A semiotic framework for understanding abstract animations

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ABSTRACT

This paper presents a novel framework for understanding and analyzing semiotic processes in abstract animations. The framework builds on predictive processing, a paradigm in cognitive neuroscience proposing that perception, and consequently action and interaction, involves the brain making multi-level and parallel predictions of potential sensory data and then modifying the predictions based on the actual data received. Building on this approach, we use embodied simulation theory to explain how humans comprehend animations (or any other stimuli) in general and, in our case, abstract animations in particular. According to this theory, humans generate several potential simulations of how we would bodily and actively respond to the given stimuli. For example, when we see a cup (or a picture of a cup), the generated simulations involve our motor circuitry in a way similar to if we would actually reach out and grasp the cup (cf. Gibson's affordances). Next, we use conceptual metaphor theory and the notion of image- and motor-schemas to explain how the motor simulations activate more abstract metaphoric, but still embodied, interpretations of the animation sequences. We explain how this semiotic chain supports the Waltonian mimesis as a make-believe theory of fiction. Finally, the paper uses the proposed framework to analyze three prize-winning abstract animations by Max Hattler. The analyses demonstrate the framework's crucial features and provide examples of how to use the framework for concrete semiotic analysis of animations.

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1. Introduction

Abstract animations represent a unique and complex form of artistic expression that challenges conventional narrative and perceptual paradigms (Gascard 1983). This paper proposes a theoretical framework that integrates cognitive and aesthetic theories to explore the semiotics of abstract animations. By weaving together predictive processing, embodied simulation theory, conceptual metaphor theory, and Walton's mimesis as make-believe theory, we aim to provide a comprehensive framework to analyze and understand the semiotic processes underlying abstract animations. This framework enables a deeper analytical engagement with abstract animated art, making it a fertile ground for practical semiotic analysis.

Abstract animations eschew traditional representational forms, instead employing non-representational, often kinetic visual elements that engage viewers in ways distinct from conventional cinematic experiences. These animations construct experiential spaces that invite viewers to interpret and interact imaginatively (Hattler and Cheung 2024). The complexity and dynamism inherent in abstract animations make them ideal subjects for exploring the advanced cognitive functions of prediction, simulation, and metaphorical thinking.

Predictive processing, a central concept in our framework, posits that the brain functions as a prediction machine, continuously generating and refining hypotheses about incoming sensory data to minimize errors between expected and received inputs (Clark 2015; Hohwy 2020). This approach highlights how viewers engage with abstract animations, anticipating and interpreting visual narratives even in the absence of recognizable objects or scenarios.

Embodied simulation theory (Gallese 2011) complements predictive processing by emphasizing that these interpretations are both cognitive and bodily. According to this theory, viewers engage with animations by internally simulating physical and emotional responses, thus experiencing the visual stimuli in a profoundly embodied way.

Conceptual metaphor theory (Kövecses 2016) extends the cognitive engagement with abstract animations by suggesting that our understanding of abstract concepts is fundamentally rooted in physical, bodily, and concrete experiences. Through metaphorical extensions, viewers use embodied knowledge to interpret the abstract visual elements of animations, mapping familiar sensory experiences onto novel visual scenarios.

Kendall Walton's (1990) proposal of mimesis as make-believe provides a framework for understanding how abstract animations function as 'props' in imaginative activities. This theory helps explain how viewers participate in a dynamic game of make-believe, where meanings are actively constructed rather than passively received. Thus, abstract animations are not just viewed but interacted with, as viewers generate personal and often varied interpretations of what they see.

Semiotics provides a theoretical backdrop for analyzing how meaning is constructed and interpreted in abstract animations. The semiotic analysis of animations examines how visual signs (shapes, colors, movements) function as aesthetic elements and carriers of meaning, engaging viewers in complex interpretative processes. By applying a semiotic approach, we can dissect the layers through which abstract animations signify and influence viewer experiences, invoking both cognitive processes and emotional responses in the meaning-making process.

This paper will detail these theories and their interconnections, applying them to analyze three prize-winning abstract animations by Max Hattler. Through this analysis, we will demonstrate how these theoretical frameworks can deepen our understanding of abstract animations and suggest broader implications for how we perceive and interpret dynamic visual media in contemporary digital culture.

2. Literature review

2.1. Definition of abstract animation

Ehrlich proposed that "Animation's constructedness and break with naturalistic representation and visual 'realism,' which since the mid-19th century has been applied to art that aims to reproduce nature and humanity without any ideal, theological determinations or preconceived notions" (2011: online). Yet, such non-representational styles embody the essence of artistic creation, the process of abstracting things. In this process, prominent elements in the scene are emphasized more than non-prominent ones. Abstract art emphasizes the distinction between essence and form, presenting a sensibility that transcends language and culture (Walls 2016). Correspondingly, animation is a structuralist symbolic representation that can effectively extract and exaggerate the characteristics of objects. Abstraction is essential in animation representation because it simplifies and abstracts visual effects, forming a language of visual symbols.

From the early days of animation until now, the relationship between abstract design and animation has been inseparable. According to Jenkins (2016), excessive character design can make animation too realistic, losing its magic – its variability. However, if too few moving lines are used, it is impossible to create a character with a unique personality, which fails to evoke audience identification and sympathy. So, balancing the realism and abstraction of character design has always been one of the conditions that animation creators need to consider in the creative process. In animation production, most directors strive to exaggerate and abstract objects to create their unique animation styles. Abstract representation in visual effects is one of the essential forms that distinguishes animation from movies in the traditional sense. As a style of art, it has been continuously discussed and innovated in the development of animation. According to Wells (1998), in the book *Understanding Animation*, the

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core feature of animation is its ability to give life, that is, to animate static images and make them vivid. Due to the traditional hand-drawn craftsmanship, early animations tended to depict simple shapes and movements frame by frame, unable to smoothly display the movement process of highly detailed shapes. During this period, animation was called graphic narrative, where moving lines were considered animated characters. Characters' movements were exaggerated to create a more dramatic effect. This performance style defied the laws of physics because the animation was done by drawing on paper or combining different layers of celluloid. Felix the Cat cartoons are a perfect example of graphic narrative, particularly in depicting moving lines on a flat page. (Jenkins 2016). However, even with the ability of computer graphics technology to render entirely realistic scenes, many abstract animation works are still being produced.

The development of animation has reached a point where styles are no longer distinguishable through a single and absolute definition. The typical characteristic of abstract animation is the lack of narrative, expressive, or causal elements. Abstract animation contrasts sharply with traditional animation genres, moving images for the sake of moving images (Walls 2016).

2.2. Animation as a fusion of film and painting

The emergence of abstract animation was aimed at adapting to the era of accelerating movement, reflecting the "kinetic urge" (Gascard 1983). This form of animation, based on abstract painting, incorporates the element of time, allowing viewers to see the changes in shape produced by the movement of objects. The birth of film art precisely addressed the artists' desire to express time. Gascard (1983) states that painting and film intersect and theoretically promote each other's development. However, they each have their limitations. Painting cannot escape the constraints of the plane to express space and time. At the same time, the film cannot transcend the existence of objective reality to satisfy the demand for formalized geometric artistic styles. The existence of animation solves this problem by integrating the two. Compared to traditional film, animation has abstract characteristics and increases the variation of time compared to painting.

The relationship between animation and film has always been a subject of discussion. If animation and live action are considered as two ends of a spectrum, one can use 'abstraction' and 'mimesis' to define their characteristics. Still, this relationship is relative rather than an absolute distinction. In other words, a work can be more abstract or more mimetic (Furniss 2008).

Abstraction in animation allows for more freedom in visual expression than in film. In animation, creators can design characters in various styles and make them move freely. Many artists in animation tend to break traditional rules of movement, exaggerating and showcasing their freedom of creativity. Kota Ezawa (Beckman 2012) believes that animation is abstract, with each line seen in animation originating from human consciousness. Every detail in animation comes from the director's mind, providing more possibilities and flexibility for creativity. This freedom brings fresh visual experiences to the audience. Unlike live-action films, animation is a highly flexible medium that often avoids confusion with reality and stability (Hernández 2007).

Hernández suggests that simplifying the depiction of characters in animation allows for greater exaggeration, making them distinct from real models and creating more dramatic effects. As a visual symbol, animation can convey new contexts beyond the surface, known as 'puns' in animation. Visual metaphors and metonyms create rhetorical connections, allowing for double entendre through juxtaposition, substitution, or understatement. This way, animation can surpass its mere functional purpose and strengthen its role as a language of symbols, representing a different dimension of reality. As Hernández (2007) described, this language can construct representations of any virtual universe. In animation, images typically do not directly imitate the real world but are represented in a simplified or exaggerated way to create a visual style different from reality. This stylistic choice emphasizes that animation is not a direct copy of reality but the result of artists creating based on their imagination. Due to its symbolic nature, animation can break traditional physical and logical limitations, creating a world entirely different from reality. Therefore, animation is not just a form of entertainment but an art form that can exist independently of reality, created and coded freely by artists.

2.3. The difference between animation and film in the creative process

As Jenkins (2016) has suggested, the main difference between animation and film lies in their fundamental approaches to producing and representing moving images over time. In traditional film, the reproducibility of time is based on shooting scenes of continuous movement, composed of a series of static photographs, presented in rapid, coherent succession during projection, creating the illusion of motion. In other words, film captures and reproduces moving parts of the real world. In contrast, animation does not rely on capturing moving scenes from the real world. It creates the illusion of time and motion through a series of static images, usually hand-drawn or computer-generated pictures. These images have not moved; they are not specific moments in time. Animation generates a sense of time and motion different from the real world. It is derived from the creator's understanding and expression of things, organisms, and their forms, motion, and meaning.

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If movies are the art of editing, animation is the art between frames. The animation follows and yet remains independent between images, and the editing of animation can occur between each frame (Gascard 1983). This means that animation directors can complete changes between different scenes according to the needs of the work, and such changes can be non-sequential and free. This characteristic is particularly prominent in some deformation animations, where the audience can never imagine what will happen in the next frame.

2.4. Perceptual abstraction

Research on the role of abstraction in animation cannot be separated from the development of abstractionism in visual arts and its value. Why humans can perceive abstraction is more of a topic in perceptual psychology and neuroscience. Snibbe and Levin (2000) explained in their article the viewpoint in Kandinsky's *Concerning the Spiritual in Art* (2012 [1912]) that human perception of the abstract is part of our lower-level perception and is innate to us. Such abstract perception may be part of our lower perceptual mechanisms, innate notions of beauty shared by all humans. This indicates that humans are born with the capability to understand the abstract. Aviv (2014), from a neuroscientific point of view, suggests that the functional constraints of real life do not limit artworks; they can strive to find new ways to organize and express things. This means that artists can freely describe depicted objects in various non-functional ways. People appreciate abstract artworks because they can freely scan the surface of the image, encouraging their minds to explore new associations and generate creative connections.

Jenkins (2016) claims that the sensation processors in the brain for processing representational motion and real motion are the same. Therefore, even when we see such a 'representational' motion like animation, we can still feel the presence of real motion. Here, the author refers to the motion occurring in the physical environment as real motion and the motion drawn by the creator as representational motion, which does not truly exist. However, the audience knows that the characters and motions in animation do not exist, yet they can still sense the motion's presence. This contradiction can bring a sense of wonder to the audience, which is why many viewers become fond of animation. Jenkins compares this experience with synesthesia and explains it as 'mimesis' in animation. 'Imitation' is distinguished from 'mimesis.' It is called 'imitation' when it is done in a replicative manner. 'Mimesis' is not a visual experience but a tactile experience, an interchange between different senses. The animation experience produces a kind of empathy, allowing the audience to feel the characters' emotions, even if the characters are very abstract.

2.5. The function of abstraction

Abstraction is undoubtedly a key presence in animation. From a production perspective, simple shapes reduce the workload for animators during the production process. But more importantly, images, lines, and forms seem to have their own lives within the animation (Gascard 1983). Abstract animation adds a layer of narrative and interpretation to shapes. In other words, the existence of animation adds logical relationships to single, simple shapes, implying a narrative causality. At the same time, abstract shapes can strengthen focal points, highlighting the key information that needs to be conveyed.

Ehrlich's (2011) article on animated documentaries indicates a close connection between form representation and the actual value of images. Although animation is more straightforward in its ability to express detailed visual elements compared to live-action videos, it can still convey the same meaning as a form of symbols. However, Ehrlich believes that such fragmented and ambiguous information is the advantage of animation as a documentary. Because these symbols can prompt viewers to think and empathize, allowing viewers to use their subjective consciousness to understand the story and enhance their sense of participation. In addition, animation's 'non-realistic' characteristics can be seen as a disguise, exposing shots that cannot be obtained due to various reasons from real people or real scenes.

From the perspective of emotional expression, animated works that combine the movement variations of geometric shapes with music, akin to dance, connect the animation's animacy with the mechanics of life through actions (Walls 2016). This type of work performs free emotions in the rhythm of music. Despite lacking narrative logic support, it is still an effective way to convey emotions. It vividly and thoroughly showcases the essence of animated movements.

3. Theoretical frameworks

Our approach combines several prominent cognitive theories (predictive processing, embodied simulations, conceptual metaphor theory) with Kendall Walton's mimesis as a make-believe theory of fiction. We propose that this framework helps analyze abstract animations and can give us better semiotic insights into this art form. The framework is inspired by existing work on applying the '4E cognition' (embodied, embedded, enacted, or extended) approach to understanding different forms of art and expression, e.g., narrative (Caracciolo and Kukkonen 2021), theatre (McConachie 2011), animation in general (Bissonnette 2019), and performance studies (for an overview see Mancing and Marston William 2022).

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3.1. Predictive processing and embodied simulations

Predictive processing is a paradigm in cognitive neuroscience proposing that perception, and consequently, action and interaction, involves the brain making multi-level and parallel predictions of potential sensory data and then modifying the predictions based on the actual data received (Nave et al. 2022).

These predictive processes work on several layers of neural information processing, from low-level sensory information, such as visual tracking, through high-level cognitive planning to even long-term life aspirations (Hohwy 2020). The architecture also claims a tight interaction between perception and action. For example, the experience of seeing a cup of coffee on the table involves multiple layers of neural predictions that try best to reduce the errors in the incoming visual sensory data. Simultaneously, the action predictions involve neural activations for grasping and holding the cup, thus giving rise to affordances (Dotov, Nie, and De Wit 2012; Gibson 1977, 2014). Affordances are opportunities for action provided by the environment. They are the actionable properties or features of objects or the environment that suggest possible interactions. For example, a chair affords sitting, a door affords opening, and a staircase affords climbing. According to predictive processing, just perceiving the actionable features in the environment activates the same neural systems as actually performing the action. Seeing a coffee cup on the table activates the same motor neuron systems as the actual grasping action. (Nave et al. 2022) The higher-level predictions are constantly modulated by the incoming sensory data and vice versa; the lower-level responses are similarly modulated moment-by-moment by the top-down predictions. The action and perception loops are thus tightly interwoven and evolve over time in a circular and self-organizing way based on reducing overall prediction errors.

This view on predictive processing is close to *embodied simulation theory*, as proposed by Vittorio Gallese (2005, 2011). According to embodied simulation theory, organisms generate several potential simulations of how they would bodily and actively respond to the given stimuli. For example, when we see a cup (or a picture of a cup), the generated simulations involve our motor circuitry similarly to if we would actually reach out and grasp the cup, as mentioned above. While embodied simulation theory and predictive processing theory approach cognition and human experience from different angles, they share common themes related to the embodied and predictive nature of perception, cognition, and action. Both theories emphasize the active role of the body and the brain in shaping cognition by generating predictions and simulations based on sensorimotor experiences in an ever-changing environment.

The same principles apply when observing representations, even very abstract ones (Kesner 2014, 2024). Our embodied minds try to make sense of the visual scenes according to how we perceive the real world (Frascaroli et al. 2024). According to predictive processing, our action-perceptual systems try to reduce the prediction errors between the subconsciously generated predictions and the actual incoming sensory data. The continuous discrepancies between the predictions and the actual data catch our attention and may even cause anxiety. For example, abstract paintings can captivate and hold our attention since our sensory systems try to make sense of the scenes based on real-world examples. The predictions are based on our experiences with real-world objects and their visual features, while simultaneously, the incoming sensory data partly confirms and partly diverges radically from these predictions. For example, the overall features in a cubist painting of a human face give rise to predictions about seeing a realistic human face. Still, at the same time, the features that contradict the 'normal' real faces maintain the prediction error. The constant prediction error might explain our fascination (or abhorrence) with art styles such as cubism and, in our case, abstract animation.

3.2. Conceptual metaphor theory and image schemas

We use conceptual metaphor theory (Kövecses 2016) and the notion of image-schemas to explain how the motor simulations activate more abstract metaphoric, but still embodied, interpretations of the animation sequences. Conceptual metaphor theory, proposed by George Lakoff and Mark Johnson (1980), is a framework originating in cognitive linguistics that suggests that abstract concepts are understood and structured through metaphorical mappings from more concrete domains. Conceptual metaphor involves mapping elements of one conceptual domain (the source domain) onto another conceptual domain (the target domain). This mapping allows us to understand and reason about abstract concepts in terms of more concrete domains. For example, in the metaphor 'time is money,' the idea of time (target domain) is understood in terms of the concept of money (source domain), with ideas like 'saving time' or 'spending time.'

In conceptual metaphor theory, image schemas are foundational concepts that help to explain how abstract concepts are structured and understood through metaphorical mappings from more concrete domains (Johnson 1987, 2008). Schemas provide cognitive structures based on bodily experiences that facilitate our understanding of abstract concepts.

The schemas are cognitive structures that represent patterns of bodily movement and interaction with the physical world. These schemas are derived from our experiences of moving and acting in the world and are closely linked to our sensorimotor systems. Image schemas serve as the basis for understanding abstract concepts by providing a metaphorical framework grounded in bodily experiences. For example, the schema of 'approach' involves the physical experience of moving towards something, which can be metaphorically extended to understand abstract concepts such as approaching goals ('we are moving closer to our objectives'). In a more abstract

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domain mapping, the idea of 'love' might be understood metaphorically in terms of a journey ('our relationship is on the rocks'), a physical force ('falling in love'), or a container ('filled with love').

Image schemas enhance our understanding of predictive processing and embodied simulation by grounding cognitive processes in physical bodily experiences. They offer a means through which the brain's predictive mechanisms are informed by both our evolutionary history and personal past interactions, thus shaping perception, action, and cognition in a deeply integrated manner (Johnson 2018). In abstract animations or any abstract visual representation, these schemas allow viewers to infer motion, relationships, and interactions, even when not explicitly depicted. By activating relevant image schemas, abstract animations prompt the viewer to predict and simulate potential realities, leveraging both concrete physical experiences and more abstract conceptual understandings. This dual activation makes abstract content comprehensible and emotionally resonant.

3.3. **Mimesis as make-believe theory of fiction**

Kendall Walton's theory of mimesis as make-believe (1990) provides a promising framework for understanding animations by treating them as props in games of make-believe, where viewers participate in imaginative experiences. In Walton's theory, objects and representations (images or texts) serve as 'props' that prescribe specific imaginings. In animations, the animated characters, objects, and scenes function as props that guide the audience to imagine a fictional world. For example, when watching an animated movie about talking animals, the animation prompts viewers to imagine a world where animals can speak and interact like humans. Principles of generation are rules that dictate what is to be imagined from the props. In animations, the principles of generation are primarily dictated by the narrative and visual style of the animation. For instance, cartoon characters' exaggerated expressions and movements encourage viewers to imagine intense emotions and slapstick humor that would not be taken literally in a real-world setting. The same applies to abstract shapes and their movements. However, in their case, the principles of generation are more open and free, potentially allowing many different imaginings. Walton argues that we have emotional responses to fictional events and characters but are directed at what we imagine, not real-world entities (Matravers 2021; Walton 1990). Thus, when viewers feel sad for a character's plight in an animation, they respond to their engagement in the game of make-believe, not a real person. Understanding abstract animation through Walton's theory also involves recognizing how different elements (style, genre, and cultural references) guide the viewers' imaginative experiences. This approach enriches the interpretation of animations by focusing on how they engage viewers in complex games of make-believe that might involve complex themes, moral lessons, or cultural critiques, even when the animated entities are abstract.

Abstract animations often lack a conventional narrative, realistic imagery, and recognizable characters and thus primarily rely on visual and auditory elements to evoke specific imaginative responses (Kulvicki 2021). The movement of shapes can suggest different types of action or interaction in the make-believe of animation. Circular shapes that expand and contract rhythmically prompt viewers to imagine breathing or other natural rhythms. Angular, jerky movements of sharp shapes might suggest mechanical or tense scenarios. These kinetic properties guide the viewer to interpret abstract forms in ways that evoke physical or emotional states. The interaction between abstract elements – such as overlapping shapes or intersecting lines – can generate ideas of conflict, harmony, or balance. For instance, if two differently colored shapes merge and create a new color, it might suggest a theme of integration or synthesis. The rhythm established through repetitive visual patterns or pacing can guide the viewer's emotional and cognitive responses. Fast-paced sequences with rapid changes might generate tension or urgency, whereas slower paces with minimalistic changes might evoke tranquility or melancholy. Finally, color can be a significant prop that guides our imaginations.

Different colors may evoke specific emotions and atmospheric qualities. For example, a sequence of bright, rapidly changing colors might generate excitement or chaos, guiding viewers to imagine a dynamic and energetic environment, even without recognizable forms or figures.

3.4. Overall framework

Together, these approaches provide a comprehensive framework for interpreting abstract animations. First, predictive processing and embodied simulation are closely linked as they both underscore the role of the body and brain in generating simulations and predictions that guide perception and action. In animations, viewers simulate interactions with abstract forms based on bodily experiences. Conceptual metaphor theory connects with the above theories by explaining how abstract thinking is influenced by these bodily-rooted simulations and predictions. Abstract animations, through metaphorical mappings, can activate these schemas, allowing viewers to understand and interpret animations in relation to our bodily experiences and interactions. Finally, Walton's mimesis as a make-believe approach complements these theories by framing animations as tools that engage viewers in imaginative experiences. These imaginative engagements are informed by predictive processing (as viewers anticipate and make sense of visual stimuli) and embodied simulations (as viewers subconsciously simulate embodied interactions with the animated forms).

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Thus, when viewing abstract animations, these cognitive and perceptual frameworks collaborate to allow viewers to predict, simulate, and metaphorically interpret visual and narrative elements. Animated entities acting as props in Waltonian make-believe games guide this imaginative framework. This multi-layered cognitive engagement explains why abstract animations can be compelling and emotionally impactful despite their nontraditional narrative and visual forms.

4. Analysis of artworks

The following three abstract animations were selected for more detailed analysis. The research team considered them fruitful in testing the limits of the proposed framework.

Divisional Articulations (2017)[1] is a 2D digital abstract animation film directed by Max Hattler. The film draws on influences ranging from Constructivist art and Paul Klee's Bauhaus teachings to computer animation pioneer John Whitney's seminal film experiment *Matrix III* (1972). In *Divisional Articulations*, music and image collide in an electronic feedback loop. The images represent Hattler's interpretation of the fuzzy analog loop-based music created by Lux Prima, the alter ego of composer and producer Jean-Gabriel Becker. The animation was created with a group of students under Hattler's direction, where everyone worked on a short sequence only, moving basic geometry to the music to create simple, synchronized visual configurations. The result was then fed through a digital video feedback process. Repetition and distortion are key motifs in the music, and video feedback became the way of mirroring this visually through repeating geometries and distorting complexities. Hattler's artistic intention for *Divisional Articulations* was to create a visual music experience that completely entrances viewers, where they stop questioning the meaning or purpose of the work, stop differentiating between sound and image, and enter a flow state.

Matter and Motion (2018)[2] is a 2D digital abstract animation film directed by Max Hattler and animated by a team of students from the School of Creative Media at the City University of Hong Kong. Here, abstract shapes hover, move, and spark across the screen in tight synchronization to a Lux Prima soundtrack derived from synthetic sounds and field recordings of gymnastics. The film builds and releases tension through swelling synths combined with gradients of purples, reds, and blues, interspersed with abrupt noises perfectly synchronized with explosive movements of flickering rectangles and glowing lines. Using an early version of the soundtrack as a base, the animation was created to synchronize, as closely as possible, to the development of the soundscape. After the animation was completed, the soundtrack was further adjusted to support the visual elements.

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[1] https://www.maxhattler.com/divisionalarticulations/
[2] https://www.maxhattler.com/matterandmotion/

The artistic intention for *Matter and Motion* was to combine shapes, movements and sounds in an abstract synaesthetic space of kinetic combustion and energy transmission. The film draws inspiration from the music-synchronized dancing shapes in Oskar Fischinger's *Studies* (the 1930s), the vibrating scratched movements in Norman McLaren's *Blinkity Blank* (1955), and the flickering shapes in Robert Breer's *70* (1970). Inspired by these predecessors but decidedly electronic in nature, *Matter and Motion* is aesthetically closer to the vertical collapse of a cathode ray tube than to celluloid film.

Shift (2012)[3] is a 3-minute analog-based film directed and animated by Max Hattler, combining science fiction themes through abstract stop-motion animation of objects and color. On a black ground, as if floating in space, the materials, including metal tubing, fixtures, pop rivets, and ball bearings, present a self-governing mechanism that continually reshapes itself into new kinetic sculptural configurations. Hattler's previous stop motion film, *AANAATT* (2008), featured abstracted scenes in real, discernible environments. With *Shift*, he wanted to remove it further from reality to increase the distancing effect of non-objectivism while still keeping a connection to the everyday by animating real objects.

Shift was commissioned by Animate Projects in the UK for Channel 4's Random Acts short film strand, with the thematic limitation '2012 Apocalypse.' Mirroring the theme, Hattler proposed an abstract film inspired by the notion of a 'dimensional shift'– a shift from our four-dimensional reality into the fifth dimension, purported by some New Age beliefs to happen at the end of 2012. Hattler aimed to probe the idea of an other-dimensional, quasi-non-objective world with its own logic, aesthetics, and rules, conversely consisting of real-world objects and materials. To help transcend the real-world origin of the objects in *Shift*, to turn them into the machine-like workings of another dimension, and raise their scale from earthly to galactic, sound designer and composer David Kamp created a tightly synchronized abstract soundscape. Setting a framework for the audience's imagination to explore, the film's audio-visual transformations create anthropomorphic and mechanomorphic associations. Formally, *Shift* is inspired by the aesthetics of early 20th-century modernism, linking it to the period's utopian impulse: El Lissitzky, Man Ray, and films such as Ralph Steiner's tribute to the Machine Age, *Mechanical Principles* (1930), and Fernand Léger's *Ballet Mecanique* (1924), which combines the dynamic abstraction of Constructivism with the absurd qualities of Dada, all fed into the work. The materials used in *Shift* come from the archives of product designer Hans (Nick) Roericht, a graduate and long-time custodian of the now-defunct Ulm School of Design, a direct descendant of the Bauhaus.

[3] https://www.maxhattler.com/shift/

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4.1. Method of analysis

The first author used multiple viewings of the animations to ensure a thorough understanding. Next, the first author performed a series of recorded 'think aloud' sessions of the animations. The animations were intermittently paused during these sessions to allow for immediate reflection and commentary. These commentaries were then transcribed. The resulting transcriptions were the primary source for subsequent analysis guided by the proposed theoretical frameworks. Throughout the analysis, iterative references to the animations were made as necessary to clarify or elaborate on the insights being developed. Additionally, discussions were held regularly with the other researchers to refine the interpretations.

4.2. Predictive processing

This cognitive theory posits that the brain continuously creates and updates a model of the world by predicting sensory inputs and then adjusts these predictions based on new sensory information to reduce the error between prediction and actual sensory input.

As the viewer begins to watch the animation, their brain generates predictions about what will happen next based on visual cues like the movement of circles and their trajectories in *Divisional Articulations* (00:00-00:22). These predictions are based on past experiences with similar stimuli, such as moving objects following predictable paths. When the animation introduces elements that deviate from these predictions (e.g., sudden changes in direction, unexpected interactions between objects, abrupt shifts in the soundscape (00:22), these constitute prediction errors. The viewer's brain must then update its predictions to account for these new, unexpected inputs.

In these animations, the moving objects frequently change direction or speed, and music/sound plays a vital role in these dynamics. Each change forces the viewer to adjust their internal model to accommodate the new information, recalibrating their expectations in real-time. The increasing complexity and rapid changes within the animations challenge the viewer's predictive capabilities, leading to moments of confusion or cognitive overload (02:00-02:09). This indicates high prediction error rates, where the viewer's predictive model struggles to keep pace with the stimuli.

Sound significantly influences the viewer's predictions. Changes in tempo or rhythm lead to anticipatory changes in how the viewer predicts the motion of visual elements. This aligns with predictive processing, which posits that all sensory inputs (including auditory) are integrated to form a coherent expectation of the sensory environment.

Some of the animations contain visual cues that emphasize the predictive processes. For example, traces left by the moving shapes in *Divisional Articulations* (02:17-02:21) help the viewer track their movement history, forming more accurate predictions about future positions and paths. This reduces prediction errors by providing a clearer picture of motion patterns.

Figure 1. Traces of moving objects in Divisional Articulations

As the animation deviates from expected patterns, it may evoke surprise or confusion, which are emotional reactions to unresolved prediction errors (*Shift* 01:20-01:26). These emotional responses can enhance engagement by making the viewing experience more compelling and unpredictable. The viewer's emotional and cognitive responses to these prediction errors can further influence their attention and subsequent predictions, creating a feedback loop that continually shapes their viewing experience.

4.3. Embodied simulations

According to embodied simulation theory, when we observe or imagine actions, sensations, or emotions, our brain activates similar neural mechanisms as if we were experiencing those actions or sensations ourselves.

Embodied simulation theory suggests that the movements in these animations (lines moving, shapes shifting, objects appearing and disappearing) trigger the observer's brain to simulate these movements internally (*Matter and Motion* 01:02-01:07). This could involve the activation of motor-related brain areas, even though the observer is not physically moving.

The animations' allusions to three-dimensional space and depth indicate an embodied simulation of spatial orientation and depth perception. The viewer interprets the illusion of depth created by the animation using their sensory experiences of navigating through space, mentally simulating a three-dimensional environment.

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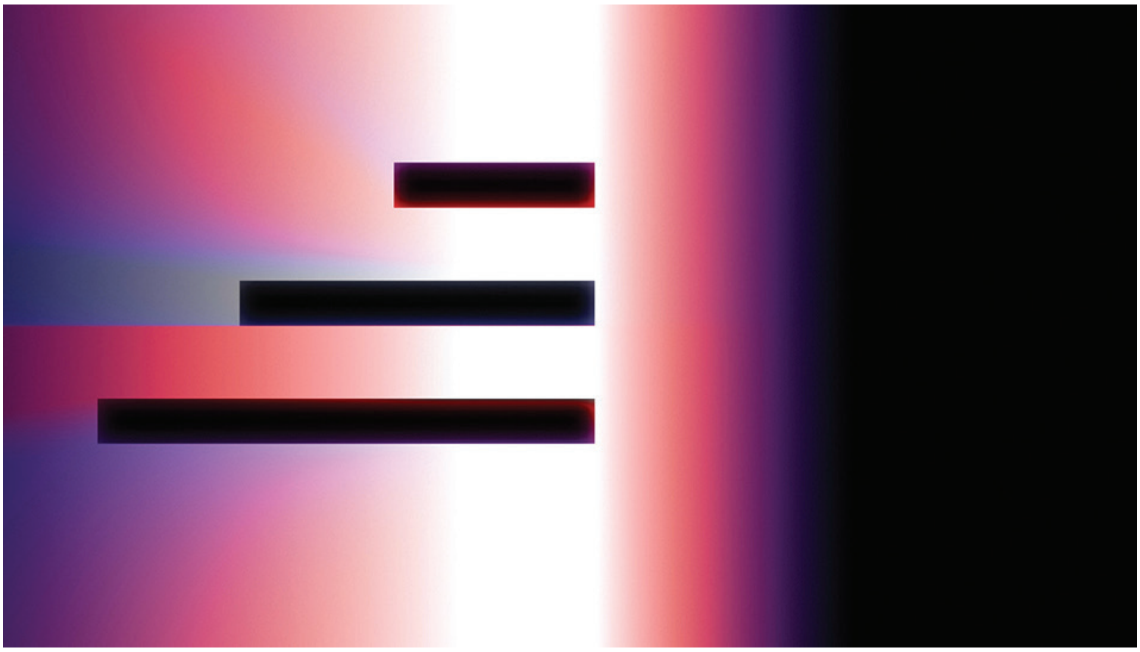

Figure 2. Illusion of depth in *Matter and Motion*

The viewer's anticipation of potential collisions between the moving objects and their adjustments in trajectory illustrates an embodied understanding of physical dynamics (*Shift* 0:10-0:18). By simulating these interactions, the viewer uses their own experiences of movement and physical space to make sense of the animation, essentially 'feeling' the motion and tension through an internalized bodily response.

The synchronization of movements with music and the noted changes when the music shifts suggest that the viewer is not only audibly processing the music but also embodying it in their visual and spatial simulations (*Matter and Motion* 01:08-01:17). The music influences the perceived intensity and pace of the visual changes, which might be internally mirrored through changes in the viewer's physiological or emotional state, thus affecting how they simulate and interpret the scene.

The animations contain many scenes that give rise to moments of conflict between different interpretations of the visual elements, for example, whether they are moving or static and whether changes are due to object movements or visual effects (*Matter and Motion* 01:12-01:22). This cognitive and perceptual dissonance might activate brain areas associated with conflict resolution and decision-making, simulating the internal struggle to resolve ambiguous stimuli. When the animation becomes chaotic or complex, the viewer experiences cognitive overload, which could be seen as an embodied response to sensory overload. Their mental simulation of the animation's dynamics becomes too demanding or confusing, mirroring physical sensations of being overwhelmed or lost, thus grounding their cognitive experience in bodily responses.

From the perspective of embodied simulation theory, the viewer's experiences indicate an active, ongoing internal simulation of visual, motor, and emotional experiences. This simulated engagement allows for a deep, embodied understanding of and interaction with abstract animation, highlighting how abstract art can evoke complex, embodied responses without literal representation.

4.4. Schemas

Motor and image schemas play a central role in how the viewer processes and interprets visual content, in this case, the abstract animations. These schemas are fundamental cognitive structures derived from bodily interactions and perceptual experiences that help us make sense of the world. As discussed above, these schemas heavily depend on lower-level predictive processing and embodied simulations. Below, we describe prominent schemas and how they are activated in the animations:

Path Schema: This schema involves movement along a trajectory from one location to another and is deeply ingrained in how we conceptualize motion and direction. The movement of objects and figures toward destinations, changing directions, and avoiding collisions reflect the activation of the path schema. This schema helps the viewer predict where the objects might go next based on their current trajectory. For example, at the beginning of *Divisional Articulations* (00:00-00:22), the moving circles leave a trace behind them, making the path schema even more concrete and obvious. The trace also reveals how our predictions are violated in moments when the circles change their direction and speed extremely rapidly.

Container Schema: This schema involves understanding phenomena in terms of in/out and boundaries. First, the viewer interprets the screen as a bounded space where objects move, interact, and change trajectories. Second, in many parts of the animation, the objects seem to, at least momentarily, be contained within other objects. For example, smaller squares move within the boundaries of a larger square and together with the larger square (*Matter and Motion*, 02:15-02:19). This gives the impression that they are contained within the larger structure.

Source-Path-Goal Schema: This extends the path schema and includes a starting point, a path traveled, and a destination. The viewer uses this schema to make sense of the objects' movements, ascribing intentions and predicting future locations based on observed movements, which align with this schema's elements. The objects leaving traces, such as the circles in *Divisional Articulations* (00:00-00:22), heighten the activation of this schema, similar to the path schema mentioned above. The traces are a constant reminder of the source and the path already taken, which makes the viewer constantly predict the goals of these movements. Rapid changes in direction and speed often thwart these predictions, leaving the viewer in a constant state of uncertainty.

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Blockage Schema: This schema is activated when the viewer predicts collisions or movements where an object avoids intersecting with another object's path (*Shift* 00:18-00:30). It involves the concept of an obstacle that must be navigated around, which is integral to understanding and anticipating the interactions among the animated objects.

Force Dynamics Schema: This schema involves the interaction of forces, which can be seen in the viewer's interpretation of objects that seem to push against each other, avoid each other, or are influenced by unseen forces (such as music changing the dynamics of motion (*Divisional Articulations*). The viewer interprets these dynamics to ascribe cause and effect within the animation.

Balance and Support Schemas: The descriptions of objects in terms of their physical support and balance (e.g., one object resting on another) invoke balance and support schemas. These are fundamental for interpreting how objects relate to each other in terms of stability and support, adding a layer of understanding to the physical and visual structure of the scenes. Additionally, when the viewer notes changes in speed or direction in response to music or other visual cues, the balance schema might be activated, particularly in understanding how objects maintain or lose stability (*Divisional Articulations*, 02:00-02:09). This schema is tied to physical experiences of maintaining or observing balance, thus also invoking embodied simulations related to bodily balance and support.

Rotation Schema: This is particularly relevant when describing movements that involve spinning or rotating objects. For example, the appearance of circular motions and concentric circles activate this schema based on the bodily experience of rotation or seeing objects spin (*Divisional Articulations*, 02:17-02:21).

Scaling Schema: This schema involves changes in size and scale, which are described when objects grow larger or smaller within the viewer's field of perception (*Divisional Articulations*, 01:43-01:52). It is linked to the physical experience of objects moving closer or farther away or growing in importance.

These schemas bridge the gap between sensory experiences and conceptual understanding, allowing the viewer to construct a coherent narrative from the complex visual stimuli presented in the animation. Furthermore, these schemas give rise to and interact with the conceptual metaphors discussed below.

4.5. Conceptual metaphor theory

The animations, understandably, use spatial metaphors extensively, such as the viewer experiencing moving toward the horizon or the movement shifting from horizontal to vertical. These experiences can be understood as grounding abstract visual changes within familiar spatial experiences. Conceptual metaphor theory suggests that these reflect our innate tendency to understand abstract phenomena (such as the progression and transformation within the animation) through more concrete, spatial experiences; for example, IDEAS ARE DIRECTIONS ('moving towards'), and TIME IS SPACE ('progression along a horizon'). The viewer frequently ascribes intentions and purposes to the moving objects (e.g., avoiding collisions or moving toward a destination), giving rise to the standard conceptual metaphor PURPOSES ARE DESTINATIONS. The viewer interprets the movement of shapes within the animation as agents with goals, similar to how people navigate toward destinations (*Divisional Articulations*, 00:00-00:22).

The references to objects and substances, notably opacity and the emergence of shapes such as rectangles and triangles, align with metaphors that conceptualize abstract ideas as physical objects (ABSTRACT IS CONCRETE). This allows the viewer to apply everyday reasoning about objects (e.g., objects blocking each other, light sources behind objects) to interpret the abstract visual elements of the animation.

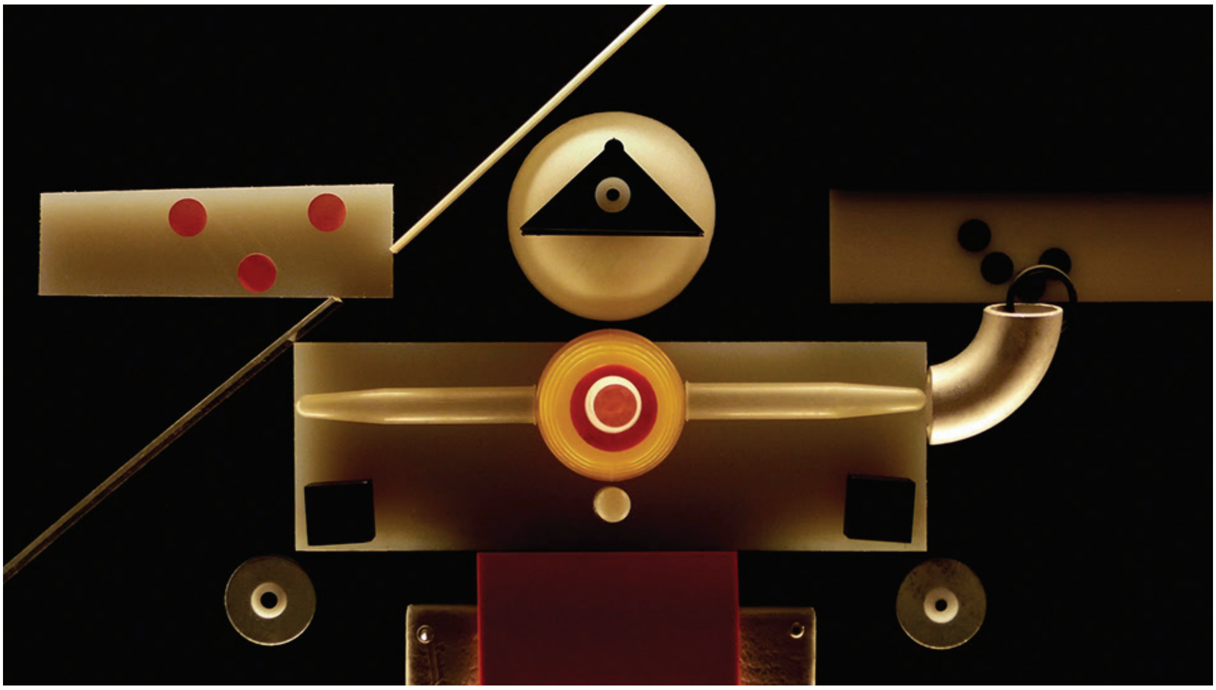

Figure 3. Abstract visual elements form seemingly concrete objects in *Shift*

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Changes in the animation are often described as journeys or movements through time (e.g., abrupt changes, quick shifts). This can be linked to the metaphorical framework where TIME IS MOTION, and CHANGES ARE MOVEMENTS ALONG A PATH (*Shift* 01:53-01:58). This reflects how people typically conceptualize time and change as physical movements through space.

The animations frequently use concepts of light and visibility, with elements becoming brighter, emitting light, or being occluded (*Matter and Motion*, 00:00-00:13). These can be tied to metaphors like UNDERSTANDING IS SEEING and CLARITY IS LIGHT. The fluctuating visibility and brightness in the animations could be metaphorically interpreted as fluctuations in understanding or clarity regarding the unfolding visual narrative.

The experiences of conflicting interpretations and visual ambiguity might be interpreted through metaphors such as KNOWING IS SEEING, and AMBIGUITY IS DARKNESS. The conflicting visual elements generate a sense of uncertainty or cognitive 'darkness' where clarity and understanding are momentarily obscured.

4.6. Mimesis as make-believe

In Walton's theory, props (objects within a work of art) prompt the viewer to engage in acts of make-believe. In the case of these animations, the abstract elements – shapes, motions, and configurations – serve as props. These props can encourage viewers to imagine familiar objects and scenarios (such as various tools in *Shift*). The viewer is not just seeing abstract shapes but is prompted to use these shapes to make believe that they are witnessing familiar objects and processes. For instance, the appearance of concentric circles (*Divisional Articulations, Matter, and Motion*) might guide the viewer to imagine these as ripples caused by an unseen impact.

Walton discusses generative rules that govern how we engage with art. These rules help viewers determine what to imagine when they encounter particular props. For instance, when the viewer sees rapid circular motions or objects that construct and deconstruct, as in *Shift* (01:18- 01:22), they might imagine these dynamics as mechanical or biological processes based on the generative rules that associate certain motions or transformations with specific real-world behaviors.

The viewer's experience involves applying principles of generation that dictate what should be imagined upon encountering certain visual stimuli. When the viewer notes that objects maintain constancy (e.g., staying circular) despite transformations, it might invoke the principle of object permanence in their make-believe play, leading them to see continuous identity in changing forms.

Principles of generation can evolve as the engagement with the prop unfolds. Initial interpretations may shift as new elements are introduced. For example, in the dynamic environment of an abstract animation, initial assumptions about the behavior of objects may change as the animation progresses and introduces new visual or auditory elements. The principles also govern emotional and symbolic interpretations; dark, looming shapes might evoke a sense of dread or menace, guiding the viewer to feel tension without explicit narrative context.

Even without a straightforward, linear narrative, the viewer uses make-believe to construct a narrative or thematic framework for understanding the animation. In *Shift*, constructing and deconstructing objects might be imagined as a theme of creation and decay, transformation, or cyclical change, allowing the viewer to explore these concepts through a personal, imaginative lens.

The abstract nature of the animation allows for multiple interpretations, each potentially consistent with the visual and auditory inputs. This flexibility is a key aspect of Walton's theory, where different viewers might engage with the same prop in varying ways, each constructing their own unique set of fictional truths based on personal cognitive frameworks and imaginative capabilities.

5. Conclusion

This paper has explored a multilayered framework for analyzing the semiotic processes in abstract animations, integrating predictive processing, embodied simulation theory, conceptual metaphor theory, and Kendall Walton's mimesis as make-believe. Our analysis of Max Hattler's abstract animations demonstrates this theoretical approach's practical application, offering insights into the interplay between viewer perception and abstract artistic expressions.

The application of predictive processing explains how viewers' brains anticipate and react to sensory data, forming a continuously evolving perceptual and interpretative experience. Embodied simulation theory further enriches this understanding by highlighting how viewers engage with animations cognitively and bodily, simulating interactions and emotions that the animations might provoke. Conceptual metaphor theory provides the cognitive scaffolding that supports translating bodily experiences into abstract thought processes, essential for decoding the non-representational forms found in abstract animations. Meanwhile, Walton's theory of mimesis as make-believe captures the imaginative engagement of viewers, who use the animations as props in personal games of interpretation and meaning-making.

Exploring the complex meaning-making processes in viewing abstract animations can potentially open new avenues for employing the frameworks in broader digital media and interactive art domains.

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