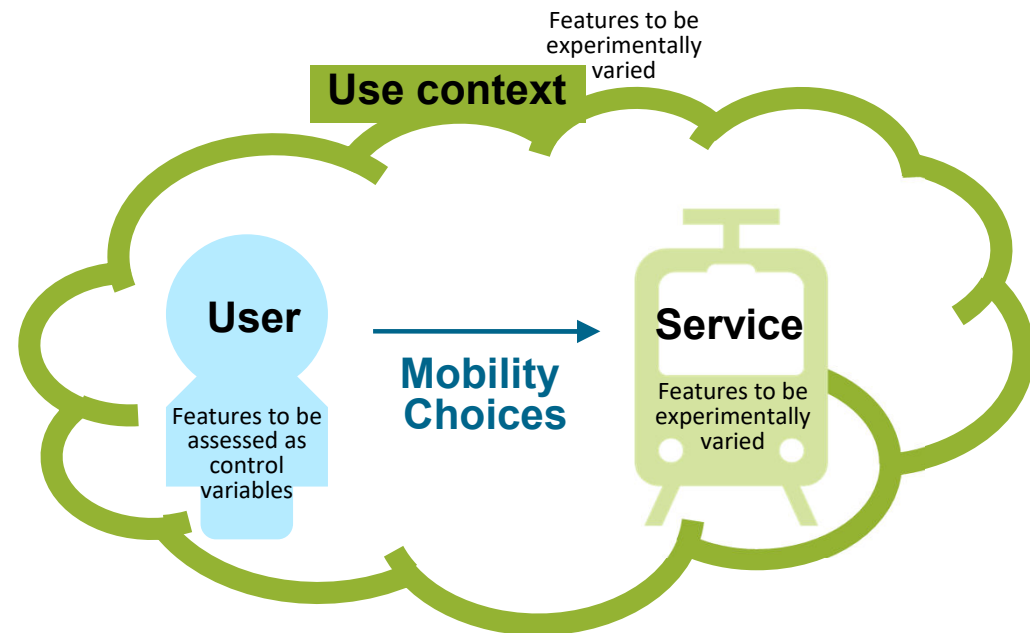
understand the rules governing user behavior towards mobility offers

design aid

study user acceptance towards new design options

- **Methodological framework:**
Choice experiment

- allows to determine **relative importance of design parameters** and **other variables** for user choices
- applicable to investigate **"what-if" questions** related to the design of new products and services



Game concept

- **Player role:**
Up-and-coming influencer
- **Goal:**
Amass as many **followers** as possible
- **Mission:**
Travel to different locations for **taking photos** associated with **trending hashtags**
- **Start:** A new morning in the influencer's home



Course of a mission



• Get informed

- **trending hashtags** (e.g. #Pumpkin) + current **weather conditions** + promising **destination** + required **luggage**

• Choose a transport option

- from a **variety of options**
(different **modes of travel** associated with **duration** and **price**)

• Step outside and travel

- **animated sequence** featuring the selected mode of transportation and environmental conditions
- **duration corresponds to the chosen mode of transportation**

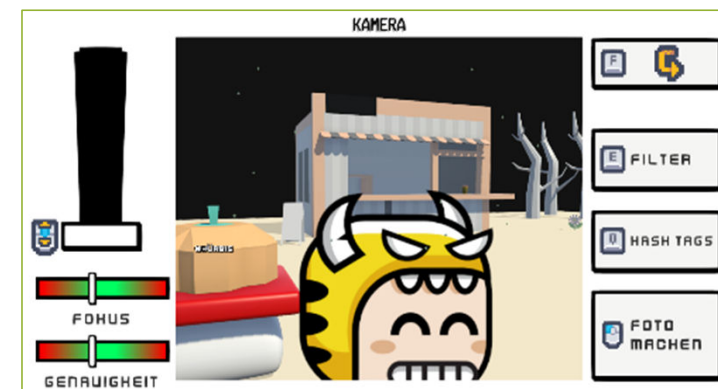
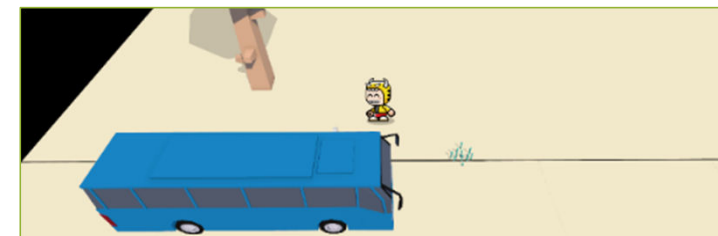
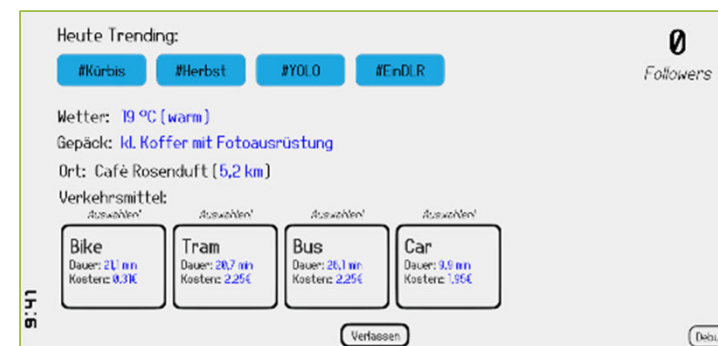
• Take a selfie at the destination

- Try to **include** as **many hashtagged objects** as possible in the photo (more attract more followers)
- **Creative photo mode** (adjustable focal length, aperture, and filters)

» “Post” the photo on a virtual social media platform

• Travel back home

- **reward screen** shows increase in **followers** and virtual **currency**



Experimental design



- **Considerable possibilities** for **variation** of **service** and **context** characteristics
 » thousands of combinations from relevant variables and conceivable levels

Initial set of independent variables + their levels:

Context				Service		
Distance	Luggage	Temperature	Precipitation	Means of transport	Duration	Price
0.8 km	none	-1 °C	no	foot	low*	low*
2.1 km	backpack	8 °C	yes	bike	medium*	medium*
5.2 km	photo suitcase	19 °C		pedelec	high*	high*
12.0 km	backpack + photo suitcase	31 °C		e-scooter		
19.0 km				bus and tram		
				car		
				train		

* In the game, **exact values** are given that vary depending on travel distance and means of transportation. Medium values reflect realistic values in the current transportation system in Germany. Low and high values are derived from the medium ones by subtracting / adding 10%.

Control variables

User			
age	gender	mobility habits	[...]

Implementation



- **Game engine:**
Unity

- **Target platform:**
web browser

- Game to run **independently of operating system**
- **No need for installation**



- **Hosting:**
DLR website

- Ensure **data protection**
- Ensure **everyone plays the same version** after updates

» enable change of **experimental conditions** for research

- **Data assessment:**
with random identifier

- **Data transmission** after each play session

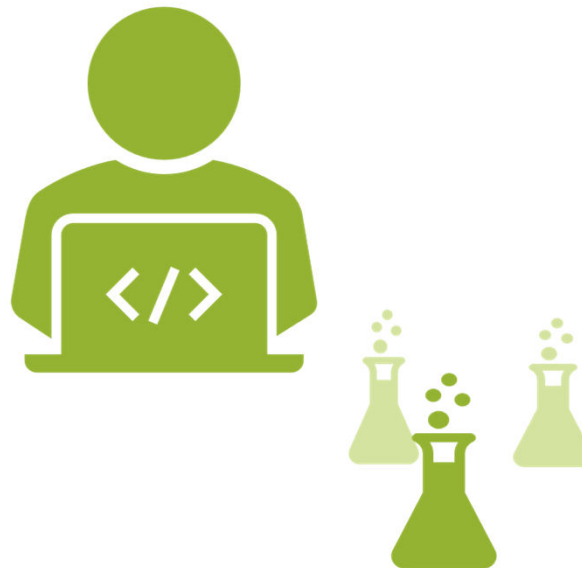
» **design matrix + corresponding decisions + identifier**

First prototype evaluation: User experience and usability



• Participants: Experts

- All work at **DLR**
- Age from **24 to 46 years**
(M = 33.0, SD = 8.3)
- **Four women, three men**
- **Fields of expertise**
human factors, usability and user experience, development of interactive applications
- **Three** are part of the **author team**



• Method: Test of game prototype

- **Play** three rounds
- Answer **flow short scale (FKS)**
- Answer **system usability scale (SUS)**
- Do **heuristic evaluation** concerning usability:
 - » **Note problems:** features that violate one of **10 usability heuristics**
 - » **Make recommendations** on how to fix them

Results: Experience Sampling



- **Flow experience (FKS, 1-7) : medium (M = 3.8; SD = 0.6)**

- **Medium smooth automated progression**
(M = 3.8, SD = 1.0)
- **Medium absorbedness**
(M = 3.9, SD = 0.8)
- **Very low concern**
(M = 1.5, SD = 0.5)



- **Difficulty, demand, ability (FKS, 1-9):**

- **Low to medium subjective difficulty** of playing the game
(M = 2.6, SD = 1.5)
- **Low to medium task demand**
(M = 2.6, SD = 1.5)
- **Heterogenous self-assessed ability in playing computer games**
majority of values in lower part of scale
(M = 3.7, SD = 2.1).



- **Subjective usability (SUS): low**

- **scores between 30 and 45**
- M = 38.7, SD = 4.9

Results: Heuristic Evaluation

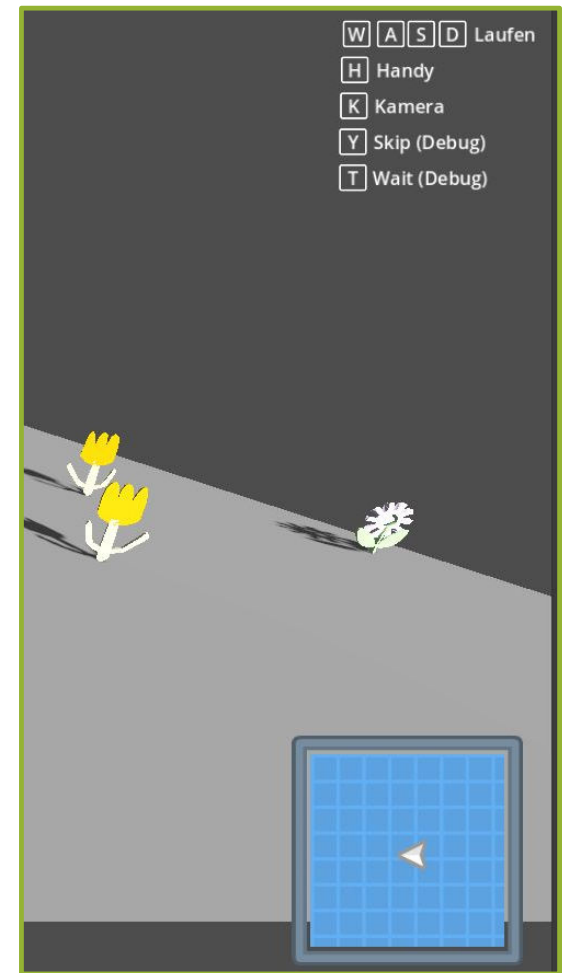


Usability heuristic	Comments	
	n	Content
1 Visibility of System Status	9	Mostly: lack of clarity about the tasks and the options/interaction possibilities in the game Partly: better visibility/recognisability of information required
3 User Control and Freedom	9	Lack of exits from different situations
5 Error avoidance	7	Character can fall into nothingness at the rim Partly options are available that are not needed in the situation
10 Help and documentation	7	Apart from the tutorial no help menu available yet
6 Recognition instead of recall	5	Informationen on how to use / interact should be available at all times
4 Consistency and standards	4	partly poor readability of fonts inconsistent use of terms in German and English
9 Help in recognition, assessment and remedy of errors	4	No error messages / solution propositions by the system in case of errors yet
2 Conformity of system and reality	2	Unclear about the inputs required to control the game
7 Flexibility and efficiency of use	2	Wish for more shortcuts with information accessible at all times
8 Aesthetic and minimalistic design	2	The complex map used does not fit the minimalistic design in the rest of the game

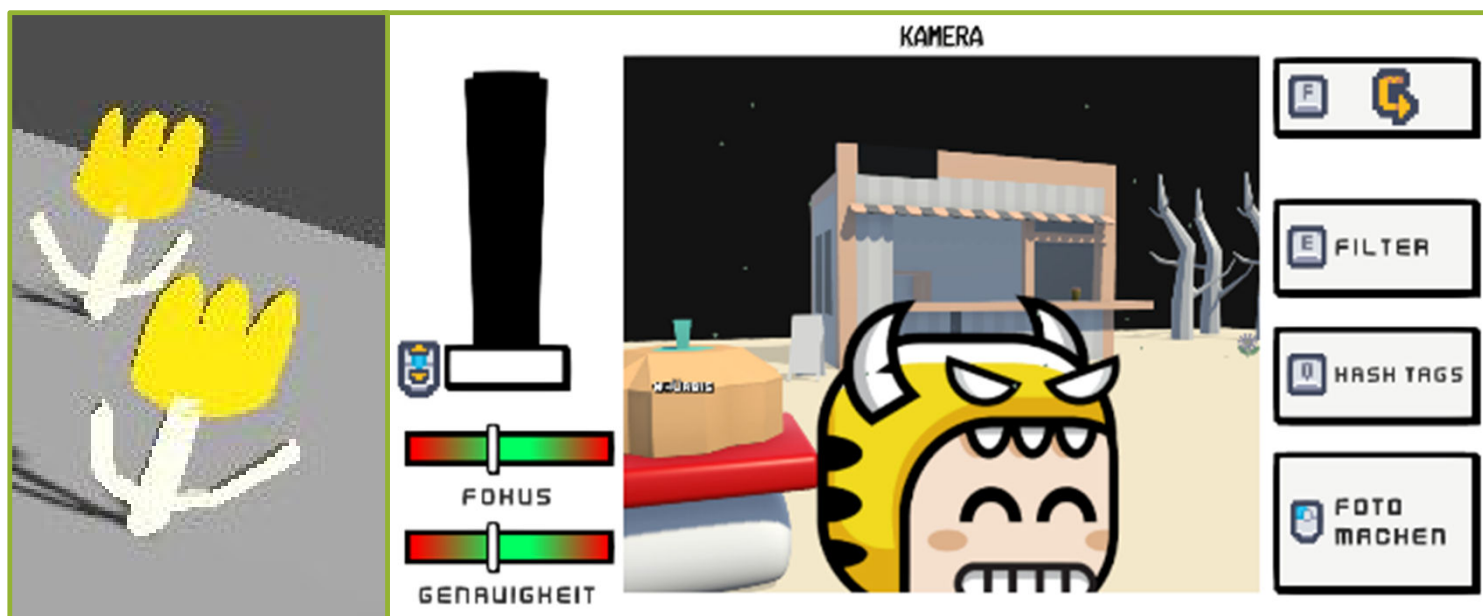
Discussion and outlook



- **Result of the first evaluation:**
many possibilities for improvement
 - **no surprise** as prototype was tested at first playable status
 - **early evaluation** is part of planned development process
 - **results give** the development team **valuable insights** on how **to optimise** the game to maximise its potential as a research tool
- **Next steps:**
 - **Implementation of feedback** from first evaluation
 - **User tests**
 - » usability and user experience
 - » data assessment functions
 - **Roll-out to test the potential for studying user preferences in the transport system**



Thank you for your attention!



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