

SwimTrain

Exploring Exergame Design for Group Fitness Swimming

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A photograph of two women in athletic gear walking on a dirt trail. They are smiling and appear to be engaged in conversation. The woman on the left wears an orange tank top and grey shorts, while the woman on the right wears a pink tank top and black shorts. The background features lush green hills under a clear sky.

Exercise Together



Sharing / comparing
exercise records

[Nike+]

Exercise Together





Sharing / comparing
exercise records

[Nike+]



Playing video games
using their own bodies

[Ahn, ACE '09]

Exercise Together



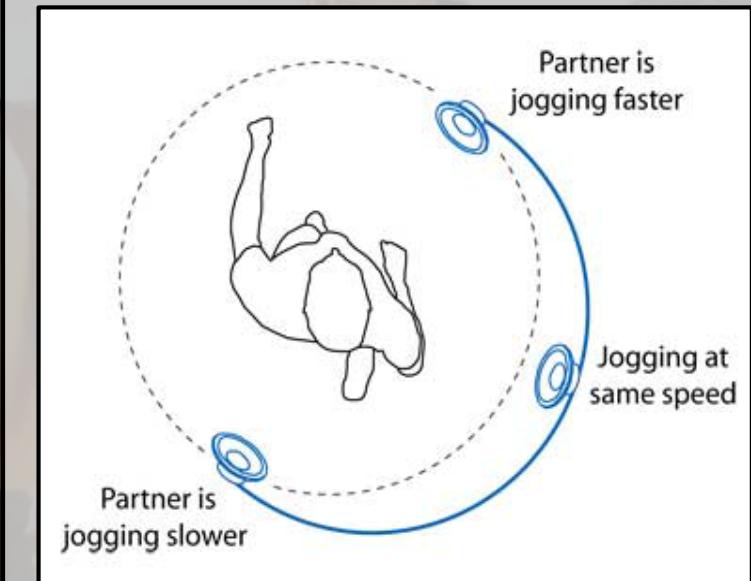
Sharing / comparing
exercise records

[Nike+]



Playing video games
using their own bodies

[Ahn, ACE '09]



Synchronously exercise
with others via network

[Mueller, UIST '10]

Exercise Together

Group Fitness



Fitness exercise performed by a group of people led by an instructor



A photograph showing four people jogging away from the camera on a paved path in a park. The path is lined with green grass and trees. The joggers are wearing athletic gear, including t-shirts, shorts, and running shoes. One person in a white shirt has a small device attached to their arm. The scene is bright and sunny.

Group Fitness with Technology

[Mauriello, CHI '14]

Group Fitness Swimming



Fitness swimming performed by a group of people led by an instructor



Small DoF
for interactions

Constraints of Swimming

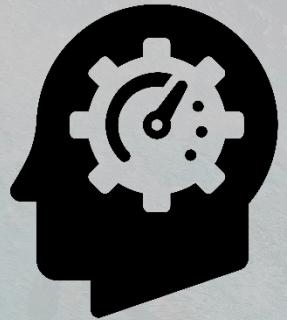


Small DoF
for interactions



Limited opportunities
for communication

Constraints of Swimming



Small DoF
for interactions



Limited opportunities
for communication



Vulnerable
network connectivity

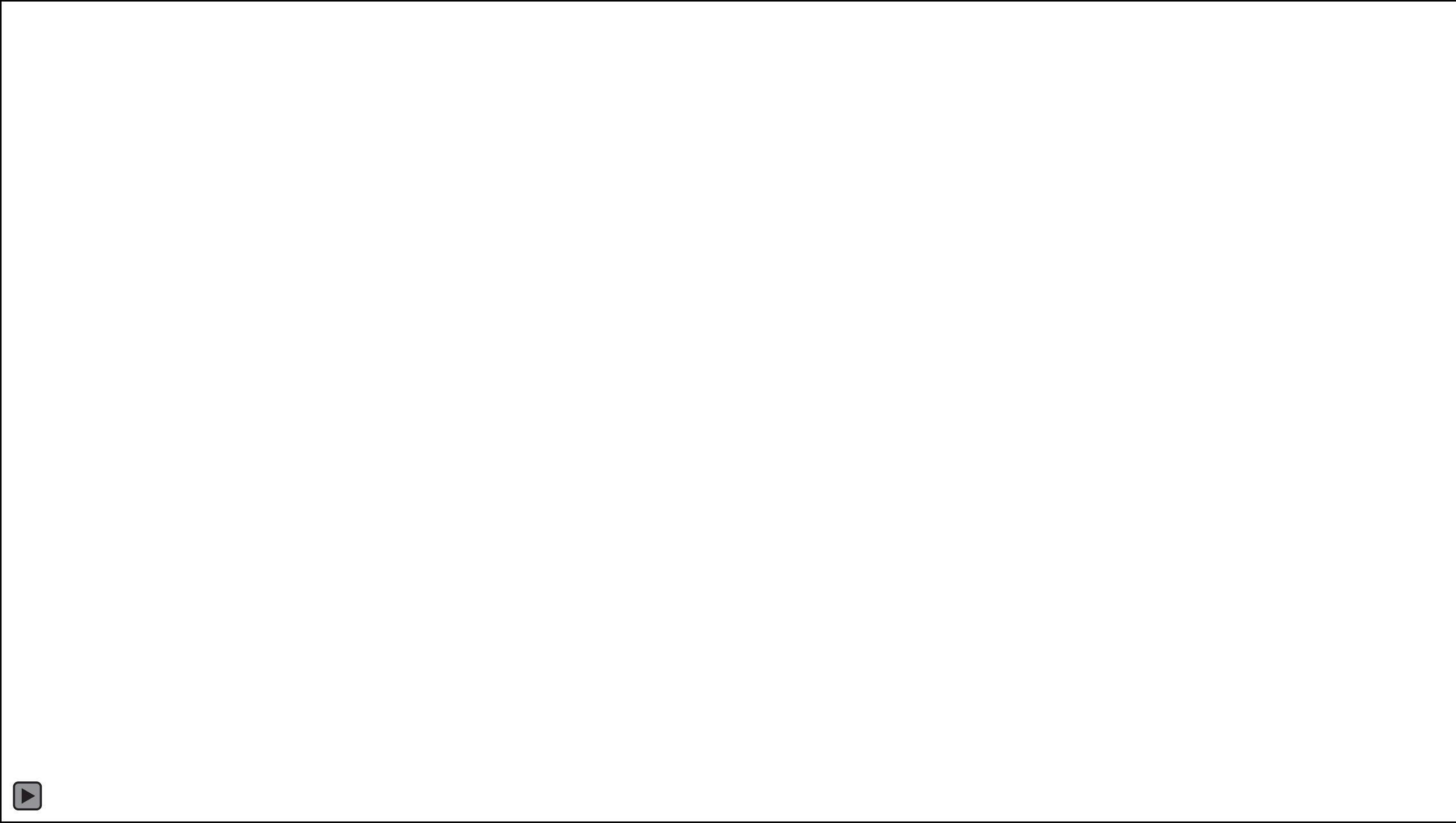
Constraints of Swimming

Design Goal

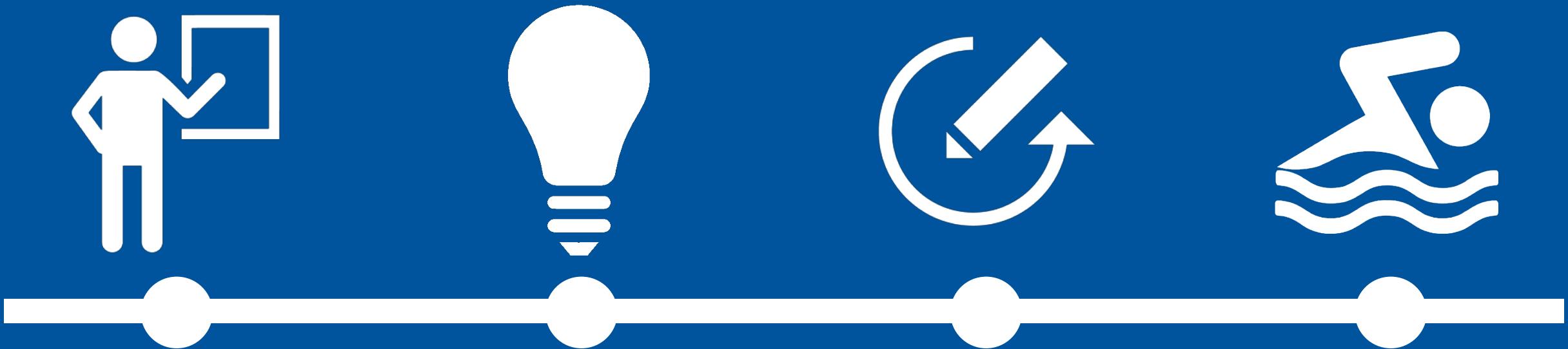
Building group fitness swimming game
providing the similar degree of social experiences as in group fitness
without causing information load

Design Goal





Design Process



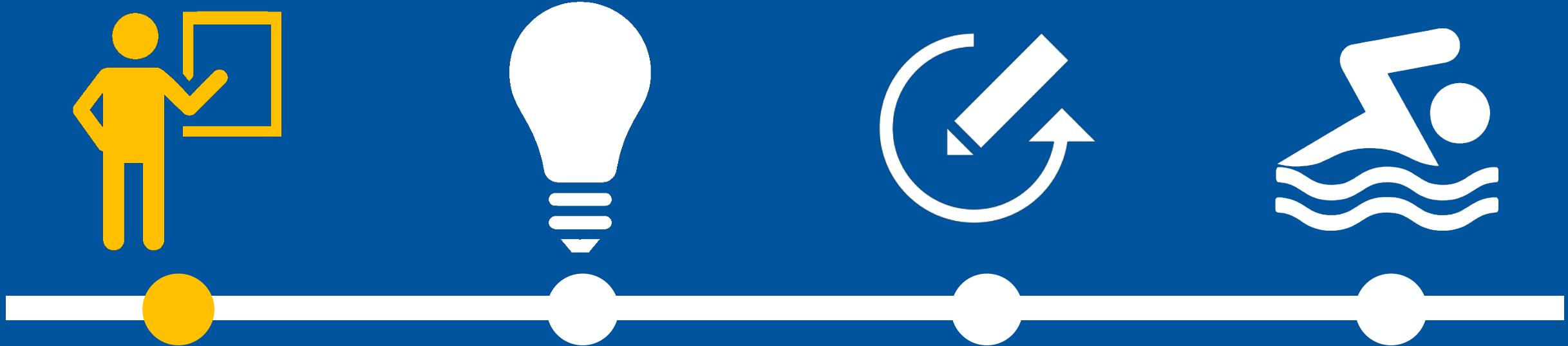
Expert Interviews
/ Observation

Ideation
/ Prototyping

Pilot Study
/ Design Revision

User Study

Design Process



Expert Interviews
/ Observation

Ideation
/ Prototyping

Pilot Study
/ Design Revision

User Study

A photograph of a woman in a pink tank top and shorts stretching her right arm above her head by a swimming pool. In the background, several swimmers are in the water, and a person is standing on the edge. A blue and white bunting banner hangs across the pool area.

Understanding Group Fitness Swimming



conducting interviews with swimming instructors (n=3)
/ observing group swimming situations

Lane sharing

“In the case of a class for elementary school students, two lanes were assigned with more than fifteen people. [...] For (adult) workers, one lane was assigned with about ten people.” – E1





Social norms of the pool avoid touching one another's bodies (regarded as a taboo) and disrupting others' training regimens

Similar pace in the same lane

"I allows skilled swimmers to swim in the deeper lane." – E1

"If I follow up the swimmer ahead and swim faster, the followed swimmer tells me to go first." – E2

Congestion in a lane

“When too many people swim in a single lane, they can collide with others [...] The main reason for congestion is swimming skill differences among attendees” – E3



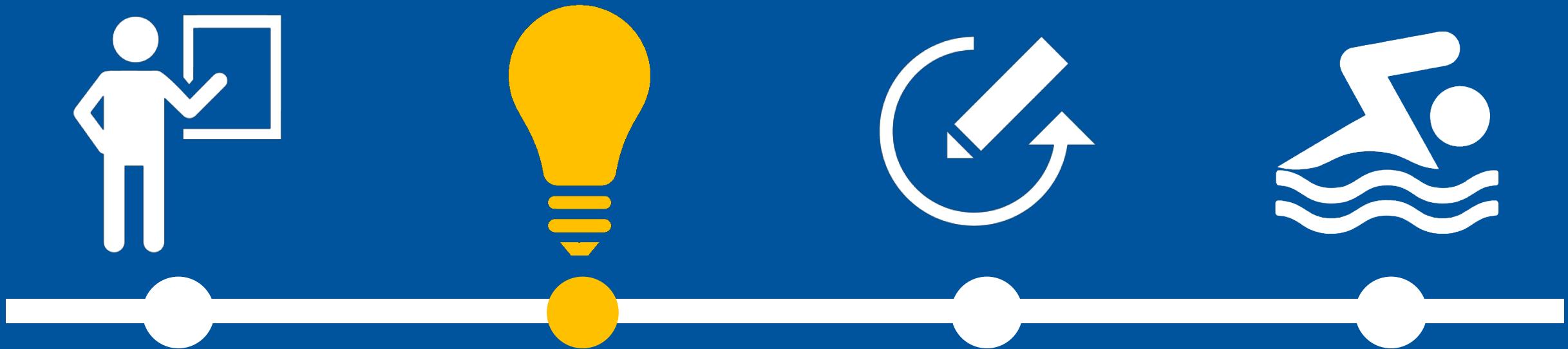


Instructor support

“I have different programs according to swimming competence.” – E3

“I give them feedback about when they should breath over as I follow them. Also, I sometimes measure lap time.” – E2

Design Process



Expert Interviews
/ Observation

Ideation
/ Prototyping

Pilot Study
/ Design Revision

User Study

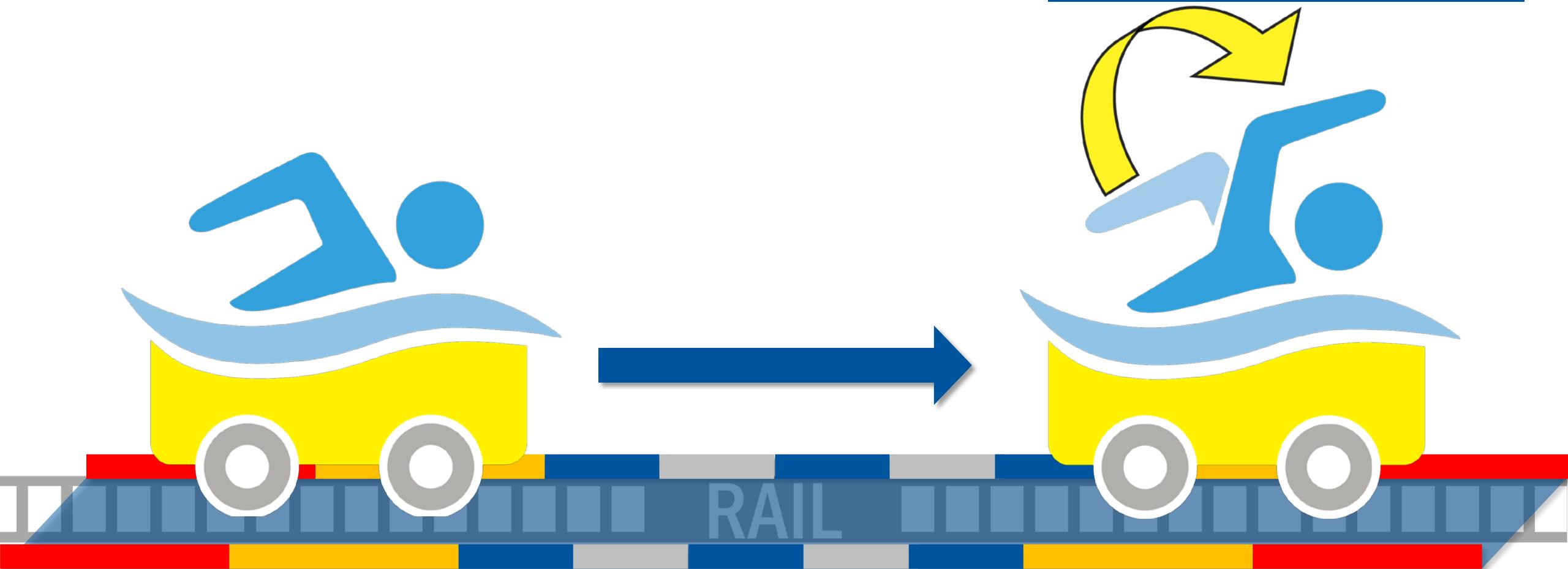
Train Metaphor

Real Space

Virtual Space



Train Metaphor



Train Metaphor



Train Metaphor



Game Flow

Single Round

Competitive phase

Compartment Ordering

Establishing a target stroke rate
with train cars racing



$$Y_t = \alpha X_t + (1 - \alpha)Y_{t-1}$$

X_t : stroke rate at time t

Y_t : accumulated stroke rate at time t

Game Flow

Single Round

Competitive phase

Compartment Ordering

Establishing a target stroke rate
with train cars racing



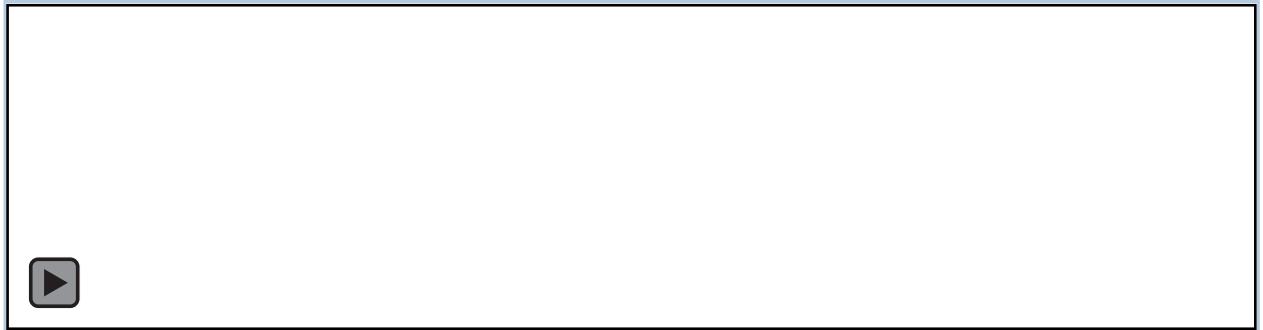
Game Flow

Single Round

Competitive phase

Compartment Ordering

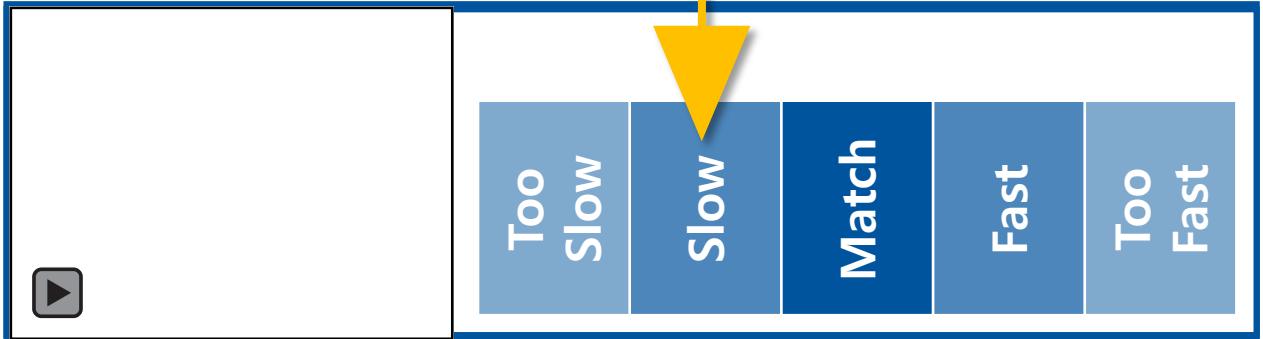
Establishing a target stroke rate
with train cars racing



Cooperative phase

Train Running

Maintaining a target stroke rate
with pseudo-cooperation



Game Flow

Single Round

Competitive phase

Compartment Ordering

Establishing a target stroke rate
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Game Flow

Single Round

Competitive phase

Compartment Ordering

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with train cars racing



Cooperative phase

Train Running

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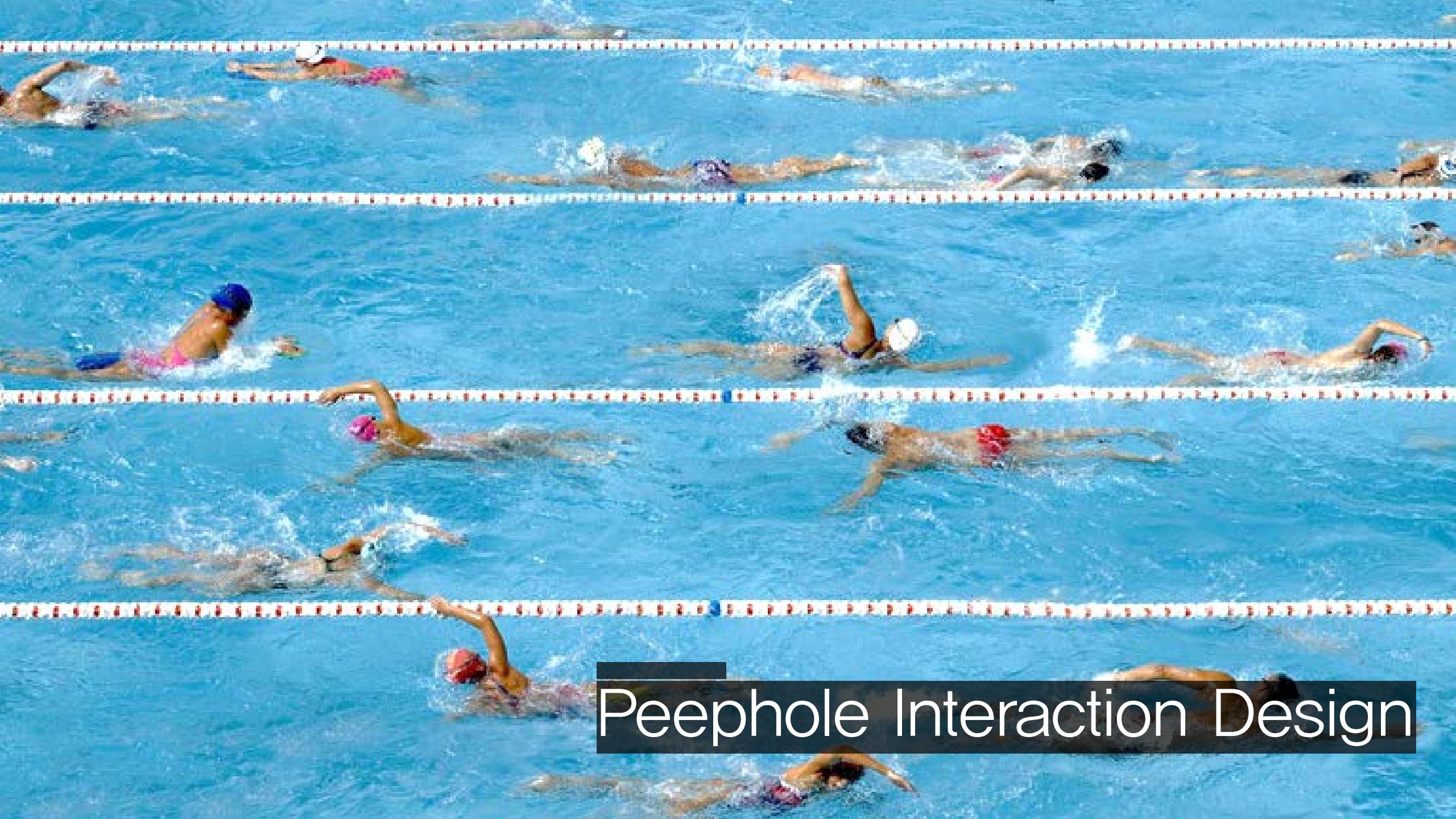


Break phase

Train Stop

Taking a short break
/ informing of rankings and next round



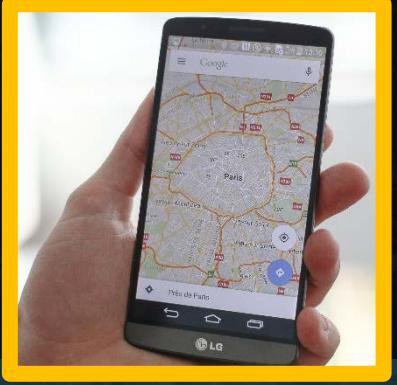


Peephole Interaction Design



Providing a limited view of a larger information space

Peephole Interaction Design



Navigating large info.
spaces in hand-held
devices with small displays



Fog-of-war system
in video games



Providing a limited view of a larger information space

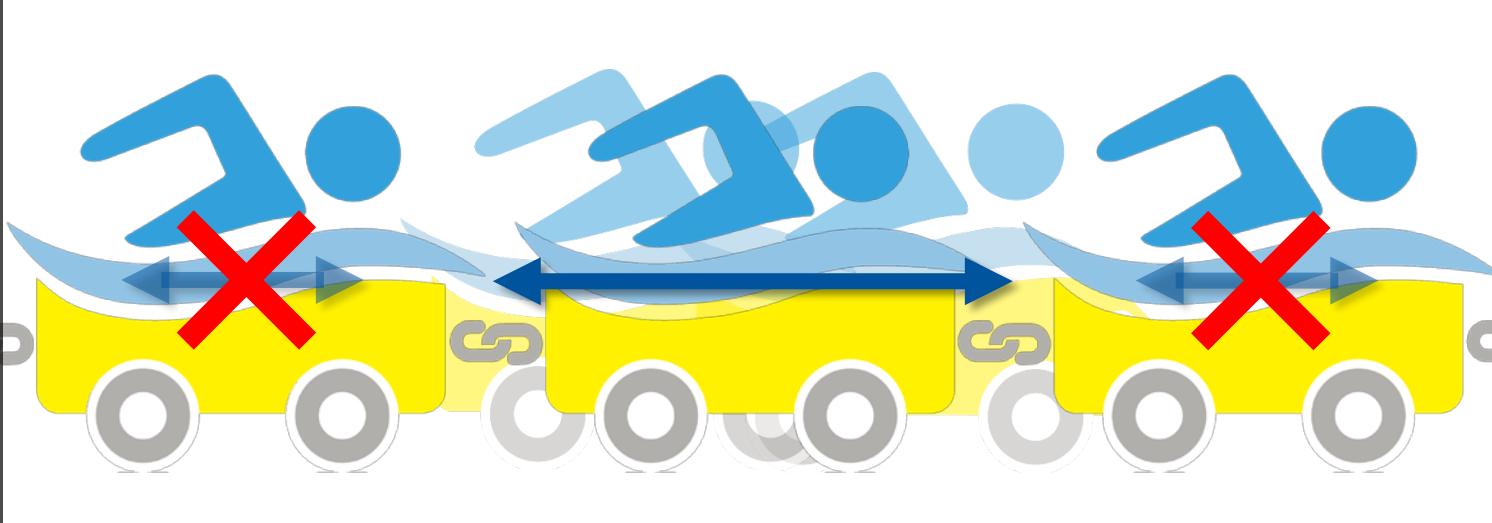
Peephole Interaction Design

Subgrouping and interacting with
virtually **ahead** and **behind** players



Peephole Interaction Design

Pseudo-cooperation: Providing the illusion of cooperation, instead of supporting actual synchrony



Peephole Interaction Design

Chaining subgroups and
organizing whole players into a single group



Peephole Interaction Design

Other Design Rationales



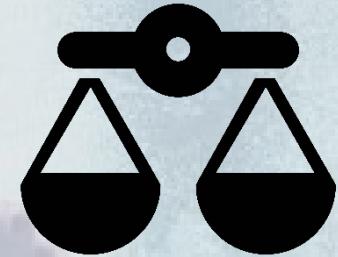
Virtual
instructor



Intuitive
interactions



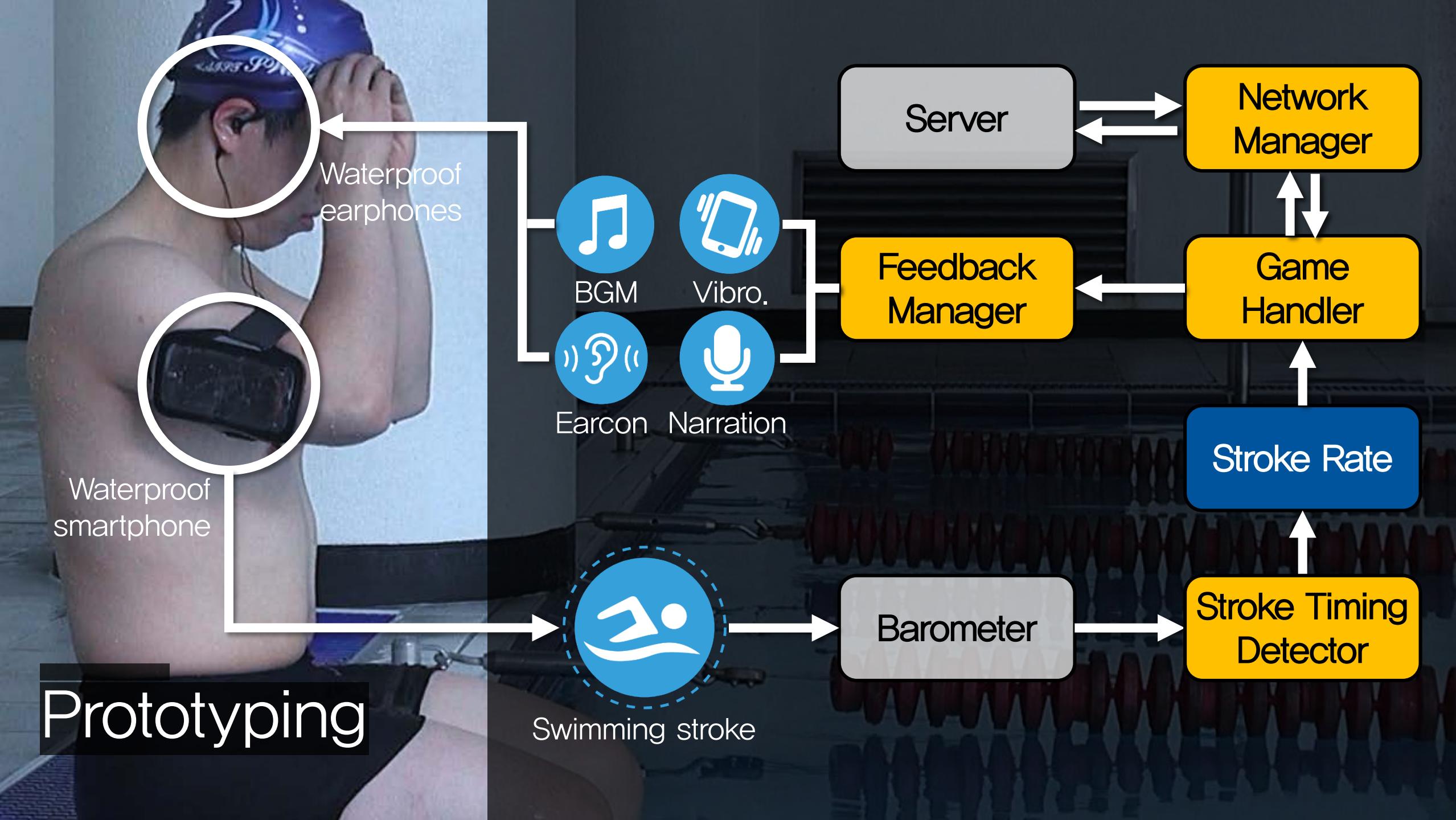
Motivating with
competition &
collaboration



Balanced
exertion



Strategic
game play

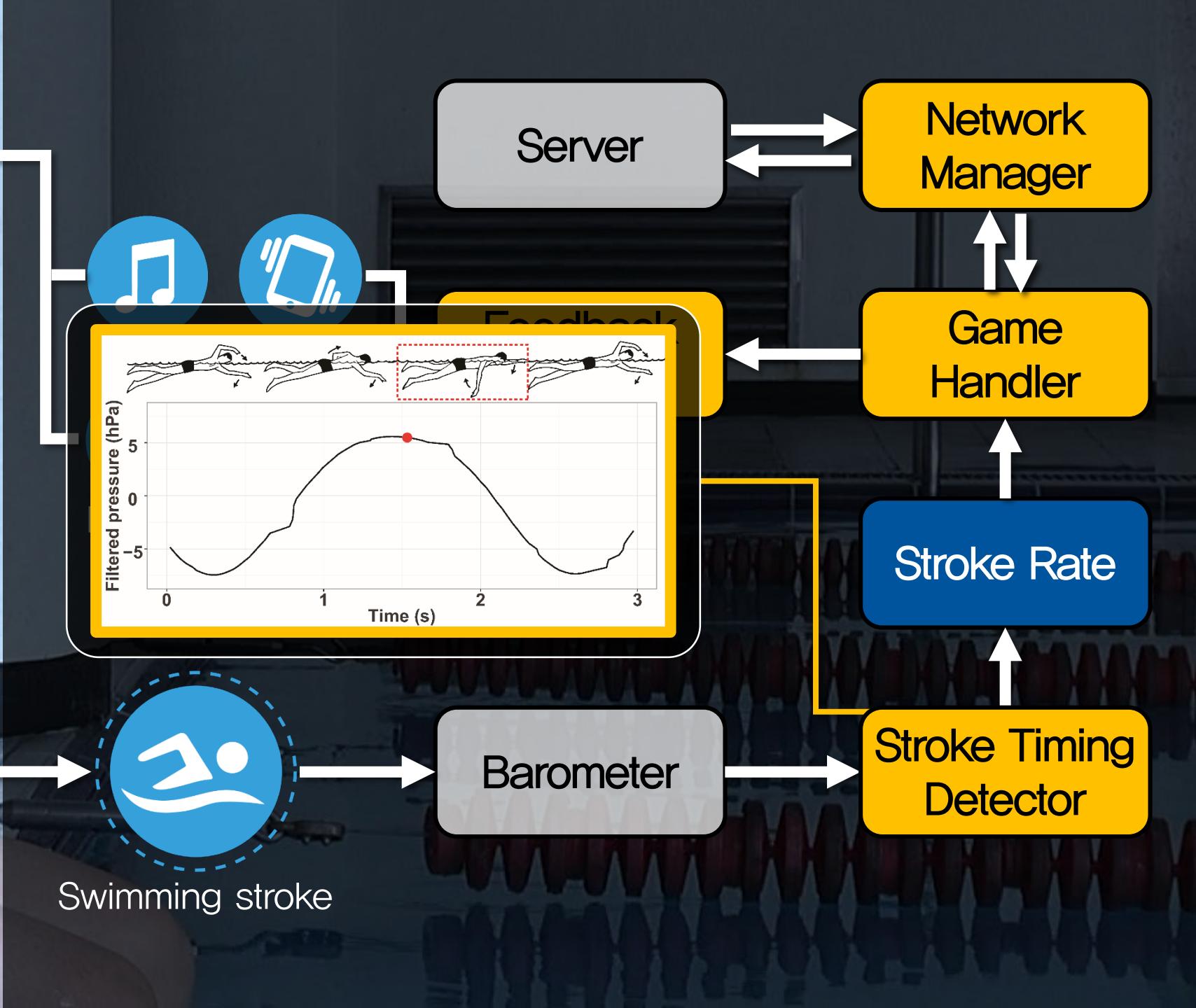


Prototyping



Waterproof
earphones

Waterproof
smartphone

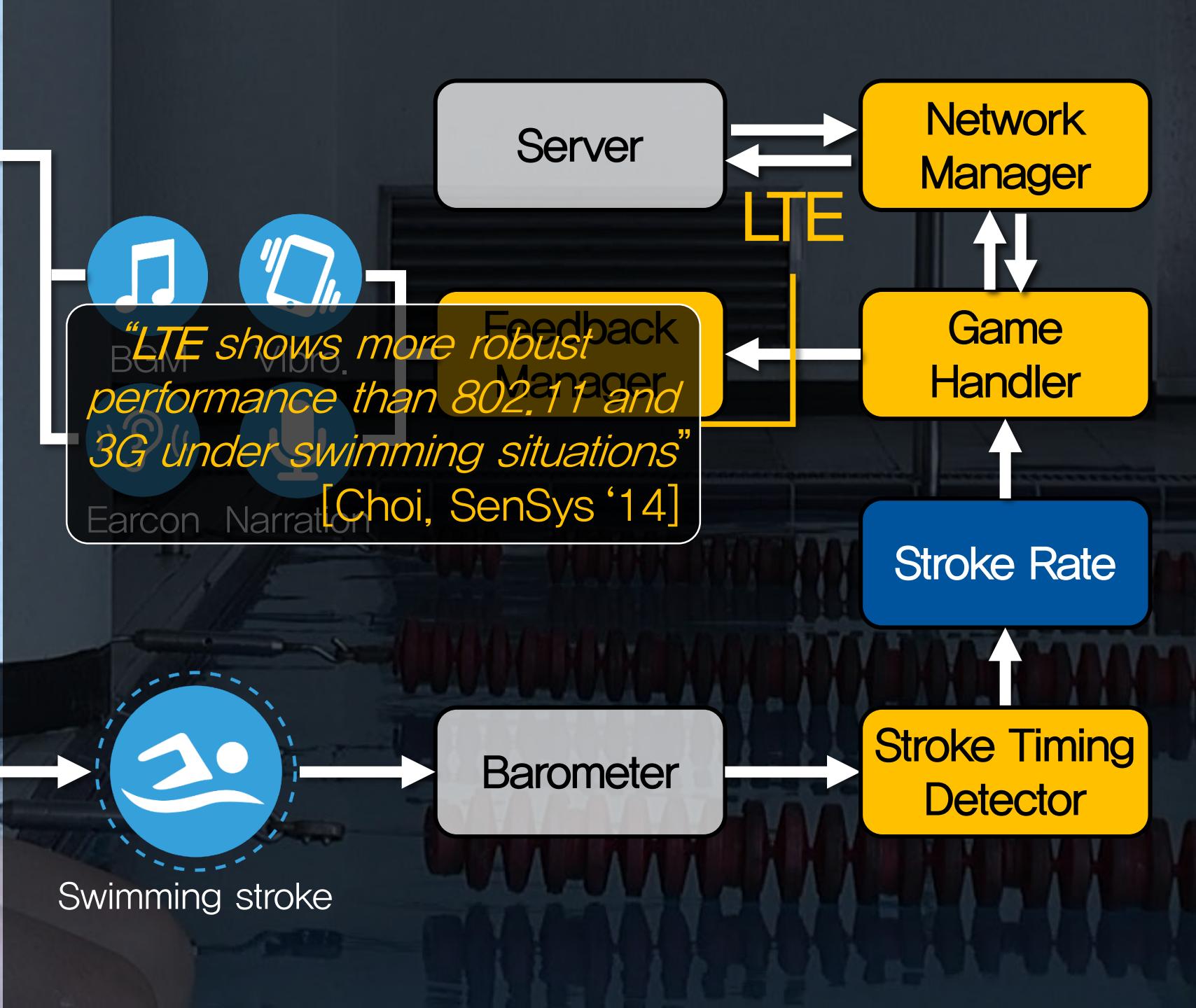




Waterproof
earphones

Waterproof
smartphone

Prototyping



Swimming stroke

Server

Network
Manager

LTE

Game
Handler

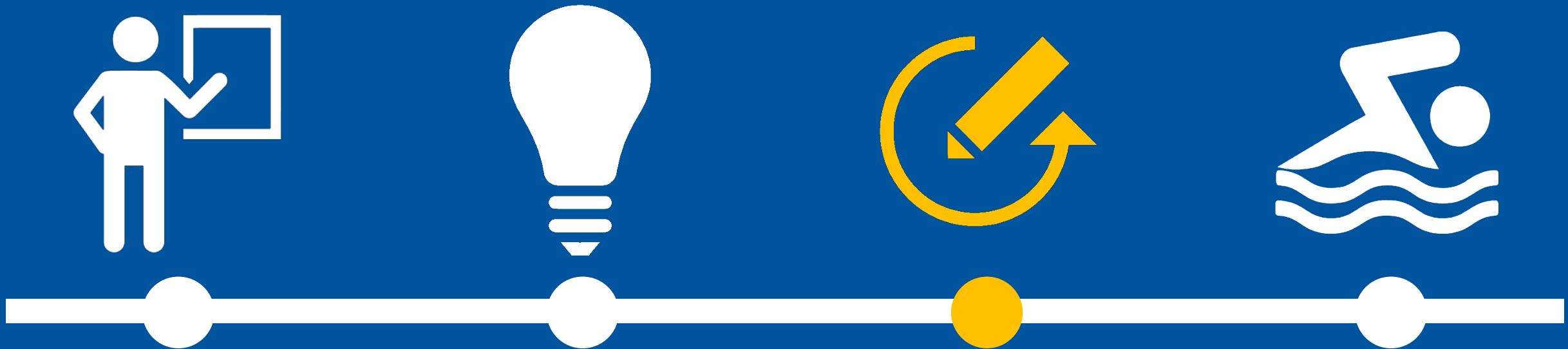
Stroke Rate

Stroke Timing
Detector

Barometer

“LTE shows more robust
performance than 802.11 and
3G under swimming situations”
[Choi, SenSys ‘14]

Design Process



Expert Interviews
/ Observation

Ideation
/ Prototyping

Pilot Study
/ Design Revision

User Study

Initial Prototype

- ★ Informing of rankings
- 💬 Directly notifying of relative SR
- 🎧 Using a spatial earcon
- 👤 Not referring to nicknames

Preliminary User Study

Initial Prototype

- ★ Informing of rankings
- 💬 Directly notifying of relative SR
- 🎧 Using a spatial earcon
- 👤 Not referring to nicknames

Every 4 seconds,
"You take 3rd place!"

Preliminary User Study

Initial Prototype

- ★ Informing of rankings
- 💬 Directly notifying of relative SR
- 🎧 Using a spatial earcon
- 👤 Not referring to nicknames

Every 4 seconds,
"You are too slow!"

Preliminary User Study

Initial Prototype

- ★ Informing of rankings
- 💬 Directly notifying of relative SR
- 🎧 Using a spatial earcon —————
- 👤 Not referring to nicknames

Being heard ahead of a player if they stroked faster than the target SR

Preliminary User Study

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Recruiting
4 swimmers

1st Round
(CO: 60s, TR:
60s, TS: 50s)

2nd Round
(CO: 60s, TR:
120s, TS: 80s)

3rd Round
(CO: 40s, TR:
40s, TS: 30s)

4th Round
(CO: 40s, TR:
80s, TS: –)

Group
interview

Preliminary User Study

Initial Prototype

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Revision

- 💡 Adding ambiguity in rankings and relative SR
- 🚫 Not using a spatial earcon
- 👤 Allowing to set nicknames
- ⌚ Adjusting phase duration

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Group
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Preliminary User Study



Revision



Adding ambiguity in rankings
and relative SR



Not using a spatial earcon



Allowing to set nicknames



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Group
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Preliminary User Study



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(CO: 40s, TR:
80s, TS: –)

Group
interview

Preliminary User Study

A photograph of four swimmers in a pool, performing the butterfly stroke. They are positioned in lanes separated by yellow and blue lane lines. The water is clear and blue.

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(CO: 40s, TR:
40s, TS: 30s)

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(CO: 40s, TR:
80s, TS: –)

Group
interview

Preliminary User Study

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4 swimmers

1st Round
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60s, TS: 50s)

2nd Round
(CO: 60s, TR:
120s, TS: 80s)

3rd Round
(CO: 40s, TR:
40s, TS: 30s)

4th Round
(CO: 40s, TR:
80s, TS: –)

Group
interview

Preliminary User Study

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- ⌚ Adjusting phase duration

Recruiting
4 swimmers

1st Round
(CO: 60s, TR:
60s, TS: **50s**)

2nd Round
(CO: 60s, TR:
120s, TS: **80s**)

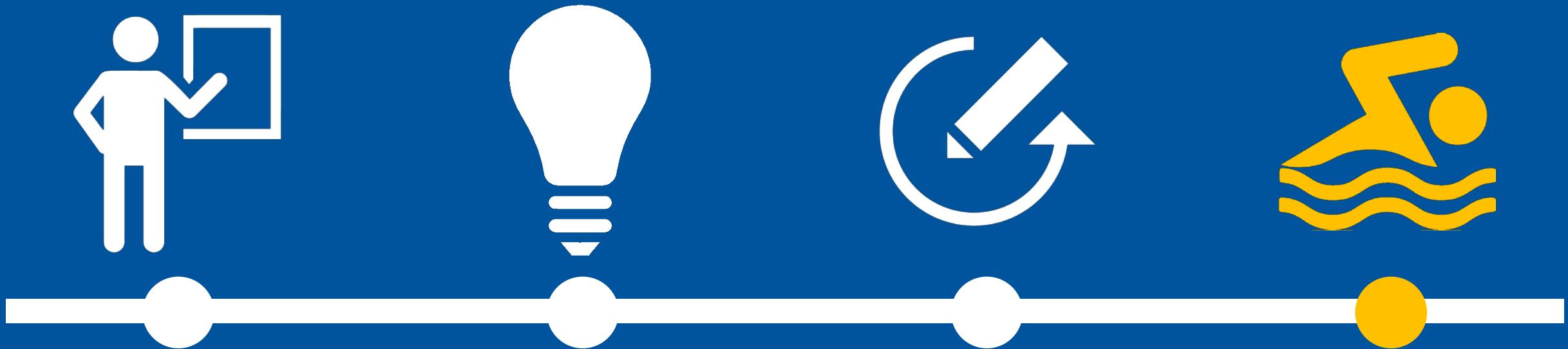
3rd Round
(CO: 40s, TR:
40s, TS: **30s**)

4th Round
(CO: 40s, TR:
80s, TS: –)

Group
interview

Preliminary User Study

Design Process



Expert Interviews
/ Observation

Ideation
/ Prototyping

Pilot Study
/ Design Revision

User Study

User Study

Recruiting
11
swimmers

6 members
5 members

1st Round
(CO: 60s, TR:
60s, TS: 90s)

2nd Round
(CO: 40s, TR:
90s, TS: 120s)

3rd Round
(CO: 60s, TR:
90s, TS: 90s)

4th Round
(CO: 60s, TR:
120s, TS: –)

Group
interviews

User Study

Enriched social experiences during swimming

“Even though each player used a separate lane, it [SwimTrain] felt like swimming in a single lane all together [...] Since it kept announcing the nicknames, it made me wonder who that person was.” – P8

“This game allowed me to feel like I was swimming together with other people, and evoked a friendly feeling, even if I was swimming alone.” – P7

User Study

Motivating highly intense workouts

“In this game, a rest time is fixed, and a narrator instructs me to resume swimming. That makes me work out more.” – P6

“I felt the strain when I heard a message like ‘Someone is right behind you.’ So I swam faster.” – P11

User Study

Confusion due to limited information

“The racing game shows me how close the opponent is. However, this game [SwimTrain] just notifies me if someone is behind or if someone has overtaken me. I hope it provides information about how close the other swimmers are in more detail.” – P8

User Study

Dealing with differences in skill level

This game allows me to swim at my own pace, and, at the same time, makes me feel as if I am swimming with others” – P8

“It will be fun to play this game with swimmers of matching skill. If not, tension or motivation seems to decrease.” – P1

“I intentionally swam slowly in the CO phase and kept up my pace consistently. So, I ended up winning first place in that round.” – P3

Discussion on Group Coordination

Main Design Challenge

Gamifying group fitness swimming by coordinating a group of swimmers and yet delivering group awareness without causing information overload



Discussion on Group Coordination

Subgroup Formation

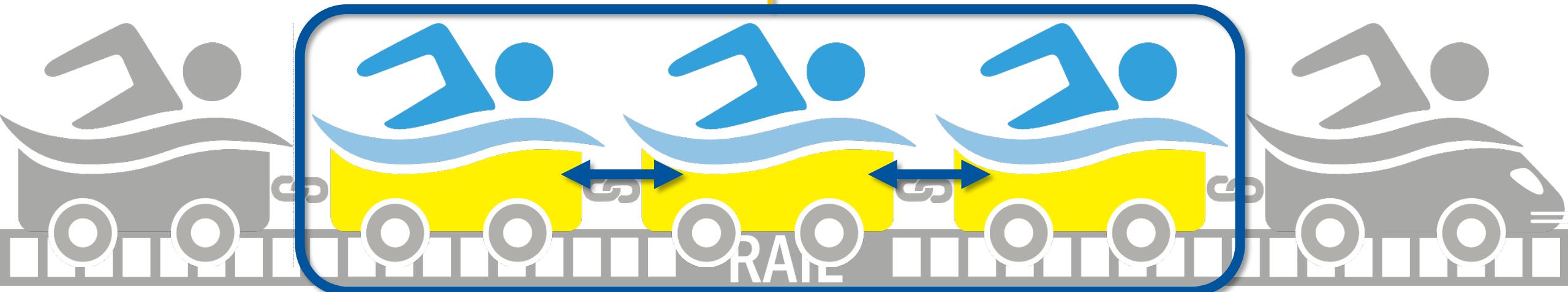
Dynamically forming subgroups according to player's exertion levels in the CO phase of each round



Discussion on Group Coordination

Intra-group Interactions

Coordinating user interactions such that three players compete against and cooperate with one another



Discussion on Group Coordination

Inter-group Interactions

Chaining adjacent subgroups to form one large group





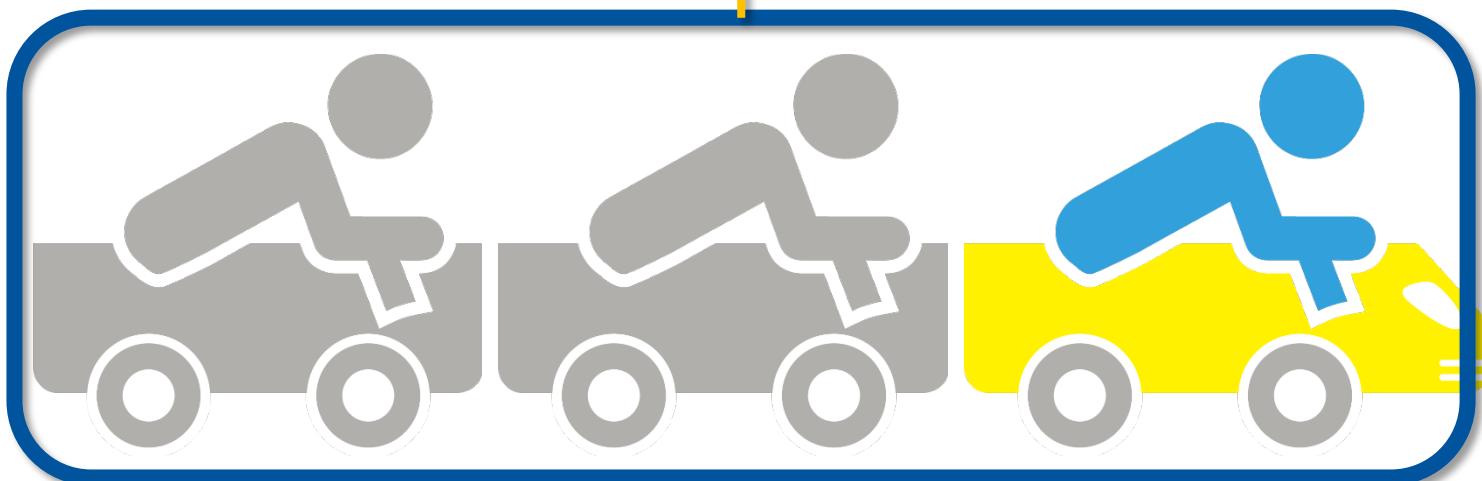
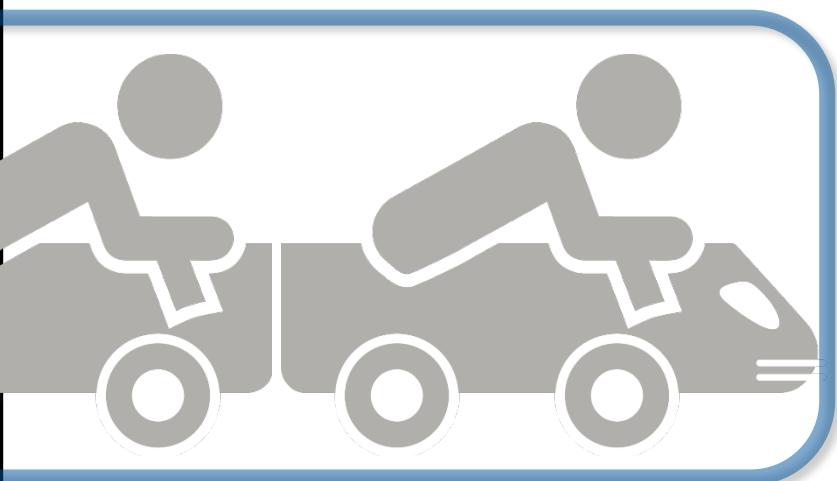
Followers

Leader

Case: Group Fitness Cycle

Subgroup Formation

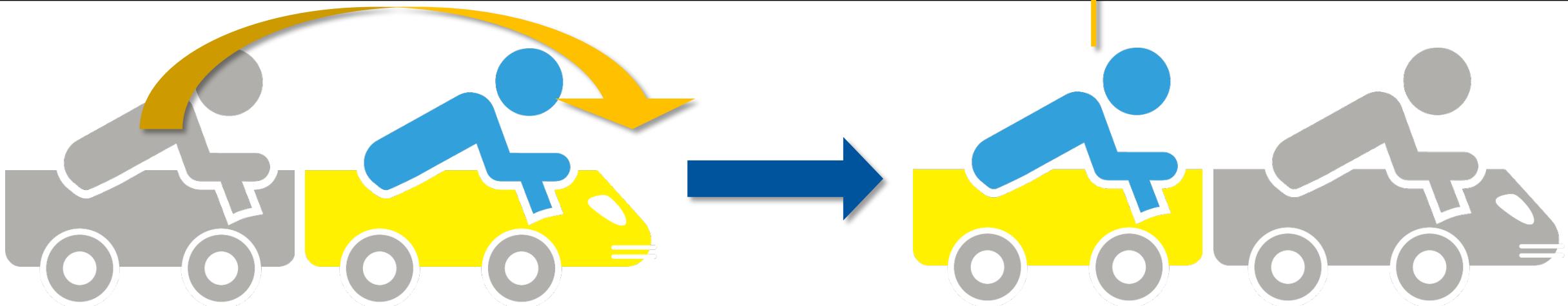
Subgrouping and interacting with a leader
and immediate followers



Case: Group Fitness Cycle

Intra-group Interactions

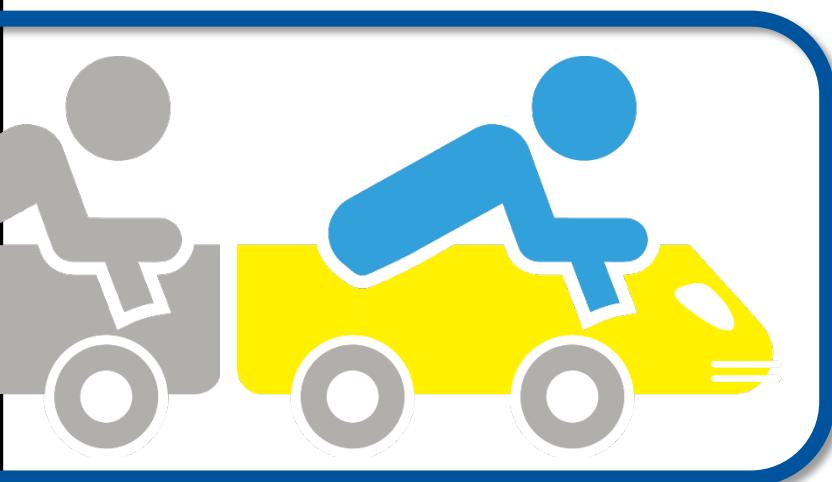
Periodically forcing followers
to be a leader within a subgroup



Case: Group Fitness Cycle

Intra-group Interactions

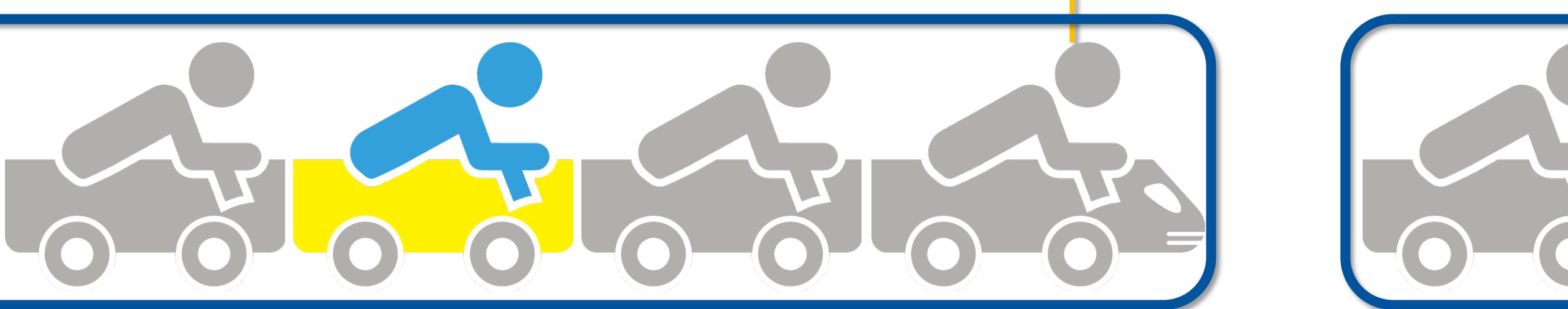
Competition among subgroups,
such as Snake game



Case: Group Fitness Cycle

Intra-group Interactions

Competition among subgroups,
such as Snake game



Case: Group Fitness Cycle

Summary

The aim of this work is to build group fitness swimming game providing the similar degree of social experiences as in group fitness without causing information load.

By forming subgroups, limiting a view of interactions to a subgroup, and organizing subgroups to form whole group, SwimTrain deliver enriched group exercise experiences without information overload