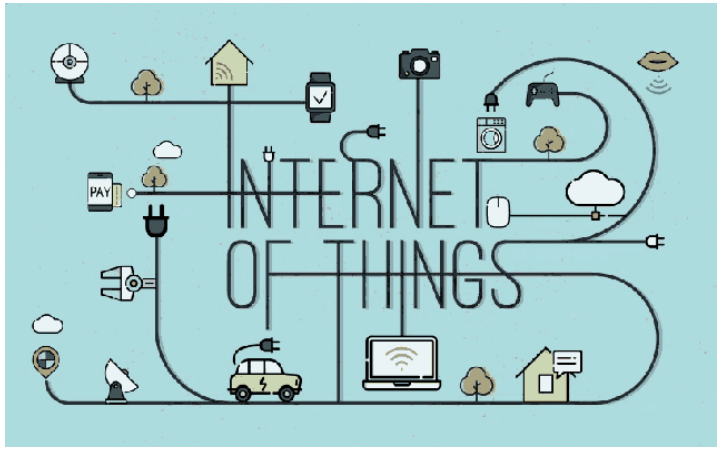


Changing Behavior toward energy efficiency actions

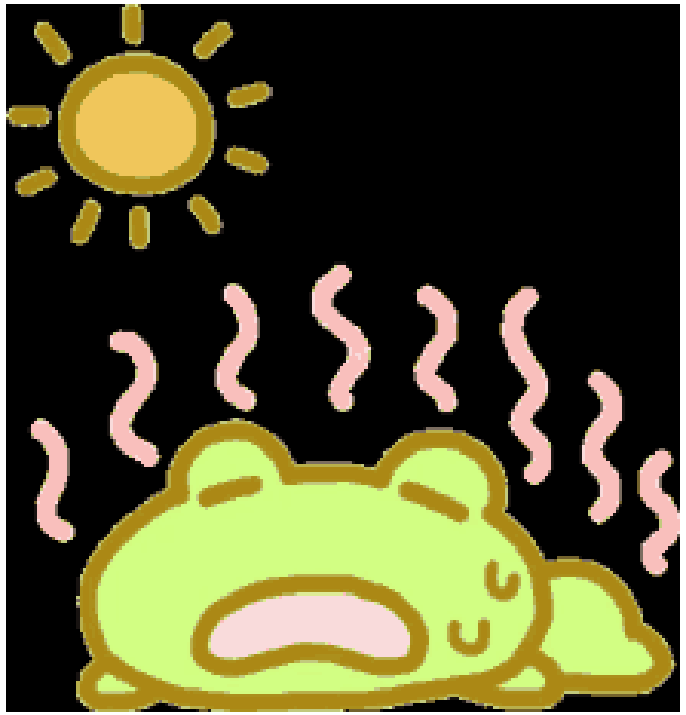
- **Dr Sanaul Haque**

- LUT Software Sustainability Research Group, Dept of Software Engineering, LUT University, Finland

- **Sunway University Climathon, January 20-21st 2025, Malaysia**

Air pollution

Heat



As a good citizen we need to take action to change our behaviours for a better future

- Behavioral change is about altering habits and behaviors for the long term. Most of the research around health-related behaviors (Davis, Campbell, Hildon, Hobbs, & Michie, 2015)

- Other behaviors that are the target of change interventions are those affecting the environment, for example: **Littering, Leaving lights on, Not recycling, Carbon Emission etc.**

Are all Intelligent machines sustainable and environmentally friendly?

Carbon emmissions of ChatGPT

https://smartly.ai/blog/the-carbon-footprint-of-chatgpt-how-much-co2-does-a-query-generate

Do we need to change our behavior?

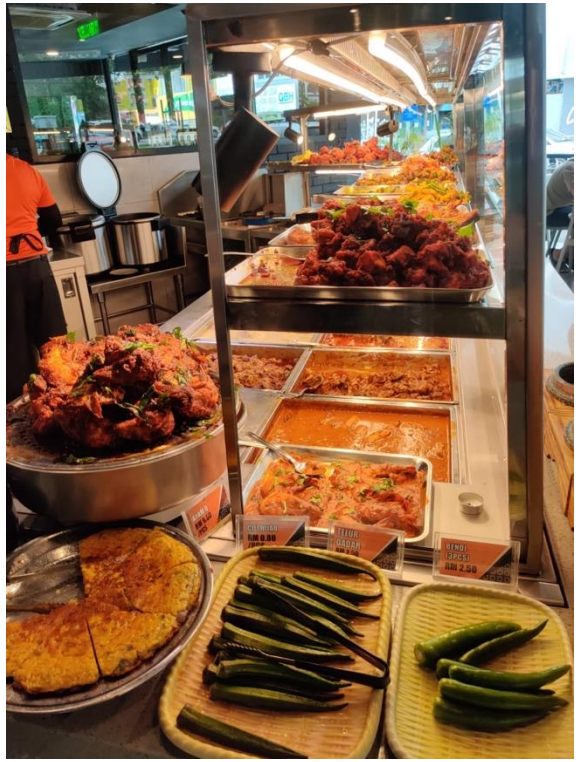
- <u>Personal level</u>

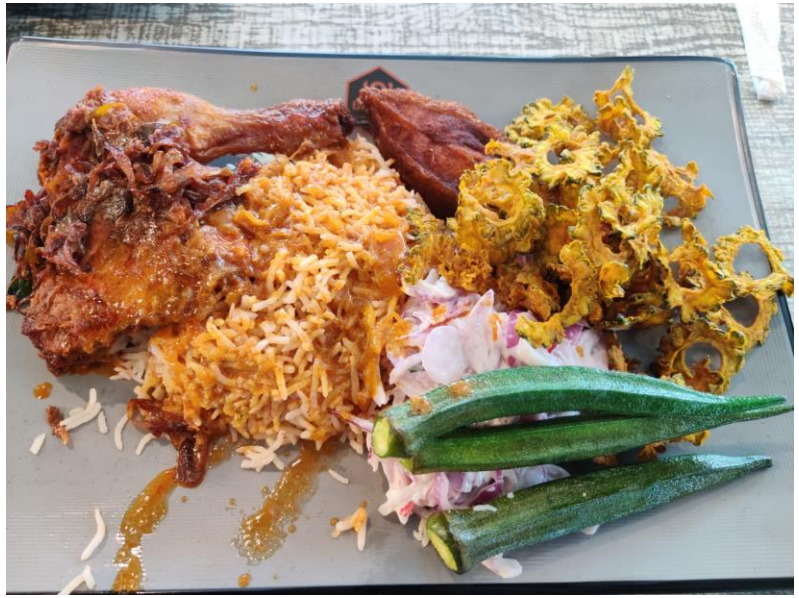
- health improvement ?
- Adapt situations/ resilience?
- boost professional success?
- enjoy life, discover strength?

- <u>Public level</u>

- save money and resources?
- help others through experience?
- improve relationships?
- improve communities?

Choice Architecture!





- Researchers at **Cornell University**, USA have estimated that **we make 226.7 daily decisions on food alone**. But how much of those decisions are rational, picking for example healthy recipes over fast food or immediate taste reward? More ambitiously, how many times do we consider the effect of our meal choices on the external environment beyond our own bodies?

- **UNDP Egypt** Accelerator lab has experimented with behavioral insights to learn how we can wake up to more deliberate and rational food choices to adapt to **climate change**

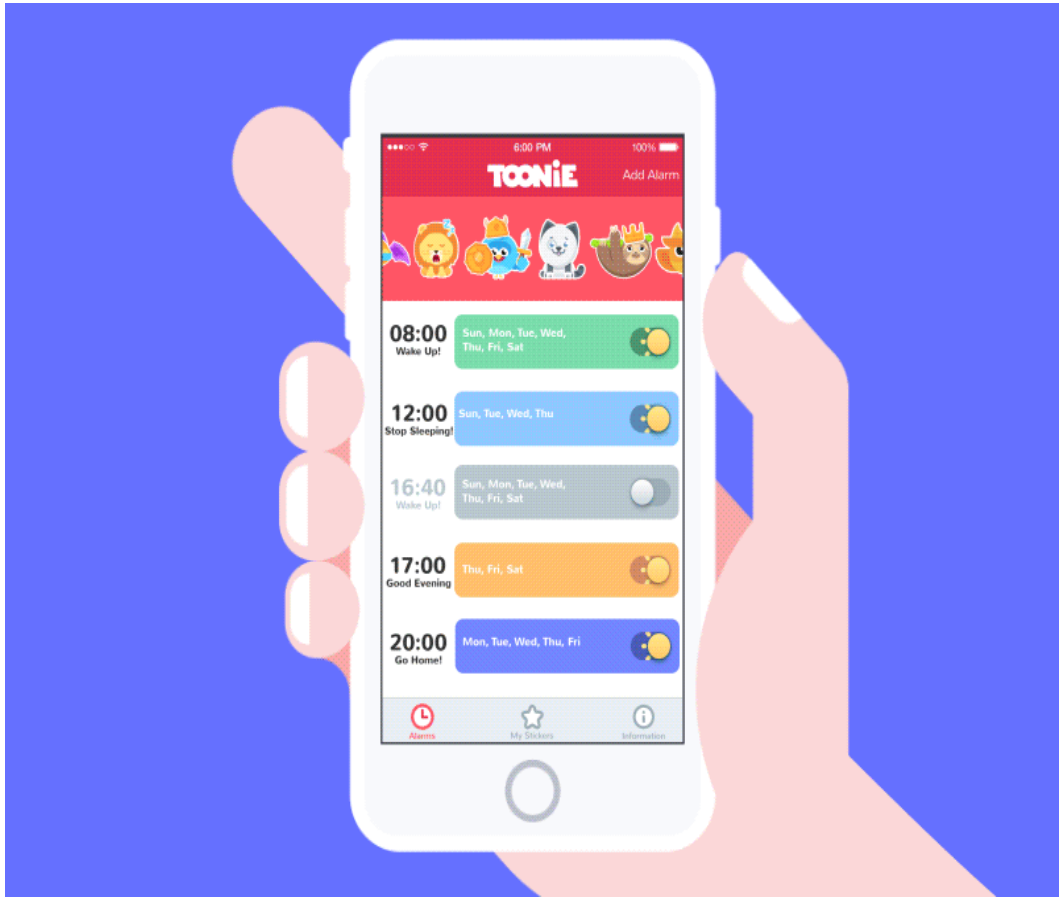
- Leveraging the power of social media, UNDP, Egypt partnered with "Kitchenista" Facebook community, a highly engaged community of 230 thousand all-women members, sharing recipes, ingredients, and food hacks

Source: https://www.undp.org/egypt/blog/nudging-change-fighting-climate-crisis-our-kitchens

How do we contribute to better sustainable actions toward health and well-being?

- **<u>Digital Technology as a solution!</u>**

- Persuasive technology
- Personalized self-nudging
- Other techniques…..



Digital Technologies focusing on Digital sustainability

- Digital sustainability refers to the design, development, and utilization of digital artifacts (e.g., IoT, artificial intelligence, data analytics) and digital resources (e.g., blockchain, cloud computing) to achieve environmentally sustainable objectives (Corbett et al., 2023)

Design thinking for digital sustainability: Promoting citizen's behavioral change toward energy efficiency actions

Aim

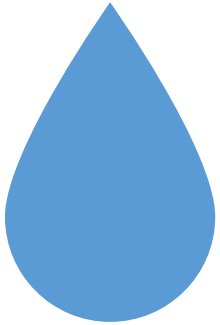
Creating awareness, action plans among the citizens

To design and develop a community-based online intervention (Based on Framework)

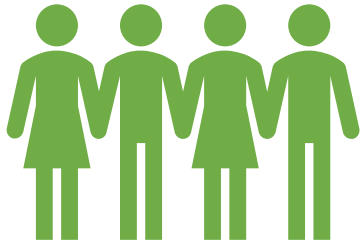
Finding the usability and feasibility of the intervention

Finding the impact of the intervention e.g., impact assessment (Susaf)

Expected outcomes



Less energy consumption among the citizens



Increasing community interaction

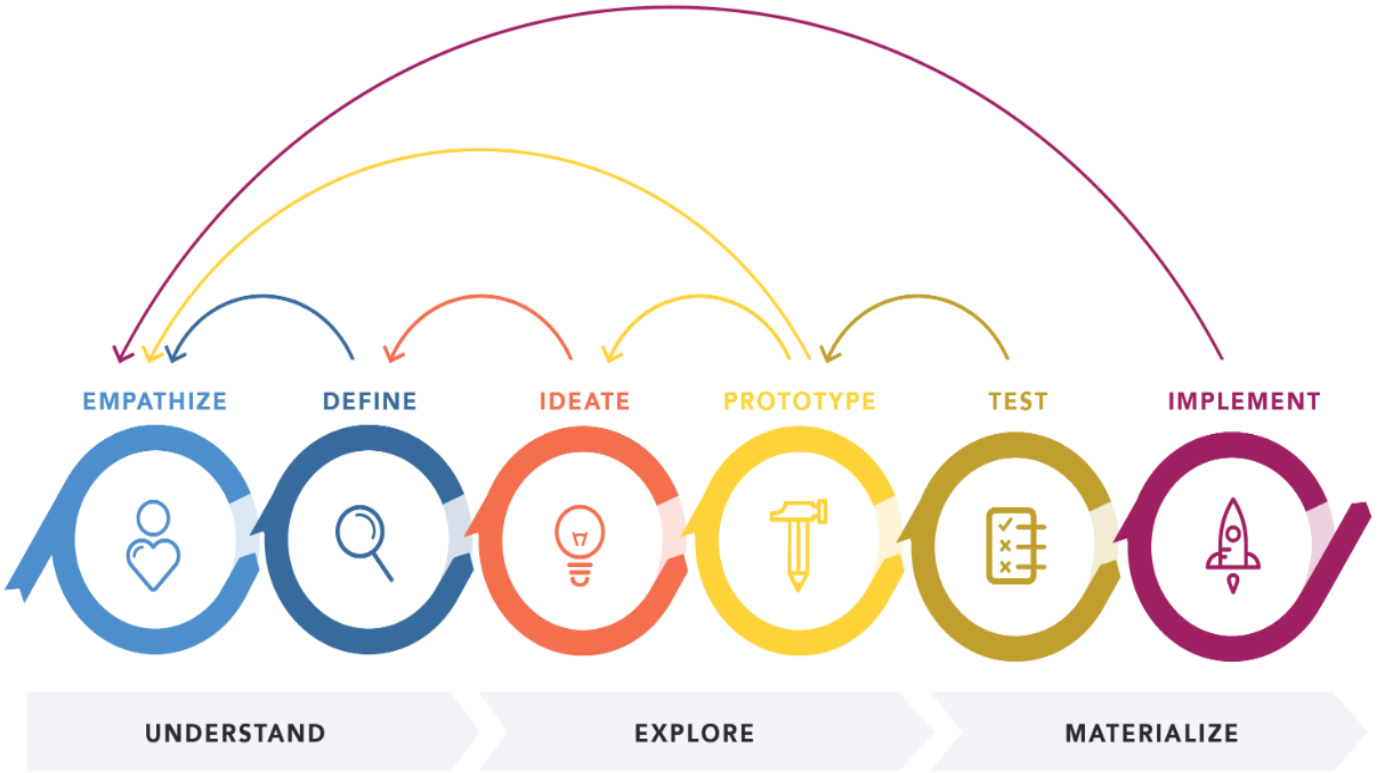
Method

DESIGN THINKING

EXPERIMENTAL STUDY

Design thinking iterative process

- Empathise
- Define
- Ideate
- Prototype
- Test
- Implementation



Design thinking iterative process

- Empathise
- Define
- Ideate
- Prototype
- Test
- Implementation

Experimental study

- Testing via citizen with the existing solution

  - Experimental group

- Testing via citizen with newly developed solution

  - Control group

Behavior Change

- Behavior Change Methods
- Behavior Change Metrics
- Collecting Behavioral Data (Subjective & Objective)
- Analyze Behavioral Data (Short term)
- Analyze Behavioral Data (Long-term)

https://www.nirandfar.com/changing-habits-amy-bucher/

Behavior change methods

How do we alter our habits and behaviour?

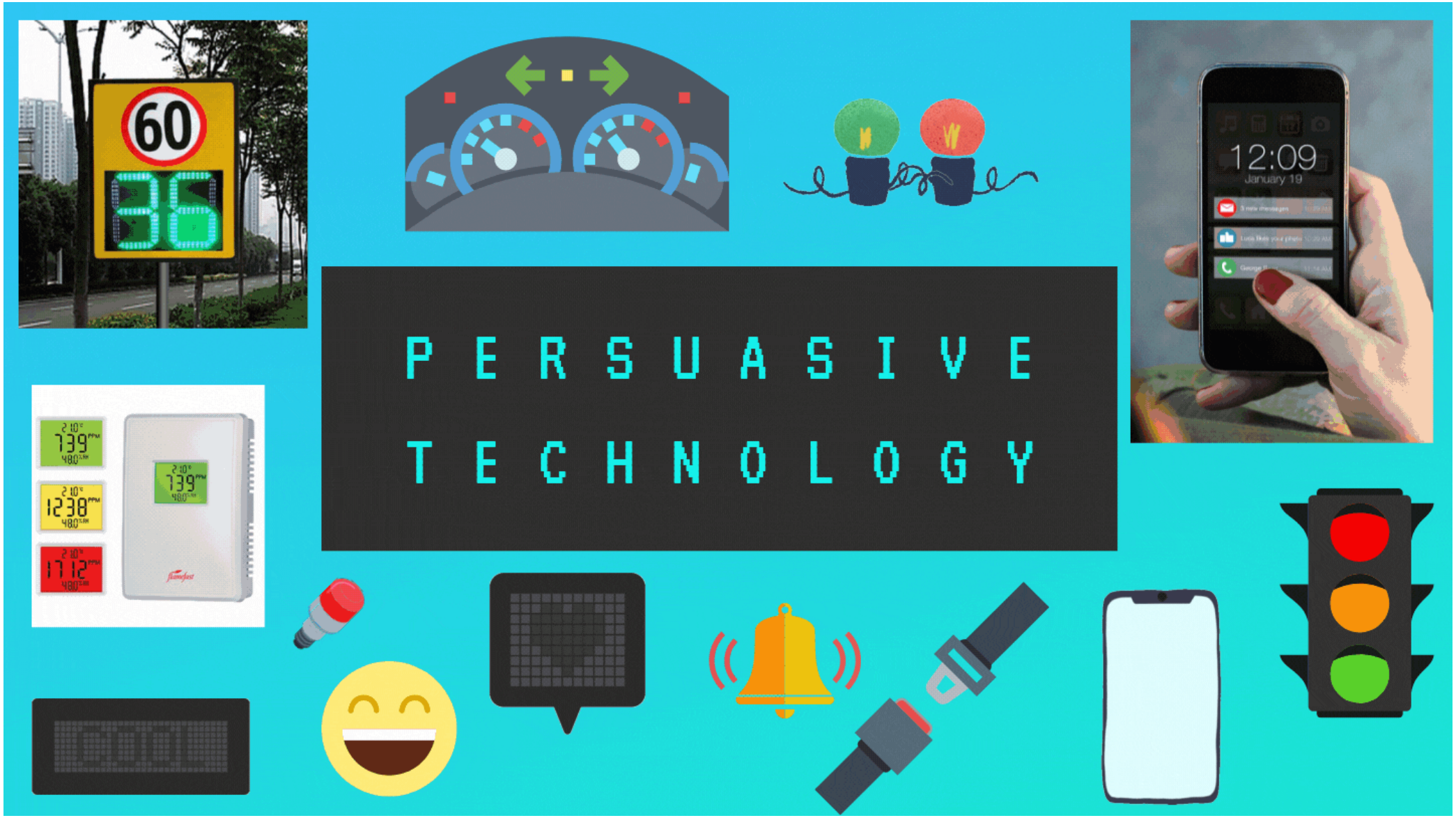
- **how can we influence someone <u>gently!</u>**

Changing behavior for digital sustainability

Digital sustainability can be achieved through digital nudges to **change bad habits or reinforce energy**-efficient consumption behaviors.

For example, Beermann et al. (2022) identify several digital nudges, including goal setting, defaults, feedback, social reference, and framing, which can facilitate behavioral change.

Similarly, Shevchuk et al. (2019) find that gamification as a design feature can enhance perceived persuasiveness in promoting sustainable energy behaviors.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PERSUASIVE
TECHNOLOGY

	PERSUASIVE DESIGN FEATURES			
PERSUASION CONTEXT	**PRIMARY TASK SUPPORT**	**DIALOGUE SUPPORT**	**CREDIBILITY SUPPORT**	**SOCIAL SUPPORT**
The Intent *Persuader* *Change type*	*Reduction* *Tunneling* *Tailoring* *Personalization* *Self-monitoring* *Simulation* *Rehearsal*	*Praise* *Rewards* *Reminders* *Suggestion* *Similarity* *Liking* *Social role*	*Trustworthiness* *Expertise* *Surface credibility* *Real world feel* *Authority* *Third party endorsements* *Verifiability*	*Social learning* *Social comparison* *Normative influence* *Social facilitation* *Cooperation* *Competition* *Recognition*
The Event *Use context*[a] *User context*[b] *Technology context*[c]				
The Strategy *Message* *Route*				

[a] Problem domain dependent features
[b] User dependent features e.g. goals, motivation, lifestyles, and others
[c] Technology dependent features

PSD Model (adapted from Oinas-Kukkonen and Harjumaa, 2009)

Citizens can be motivated intrinsically

Nudge technique (Thaler and Sunstein, 2008)

- Influence our knowledge about cognitive biases to change behavior in a positive direction.
- Cost-effective intervention, such as used in health and wellbeing promotion

Behavioral Nudges

Convenience Enhancement

Placing a bowl of nuts/fruits for "grab and go"

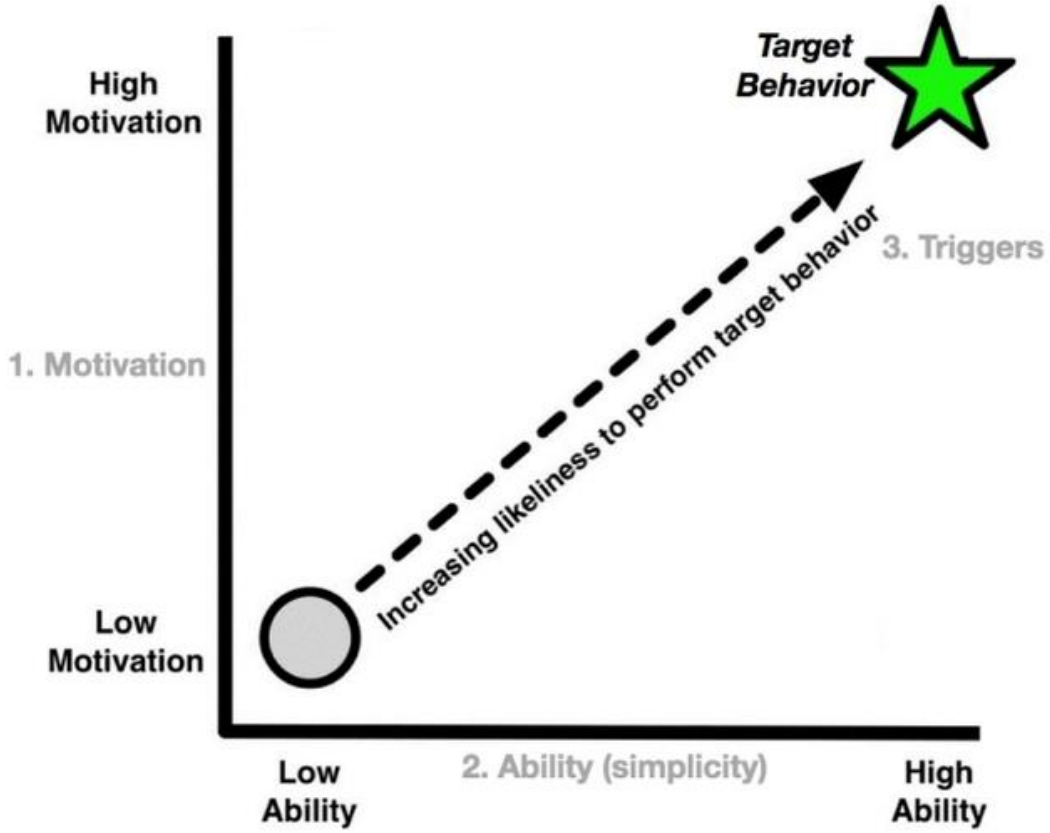
Size enhancements

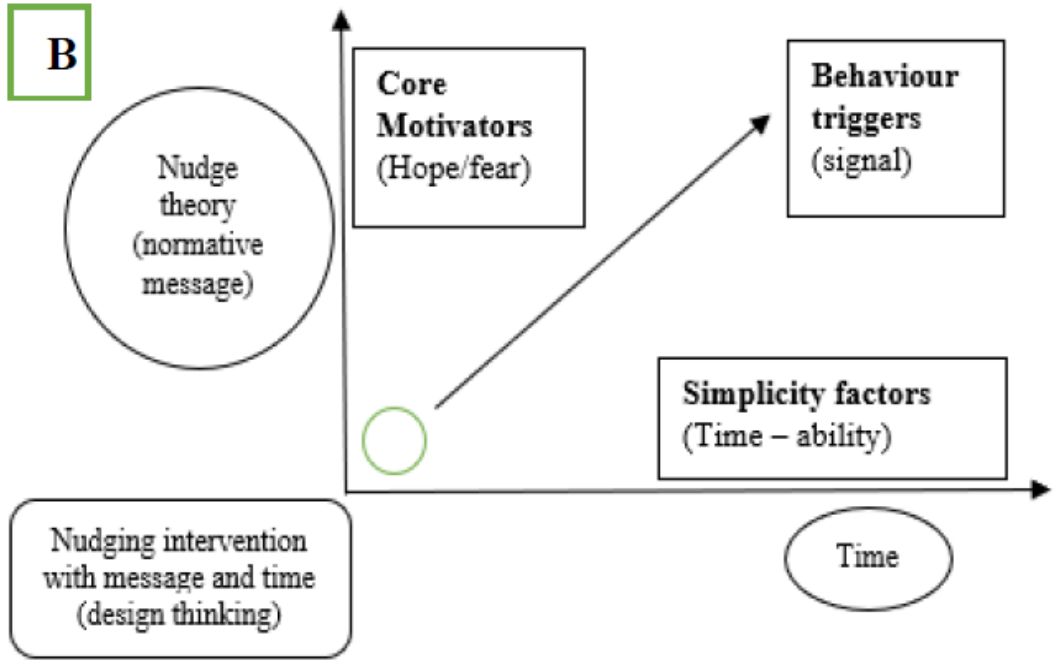
Choosing a bowl for a snack

A nudge-based physical activity promotion prototype

Haque, M. S., Lanzilotti, R., & Jämsä, T. Do nudges work? Using personal normative message in mHealth intervention to dissuade from physical inactivity, DNDP. Persuasive Technology (2022)

Adopting Fogg behavioral model





Behavior Change Metrics

- Quantitative indicators of your users' actual or observable behaviors include duration, frequency, completion, and retention etc.

- **Example: Customer lifeline Value (CLV)/User Lifeline Value**

Customer lifeline Value (CLV)/User Lifeline Value

Calculator	Average Annual Revenue Per Customer	$ 100,000.00	Per Year
	Average Lifetime of Customer	5	Years
	Customer Lifetime Value	$ 500,000.00	

Now it is your turn to proceed!

Average Annual Energy Consume Per Customer?

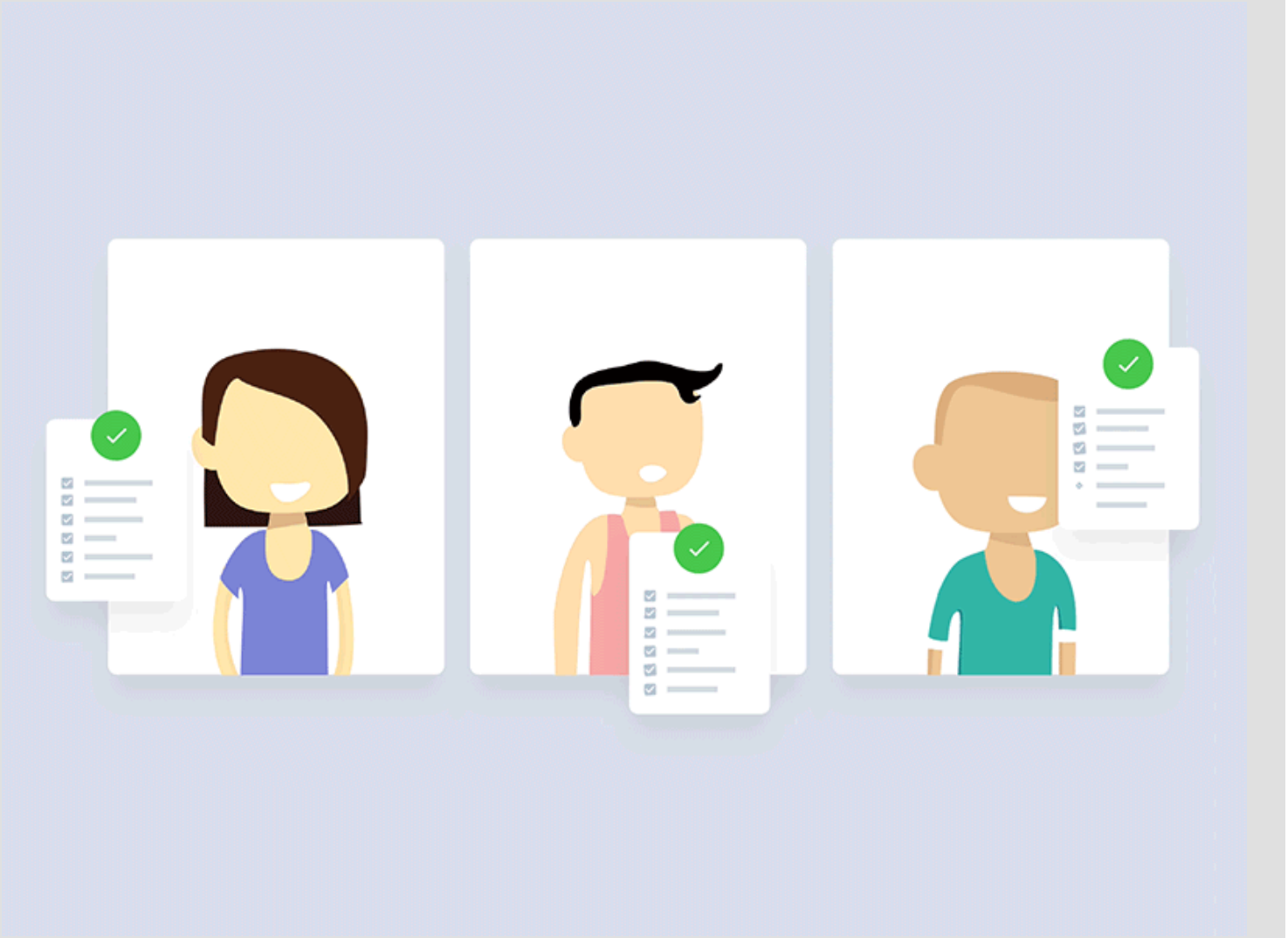
Amount of time

Hints: Lower CLV values is positive for user behavior change (when we don’t consider money)

Analyze user behavior change data

Can we measure user satisfaction and experience?

What is Usability testing?

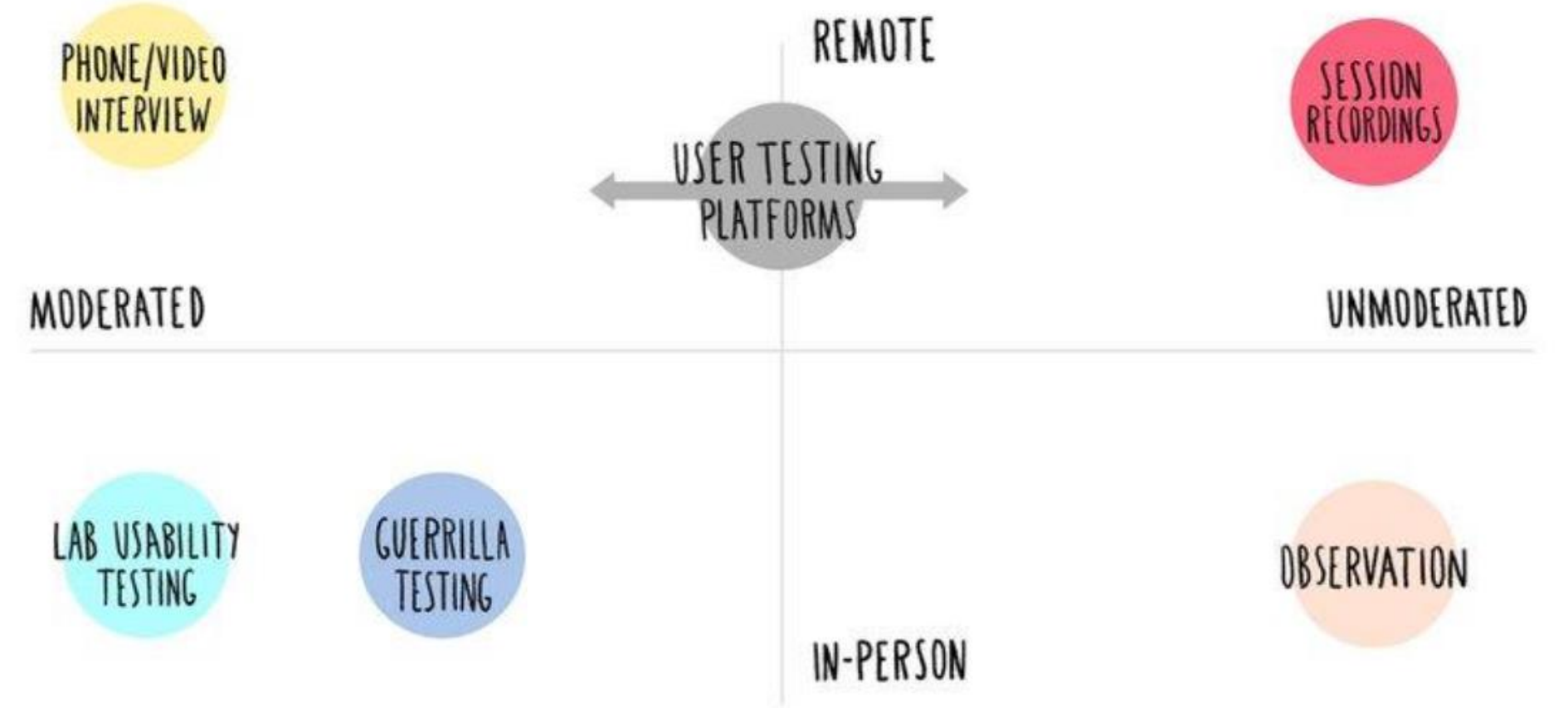


Usability testing of software solutions

SUS (System Usability Scale) created by John Brooke in 1986.

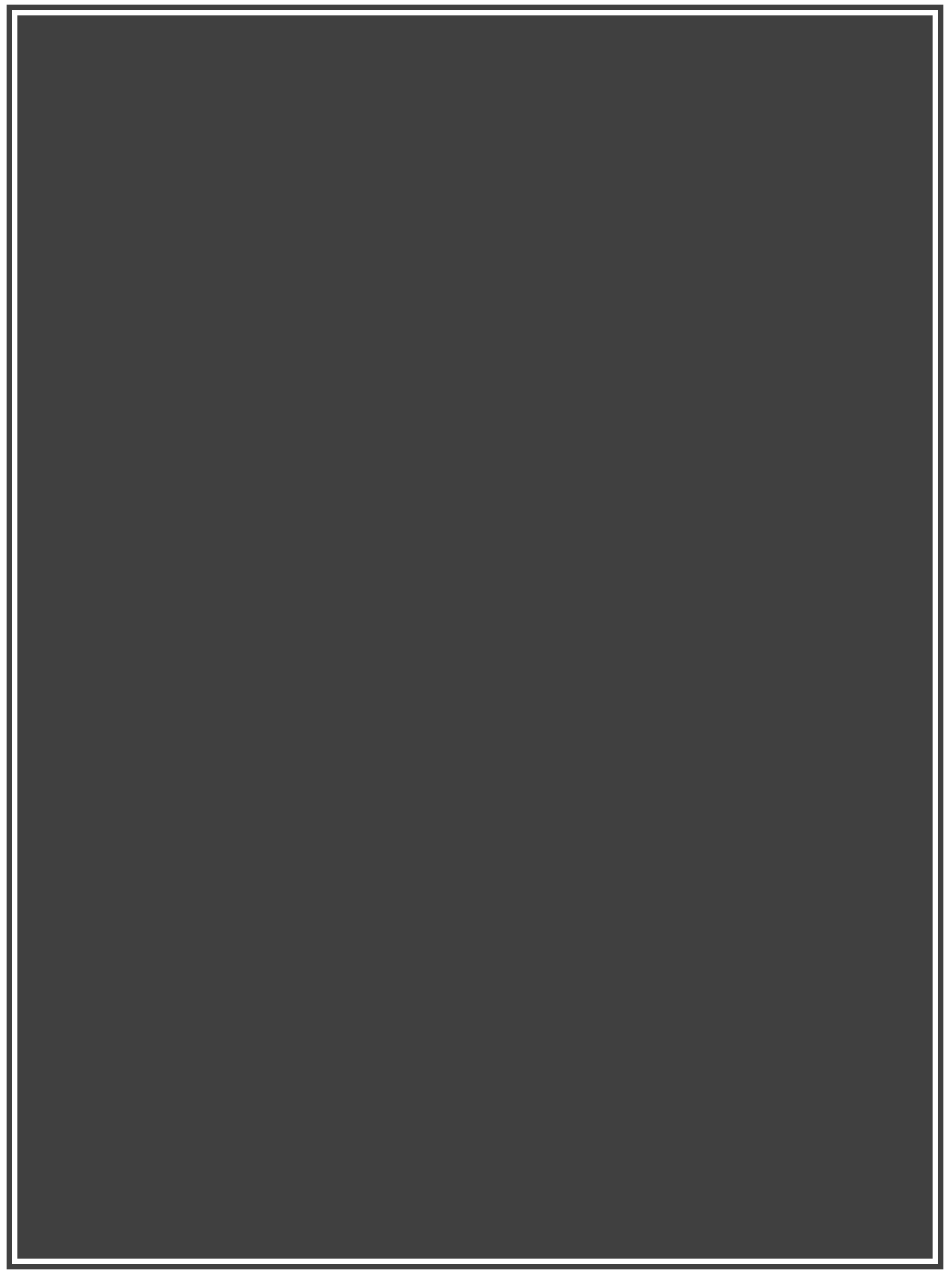
- quick processing time. Since there are definitive 10 questions.
- versatility and applicability for various software, hardware or websites.
- Since the SUS score is simple to calculate, the results are easily obtained and can be worked upon for making a system perform better.
- helps in understanding where the problem lies.
- SUS has the ability to evaluate user satisfaction and is considerably inexpensive (zero-cost)

User testing methods



SUS questionnaire: 10 questions in 5-Likert scale

	The System Usability Scale Standard Version		Strongly Disagree				Strongly Agree
			1	2	3	4	5
1	I think that I would like to use this system frequently.		O	O	O	O	O
2	I found the system unnecessarily complex.		O	O	O	O	O
3	I thought the system was easy to use.		O	O	O	O	O
4	I think that I would need the support of a technical person to be able to use this system.		O	O	O	O	O
5	I found the various functions in this system were well integrated.		O	O	O	O	O
6	I thought there was too much inconsistency in this system.		O	O	O	O	O
7	I would imagine that most people would learn to use this system very quickly.		O	O	O	O	O
8	I found the system very awkward to use.		O	O	O	O	O
9	I felt very confident using the system.		O	O	O	O	O
10	I needed to learn a lot of things before I could get going with this system.		O	O	O	O	O



How to calculate SUS scale?

X0 = X (sum of odd number points) – 5

Y0 = 25 – Y (sum of even number points)

SUS Score = (X0 + Y0) x 2.5

Interpretation of SUS

SUS Score	Grade	Adjectival Rating
>80.3	A	Excellent
68-80.3	B	Good
68	C	Okay
51-68	D	Awful
<51	F	Poor

- **LUT Software Sustainability Research Group**
- **Hackathon, April, 24-25th 2023**

(P: 13) Go green = **60.8**

(P:13) Reactors = **64.6**

(P:6) Oh my hack = **66.23**

(P:11) SusAI = **63.1**

Interpretation of SUS

SUS Score	Grade	Adjectival Rating
>80.3	A	Excellent
68-80.3	B	Good
68	C	Okay
51-68	D	Awful
<51	F	Poor

Reasons for low score (Iteration 1)

- System did not follow user-centric design approaches
- Low number of testers
- Not understanding each other's context
- The interface is relatively complex
- You have not used it in real but only pretended to use
- Envy/competition to each others work

UEQ questionnaire: 22 questions in 5-Likert scale

Attractiveness
Dependability
Efficiency
Novelty
Perspicuity
Stimulation

UEQ questionnaire: 22 questions in 5-Likert scale

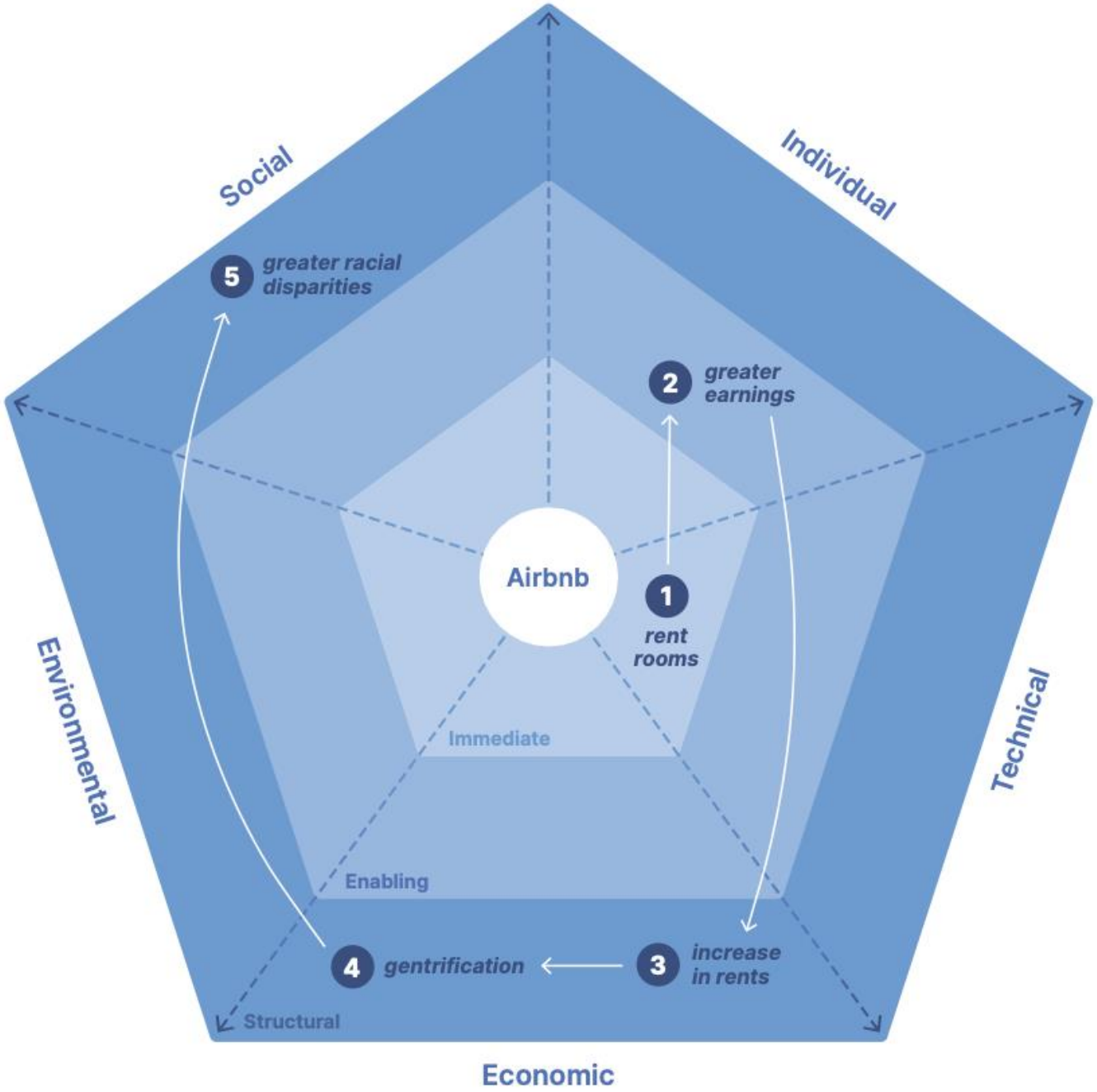
annoying/enjoyable	**Attractiveness**
attractive/unattractive	**Attractiveness**
friendly/unfriendly	**Attractiveness**
good/bad	**Attractiveness**
unlikable/pleasing	**Attractiveness**
unpleasant/pleasant	**Attractiveness**
meets expectations/does not meet expectations	**Dependability**
obstructive/supportive	**Dependability**
secure/not secure	**Dependability**
unpredictable/predictable	**Dependability**
fast/slow	**Efficiency**
impractical/practical	**Efficiency**
inefficient/efficient	**Efficiency**
organized/cluttered	**Efficiency**
conservative/innovative	**Novelty**
creative/dull	**Novelty**
inventive/conventional	**Novelty**
usual/leading edge	**Novelty**
clear/confusing	**Perspicuity**
complicated/easy	**Perspicuity**
easy to learn/difficult to learn	**Perspicuity**
not understandable/understandable	**Perspicuity**
boring/exciting	**Stimulation**
motivating/demotivating	**Stimulation**
not interesting/interesting	**Stimulation**
valuable/inferior	**Stimulation**

BPNSS questionnaire

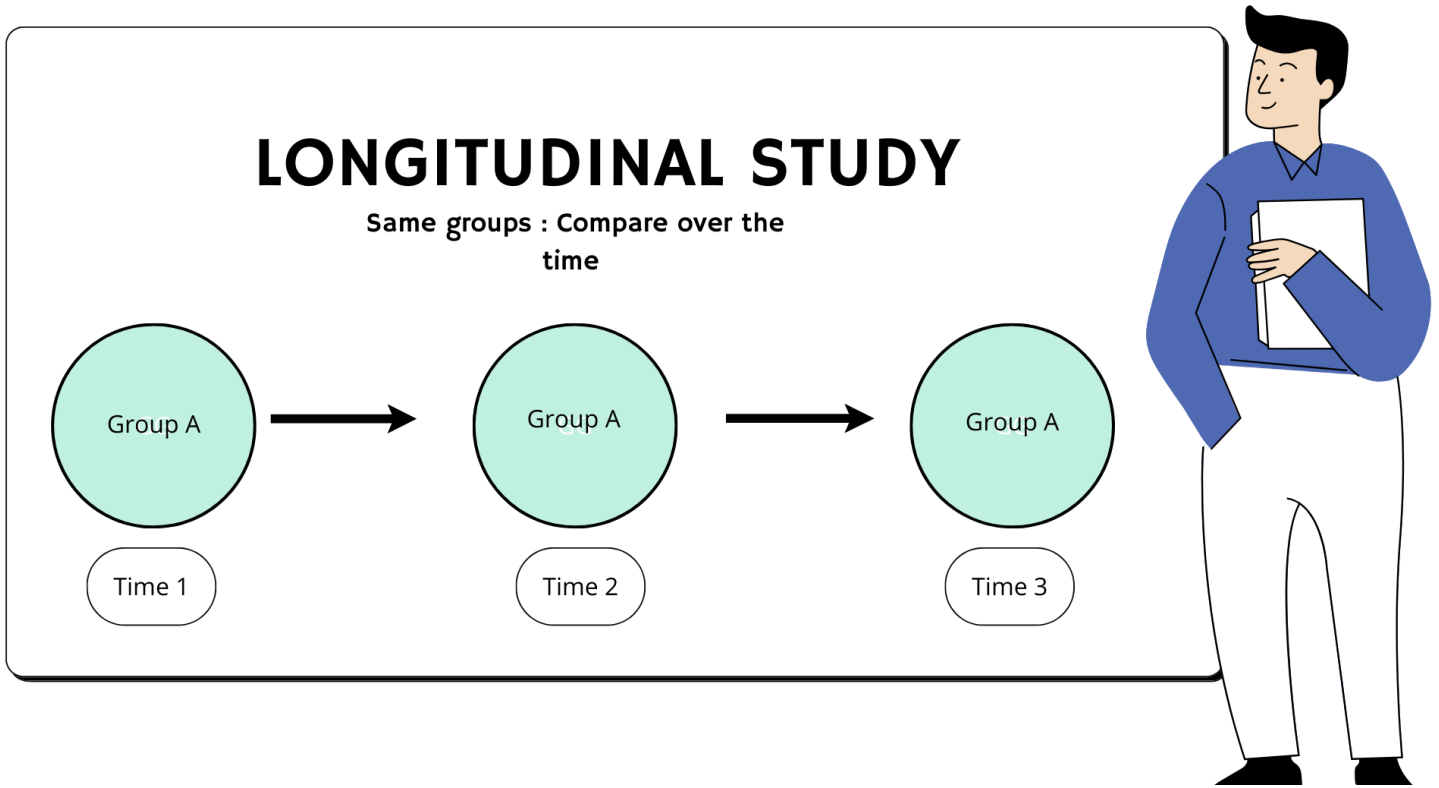
- The Basic Psychological Need Satisfaction Scales is a set of original **questionnaires** that assess the degree to which citizens feel the satisfaction of these three needs of autonomy, competence, and relatedness.

Qualitative approach

- Interviews, semi-structured
- Surveys
- ……



But we need to evalaute the long term effect of the solutions over changing behaviour



https://university.sopact.com/article/longitudinal-study-vs-cross-sectional

THANK YOU

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