

# BirdMan VR: Binocular Rivalry and 4E Cognition

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## Abstract

This paper is an artistic self-criticism for my artwork entitled BirdMan VR. This work was created in 2023 as part of the BirdMan series, which I have been creating continuously since 2006. BirdMan is both an artistic experiment and a cognitive science thought experiment about a hypothetical being with a combination of human vision and bird vision. The thought experiment begins with the question of hybrid perception, based on Buddhist epistemology's "five-fold (pañca skandha) and six-fold (ṣaḍ indriyāṇi)" and Thomas Nagle's "What is it like to be a bat?". A research paper on these works was published in 2015, BirdMan: Hybrid Perception.[1] This paper is an extension of that research, using the medium of VR and exploring issues of perception and consciousness from a 4E Cognition perspective, with a focus on binocular rivalry. What I want to see through the BirdMan Hybrid Perception art-science experiment is Qualia Landscapes. Qualia are controversial but important because they are deeply correlated with the individual's body and are expected to bridge the gap between body and mind. They can also be the first step towards understanding the other.

## Keywords

BirdMan, VR, Binocular Rivalry, Hybrid Perception, 4E(Embodied, Embedded, Enacted, Extended) Cognition, Consciousness

## Introduction

I first created BirdMan in 2006, an artistic attempt to virtually blend the two visual systems based on scientific knowledge of the human and bird visual systems, which was exhibited in the context of a museum of the history of science. I then created a wearable device that added eye-tracking capabilities, which allowed the wearer to recreate a photographic representation of a space from a specific memory. This series of creative and theoretical research was published in a 2015 paper titled "BirdMan: Hybrid Perception". I created a new work, "BirdMan VR," in 2023. This paper aims to explain the theoretical background to this work. I explore the issue of body and mind from the perspective of

Buddhist epistemology and refer to 4E Cognition, which has recently been discussed in the field of cognitive science. I created an artwork centred on the phenomenon of binocular competition between matter and consciousness. Important factors in the appreciation of this work are the media environment of VR, the perceptual phenomenon of binocular rivalry, and the experience of changing gravitational fields.

## Buddhist epistemology: Five Aggregates(Pañca Skandha) and Six Internal Bases(Ṣaḍ Indriyāṇi)

In the domain of Buddhist epistemology, there is a discernible consonance with the paradigms of contemporary 4E Cognition theory, particularly concerning the doctrinal constituents of the Five Aggregates (Pañca Skandha) and the Six Internal Bases (Ṣaḍ Indriyāṇi). Although there are divergences from modern cognitive science, Buddhist epistemological frameworks have significantly influenced contemporary cognitive discourse.[2]

The doctrine of the Pañca Skandha, commonly delineated as the "Five Aggregates," articulates the quintessential elements that constitute sentient existence according to Buddhist philosophy. These elements encompass Rūpa (material form), Vedanā (sensory experience), Saññā (cognitive recognition), Saṅkhāra (volitional formations), and Viññāṇa (conscious awareness). Rūpa pertains to the physical dimension, inclusive of corporeal forms and the material cosmos, as well as the sensory faculties and their respective phenomena. Vedanā denotes the affective reactions—pleasure, pain, or neutrality—elicited by sensory stimuli. Saññā involves the cognitive processes of identification and classification of experiential data. Saṅkhāra encompasses the spectrum of mental dispositions and volitional impulses that precipitate action. Viññāṇa represents the composite awareness that not only perceives but also integrates the experiential input from the preceding aggregates. Within the Buddhist philosophical tradition, these aggregates are posited as impermanent and interdependent, thus challenging the notion of a static and enduring self, encapsulated in the concept of "anatta" or "non-self."

The Ṣaḍ Indriyāṇi, or "Six Internal Bases," as expounded in Buddhist doctrine, constitute the sensorial and cognitive faculties, inclusive of the mental faculty. These are enumerated as follows:

1. Cakṣur-indriya: The visual faculty.
2. Śrotra-indriya: The auditory faculty.
3. Ghrāṇa-indriya: The olfactory faculty.
4. Jihvā-indriya: The gustatory faculty.
5. Kāya-indriya: The tactile faculty.
6. Manas-indriya: The mental faculty, encompassing both cognitive and conscious processes.

Each faculty engages with its correlative phenomenal object (e.g., visual forms, auditory sounds) engendering subjective experiences. The mental faculty, manas, is regarded as a sense within this framework due to its role in apprehending mental phenomena.

In the Buddhist intellectual tradition, the elucidation of the dynamics between these faculties and their corresponding objects is fundamental to comprehending the essence of experiential reality and the genesis of dukkha, or suffering.

Collectively, the conceptual frameworks of pañca skandha and ṣaḍ indriyāṇi provide a sophisticated scaffolding for the interpretation of human experience from a Buddhist vantage point, accentuating the transient, interrelational, and anattic (non-self) aspects of being.

#### 4E Cognition and The Self

Clark (1999) and Gallagher (2017) discussed embodied cognition and enactivism. They emphasize the idea that cognition extends beyond the brain, involving the body and the environment. The 4E Cognition framework is a contemporary approach in cognitive science that emphasizes four key aspects of cognition: embodied, embedded, enacted, and extended. This framework challenges traditional views of cognition as merely brain-based processing, proposing instead that cognition is deeply intertwined with our bodies, our environment, our actions, and the tools we use.

Embodied cognition posits that cognitive processes are deeply rooted in the body's interactions with the world. George Lakoff and Mark Johnson suggest that the mind is not just situated in the brain but is distributed across the body. [3] This view emphasizes the role of sensory and motor systems in shaping cognitive processing.

Embedded cognition argues that cognitive processes are deeply influenced by the physical and social environment in which an individual operates. [4] This perspective maintains that cognition cannot be fully understood without considering the context in which it occurs.

Enacted cognition focuses on the idea that cognition arises through the dynamic interaction between an organism and its environment. [5] It emphasizes that cognition is a process that involves active exploration and manipulation of the environment.

Extended cognition proposes that cognitive processes can extend beyond the brain to include external devices or tools that an individual uses. [6] This view suggests that external

objects and technologies can become integral parts of our cognitive processes.

Anil Seth asks the question, can we approach the very difficult question of consciousness by fusing scientific and phenomenological perspectives on what we feel to be the Self? These questions challenge us to consider the embeddedness of the mind in our body-based experiences. [7]

#### 4E Virtual Reality and Binocular Rivalry

Examine the insights from Sanchez-Vives and Slater (2005) on the relationship between presence in virtual reality and consciousness. [8] Discuss how VR technology can induce a sense of presence, altering perceptual experiences and potentially engaging embodied cognition. Highlight the implications of these findings for understanding the integration of virtual experiences into our cognitive processes.

Paffen and Alais's (2011) study on attentional modulation of binocular rivalry discusses the phenomenon of binocular rivalry and how attention affects the dynamics of perceptual competition. When different images are presented to the right and left eyes, the two images are perceived alternately, a phenomenon known as binocular rivalry. Binocular rivalry affects attention. Voluntary control of binocular rivalry has been found to be limited. Endogenous (internal) and exogenous (external) attention influences the perceptual dominance of binocular rivalry. Diverting attention away from the other image does not stop the perceptual shift in binocular rivalry. This study proposes a theory that attention influences binocular rivalry by modulating the effective contrast of competing images. Paffen and Alais argue that this enhancement of image contrast, which results from top-down attention, is balanced by the response-attenuating effects of neural adaptation in the early stages of visual perception, resulting in a weakened response to the dominant image. [9] They find that, despite the overlap of brain regions involved in binocular rivalry and visual attention, a self-balancing, mutually inhibitory arrangement in early visual cortex allows perceptual triggers to prevail independent of higher-level 'selection' mechanisms. This implies that complete attentional control over binocular rivalry is not possible and opens up important discussions about the problem of consciousness.

#### BirdMan VR

Inspired by René Magritte's 1959 surrealist painting "The Castle in the Pyrenees", the seemingly eternal rock castle conveys both a sense of danger and sublimity, as it could collapse at any moment. As VR-equipped audiences stare at the holographic castle floating in mid-air above a vast ocean, it transforms into an ice castle. The ice castle quickly melts to form a giant waterfall, and the audience realizes where the sound of the waterfall is coming from. Wearing an XR

device, the audience can walk or fly around the exhibition space. As they climb higher into the sky, one eye will see an image with the visual characteristics of a bird. The higher the altitude, the more intense the binocular competition becomes. The video generated by the audience's actions is recorded in real time and classified and semanticized by computer vision based on ImageNet. After the experience, the interview transcripts and the AI's semanticization will be shown together.

The BirdMan project, which has been ongoing since 2006, is a virtual hybridization of the human visual system and the bird's visual system, and an artistic imagining of how the fictional being BirdMan would perceive the world. This <BirdMan VR> work maximizes the effect of binocular rivalry. It makes the environment in the virtual world more surreal by displaying different images on both sides of the

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head-mounted display. BirdMan is an imperfect being between humans and non-humans. A human wearing a BirdMan emulator will have a strangely distorted perception. Like Wittgenstein's rabbit-duck illustration or the Necker Cube, BirdMan's hybrid perception gives us the opportunity to perceive our perception. As Thomas Nagle demonstrated in his thought experiment on what it is like to be a bat, we cannot perceive the perceptions of others. Still, we cannot stop this artistic experiment predicated on failure because we cannot give up understanding others for the sake of co-existence and symbiosis with ourselves.

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## Author Biography

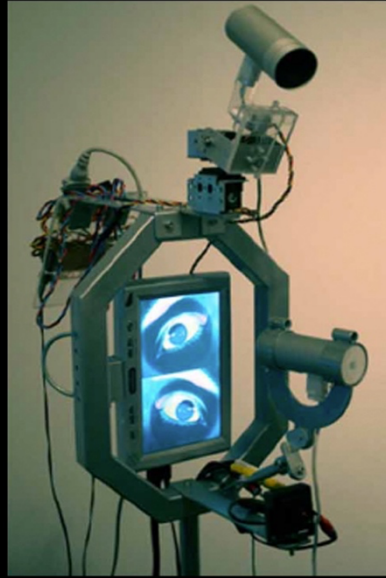
Kim, Jeong Han is an artist working on the convergence between Cognitive Science and Media Art. He is exploring the 'Qualia Landscapes' transversally in the micro and macro world. Kim earned his Ph.D. in Cognitive Science at Seoul National University and MFA at the School of the Art Institute of Chicago. With the support of the Rockefeller Foundation Asian Cultural Council, he participated in the artist residence program organized by the Lower Manhattan Cultural Council in New York City. He was a researcher in the Biomedical Knowledge Engineering Lab. at Seoul National University. He was also a Fulbright visiting scholar in DXARTS at the University of Washington, Seattle, U.S., during his 2014-15 sabbatical year. His artworks have been featured at the "Infosphere" at ZKM, the Media City Seoul, Whitebox at NYC, and other selected group exhibitions globally. Now, he is a professor in the Department of Painting, Seoul National University.

## BirdMan VR : Hybrid Perception

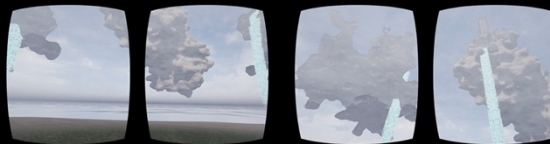
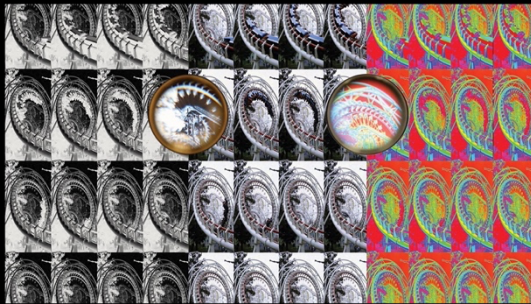
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Figure 1. Binocular rivalry and transformation from the horizontal eyes' position to the vertical eyes' position ; the skeleton of the BirdMan with a wing and a human arm, shows the traces by which the atrophy of vertically positioned eyes and the evolution to the horizontally positioned eyes can be shown.



## BirdMan VR : Hybrid Perception



Jeong Han Kim, *BirdMan VR: Hybrid Perception*, 2023. VR & video screening.



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