

# EVODES: An evolutionary poster design environment

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## Introduction

Research in cognitive science suggests that there does not exist a central decision-maker in the brain. In particular, Dennett (1991) claims that the decisions that we make are the products of super fast evolutionary processes going on in our minds and they do not require an 'Inner Conceptualizer' or 'Central Meaner'. Blackmore (1999) also argues that a brain is rather a battleground of millions of memes coming from imitation, communication and education, without an independent conscious entity in control.

In that light, we elaborated an evolutionary approach to visual design, based on replication, random variation and selection. We tried to simulate the brain of a graphic designer on a computer using evolutionary processes interacting with human selectors. We built a semi-automated collaborative poster design environment, EVODES, which is not only a practical tool for making graphic design but also an explicit model for creative brain processes that researchers can work on.

There are many examples of evolutionary design and art software in the literature (Dawkins, 1986; Sims, 1991; Bentley & Wakefield, 1996; Todd & Latham, 1999; Mount, 2006; Rowley, 2006). EVODES, however, differs from most of the visual evolution software because it aims to answer specific design problems with some objective criteria, rather than just creating good-looking images. What EVODES makes is *aesthetic evolutionary design* working on building blocks, not *evolutionary art* generating images from scratch. In EVODES, we also introduce a new non-trivial way of collaboration between selectors by borrowing the idea of migrations from genetics.

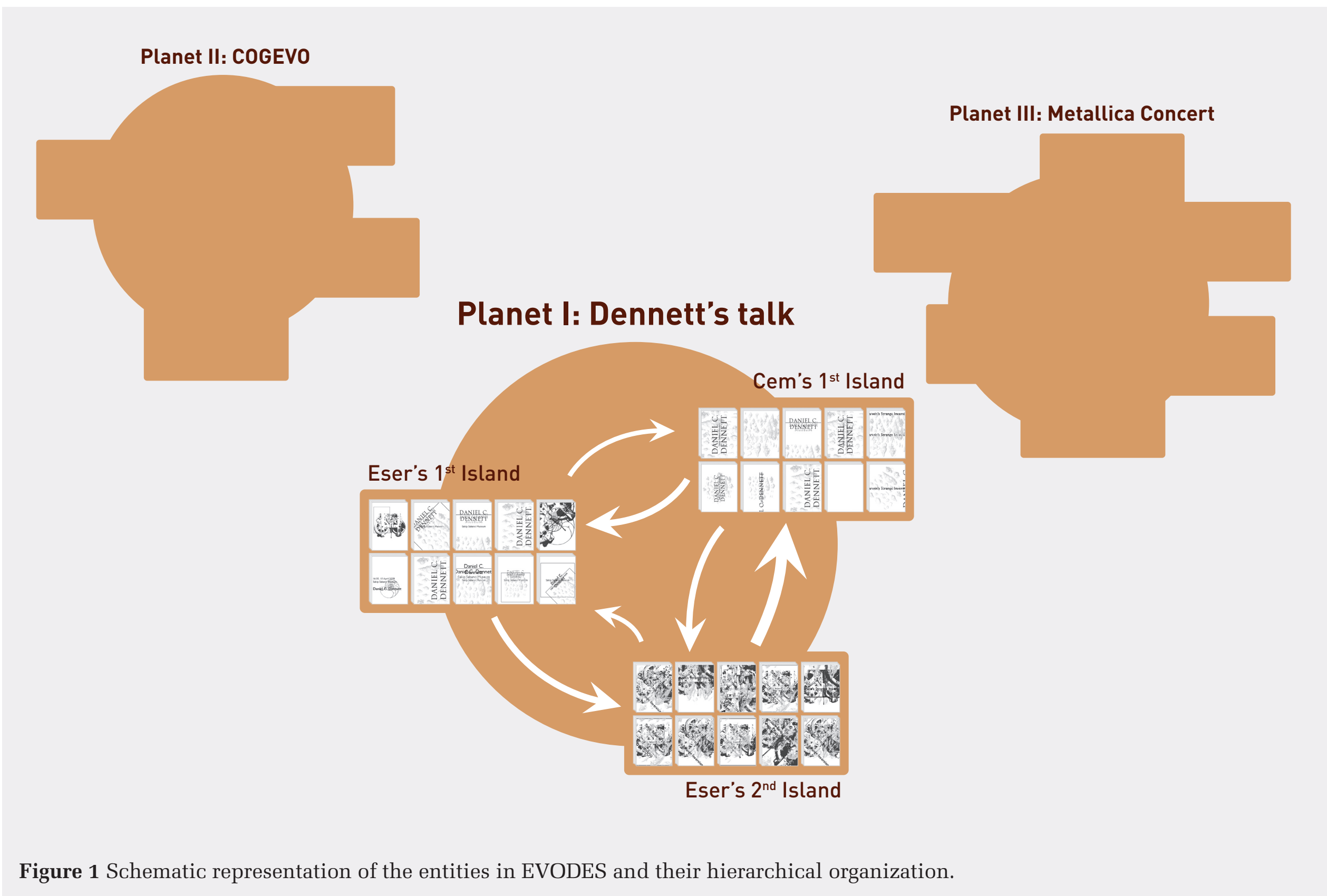


Figure 1 Schematic representation of the entities in EVODES and their hierarchical organization.

## Methodology

### How does a designer design a poster?

For a poster design project, a designer usually

- observes existing posters made for similar projects,
- collects images that are somehow relevant to the project and creates a pool,
- tries out different combinations, typefaces and layouts to *see which ones look better*,
- develops several alternatives out of the best ones,
- consults her colleagues and friends,
- chooses one of the developed alternatives.

### How do we evolve posters in EVODES?

In EVODES,

- We also observe related work and collect images, fonts and texts to create a pool of elements.
- We create *islands* with random initial designs.
- We let EVODES mutate and combine those designs.
- EVODES also makes designs migrate between islands allowing us to "share ideas".
- We decide which designs should stay and which ones should not as they are generated.
- We collect the best ones after generating sufficiently good designs.

During this process, we do not *create* designs, we only *select* them.

### What does EVODES consist of?

EVODES is an online web application that is based on the following entities (also shown in Fig. 1):

- **Planets:** Entities that represent different design tasks.
- **Islands:** Partially isolated environments where populations emerge, regenerate and disappear. Every island is managed by exactly one selector.
- **Populations:** Sets of individuals that live on the same island and that share the same generation. Every population contains exactly 10 individuals.
- **Individuals:** Entities that are subject to evolutionary processes. Every individual stores a genetic code that is used to generate its phenotype, which is a poster design.
- **Selectors:** Users of EVODES that mark individuals as elite or infertile. Selectors can manage as many islands as they want.

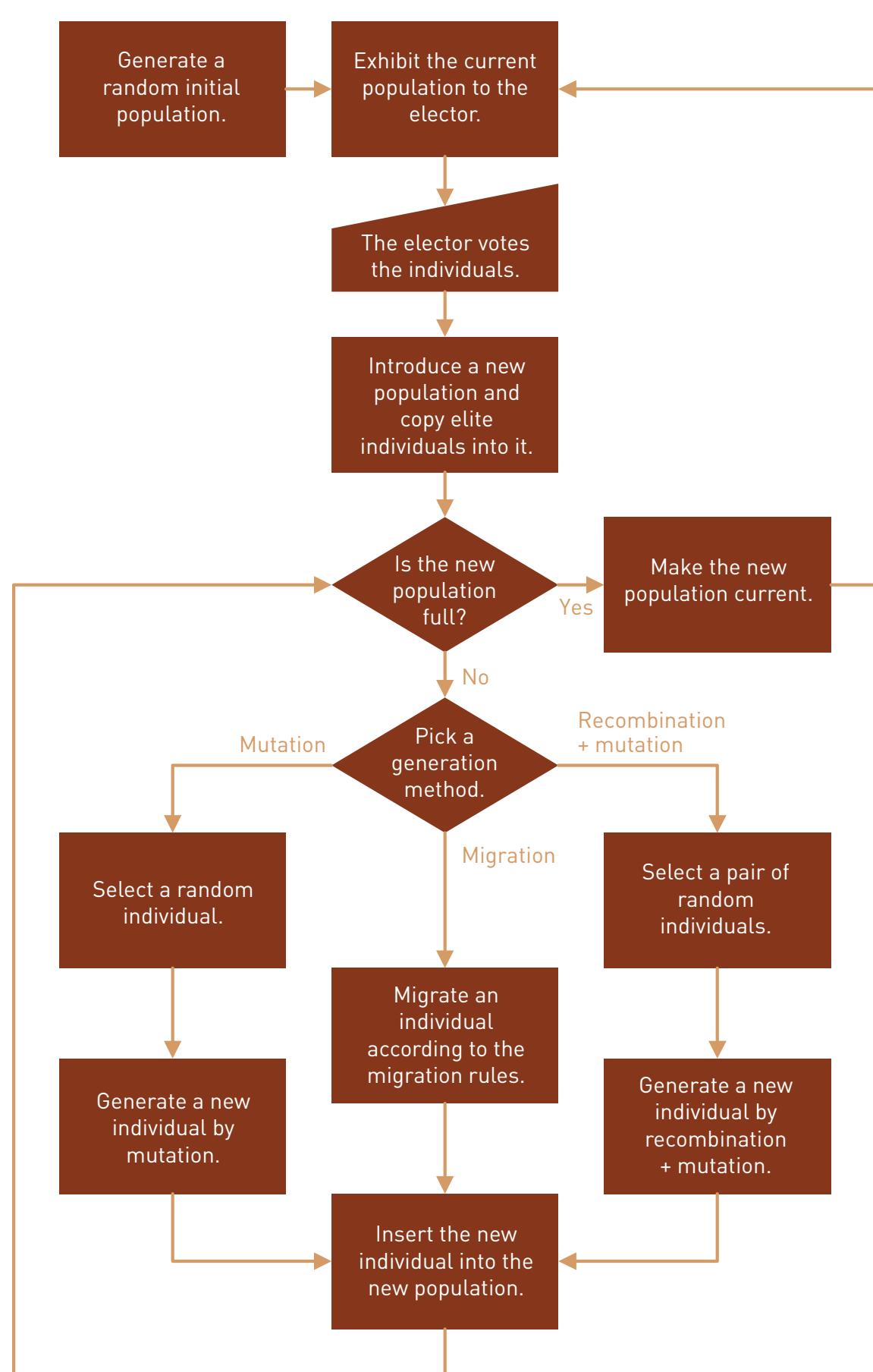


Figure 2 Flow chart of the evolutionary process going on in an island of EVODES.

## Evaluation

- We organized a competition between human designers and EVODES.
- We prepared two questions with six choices in each.
- In each question, there were two human-made designs and four EVODES outputs.
- Human designers are asked to follow the same constraints that EVODES is subject to.
- We asked 34 people to choose the designs that they liked most.

Results are shown in Fig. 3

## Future Work

EVODES, in its current state, has many limitations. Current genetic representation often leads to designs that miss important information. To overcome this problem, we thought of a way of telling EVODES which elements are essential and which ones are optional. Also coloured texts and evolving shapes and textures may be implemented to achieve more sophisticated designs.

The difficulty to automatically evaluate the success of images lead researchers in this field to use people for the evaluation of the outputs (Sims, 1991). We predict that modelling selection in design should be easier than modelling selection in art because design products, in contrast with artworks, need to have particular functions and to satisfy predetermined criteria by definition. In order to do that, we can train a mechanic selector by analysing the conservation of genetic information and the usage data collected from selectors. Similarly, we can train smart mutators that are not completely random but trained to optimize the output, although this would not be a Darwinian evolution.



Figure 3 Results of Human vs. EVODES poll. Numbers show the number of votes that each choice got and the total number of votes.

## Mutation

The only type of mutation that EVODES uses is the point mutation. During a point mutation, a residue may be deleted or substituted by a random residue, or a new residue can be inserted in a random position.

## Recombination

EVODES occasionally combines genetic materials of individual pairs by applying one-point crossover. One-point crossover operator chooses one random cut-point for each sequence and exchanges the subsequences that are on the same side.

## Migration

As Gould (1991) puts it, in human design, "transmission across lineages is, perhaps, the major source of cultural change" in contrast with biological evolution in which lineages are separate forever once they branch. Accordingly, we implemented a new genetic operator, namely the migration operator, that works across populations. It is seldom triggered and when it is triggered, a random elite individual from a proper population is copied directly into the new population that is being generated. A proper population is defined to be a present or past population whose generation number is between  $g/2$  and  $g$ , where  $g$  is the generation number of the new population. The limit on the generation number ensures that neither too much nor too less information is transferred to the island.

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