The dynamics of social interactions in a collective creativity experiment

Giulia Pullano (La Sapienza, ISI Foundation)

Supervisor: Prof. Vittorio Loreto (La Sapienza, ISI Foundation)
Co-advisor: Dott. Bernardo Monechi (ISI Foundation)

Coordinator **Prof. Vittorio Loreto**

- Tria, Francesca, et al. "The dynamics of correlated novelties." Nature Scientific Reports, 4 (5890), 2014.
- Gravino P., et al. "Crossing the horizon: exploring the adjacent possible in a cultural system."*Proceedings of the Seventh International Conference on Computational Creativity* 2016.
- Rodi Giovanna Chiara, et al. "Search strategies of Wikipedia readers." *PloS one* 12.2 : e0170746. 2017
- Gelardi V., et al."Analysis of the Structure and the Collaborative Dynamics of GitHub Projects."2016.(submitted)

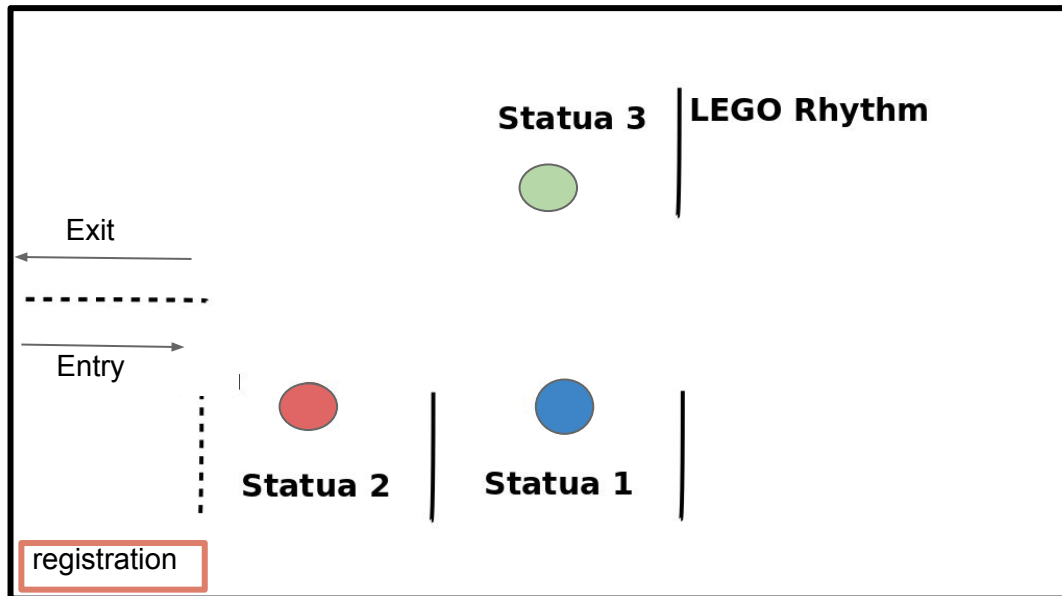We are looking for a definition of innovation and creativity in human collaborative systems **in real life**.

Lego sculpture experiment

Designed by **Dott. Bernardo Monechi**
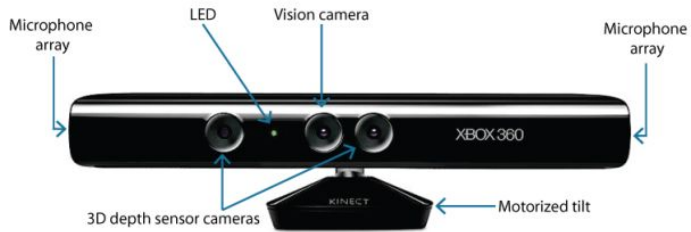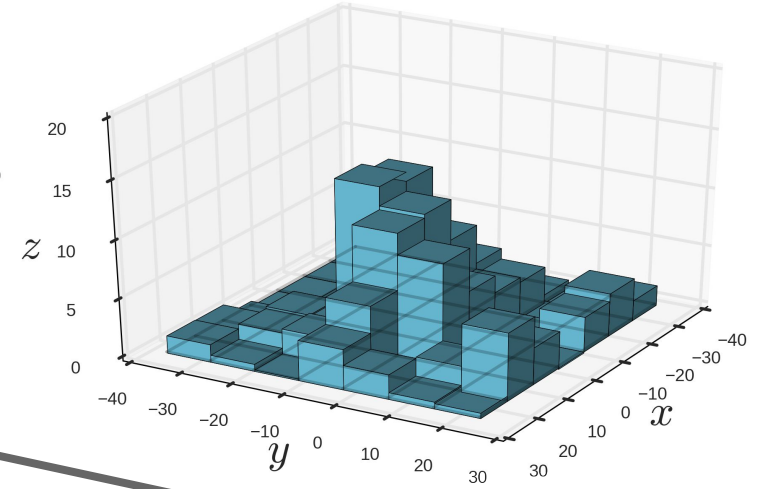

Statua 3   **LEGO Rhythm**

Exit

Entry

Statua 2   **Statua 1**

registration
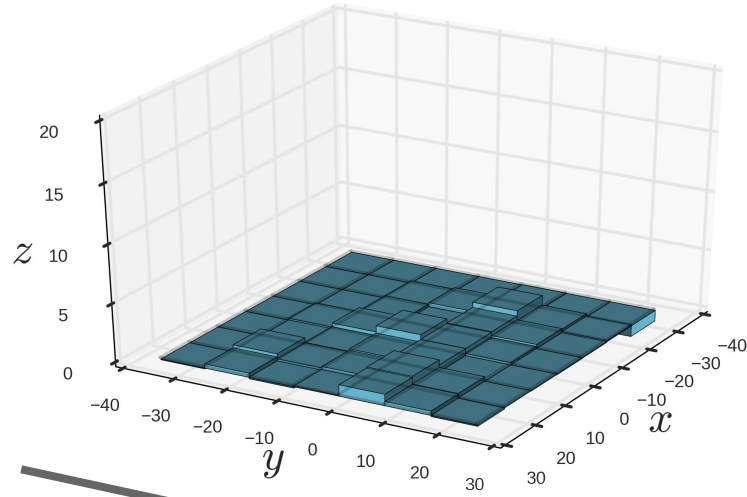
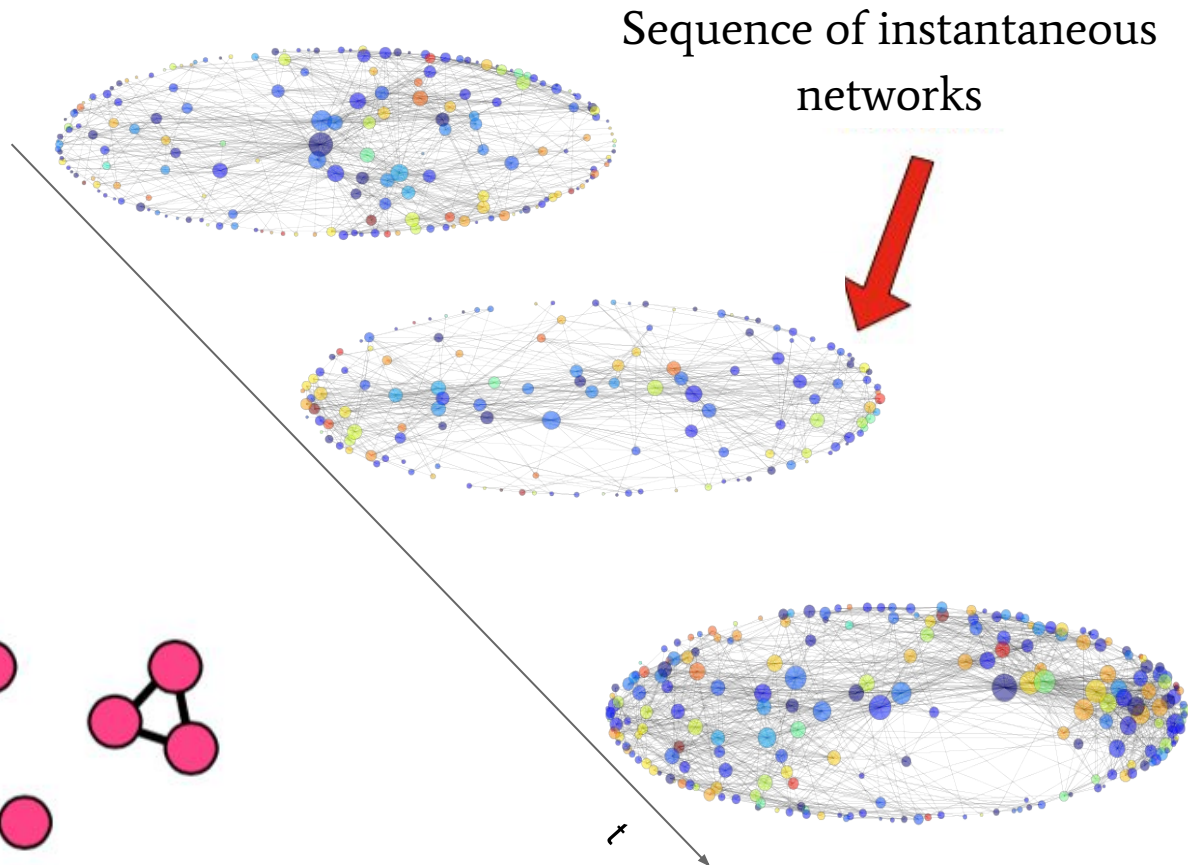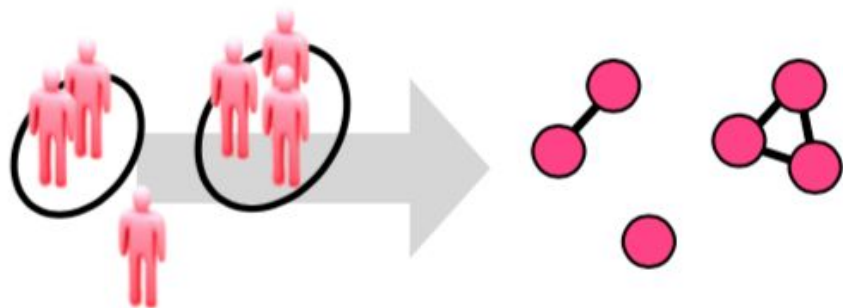# Why collective creativity experiment?

- Network analysis to unfold fundamental patterns in the dynamics of social interactions.

- Find the link between the evolving social network and the growth of the sculptures in the short and long term studying the conditions that are particularly favorable for the emergence of innovation.
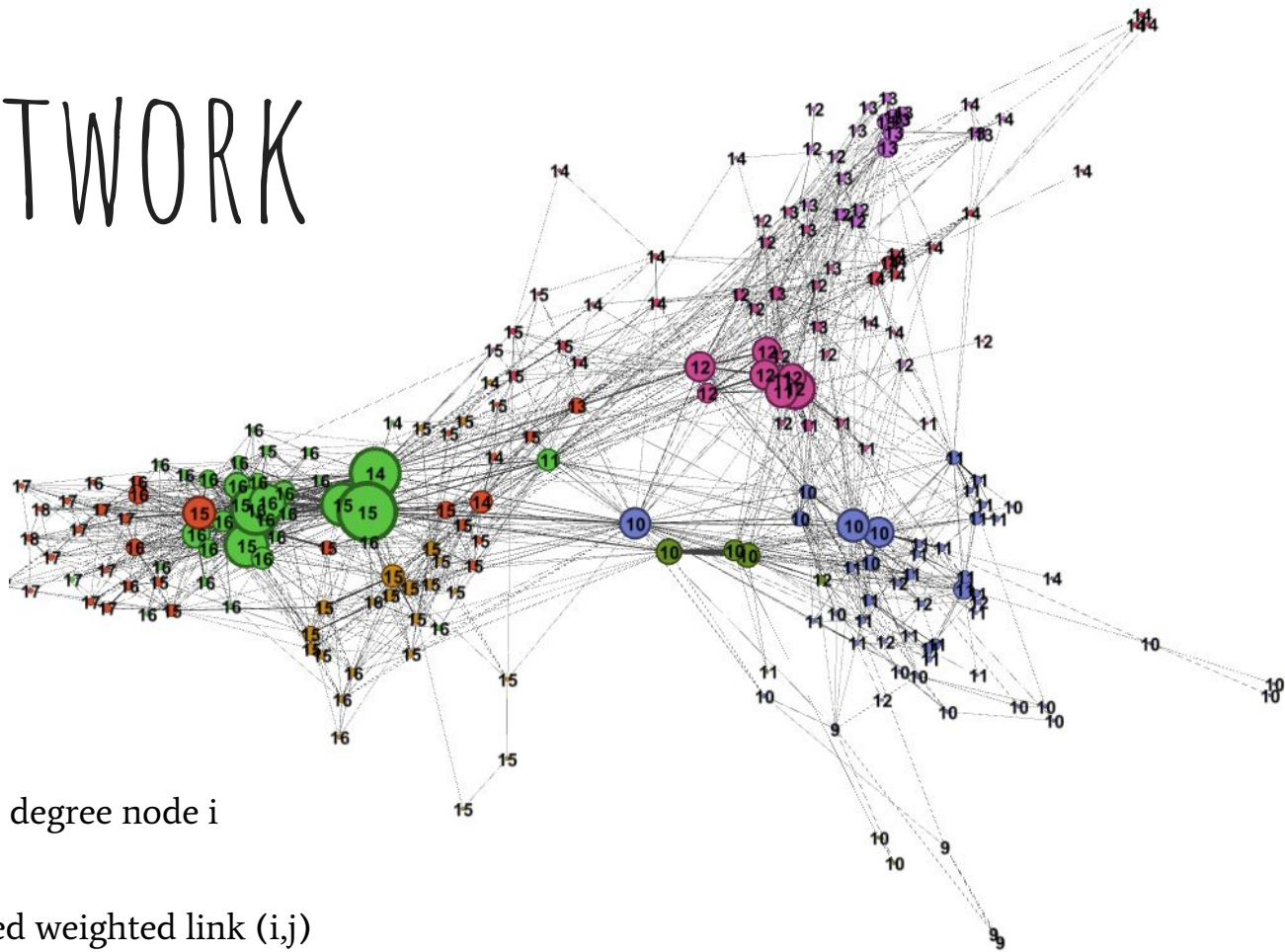
Khoshelham, Kourosh. "Accuracy analysis of kinect depth data." ISPRS workshop laser scanning. Vol. 38. No. 5. 2011.

Radio-Frequency Identification devices (RFID)

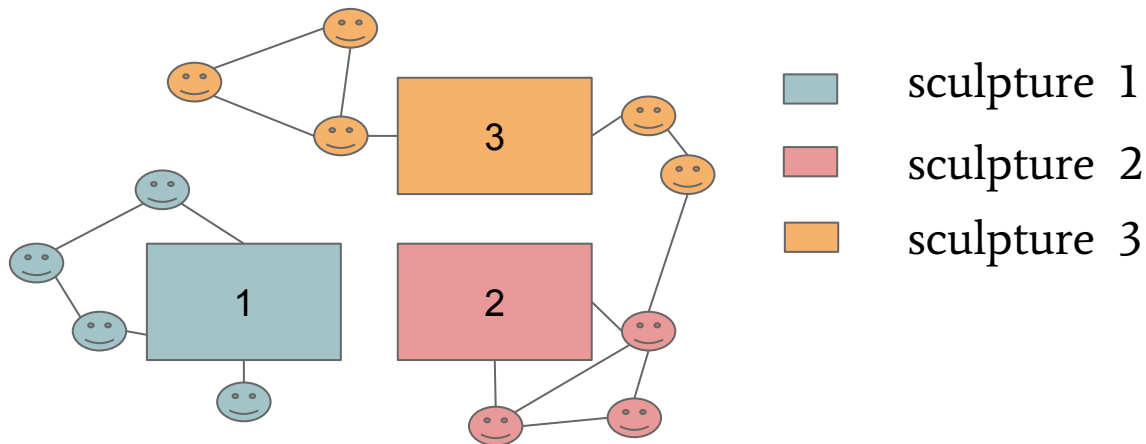Sequence of instantaneous networks

Static network

$k_i = \sum_j w_{ij}$ Weighted degree node i

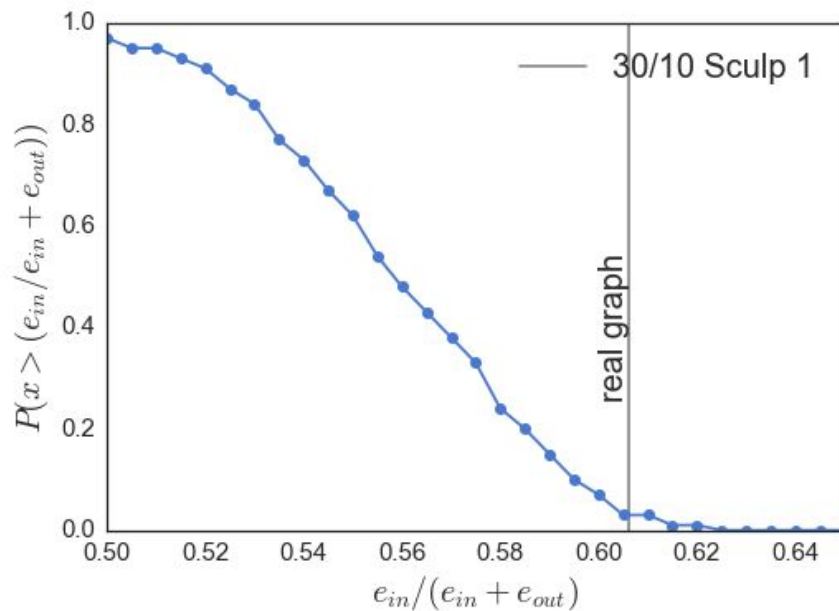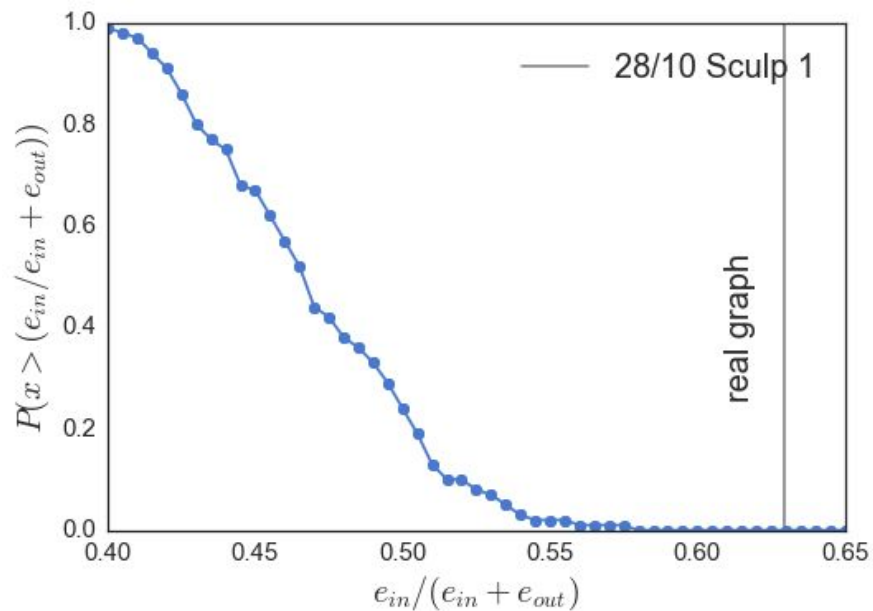$w_{ij} = \sum_t \chi(i,j,t)$ Aggregated weighted link (i,j)

Social clustering around LEGO sculptures

sculpture 1
sculpture 2
sculpture 3

e_{in} = sum of all contacts durations among persons who worked on the same sculpture for at least 60 seconds.

$e_{in} + e_{out}$ = sum of all contacts durations in the whole network of contacts.

Social clustering around LEGO sculptures

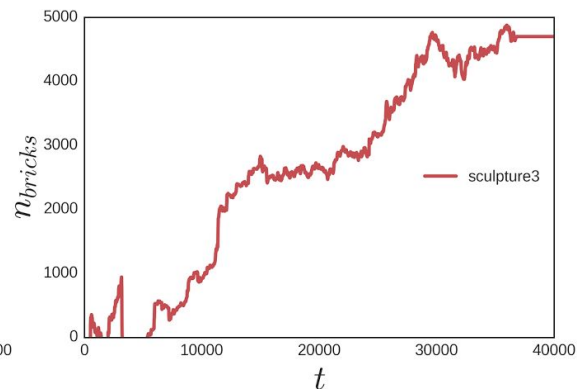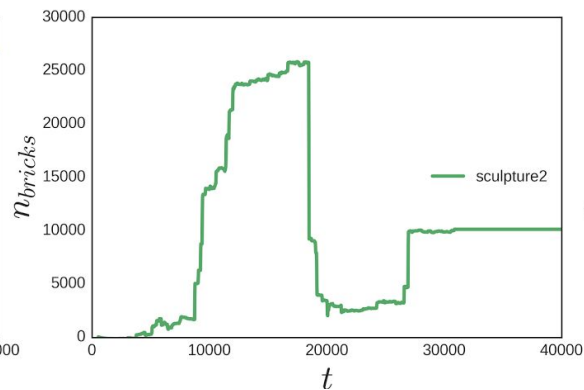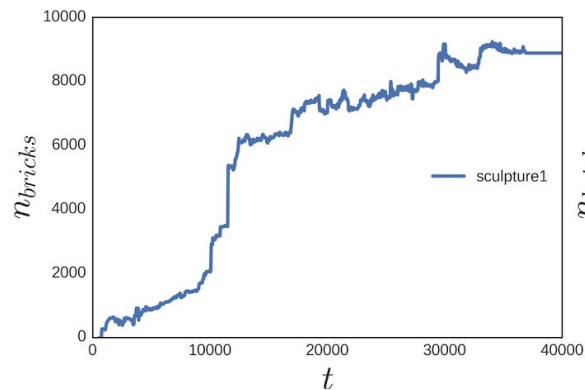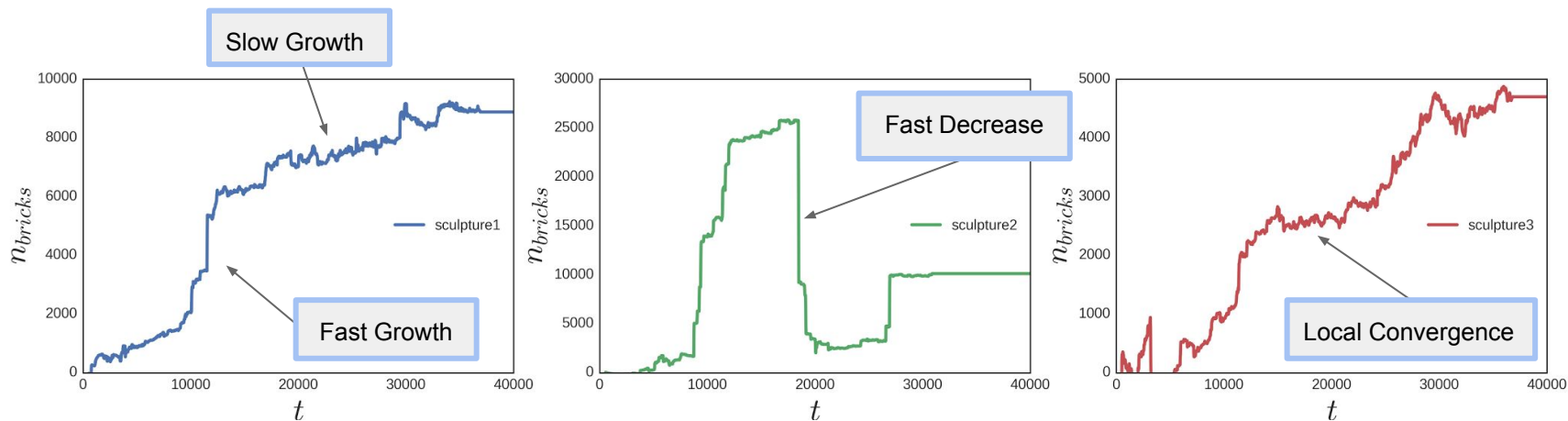# Entropy to analyse participants dispersion on sculptures

Entropy Distribution

1 sculpture

2 sculptures

3 sculptures

26-27-28/10
29-30/10
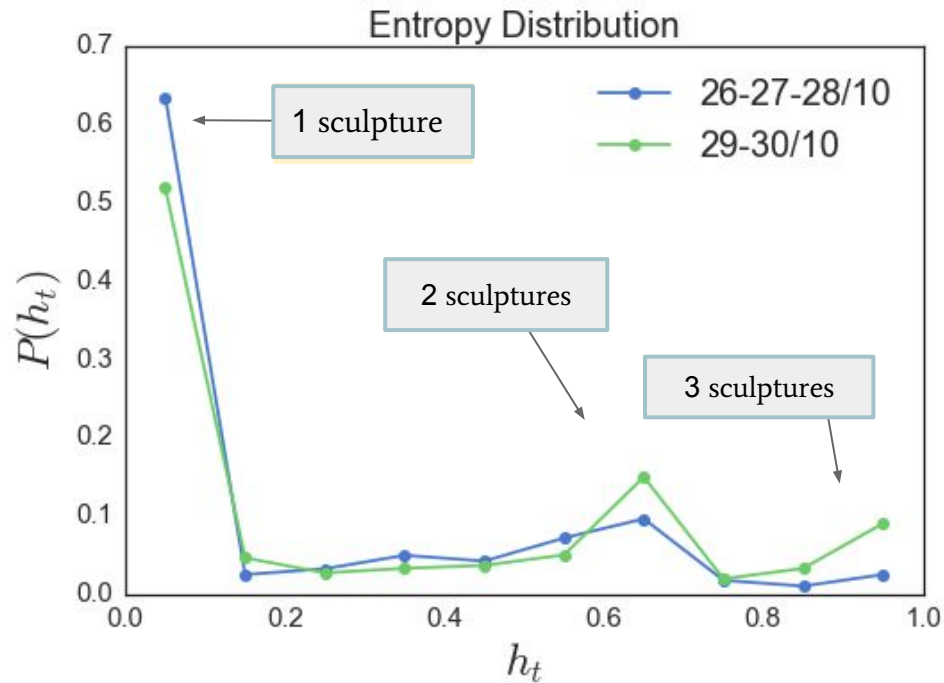
$$H[p] = -\sum_{i=1}^{k} p_i \log p_i$$

- k= 3 number of sculptures.

- p_i= permanence time of participant on sculpture i normalized on total permanence time on sculptures.

How do we Quantify Innovation?

How do we Quantify Innovation?

Different Growth Regimes
- Is there a link with the social network of the participants?

METRICS OF SPEED OF GROWTH OF VOLUME
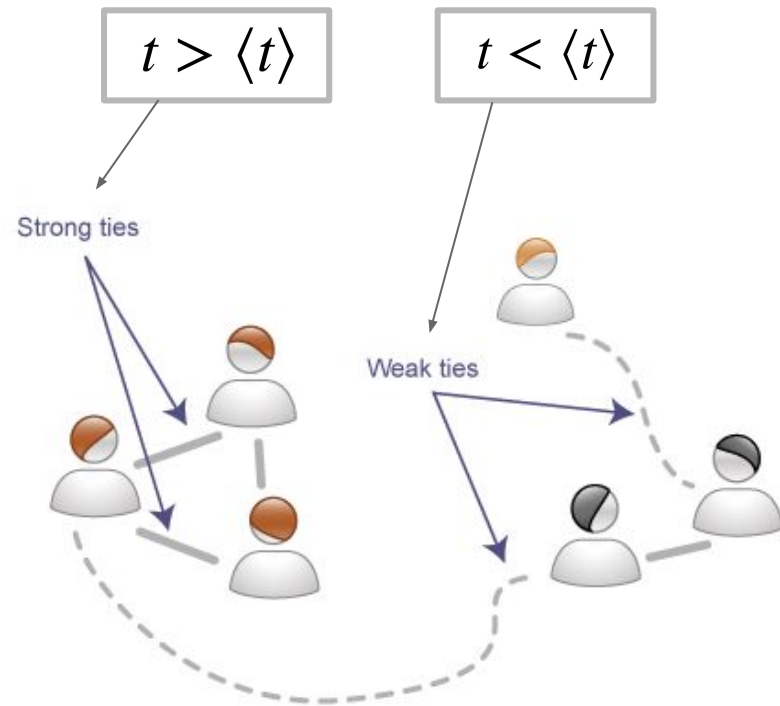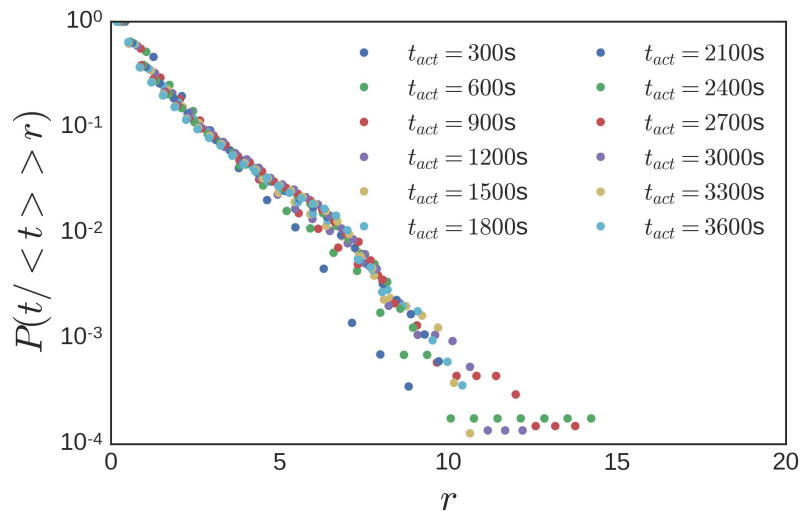
$$v(t) = \frac{vol(t + dt) - vol(t)}{dt}$$

The instantaneous
speed of growth

$$v_{avg}(t) = \frac{vol(t_{fin}) - vol(t)}{t_{fin} - t}$$

The long-term
speed of growth

We have measured v(t) for several dt at each time step t of 20 sec for all artworks.

Weak and strong ties

$$t > \langle t \rangle$$

$$t < \langle t \rangle$$

Strong ties

Weak ties

❖ Onnela, J-P., et al. "Structure and tie strengths in mobile communication networks." Proceedings of the National Academy of Sciences 104.18 (2007): 7332-7336.

❖ Perry-Smith, Jill E., and Christina E. Shalley. "The social side of creativity: A static and dynamic social network perspective." Academy of management review 28.1 (2003): 89-106.

❖ Granovetter, Mark. "The strength of weak ties: A network theory revisited." Sociological theory (1983): 201-233.

G_T with $T = \{0, ..., t, ...4000\}$ $\longrightarrow$ subgraph g_t^s of G_t

Subgraph of the users having interacted with the sculpture s in the considered time frame (t , t + Δt) .
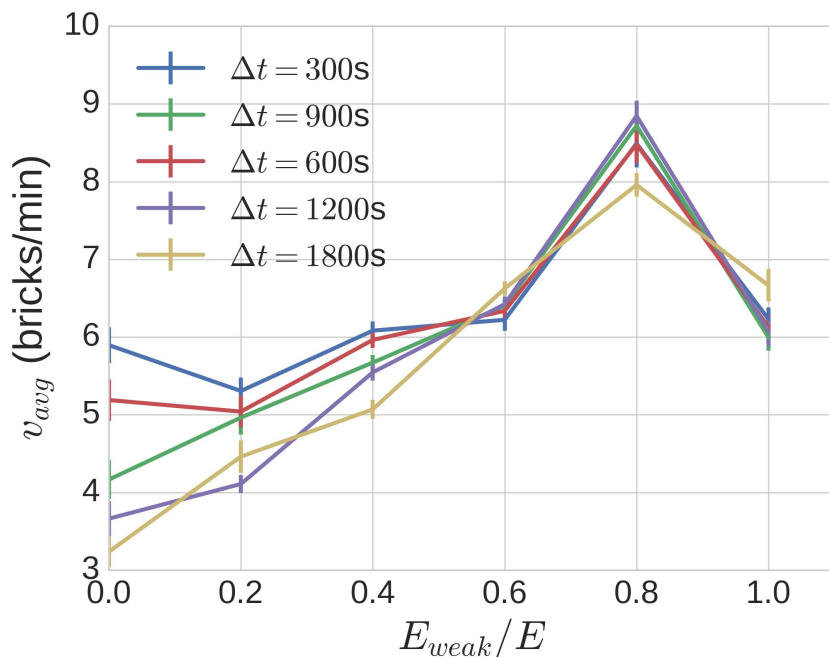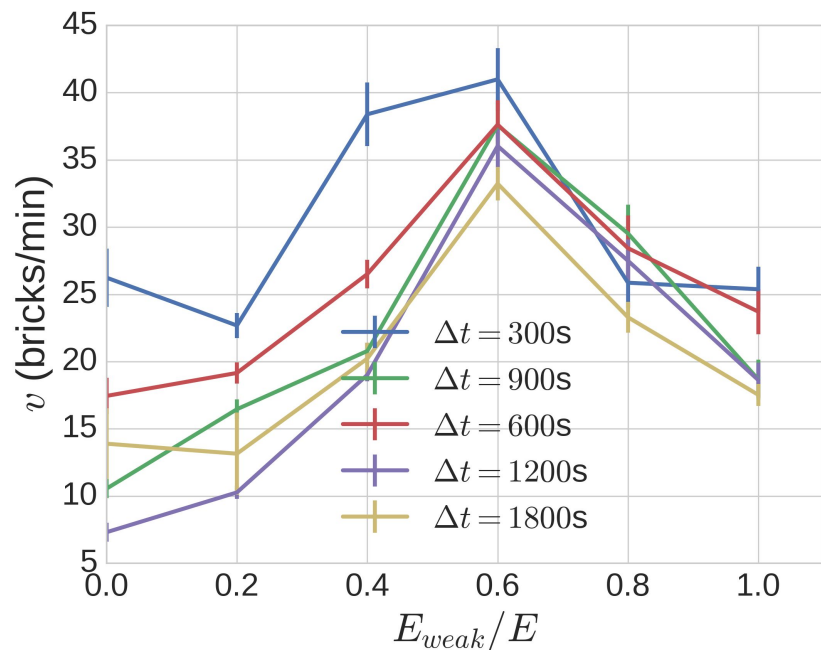
How entropy influence the growth of volume?
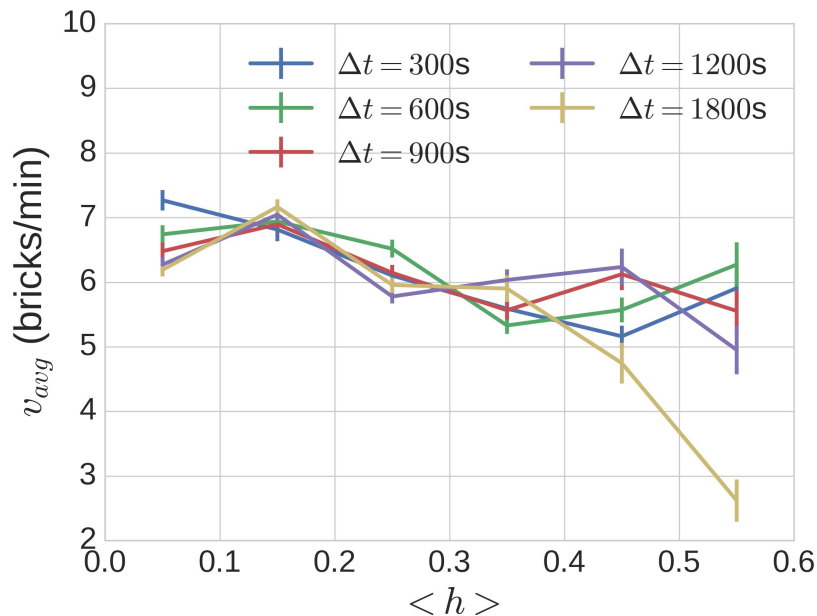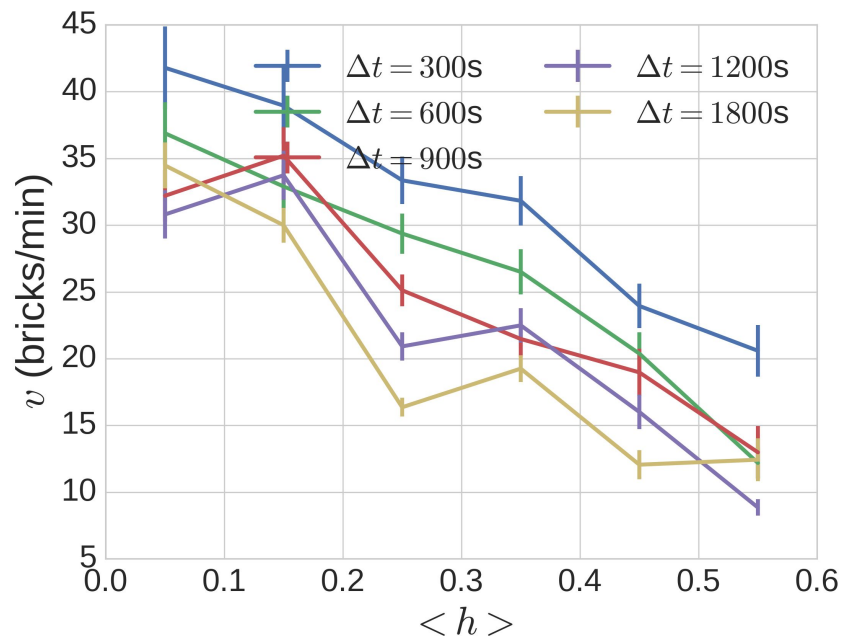
Conclusions

- The social ties are clustered between people who contributed to the same sculpture and most of the participants are focused mainly on one single artwork.

- Creativity is promoted if participants focus their work mainly on one artwork, so dispersing the attention in different artworks seems to introduce a factor of distraction.

- There is an optimal value for the amount of weak ties a certain work group must own in order to maximize its efficiency.

Total duration of social interactions for different activity times
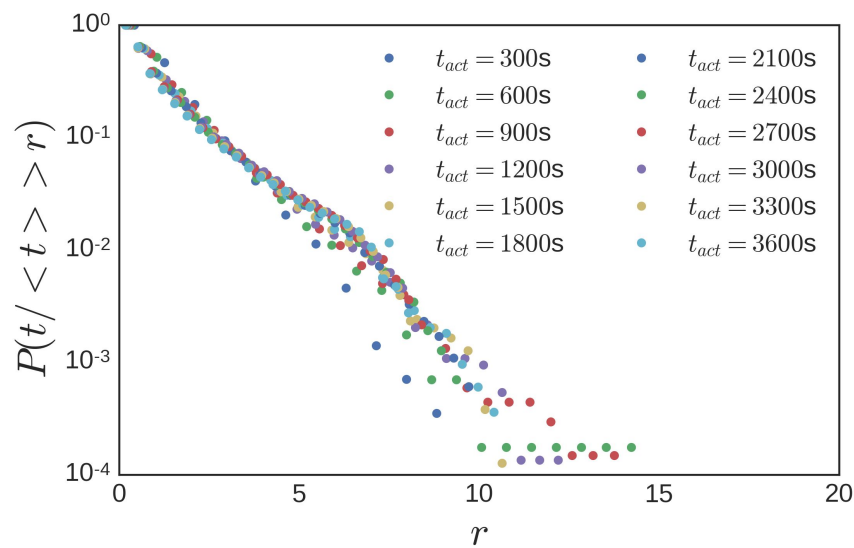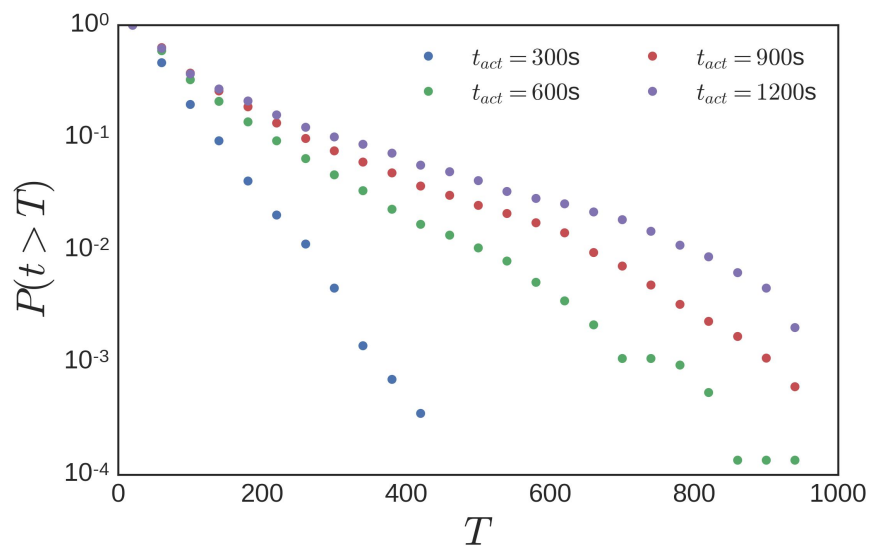
$< t > (t_{act})$ represents the natural scale of the time of interaction given a certain activity time.