

# CONNECT2CREATE

## Assessment of **divergent thinking** through game based robotics



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30.10.24 - Paris, France

## 1. Activities

### 1. #Creacube Research program

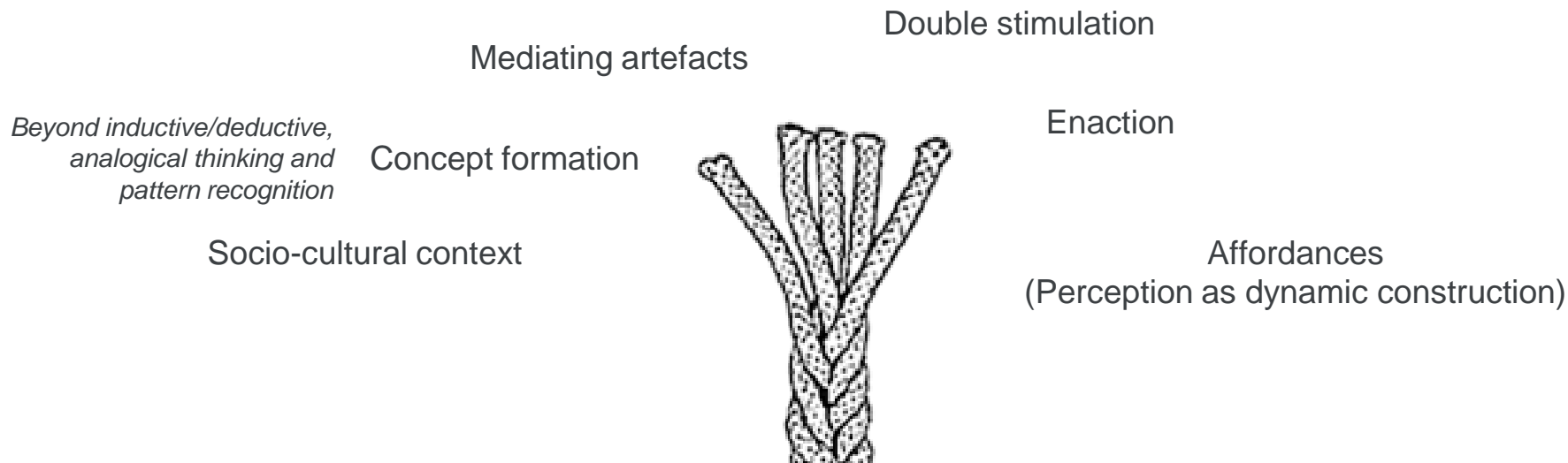
### 1. Studies within the #Creacube framework

# 1. Activities

ACTIVITY 1 : Discuss in pair about the 3 main difference between Creative Problem Solving and Creativity

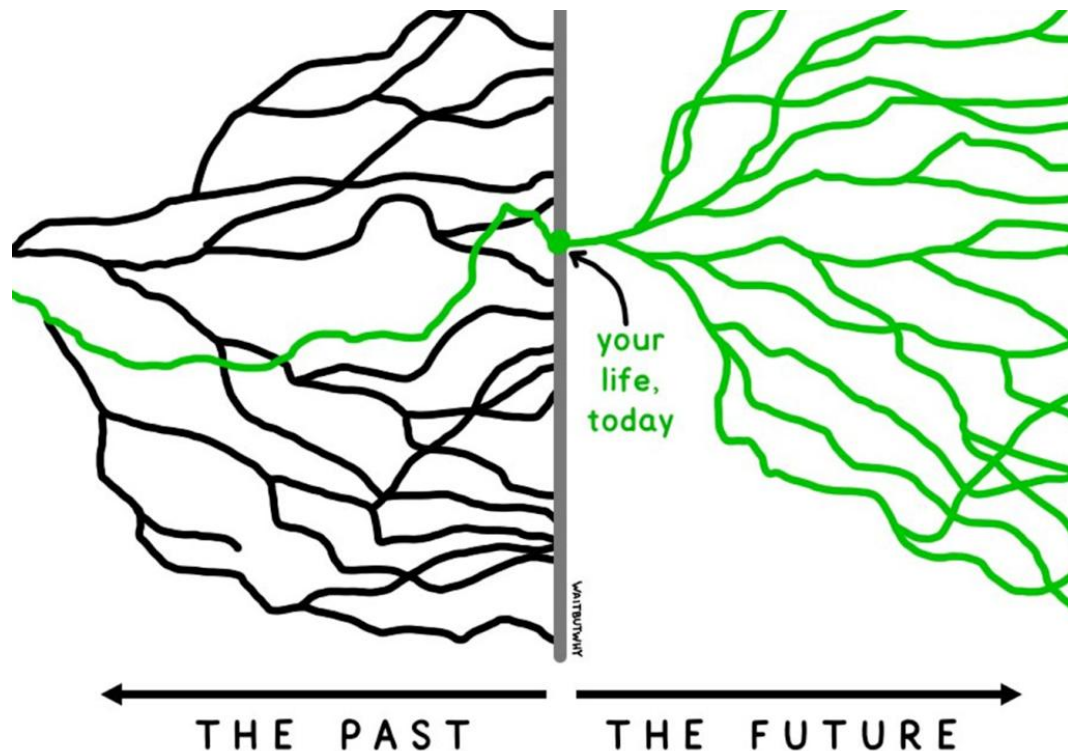
## Creative Problem Solving: A complex phenomenon to be understood.

1. Problem-solving is domain and **task-specific** and dependent on factual, conceptual, procedural and strategic knowledge (Kilpatrick et al. 2001)
2. Problem-solving takes place in a specific **socio-cultural context**
3. Humans have a brain that can experience quite similar (meta)cognitive processes.

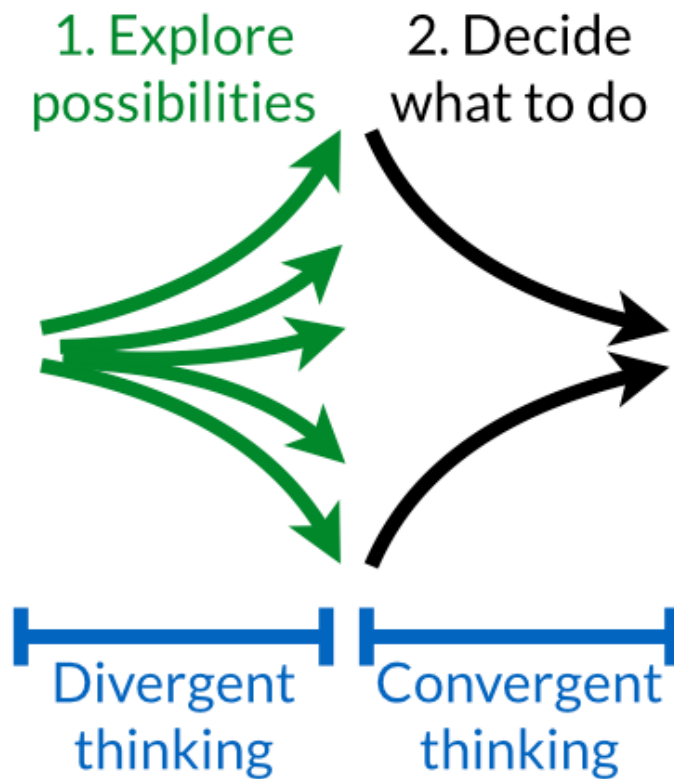


## Creative problem solving

- “Imagined alternatives [divergent thinking] play a serious role in our cognitive lives” (Byrne, 2022)
- Creative problem solving (CPS) expands the boundaries of what is considered possible and propelling the field of possibility studies forward.
- CPS facilitates the identification and evaluation of alternative paths, enabling researchers to **navigate through uncertainties and complexities**



Urban (2021)



## ACTIVITY 2 : Two volunteers to play



## ACTIVITY 3 : What did you observe?

ACTIVITY 4 : Discuss with someone nearby of the possible application of such tools

## 2. #CreaCube research program

## #CreaCube research programme (2017-2027)

*Objective :*

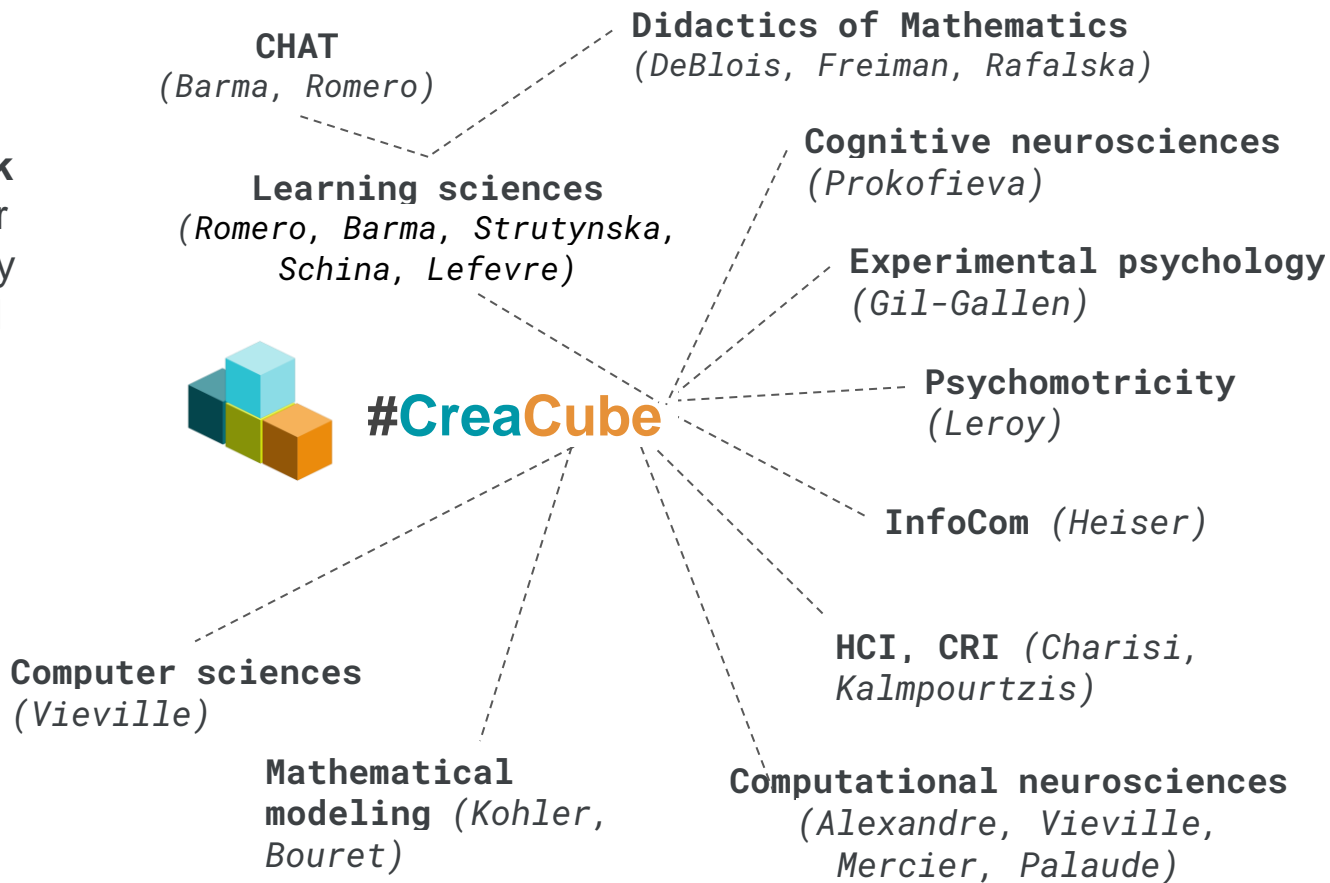
Study of **creative problem solving**

- Developmental perspective  
(from 7 to 86 years old)
- Individual, dyadic and small-group modalities
  - Scripted and non-scripted collaboration
- Diversity (neurodiversity and functional diversity)



Ontological, epistemological, and  
methodological pluralism

Focus on the  
**#CreaCube Creative  
Problem-Solving task**  
as unit of analysis for  
supporting the diversity  
of epistemological and  
methodological  
approaches

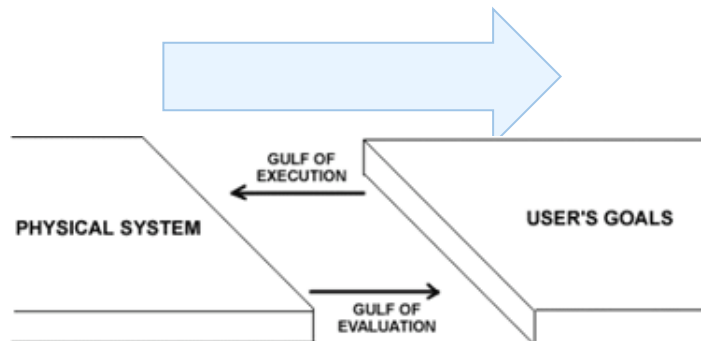
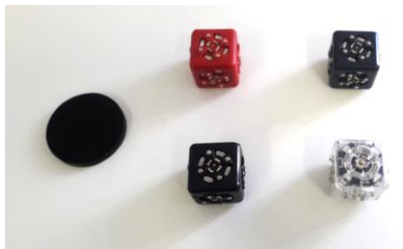


## #CreaCube: a creative problem-solving task

### Problem

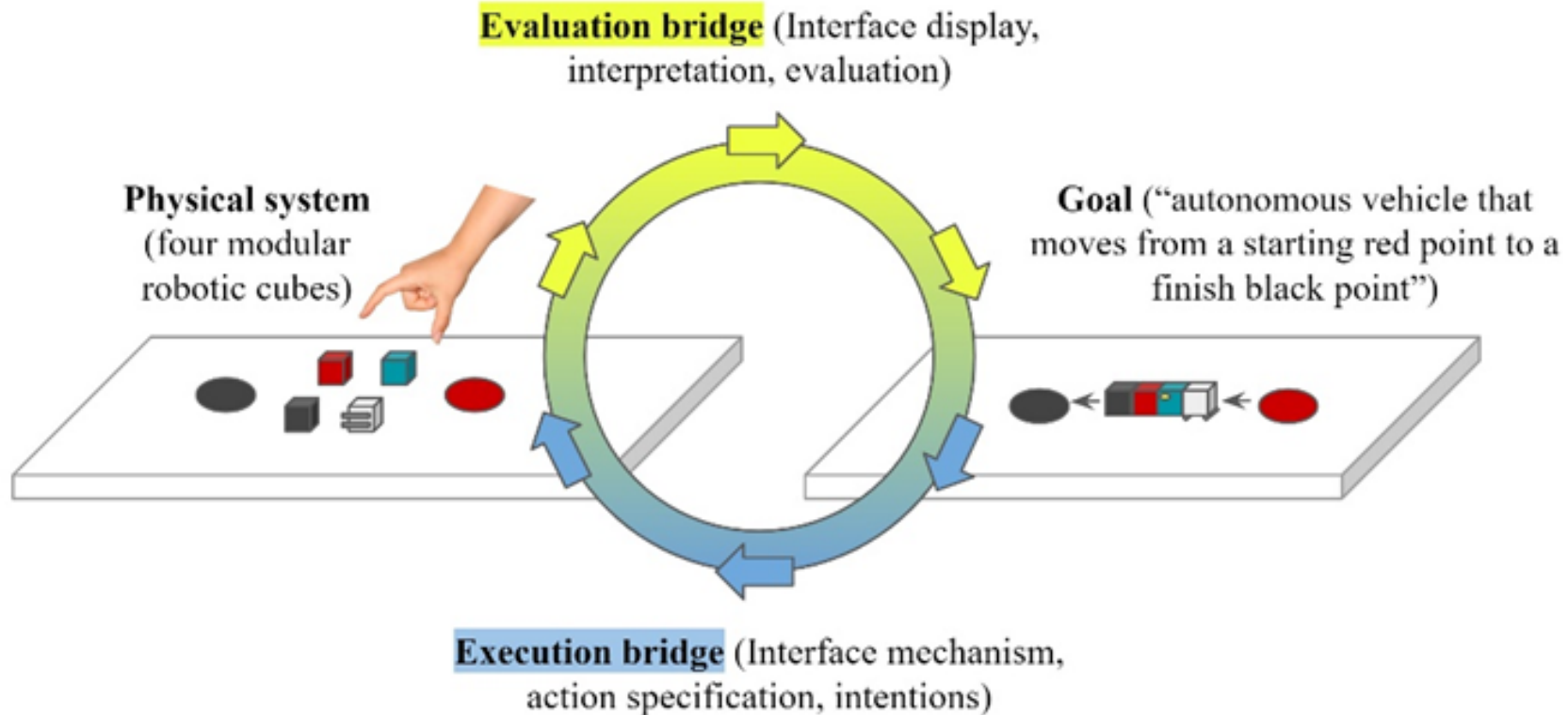
“Build a vehicle composed of 4 items, moving autonomously from a black point to a red point”

⇒ *an ill-defined problem*



Solution ?

Norman (1986) designates as the gulf of execution, the distance between the user's goals and the means of achieving them through the system.



## Développement d'une interface ad-hoc pour l'analyse des vidéos en base à un code de traces comportementales observables (*behavioral learning analytics*)

**CREACUBE 2. Activity**

AS00										<input type="checkbox"/> OFF B01	
AS01										<input type="checkbox"/> ON B02	
AS02											
AS03											
<b>FL01</b> Turn cube wo reloc	<b>U00.</b> Play instructions <b>U01.</b> Stop instructions	<b>U02.</b> Questionning instructions	U03. No cubes in hand (no manipulation)	U04. Hands up with 1 cube	U05. Hands up with 2 cubes	U06. Hands up with 3 cubes	U07. Hands up with 4 cubes	T01. No test T02. Drop Out / Abandon T03. Succeeded	P01. Imbalance P02. Rotation P03. Wrong direction P04. Reverse (outward) P05. Reverse (to the person) P06. Colour association P07. Connexion P08. Doesn't move (wheels) P09. Doesn't move (on/off) P10. Doesn't move (capteur) P11. Doesn't move (invers) P12. Not autonomous		
<b>FL02</b> Repositionner cube même forme	B01. Trial/error	B02. Analytical /systemic	B03. Hypothesizing	B04. Ego preservation	B05. Complaining	E01. Ecstasy/Joy/Serenity	E02. Admiration/Trust/Acceptance	E03. Terror/Fear/Apprehension	E04. Amazement/ Surprise/ Distraction		
<b>START</b> A1	AF01. Wheels	AF02. Magnets	AF03. Button on/off	AF04. Two eyes	AF05. Sensor	E05. Grief/Sadness/Pensiveness	E06. Loathing/Sadness/Pensiveness	E07. Rage/Anger/Annoyance	E08. Vigilance/Anticipation/Interest		
<b>START</b> A2					<b>UNDO</b> ✕						

Search bar:

- F000-BIWS
- F000-BSIW
- F000-BWSI
- F000-IBWS

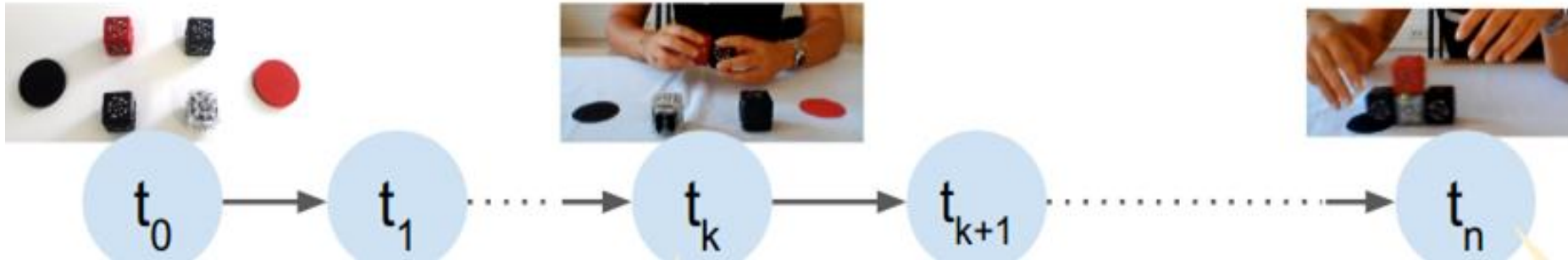


## #CreaCube corpus: *high-quality* learning analytics

“ Build a **vehicle** composed of **4 items**, moving **autonomously** from the **red point** to the **black point**. ”

> 1600 videos (5 min. duration av./video) manually coded (JSON structure) during the last 5 years

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### 3. Studies within the #CreaCube framework

Study 1. Assess the components of divergent thinking during the creative problem-solving task

## AUT (Guilford, 1967)

**Flexibility:** different alternative uses found by object

**Fluidity:** total number of alternative uses found per object

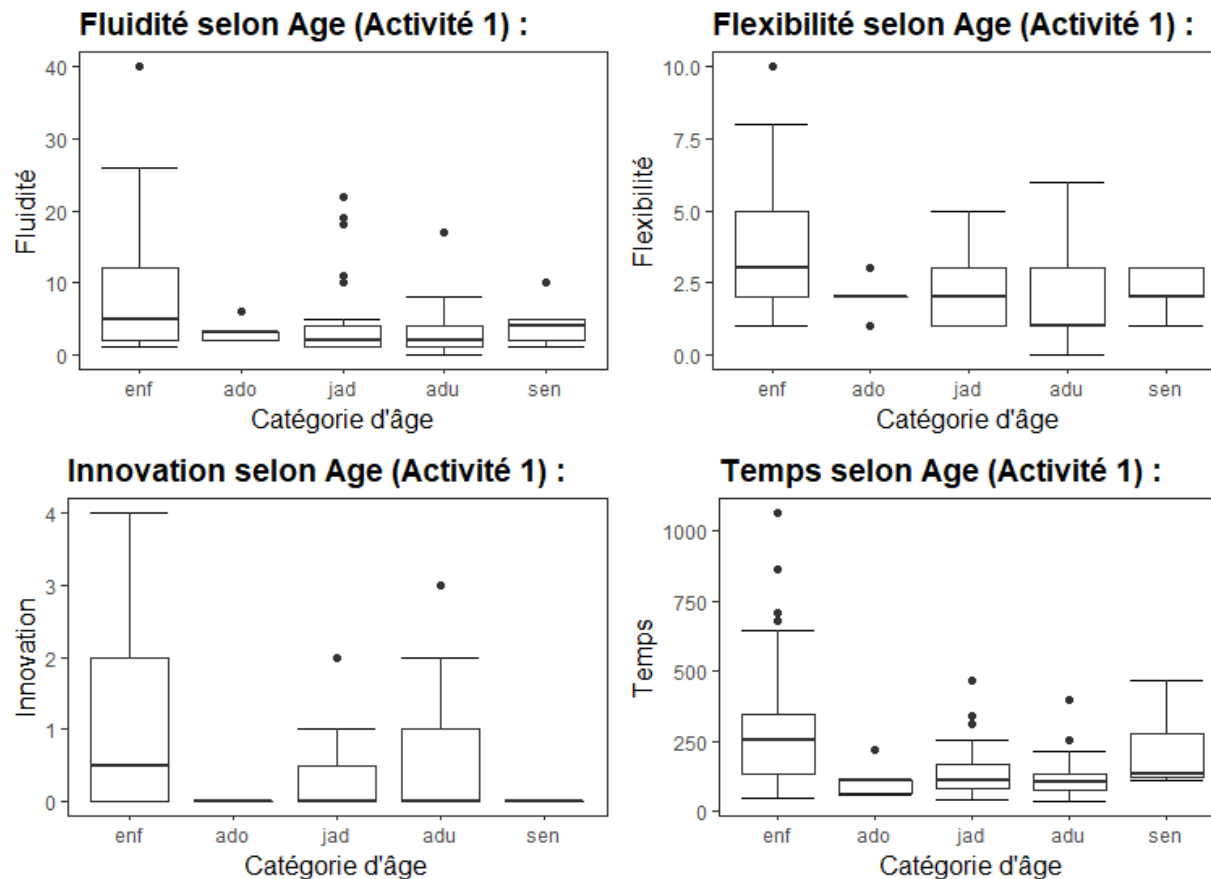
**Originality:** uniqueness of each response



DT components	Results: mean score (standard deviation) for the AUT task	Results: mean score (standard deviation) for the CreaCube task
Fluency = total number of ideas for the objects in AUT and total number of configurations for the CreaCube Task	$M = 5.8 (1.49)$	$M = 4.9 (3.89)$
Flexibility = number of different category or different configurations	$M = 3.97 (1.07)$	$M = 2.85 (1.77)$
Originality = response given by fewer than 5% of the participants	$M = 0.82 (0.78)$	$M = 0.51 (0.79)$

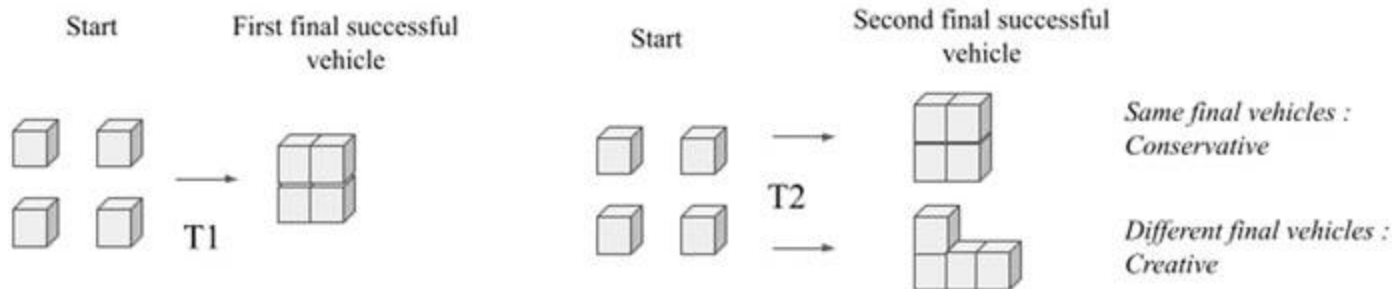
Leroy, A., Romero, M., & Cassone, L. (2021). Interactivity and materiality matter in creativity: educational robotics for the assessment of divergent thinking. *Interactive Learning Environments*, 1-12.

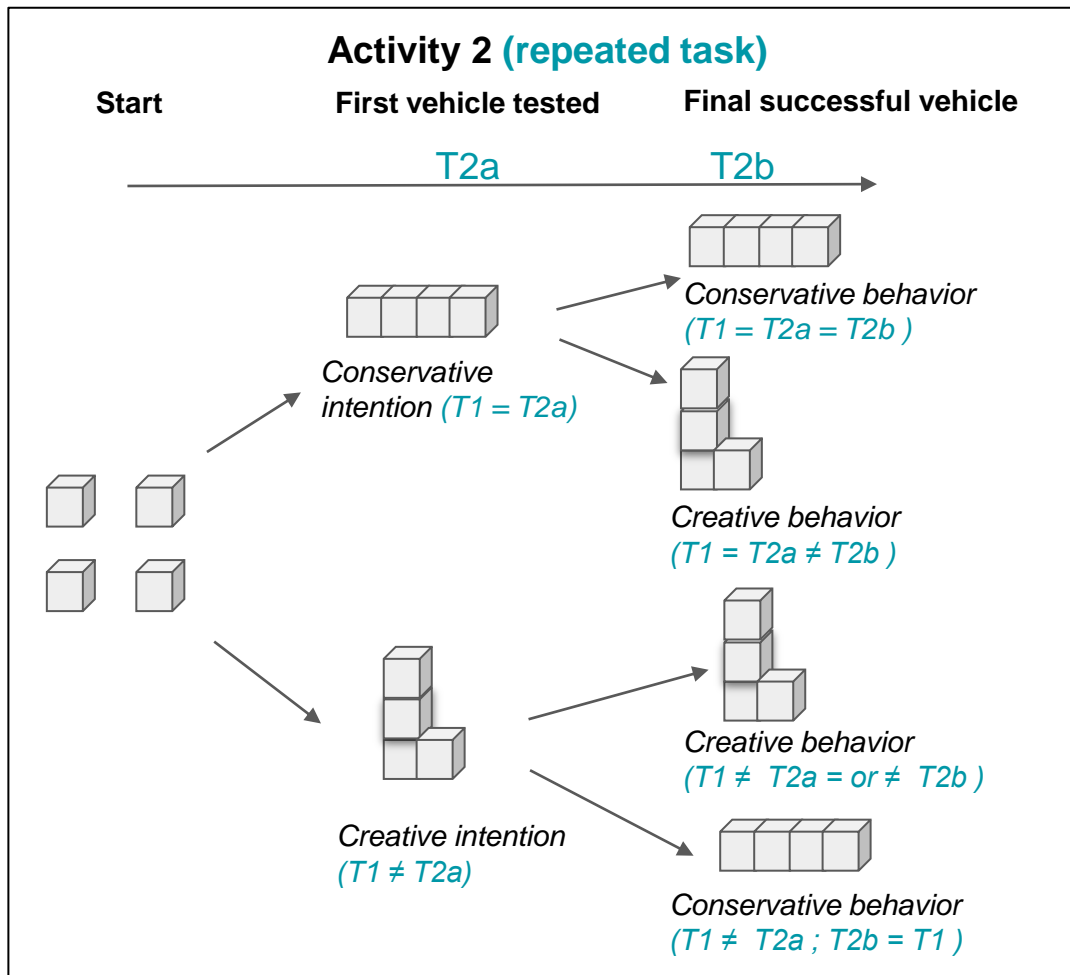
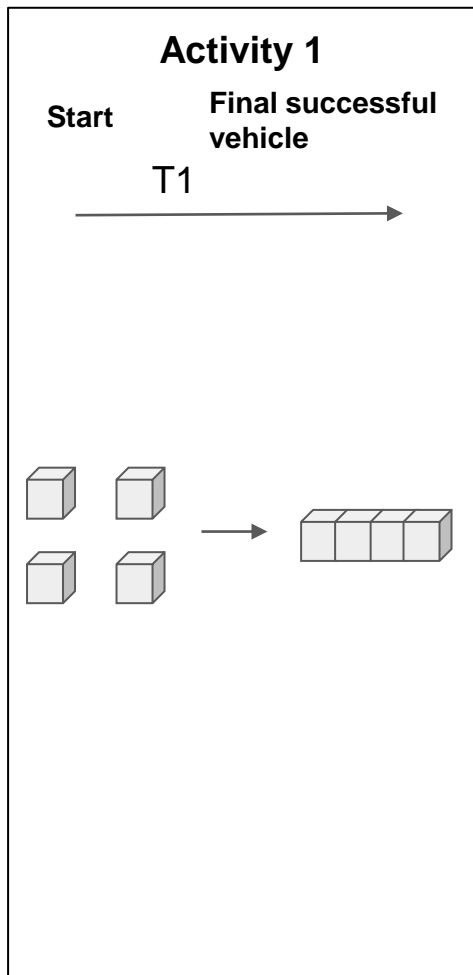
## Study 2. Creative problem solving by age (Romero &amp; Kohler, 2021)



### Study 3. Creative perseverance in the task

- 37 primary school teachers (neo teachers) who took part in continuing training on the creative uses of digital technologies.
- Repeat CreaCube task
  - First activity without solution model
  - Second activity with solution model
    - **Conservative behaviour** is observed when the participant applies an existing solution, often as a means of resolving tasks as quickly as possible.
    - **Creative behavior** requires inhibiting previous solutions and exploring new ideas.





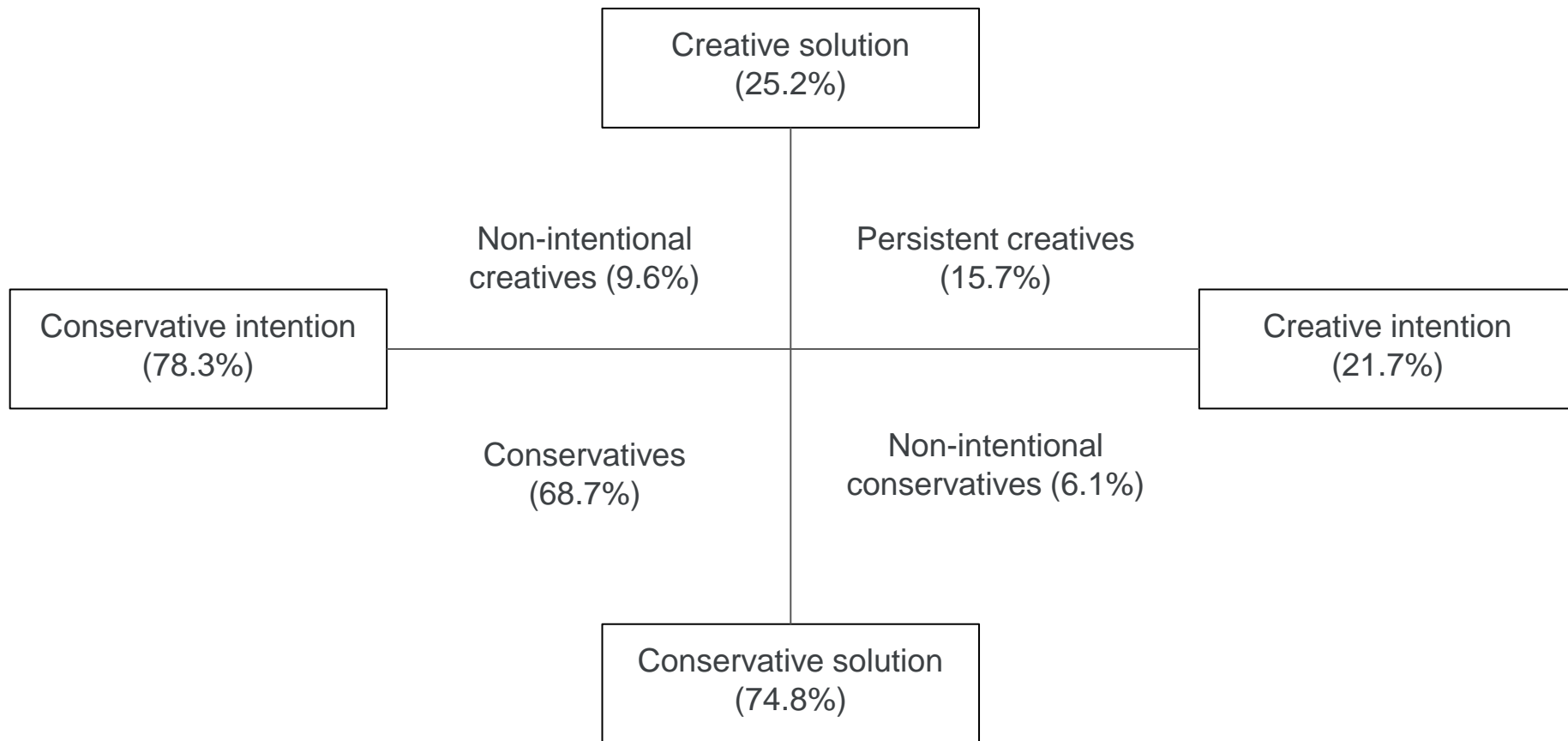
Subject profiles

Conservatives

Involuntary creatives

Creative perseverants

Creative irresoluteness



## Study 4. Effects of instruction on Creative Thinking

Explicit instructions appear to improve scores on divergent thinking dimensions (Acar et al., 2020)

23 students of  
INSPE of Nice

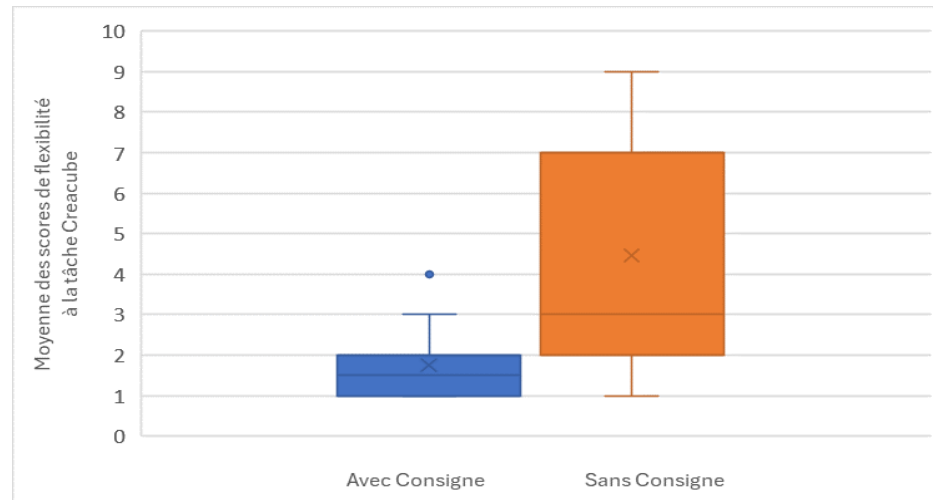
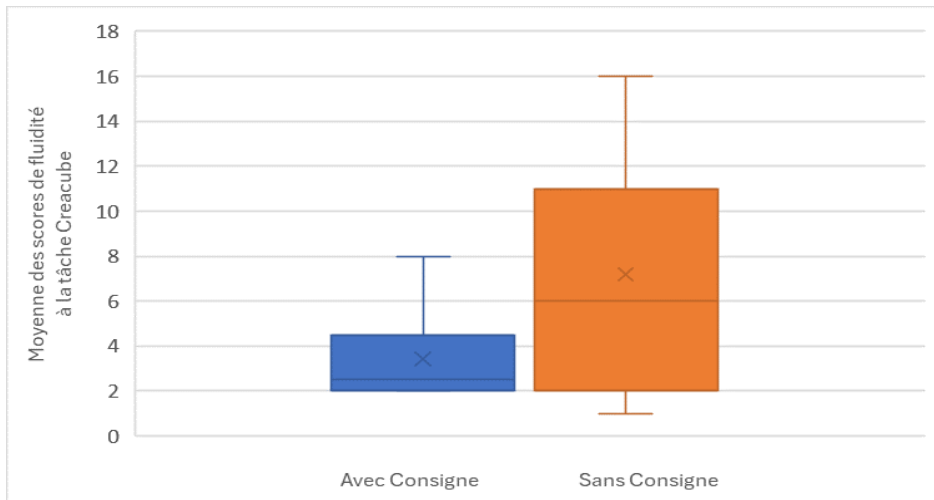
2 groups:  
With instructions or  
without instruction

AUT (Guilford, 1967)





## Effects of instruction on Creative Thinking : Fluidity and Flexibility factors



Study 5. Instantaneous behavioral effects of self-induced cognitive trance on creative thinking: the case of Art School students.

### **Self-Induced Cognitive Trance** as an non-ordinary state of consciousness






- Can be achieved voluntarily after a training
- Inspired by traditional Mongolian shamanic trance
- Without religious or spiritual ritual
- Studied scientifically through different scientific lenses



<https://trancescience.org/>

## Non-ordinary states of consciousness and creative thinking

Effects of non-ordinary states of consciousness, **self-induced** (different types of meditation) or **induced by psychotropic substances**, on convergent and divergent thinking.

	Divergent thinking	Convergent thinking
Ayahuasca		
Psilocybin		
Meditations		?

Colzato et al., 2012; Ding et al. 2014; Frecska et al., 2012; Kuypers et al., 2016; Prochazkova et al., 2018; Zabezina et al. 2011

J1 - Before  
the training

Self-Induced Cognitive Trance Training

J4 - After a  
SICT

Traits questionnaires  
State questionnaires

State questionnaires



**SET 1**  
Creative Problem solving task  
#CreaCube  
Imaginative Verbal Skills



40 art students divided in  
Randomized groups



**SET 2**  
Alternative uses  
Imaginative ability drawn  
Semantic association  
Insight



# Questions ?



Thank you !

*Image generated by AI DALL-E with the prompt "An abstract oil painting of trance".*

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