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Magali Coupaud, Jonathan Mirault, Alice Delsérieys

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# Effect of the structuring of an instruction on the exploration and comprehension of a text : a dual oculometric and behavioural approach.

Magali COUPAUD<sup>1</sup> ; Jonathan MIRAULT<sup>2,3</sup> ; Alice Delserieys<sup>1</sup>

<sup>1</sup>ADEF, Aix-Marseille Université

<sup>2</sup> Pôle pilote Ampiric, INSPÉ, AMU

<sup>3</sup> LPC, AMU & CNRS



# Darwinium, a serious game

## Objectives

To identify how the elements of the Darwinium game are perceived by young people and what effects the specificity of a set of instructions has on their understanding of the rules of the game.

# Context of the research

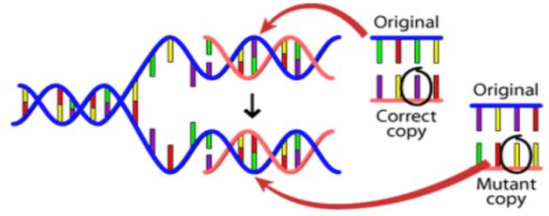
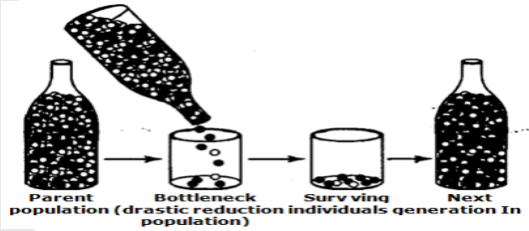
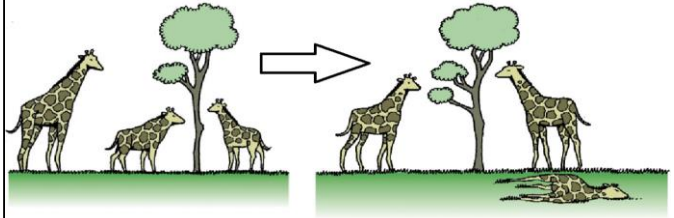
Randomness in ToE

Approaching randomness in ToE through an educational game

Darwinium game: Approaching randomness in ToE

# Randomness in ToE

Gayon, 2005 ; Merlin, 2013

Evolution mechanisms	Associated ideas of Randomness
<p><b>Genomic variation</b></p> 	<p><b>Chance</b></p> <p>Unintentional fortuitous event (not associated with any purpose)</p> <p>Associated with mutations and can sometimes give genetic innovations</p>
<p><b>Genetic drift</b></p> 	<p><b>Random probabilities</b></p> <p>Depending on the size of the biological population and the laws of probability. For a population to evolve, it is not necessarily related to adaptation, it may simply reflect the effect of random probability at any stage of reproduction (Jacob, 1981).</p>
<p><b>Natural selection</b></p> 	<p><b>Contingence</b></p> <p>Intersection of independent causal series: the presence of external factors and the internal variation of an organism</p> <p>Mechanism combining fortuitous events, that are contingent in a historical perspective</p>

# Approaching randomness in ToE through an educational game

- Randomness, intrinsically linked to gaming (Solinski, 2015)
- Games in education:
  - Allows to experiment with the right to make mistakes (Sanchez et Romero, 2020)
  - Engaging et motivating  
(Alvarez et al., 2016)
  - Allows access to the complexity of a concept
  - Must be efficient (Sanchez et Romero, 2020)

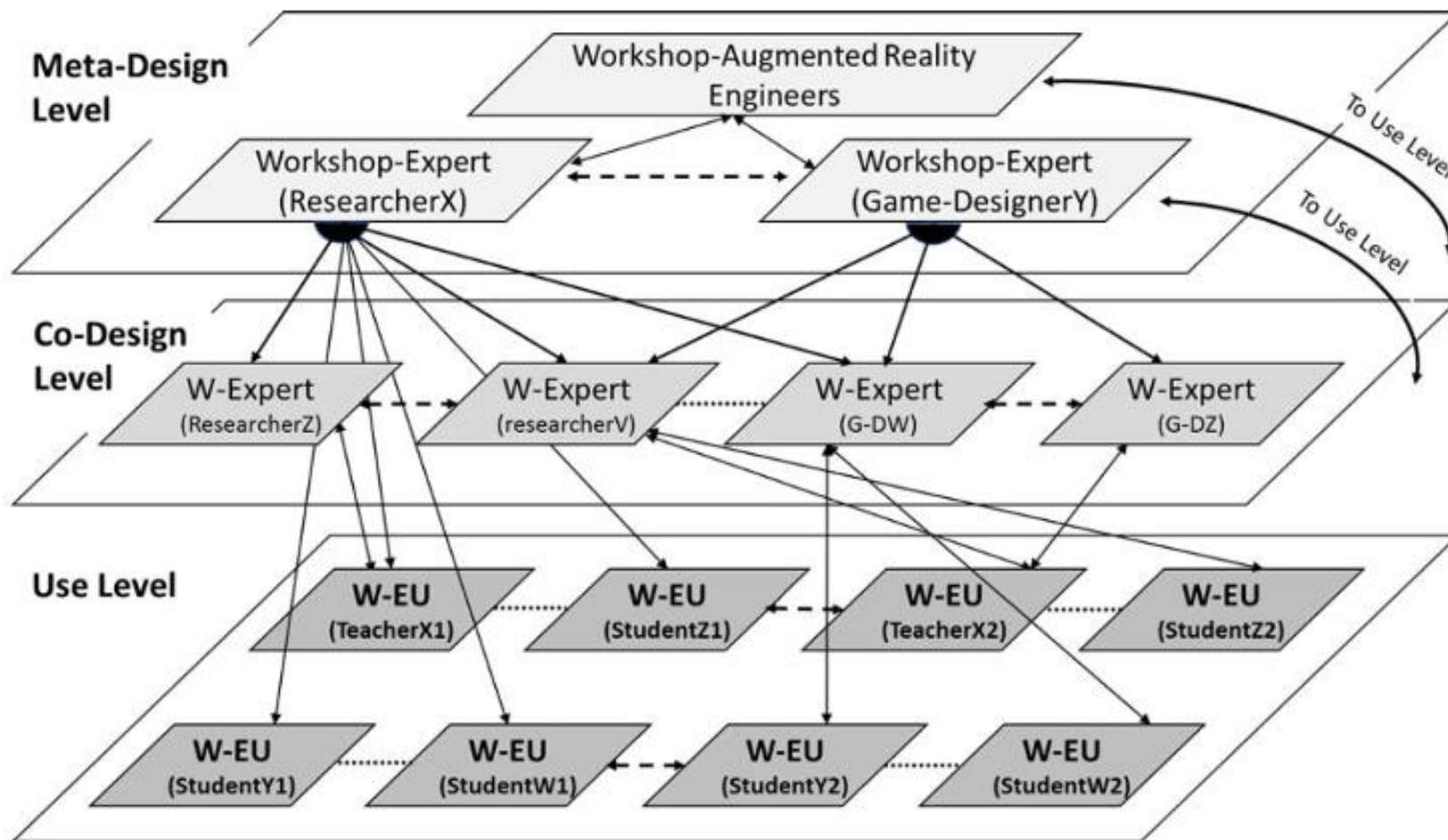
Du premier  
prototype



Au jeu de  
plateau tangible

# Metaconception process of the game « Darwinium »

(adapted Ardito *and al.*, 2015)





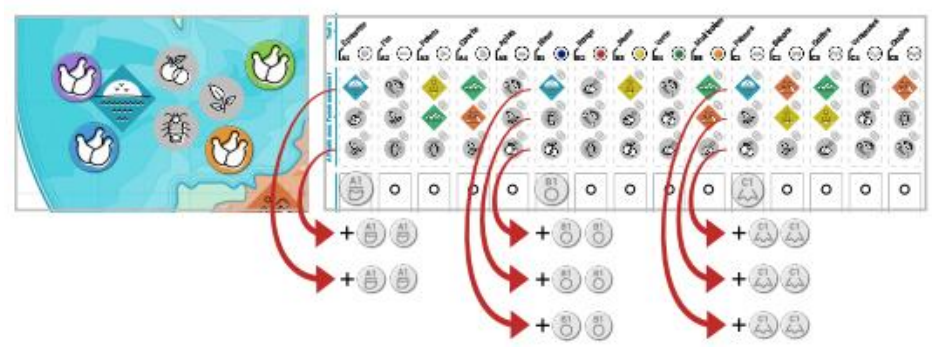


# Darwinium game: Approaching randomness in ToE

Random probability



Contingency



## Research question

How the elements of the Darwinium game are perceived by young people and what effects the specificity of a set of instructions has on their understanding of the rules of the game ?



# Methods

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Material

Response modalities

Design

Participants

Procedure

# Material

➤ 10 elements from the game (rules, board game and cards)



**Histoire du jeu**

La découverte d'une espèce d'animaux qui se reproduisent très rapidement a révolutionné le monde scientifique.

En tant que chercheur accidentellement connu, tu participes à un vaste programme de recherche grandeur nature.

Un dôme de plusieurs kilomètres de diamètre a été installé en milieu naturel pour te permettre de modifier et modifier les environnements dans lesquels vivent des populations de cette espèce.

Tu cherches à comprendre l'évolution de ta population et à augmenter ses chances de survie.

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Noms et prénoms des joueurs:

\_\_\_\_\_

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**Population de départ**

Observation



Prise de note

Population en mer: Environnement favorable à la reproduction des animaux possédant des épines, peau bleue et pattes palmées.

Population qui se reproduit vite mais peu de variation entre les individus. Ne savent pas si la population survit à des modifications d'environnement ??





Proportions

		
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**DARWINIUM** Cartographie des environnements


**Légende**

**Types d'environnement**

-  Mer
-  Désert
-  Forêt
-  Montagne

**Ressources**

-  Fruits
-  Végétaux
-  Insectes
-  Matière organique morte
-  Viande



**Pollution**



Lors de travaux, en creusant on découvre accidentellement une ancienne carrière de soufre. Cela provoque le dépôt d'une poussière jaune toxique à la surface des montagnes et des déserts. Les animaux à peau jaune et à peau multicolore se camouflent mieux et échappent davantage à leurs prédateurs. Pour les autres animaux, c'est plus difficile.

En montagne et dans les déserts, les joueurs qui ont des jetons peau bleue (B1), rouge (B2) ou verte (B4) en perdent 1 de chaque. Les joueurs qui ont des jetons peau jaune (B3) ou multicolore (B5) en gagnent 2 de chaque

		
-1	-1	-1
		
+2	+2	+2

# Response modalities

- Different modalities of responses (open question, forced choices, drag and drop items)

Cite une particularité associée aux caractéristiques des animaux mentionnée dans l'une des 3 cartes que tu viens d'observer.

Réponse du participant...

Suite

Coche les symboles qui correspondent aux traits de caractère de la population de départ.

- |  |  |   |
|--|--|---|
| <input type="checkbox"/> A1  A1 – Bec épuisette | <input type="checkbox"/> B1  B1 – Peau bleue  | <input type="checkbox"/> C1  C1 – Pattes palmées   |
| <input type="checkbox"/> A2  A2 – Bec fin       | <input type="checkbox"/> B2  B2 – Peau rouge  | <input type="checkbox"/> C2  C2 – Pattes sabots    |
| <input type="checkbox"/> A3  A3 – Bec pointu    | <input type="checkbox"/> B3  B3 – Peau jaune  | <input type="checkbox"/> C3  C3 – Pattes griffes   |
| <input type="checkbox"/> A4  A4 – Bec courbé    | <input type="checkbox"/> B4  B4 – Peau verte  | <input type="checkbox"/> C4  C4 – Pattes ventouses |
| <input type="checkbox"/> A5  A5 – Bec plat      | <input type="checkbox"/> B5  B5 – Peau orange | <input type="checkbox"/> C5  C5 – Pattes ongles    |

Suite

# Design

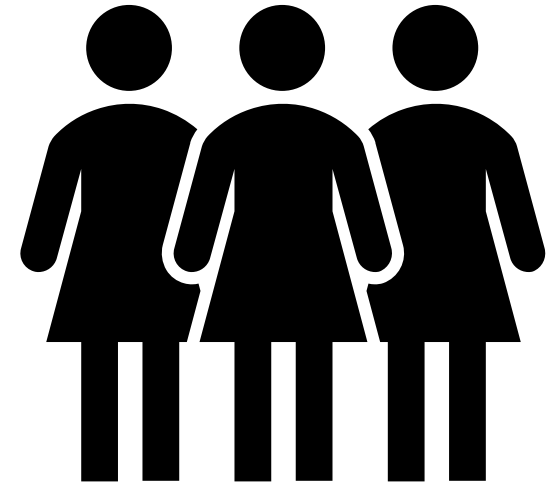
We choose a 2x1 design with 'Instruction' as 2-level factor ('detailed' / 'global')

**Detailed** : « Discover the story of the game presented in the image on the first page of the research booklet, then find out what characterises the starting population of animals. »

**Global** : « Explore the image on the first page of the research booklet, which tells the story of the game and describes the starting animal population. »

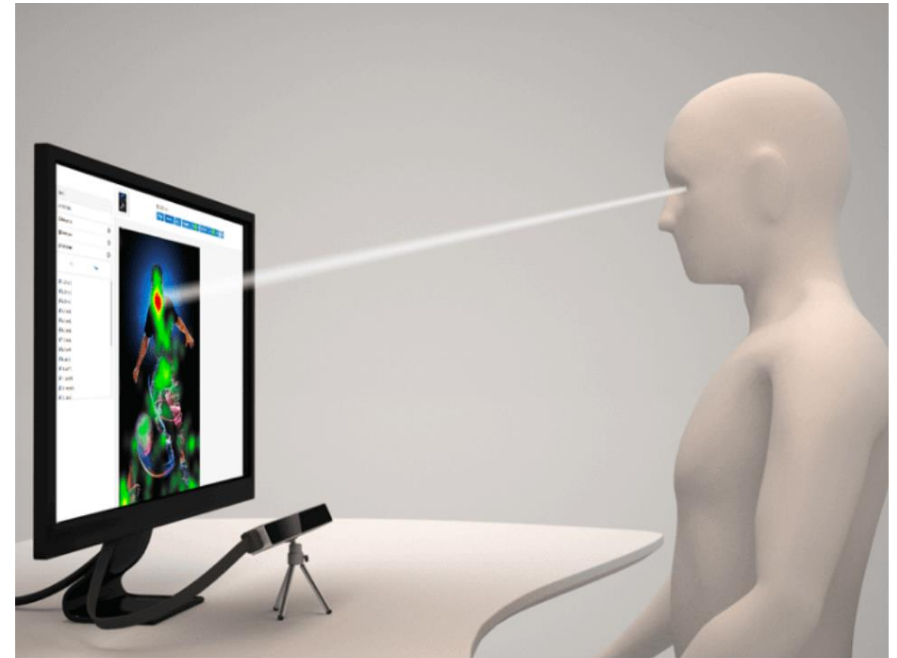
# Participant

- 8 volunteer student
  - naive to the purpose
  - 6 girls + 2 boys
  - from 14 to 25 y.o (M=21; SD = 3.9)
  - normal or corrected-to-normal vision



# Procedure

- Tobii Pro Fusion 250
- 27" screen
- at 144 Hz
- Webcam Logitech

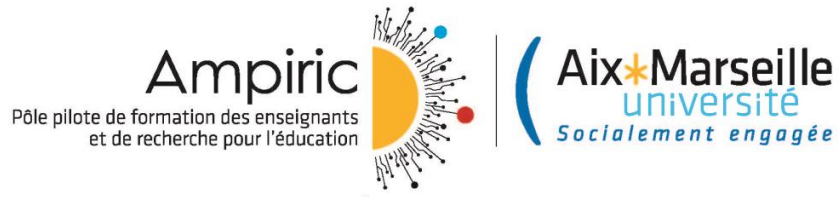




Explore l'image du plateau central pour  
comparer les ressources qui se trouvent dans  
les mêmes types d'environnement.



Appuis sur la touche ESPACE quand tu as fini !



# Results

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Comprehension (accuracy & response time)  
Eye tracking (heatmaps)

## Comprehension (accuracy & response time)

Accuracy (%)	Mean	SD
Instruction +	<b>70.79</b>	38.77
Instruction -	<b>70.31</b>	32.55

RT (s)	Mean	SD
Instruction +	<b>60.21</b>	14.46
Instruction -	<b>63.14</b>	35.65

# Eye tracking (heatmaps)



Detailed  
instruction

# Eye tracking (heatmaps)



Global instruction

# Eye tracking (heatmaps)

## Detailed instruction

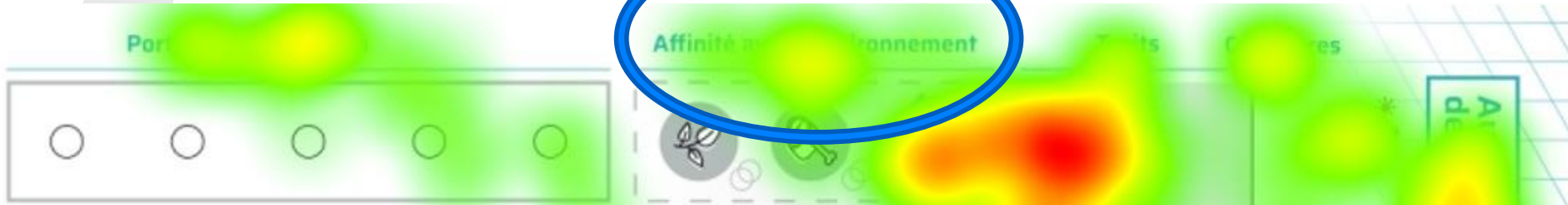


## Global instruction



# Eye tracking (heatmaps)

Detailed instruction



Global instruction



# Eye tracking (heatmaps)

## Detailed instruction



## Global instruction





# Eye tracking (heatmaps)

## Detailed instruction



## Global instruction





# Conclusion

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In conclusion  
Perspectives

Recherche en éducation

**COLLOQUE INTERNATIONAL** 4 au 6 octobre 2023

en hommage à JACQUES GINESTIÉ

## Conclusion



Detailed instructions seem to allow children to access faster to the information.



However, the accuracy seems to be equal in both cases.



The game's elements seem to be self-sufficient for pupils to play but teachers can improve the experience with focused instructions.

# Perspective

- To continue “proof of concept” by improving the design and the population