



SAPIENZA
UNIVERSITÀ DI ROMA

UNVEILING INNOVATION DYNAMICS IN A WEB
EXPERIMENT WITH LEGO® BRICKS.

Giulio Tani, Pietro Gravino, Cesare Bianchi and Vittorio Loreto

September 7, 2017 *Kreyon Conference 2017*

Introduction

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- Is running since 2015 ...and you can play it at the entrance if you want
- Its aim is to unveil the dynamics of innovations in a controlled environment
- Is a game because in games that probably we can exploit our creativity at our best



From experiment to game

LEGOPIXELART  **Disegna** 10783 🗲 1556 🗲 🔌

Disegna il concetto: Sole
Scegli un disegno da modificare, o creane uno nuovo.



Indovina più disegni per avere maggiore scelta

 **Home**

 **Indovina**
Indovina i concetti disegnati dagli altri! Puoi

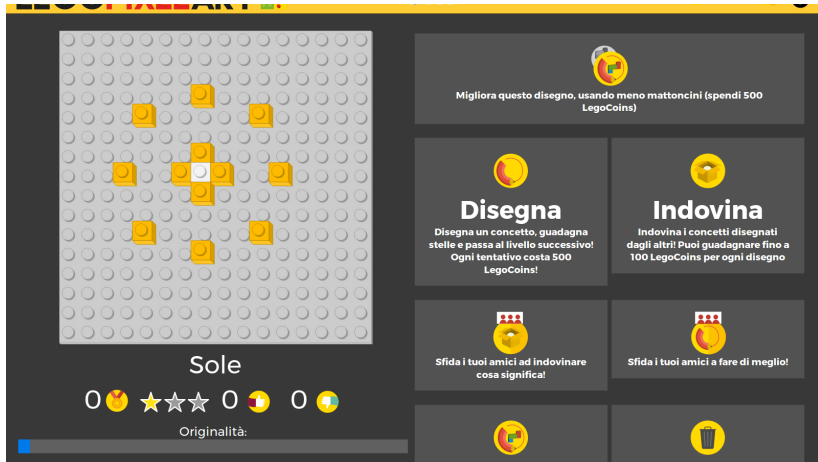
 **Top 10**
Guarda la classifica dei migliori disegni.



From experiment to game



From experiment to game



The screenshot shows a game interface with a central drawing area and several interactive panels. The drawing area is a 10x10 grid of grey circles. A drawing of a sun is partially completed with yellow square pieces. Below the grid, the word "Sole" is written. At the bottom left, there are icons for a coin, stars, and thumbs up/down. A progress bar labeled "Originalità:" is at the bottom. On the right, there are six panels with icons and text:

- Top panel: Icon of a coin with a plus sign. Text: "Migliora questo disegno, usando meno mattoncini (spendi 500 LegoCoins)"
- Second row, left panel: Icon of a coin with a plus sign. Text: "Disegna", "Disegna un concetto, guadagna stelle e passa al livello successivo! Ogni tentativo costa 500 LegoCoins!"
- Second row, right panel: Icon of a coin with a plus sign. Text: "Indovina", "Indovina i concetti disegnati dagli altri! Puoi guadagnare fino a 100 LegoCoins per ogni disegno"
- Third row, left panel: Icon of a coin with a plus sign and a star. Text: "Sfida i tuoi amici ad indovinare cosa significa!"
- Third row, right panel: Icon of a coin with a plus sign and a star. Text: "Sfida i tuoi amici a fare di meglio!"
- Bottom row, left panel: Icon of a coin with a plus sign.
- Bottom row, right panel: Icon of a trash can.



From experiment to game

LEGOPIXELART Indovina concetto 9593 866

Per **10** punti indovina il concetto

Tempo rimanente: **00:08**

sole

mare alba tramonto

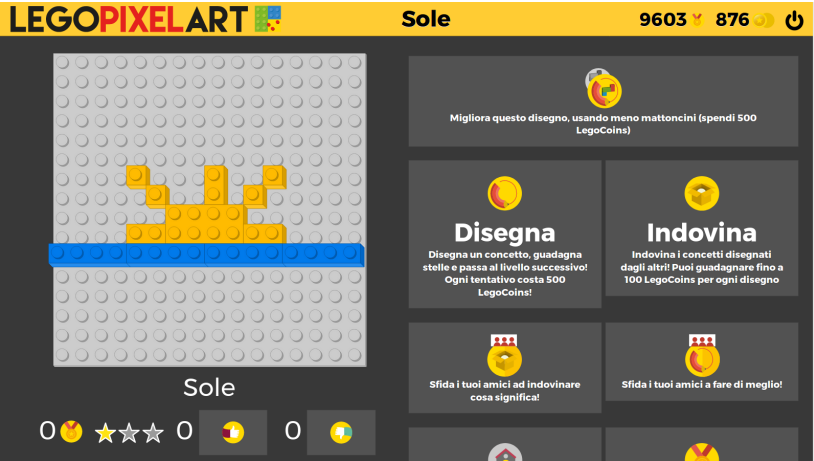
Prova risposta

Indovina altro disegno

Annulla



From experiment to game



and back to experiment

- Compositions
 - fundamental elements of this study
 - show emulation or innovation by users



and back to experiment

- Compositions
 - fundamental elements of this study
 - show emulation or innovation by users
- Guesses
 - give us feedback about the compositions
 - may be interesting by themselves



Definitions

We defined a distance function between composition combining 9 different sub-distances:

$$d_{ij} = \sum_k \alpha^{(k)} d_{ij}^{(k)}$$



Definitions

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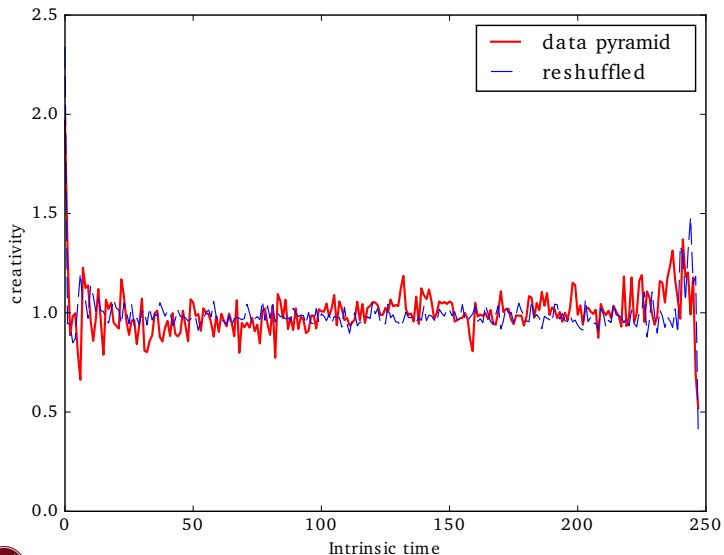
$$d_{ij} = \sum_k \alpha^{(k)} d_{ij}^{(k)}$$

As creativity is variably defined as a combination of newness and usefulness, from this distance we got definitions of the originality and value of the compositions:

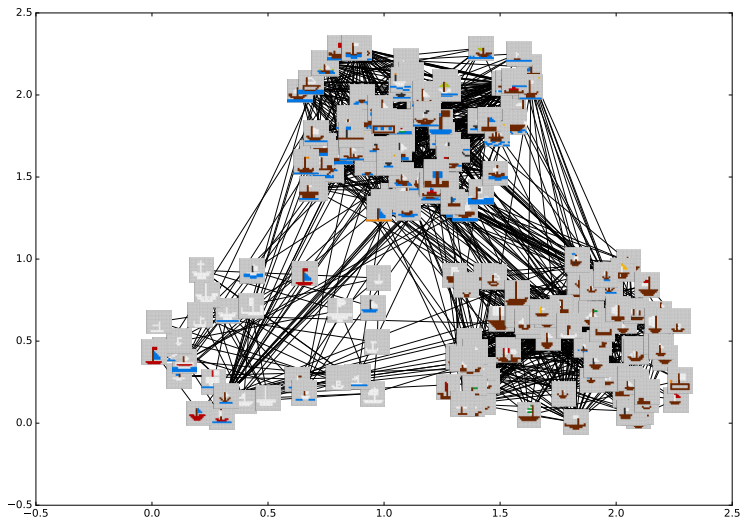
$$O_i = \sum_{j < i} d_{ij} \qquad V_i = \left[\sum_{j > i} d_{ij} \right]^{-1}$$



Communities



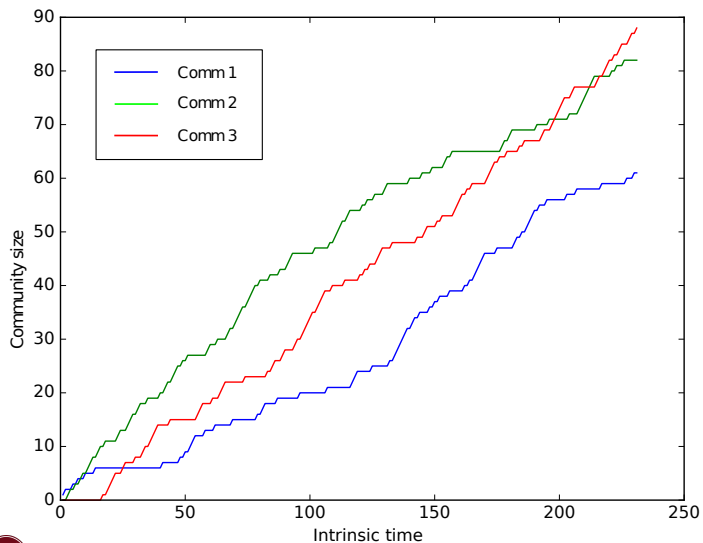
Communities



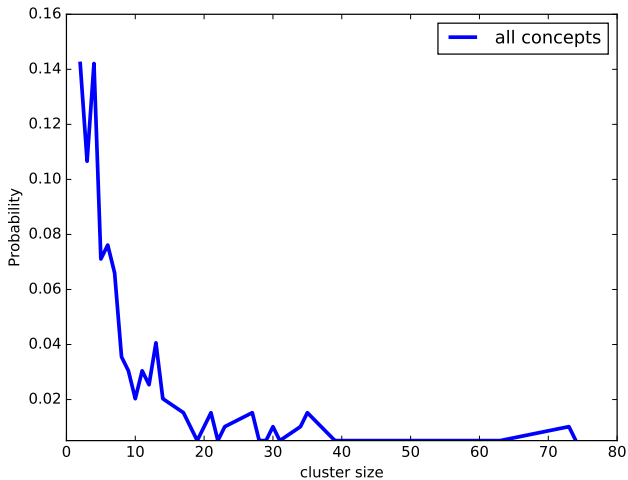
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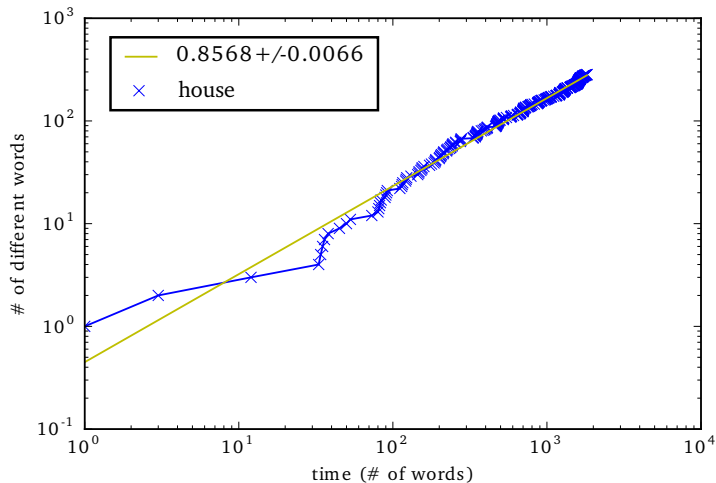
Communities



Communities



Errors

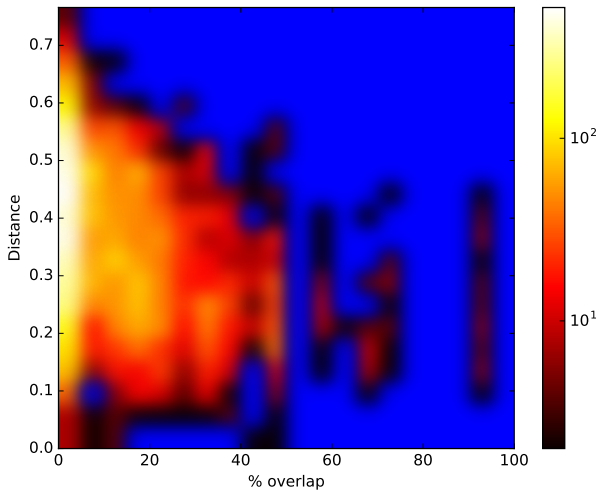


Only one of that words is correct, what can we learn from errors?

Are compositions sharing the same set of wrong tags similar to each other?



Errors



$r=-0.36$

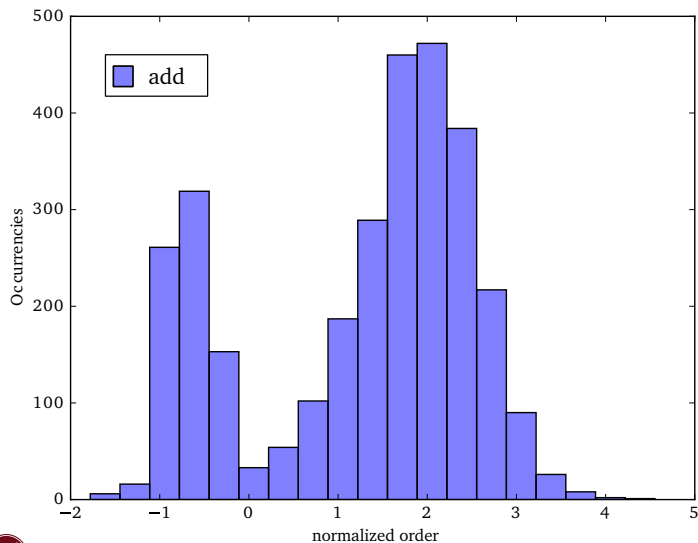


Is there something we can learn from how the compositions are created?

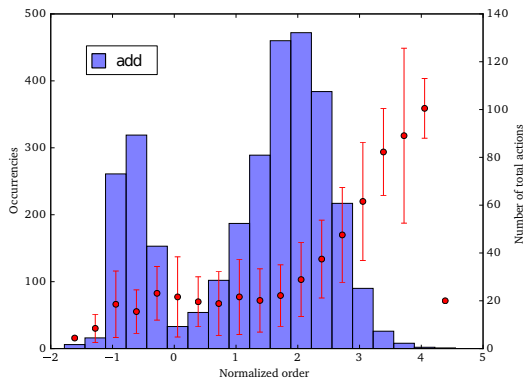
Can we find different strategies looking at the disorder in the actions (adding, changing or removing bricks) made while creating the composition?



Strategies



Some relationships with this strategies are evident and we're investigating in that direction right now.



Thank you!



Distance function

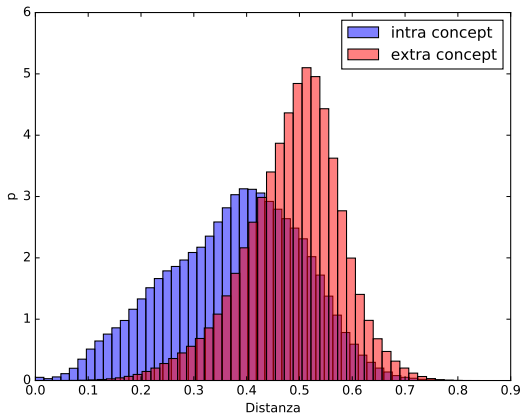
The distance function is made by 9 different metrics:

1. The distribution of the bricks used, *bri*;
2. The distribution of the colours used, *col*;
3. The relative difference in the number of pixels, *npix*;
4. The distance between the centres of mass, *avg*;
5. The similarity under reflection, *ref*;
6. The similarity under rotation, *rot*;
7. The relative difference between the radius of the compositions, *res*;
8. The distance between the proportions, *prop*.
9. The point matching distance between the two compositions, *diff*.



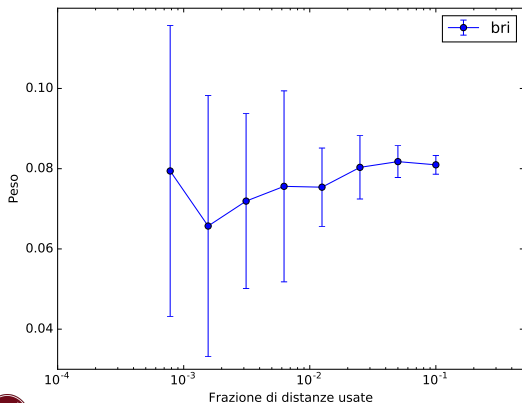
Distance function

The weights of this nine metrics were optimised in order to maximise the difference between intra-topic and extra-topic distance distributions:



Distance function

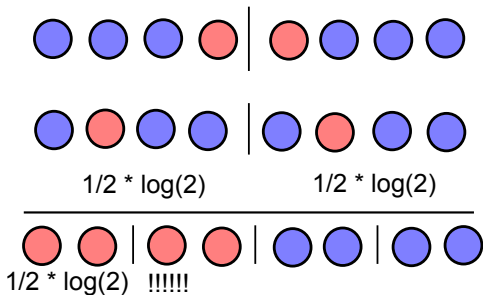
The weights of this nine metrics were optimised in order to maximise the difference between intra-topic and extra-topic distance distributions optimising over increasingly large subsets of distances and looking for convergence:



Disorder

To evaluate the disorder in time series three different definitions were used:

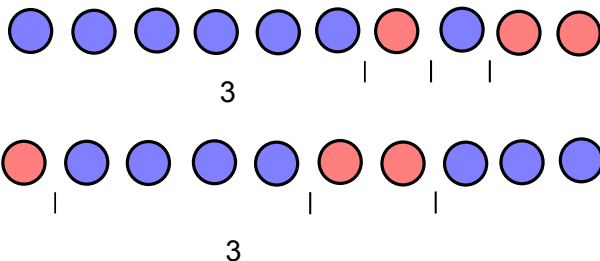
- The entropy as defined in Tria *et al.* 2014



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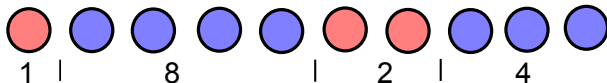
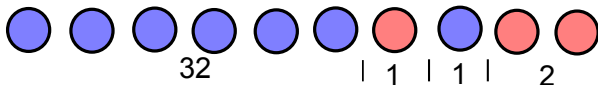
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Disorder

To evaluate the disorder in time series three different definitions were used:

- The entropy as defined in Tria *et al.* 2014
- The disorder as the number of changes of label
- The disorder defined starting from the sum of the exponential of the length of contiguous series of labels



$$36 > 15$$



Disorder

Because everyone of them had some issues we used all (after correcting the bias they had due to series length and fraction of labelled items) requiring a qualitative agreement from all the three of them.

