CHAOS AND ORDER AS DESIGN PRINCIPLES IN EVOLUTIONARY AND CELLULAR BIOLOGY AND THEIR EXPRESSION IN THE VISUAL ARTS: A CASE STUDY OF HUMAN–ROBOT COLLABORATION *

Dr. Rudolf Friedrich Bliem

Artist, Illustrator, Musician and Scientist/Biotechnology, **Austria**

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ABSTRACT

This paper examines how chaos and order interact across evolutionary and cellular biology and the visual arts, proposing that creativity in both natural and artistic systems emerges from their dynamic tension. It presents a collaborative project in which a robotic drawing machine and a human painter co-created artworks, representing structured and unpredictable processes respectively. By comparing biological mechanisms such as mutation and repair with compositional strategies in visual art, the study positions chaos and order as universal design principles. The paper further demonstrates how these principles can be materially expressed in contemporary artistic practice, particularly through emerging AI-based and robotic technologies, and discusses their implications for future human–AI creative partnerships.

Keywords: Chaos and Order, Biology, Physics, Art, Science Art

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1. INTRODUCTION

Science and technology increasingly intersect with the arts, giving rise to the emerging field of Science Art [6]. Within this context, the present paper explores how concepts fundamental to biology—chaos and order—can be articulated through visual art.

The argument unfolds in two stages. First, it outlines how chaos and order have been conceptualized across philosophy, physics, and biology, emphasizing their role as complementary forces rather than opposites. Second, it translates these ideas into artistic practice through a case study of human–robot collaboration. In this project, a robotic system generates precise linear structures that embody order, while a human artist introduces color, irregularity, and gestural intervention that embody chaos.

By staging the interaction between these principles within a single creative process, the project highlights parallels between biological organization and artistic composition, suggesting that the negotiation between chaos and order functions as a shared design principle across disciplines.