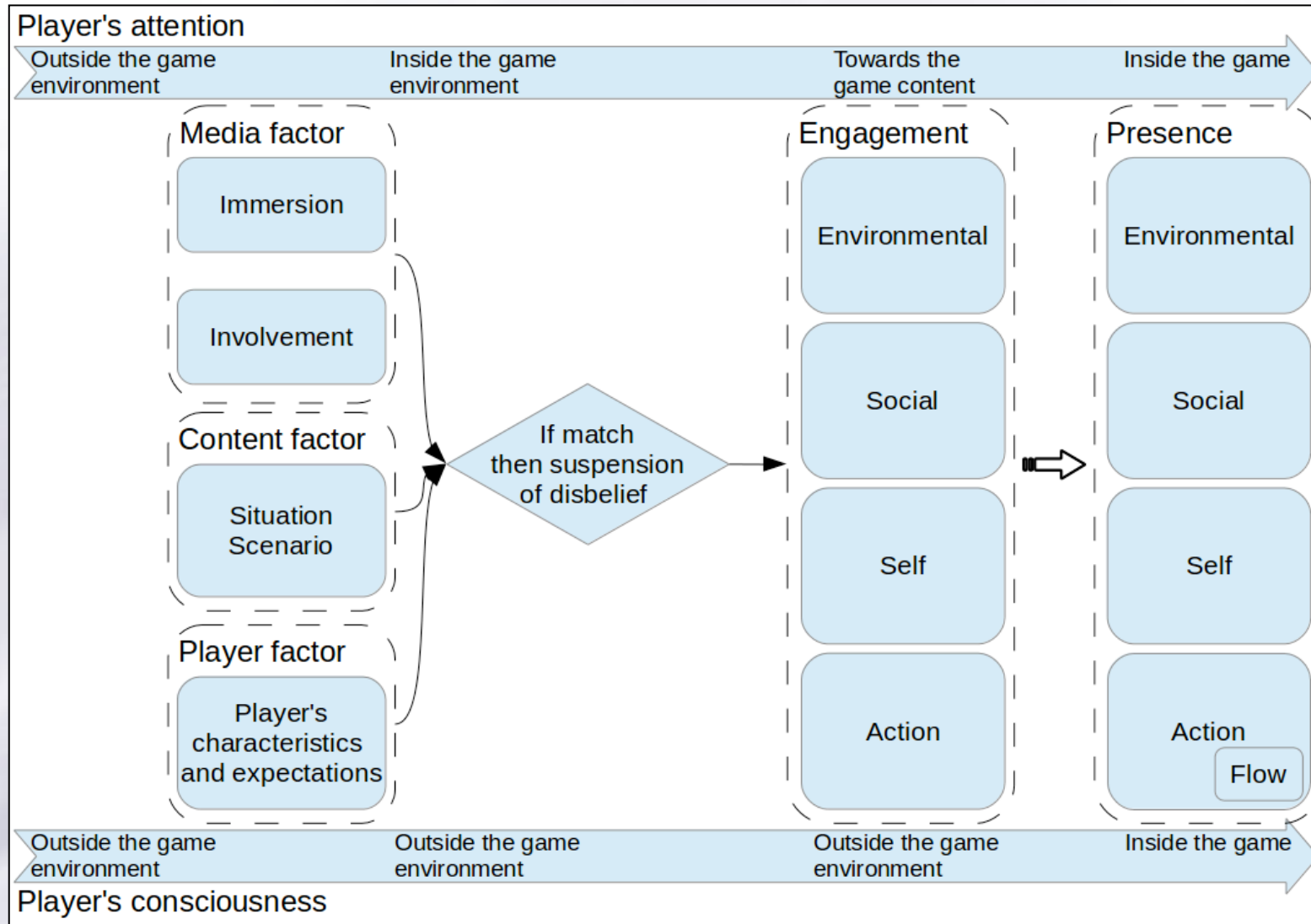# Identifying Engagement with Learning in Serious Games

Claudia Ribeiro, **Élise Lavoué**, Karim Sehaba, João Pereira, Jannicke Baalsrud Hauge

University of Lyon, France

INESC-ID, Lisbon, Portugal

Workshop on Learning Analytics in and for Serious Games
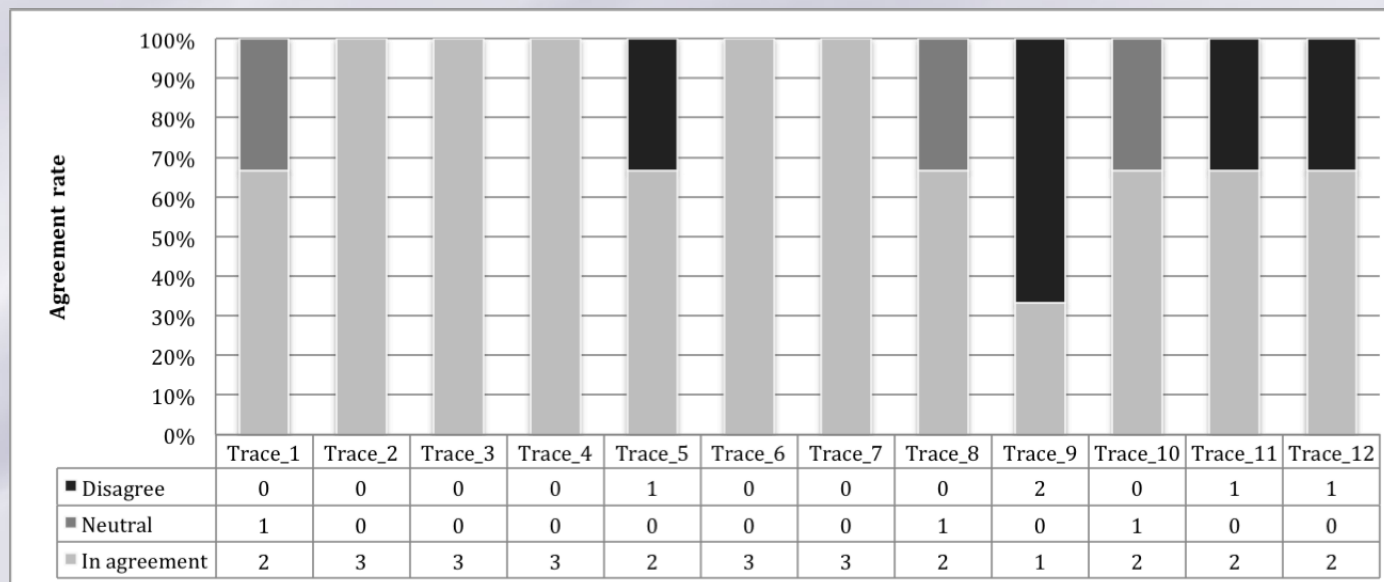
Graz (Austria), 18 September 2014

Previous works

Previous works

A trace-based approach to identifying users' engagement and qualifying their engaged-behaviours in interactive systems (UMUAI, 2014)

- **Application to a social game**
- **Engagement prediction rate: 91,67%**

	Trace_1	Trace_2	Trace_3	Trace_4	Trace_5	Trace_6	Trace_7	Trace_8	Trace_9	Trace_10	Trace_11	Trace_12
■ Disagree	0	0	0	0	1	0	0	0	2	0	1	1
■ Neutral	1	0	0	0	0	0	0	1	0	1	0	0
■ In agreement	2	3	3	3	2	3	3	2	1	2	2	2

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Engagement in serious games

Engaged learners?

- **"Students that are intrinsically motivated to learn due to the meaningful nature of the learning environment and activities"** (Kearsley & Shneiderman, 1998)

- **"The learners' act of investing effort and commitment to meaningful activities in anticipation of learning outcomes"** (Chatterjee, 2010)

Outcome of engagement:

- **A learner committed and willing to make the necessary efforts to achieve the learning outcomes**

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Why identifying engagement in serious games?

- **Expectations from Serious Games:**
  - **Enhancement of students' interest, motivation and engagement in learning activities**

- **Learners' engagement depends on:**
  - **Learners' characteristics (needs, motives, expectations, etc.)**
  - **The form and content of the SG**
  - **The context of the SG**

- **An effective indicator of:**
  - **Learners' motivation, acceptance and attachment to the SG**
  - **The relevance of the content and the effectiveness of the SG**

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Our approach

Aims:

- **To identify engagement from learners' traces**
- **To extract qualitative and valuable information on engaged-behaviours**

A behaviour?

- **A chain of actions (i.e. an aggregation of actions) actually performed by the user in the interactive system**

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Our approach: 3 steps

1. Identification of high-level engaged-behaviours

- **Self-Determination Theory (SDT)**

2. Deconstruction of the high-level engaged-behaviours into *activities*, chains of *actions* and chains of *operations* actually performed by the users

- **Activity Theory**

3. Detection of the chains of *operations* among the collected data and reification of the relationships between *operations*, *actions* and *activities*

- **Modelled Trace framework**

Our approach: illustration

Environmental engagement | **Social engagement** | Self engagement | Action engagement

Highest-level transformed trace — Activity

Activity A
Motive: Motive A
Object: Object A

r_activity_A

Intermediate transformed-trace — Action

| Action 1 | Action 2 | Action 3 | Action 4 | Action 5 |
| Goal 1 | Goal 2 | Goal 3 | Goal 4 | Goal 5 |

r_action_1   r_action_2   r_action_4

Primary trace — Operation

5   19   3 8   22   9   10

Interactions performed though input devices   time

Transformation trace process

Transformation trace process

Interactions

Data collection process

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Application to a social game

(UMUAI, 2014)

Environmental engagement	**Social engagement**	Self engagement	Action engagement

Activity
Highest-level transformed trace   Motive / Object

Develop new social relationship
Motive : Feeling social interaction emotions
Object : Increasing the number of Friends

Action
Intermediate transformed trace   Goal

Propose confrontation   Ask to be friend
Find players   Accept to be friend
Be interested in other player

Operation
Primary trace   Conditions

Interactions performed though input devices

Obsels   time

Transformation trace process

Transformation trace process

Data collection process

Elise Lavoué   LASG 2014

Implementation with D3KODE

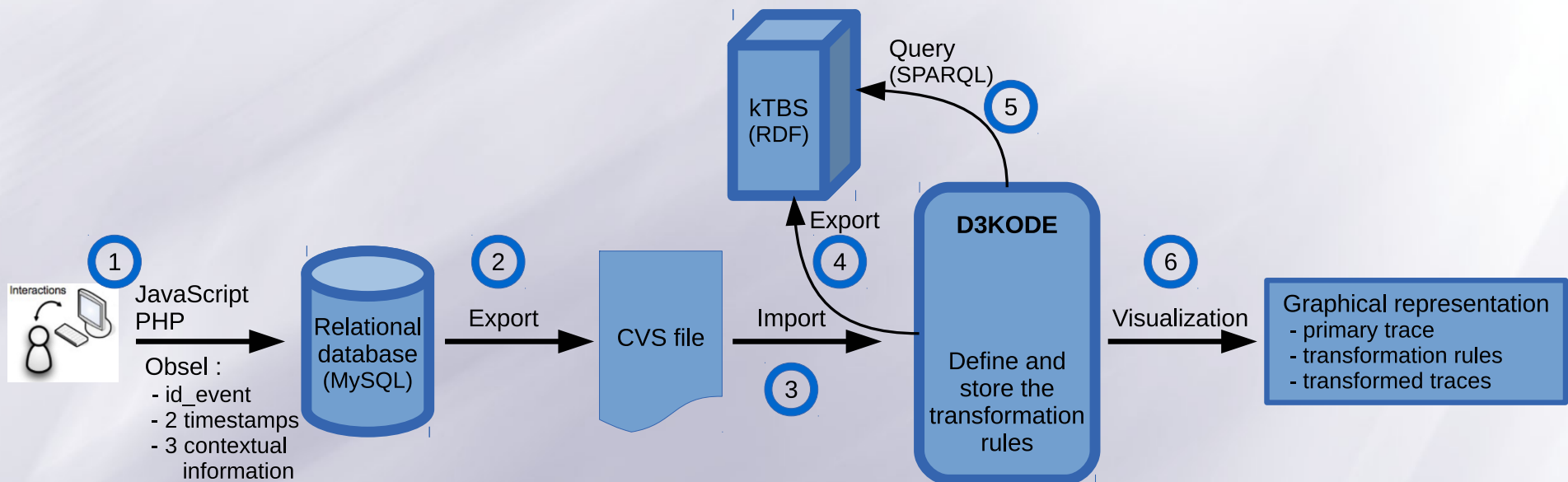Data Collect   Initial Storage   D3KODE – Engagement

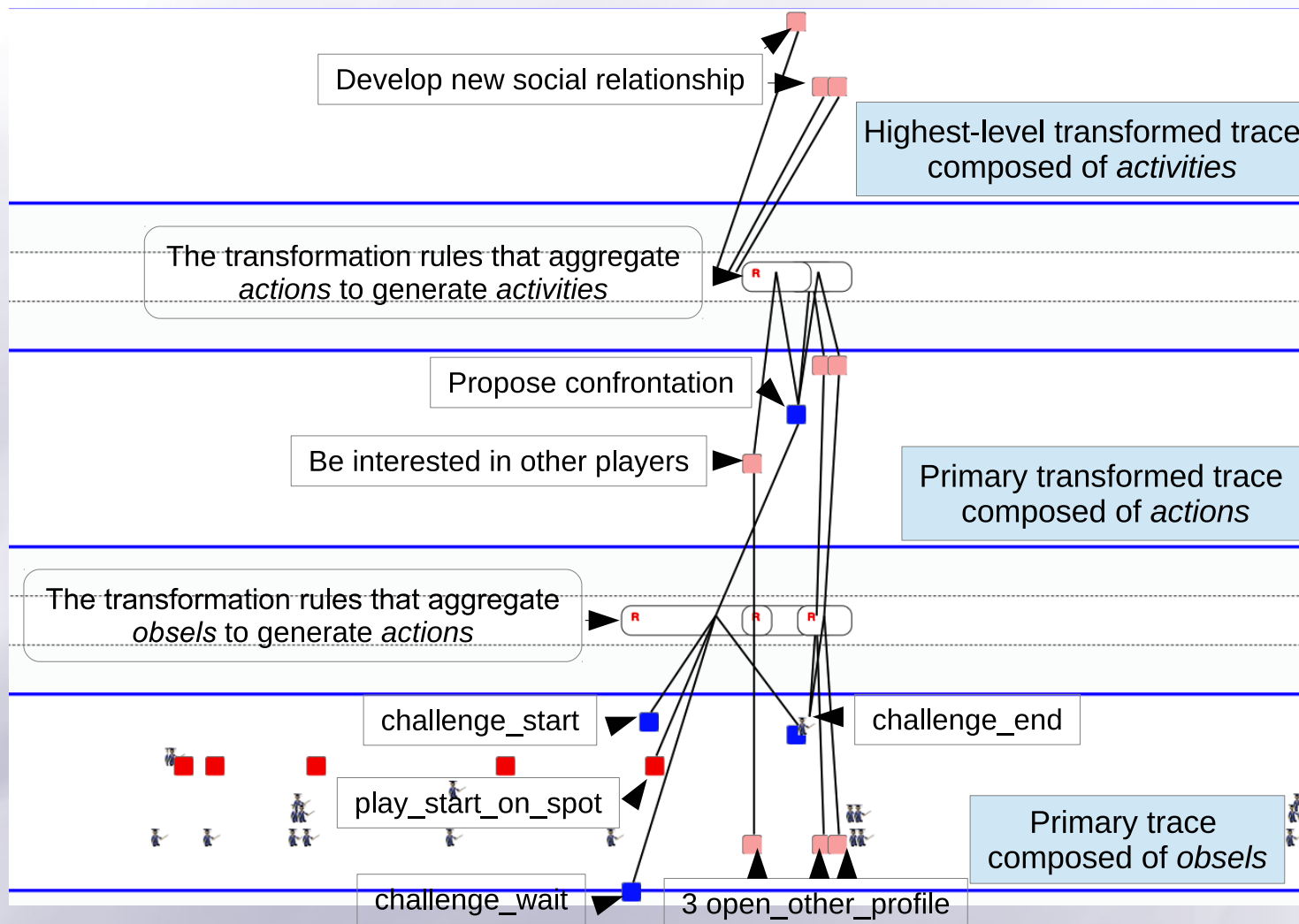Automatic   New Data Storage   Data Analysis   Interactive and
Nonintrusive   Dynamic Visualization

Elise Lavoué   LASG 2014

(UMUAI, 2014)

Develop new social relationship

Highest-level transformed trace composed of *activities*

The transformation rules that aggregate *actions* to generate *activities*

Propose confrontation

Be interested in other players

Primary transformed trace composed of *actions*

The transformation rules that aggregate *obsels* to generate *actions*

challenge_start

challenge_end

play_start_on_spot

Primary trace composed of *obsels*

challenge_wait

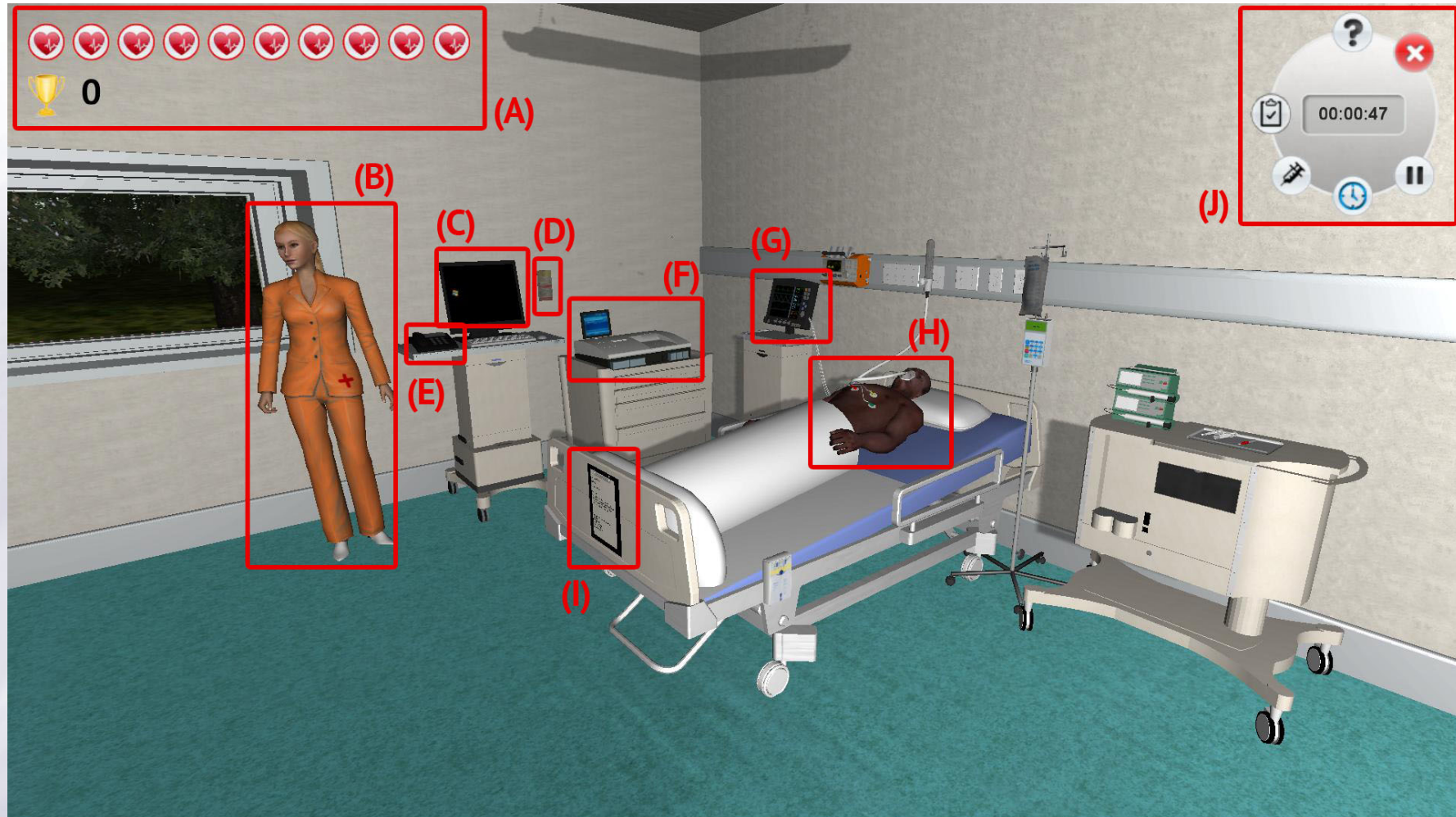3 open_other_profile

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Application to a serious game

Sepsis Fast Track Serious Game

- **Incorporates the sepsis fast track protocol**
- **Physicians training**
- **12 clinical cases**
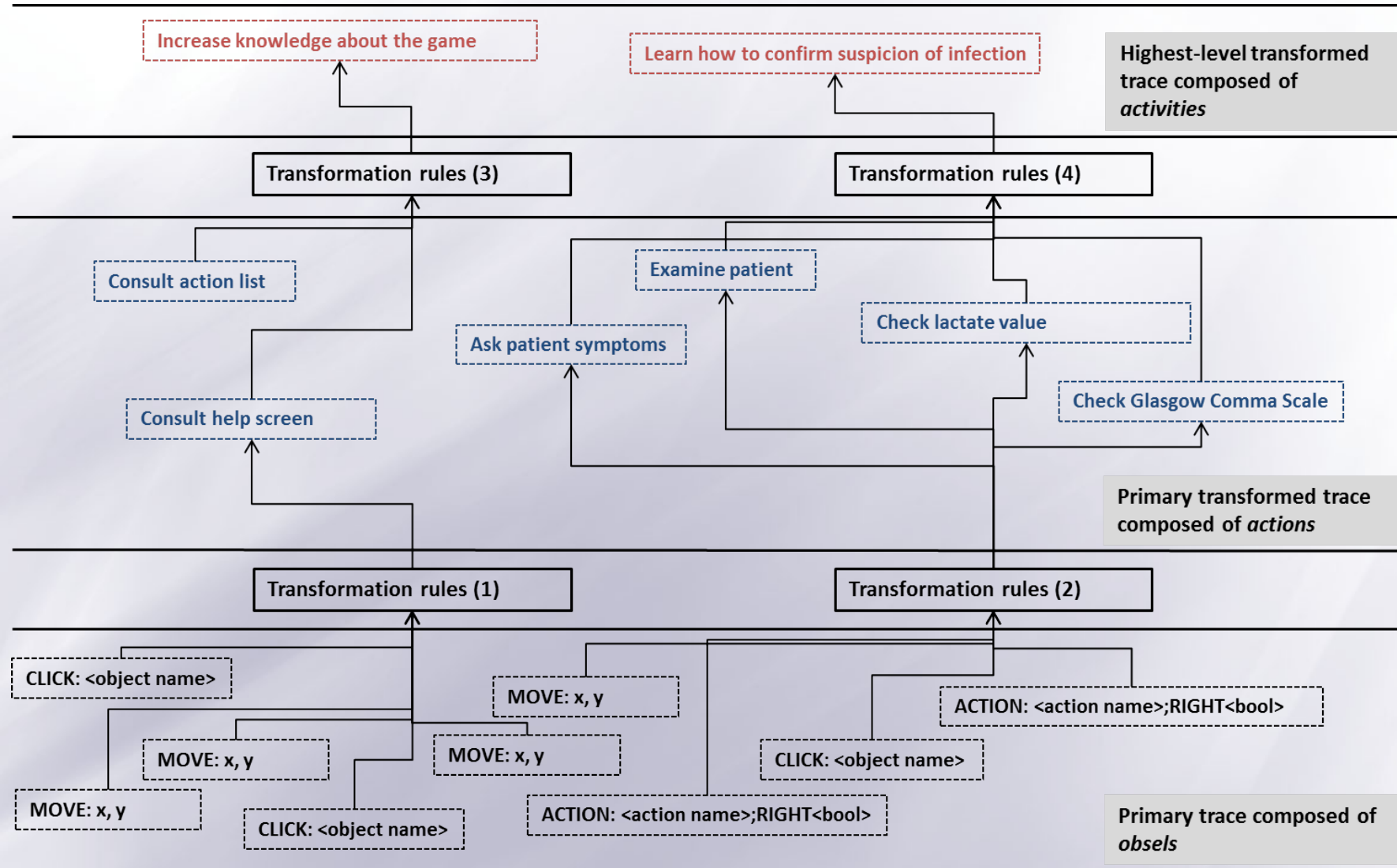- **Identifying and treating patients in a safe environment**

Focus:

- **Sequence of medical interventions**
- **Appropriate therapeutics that should be applied and when**
- **Interactions between physician-nurse and physician-patient**
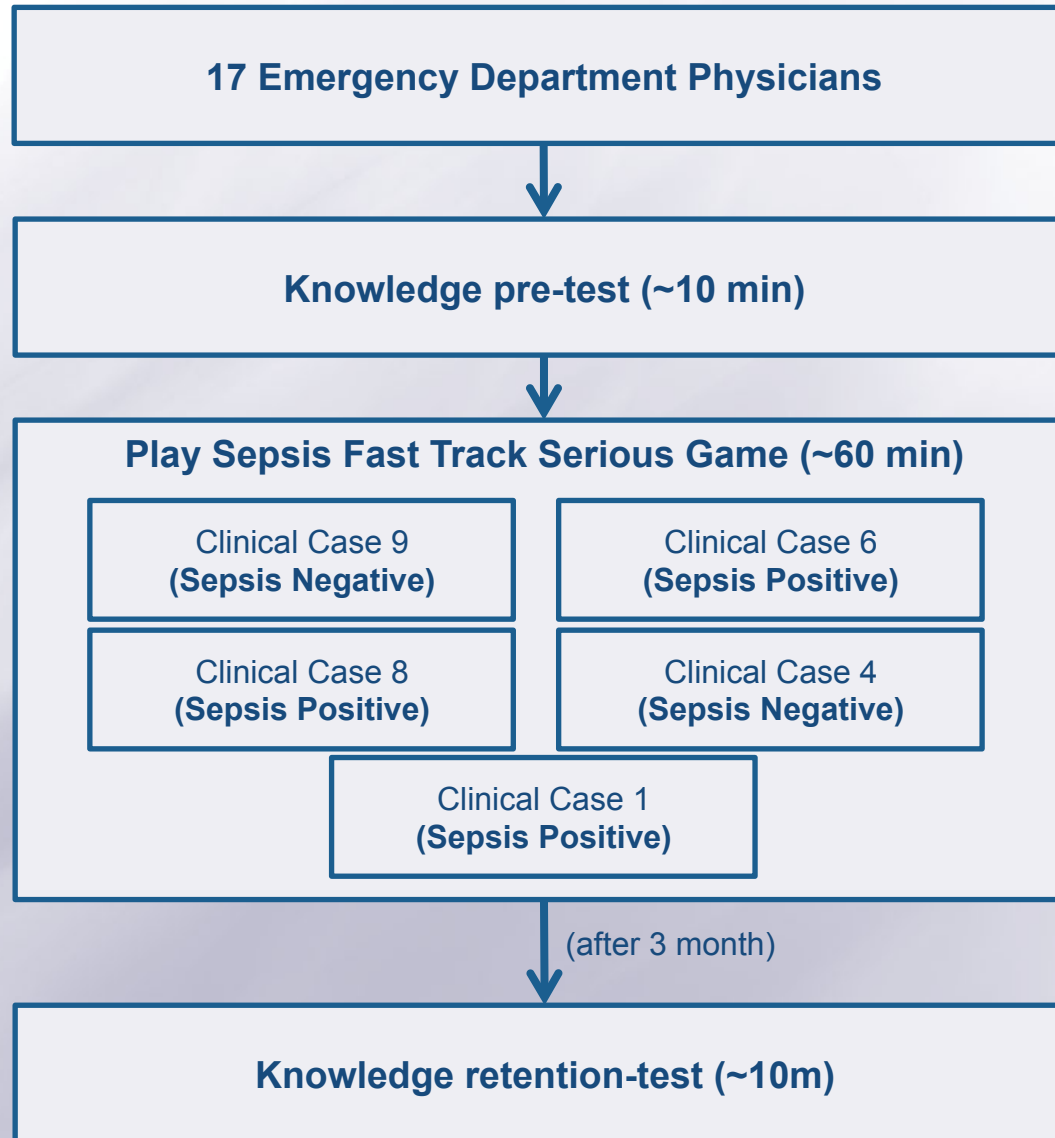
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Application to a serious game

Application to a serious game

Increase knowledge about the game

Learn how to confirm suspicion of infection

Highest-level transformed trace composed of *activities*

Transformation rules (3)

Transformation rules (4)

Consult action list

Examine patient

Check lactate value

Ask patient symptoms

Consult help screen

Check Glasgow Comma Scale

Primary transformed trace composed of *actions*

Transformation rules (1)

Transformation rules (2)

CLICK: <object name>

MOVE: x, y

ACTION: <action name>;RIGHT<bool>

MOVE: x, y

MOVE: x, y

CLICK: <object name>

MOVE: x, y

CLICK: <object name>

ACTION: <action name>;RIGHT<bool>

Primary trace composed of *obsels*

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Application to a serious game

Example of transformation rule

$$(CLICK\_patient.timestamp - CLICK\_help.timestamp <= 2000) \; AND$$
$$(CLICK\_ECG.timestamp - CLICK\_help.timestamp <= 2000) \; AND$$
$$(CLICK\text{-}nurse.timestamp - CLICK\_help.timestamp <= 2000) \; AND$$
$$(CLICK\_computer.timestamp - CLICK\_help.timestamp <= 2000) \; AND$$
$$(CLICK\_clipboard.timestamp - CLICK\_help.timestamp <= 2000)$$

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Participants, data, protocol

17 Emergency Department Physicians

↓

Knowledge pre-test (~10 min)

↓

Play Sepsis Fast Track Serious Game (~60 min)

Clinical Case 9
(Sepsis Negative)

Clinical Case 6
(Sepsis Positive)

Clinical Case 8
(Sepsis Positive)

Clinical Case 4
(Sepsis Negative)

Clinical Case 1
(Sepsis Positive)

↓ (after 3 month)

Knowledge retention-test (~10m)

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Research questions and future works

- Can we identify engaged and non-engaged learners?
- Can we identify different types of engaged-behaviors?
- Is there a correlation between learners' engagement and their results in the retention test?
- Do engaged-behaviors identified from learners' traces correlate with the results of the questionnaire?
- Does engagement evolves in the game session?

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Thank you for your attention!

Questions?

Elise.Lavoue@liris.cnrs.fr

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