

## Abstract

In this paper we characterize a shift paradigm in modern western (european) painting art between the late 1800s and early 1900s, in which avant-garde movements and more abstract concepts developed in the broad of paintings. On one hand, this characterization of transition can be measured in terms of complexity measures in painters community, like number of artists and heterogeneity, focusing on art movements and art specialities by painter. On the other hand, we show that the cultural trait of art production can be proved extracting concepts of pictures via Image Content Analysis and thereafter applying Structural Topic Modeling in these concepts in order to see how the painters developed emergent ideas in their works in this revolutionary epoch. This work shows evidence for that the transitions in sociocultural evolution can be described in terms of complexity measures of systems and showing how certain cultural traits changes according to the change of another critical variables that motivates those changes.

## Background



Figure 1: Evolution of art in Europe between Realism to Surrealism

- Evolution of complexity can be explained in terms of number of components, frequency, heterogeneity and energy of system. [2, 1]. In biological evolution, the *transitions* can be explained in these terms [9]. Also, in the same spirit, transitions can be described as a rapid interlap between the different paradigms [6] and this idea of evolution can be extended to other areas [5].
- What happened in modern art history? Avant-Garde movements are broadly studied in a qualitative way [4, 3, 10]. Also, the development of new techniques, the rise of republics, among other factors, influenced changes in art production [7, 8, 11]. In particular, before these changes, art production was motivated via patronage and thereafter, art production was more free and far from an extremely academicist. The number of artists who criticized the old way of making art increased, leading a more free production and probably, leading a more abstract concepts inserted in art production. These *critical variables* may explained the paradigm shift in art production of painters.
- This paper focuses in describe the paradigm shift in European painters production between XIX and XX centuries considering complexity measures, that is, seeing how community of painters changed (number and heterogeneity) and how the cultural trait change who describe paint production (more realistic paradigm to a more abstract paradigm)

## Methods

### Data analysis:

- $N = 145$  artists,  $m = 28$  art movements. Time-unit: midlife artist year and decades of time studied (c.1850 – c.1930). **Source:** This sample data comes from a simple extraction from Wikipedia website.
- Moving average models on increasing art movements and specialities in the transition.
- Normalized Shannon diversity ( $N^{-1} \exp(-\sum p_i \ln p_i)$ ) on art movements per decade.

### Picture analysis:

- Sample of  $N = 94$  digital paintings, in which year of production were from c-1850 to c.1940.
- Cultural trait change: Image Content Analysis (ICA) extracting concepts from pictures & Structural Topic Modeling [12] over these concepts in order to see change in topics (from more *realistic* to more *abstract* perspective) using a Corpus Topic Proportion measure.

## Discussion

Results show how in terms of number and heterogeneity (focusing in art movements and art specialities), the community of painters changed, showing an increasing in these variables that may explained conditions to break old paradigms. In parallel, the concepts that motivated the paintings changed too, leading from more mimetic-realistic concepts to more abstract-free concepts, and this can be considered as cultural trait change. The world changed and also changed the art which is in essence, a particular human behavior. The ideas of this research show that we can systematically describe how the transitions of a particular human behavior of a community are given, which are correlative to how transitions in biological and social evolution occurred.

Special thanks to Ignacio Toledo Román (CICS), Nicolás Barriá González (Universidad de Concepción, Chile) and David Barra (Consejo Nacional de la Cultura y las Artes, Chile) and Daniela Li-Jó (Red de mediación artística, Galería de Arte Contemporáneo Gabriela Mistral, Chile) for their suggestions and relevant ideas to this project

## Results

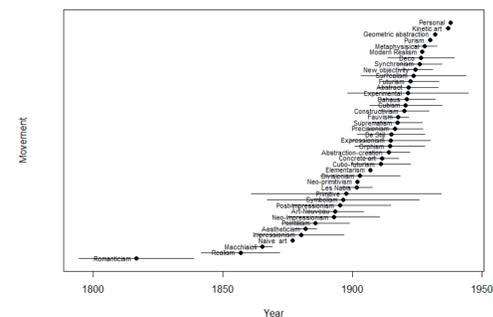


Figure 2: Art movements according time. Points indicate midlife of artists belonging these movements and lines represents standar deviations. This show that art movements quickly increasing according time in this period.

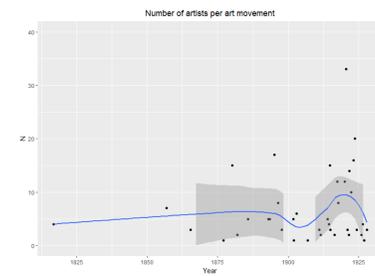


Figure 3: Number of artists per movement according time. Solid line is moving average tendence. This show that the art movements were more numerous according time increasing.

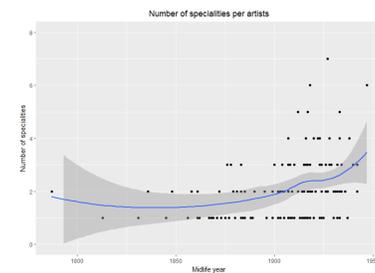


Figure 4: Number of art specialities per artists according time, in which x-axis represent midlife of artists. Solid line is moving average tendence. This show that the painters were more multi-faceted artists according time.

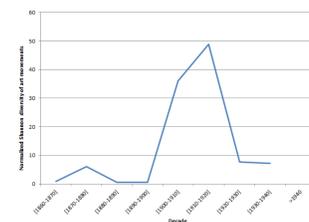


Figure 5: Normalized Shannon diversity of art movements per decade. This show that in the first two decades of c.XX, many movements and different expressions of art taked part.

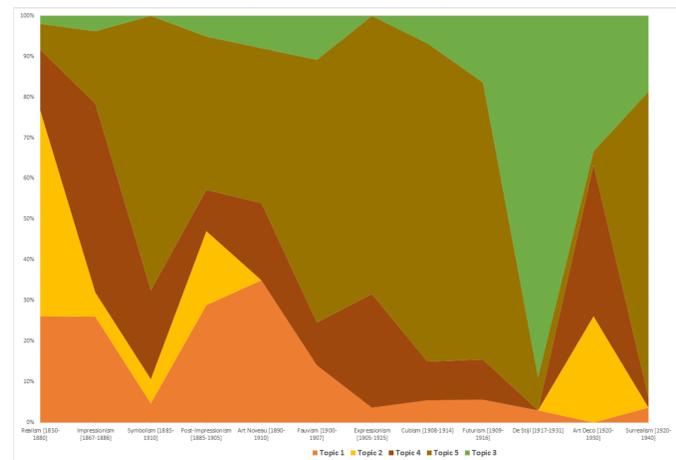


Figure 6: Evolution of topics per art period. From the total of topic, graph is showing how the topics distributed among them, in a particular time. Y-axis indicates the *topic proportion of corpus*, that is, how much concepts of these topic are relevant in that particular era. The topics are the following, according to maximum probabilities: **Topic 1:** tree, paint, art, impressionist, water, tapestry, watercolor-paint; **Topic 2:** sky, paint, landscape, grass, ecoregion, visual-art, steppe; **Topic 3:** organ, pattern, flower, yellow, red, font, fictional-character; **Topic 4:** paint, portrait, art, watercolor-paint, girl, impressionist, artwork; **Topic 5:** paint, art, modern-art, artwork, visual-art, illustration, mural. Here we show how the green area (topic 3, which is more leading to "abstract" concepts), and the orange and yellow areas (topics 1 and 2 r., leading to more "realistic" concepts) disappears. Thereafter, yellow area re-emerges, but may be due to more general concepts.