

## Between Sensorimotor Data and Conceptual Message: Embodied Simulation as an Approach to the Reading of Two Science Fiction Plays, Jennifer Haley's *The Nether* and Peter Sinn Nachtrieb's *Boom*

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### ABSTRACT

This paper explains how the activation of the reader's cognitive capacity of embodied simulation can improve the perception of science fiction and its interest in exploring the materiality of bodies. It offers an embodied cognitive interpretation of Haley's *The Nether* and Nachtrieb's *Boom*, stressing the role of close reading of sensorimotor data in triggering the mental process of simulation and reinforcing the reader's embodied involvement within the text. This paper also illustrates the cognitive link between linguistic input data in the process of reading science fiction and the stimulation of the capacity of embodied simulation. It argues that the more intensive the sensorimotor data is, the more appealing to the capacity of embodied simulation the text proves to be. The paper attempts to prove that the close reading of science fiction drama, abundant in sensorimotor data, is capable of generating an embodied simulative experience which guarantees a deeper understanding of the thematic content and an empathic engagement with the characters.

**Key words:** Embodied Simulation, Science Fiction, Sensorimotor Data, Engagement

### INTRODUCTION

This study aims at exploring the potential embodied dynamics of close reading of science fiction which can illuminate common regularities in how readers perceive fiction. It focuses on analyzing the sensorimotor data abundant especially in science fiction and infers the reader's simulative response to it. It argues that contemporary science fiction drama abounds with representations of bodily experience anticipating a future of increasing cases of deprivation, abnormality and affliction whose perception finds way through the reader's capacity of embodied simulation. This paper points out the role of embodied simulation in perceiving the physical demonstration of the human body and its surroundings as depicted by Peter Sinn Nachtrieb's *Boom* and Jennifer Haley's *The Nether*. The researcher indicates that the emphasis of the linguistic content of the two plays is on bodily susceptibility and material representation, promoting embodied cognitive interaction with the characters through the mechanism of simulation. This study evaluates the role of sensorimotor content in the activation of the process of embodied simulation which instigates the readers in some measure to inhabit the fictional realm and reproduce the characters' actions and sensations in the readers' sensorimotor system, guarantying more profound empathic engagement with the dramatic representation.

### EMBODIED SIMULATION AND SCIENCE FICTION

#### Research Questions

The present study aims at addressing the following research questions:

1. Why does the reading of science fiction represent a special case for the stimulation of embodied simulation?
2. Why is embodied simulation a required capacity in the reading of science fiction?
3. What is the role of embodied simulation in relating sensorimotor data in science fiction to the conceptual content?

This study will first answer these questions; then, it will point out the applicability of embodied simulation approach to the reading of science fiction with reference to two specific plays.

#### Significance of the Study

This paper argues that the reading of science fiction drama involves an embodied engagement with the text developing a cognitive process of simulation by which the reader perceives the indicative sensorimotor data and transforms them into a conceptual dramatic effect. It also explains that embodied simulation plays a crucial role especially in the reading of science fiction for some basic reasons. First, science

by nature focuses on tangible evidences, the materiality of existence and natural phenomena, so science fiction, grounded in actual science, basically provides an imaginative representation of the corporeality and metamorphosis of human and nonhuman subjects, depending on profuse sensorimotor data. Second, science fiction envisions imaginative worlds ahead of its time and explores the potential outcomes of imagined scientific developments. Accordingly, embodied simulation is crucial in the production and perception of this literary experience because it can direct the mind's eye to recreate a projection of this novel experience and envision the circumference of what does not actually exist. Thus, "in order to understand other people's minds, or to make decisions about future events, people create hypothetical 'simulations' of these occurrences; they imagine them happening" (Seymour 120-21). Thus, people can make sense of science fiction and draw relevant conceptual extrapolations through embodied simulation processes. Last, science fiction works, equipped with physical insinuations and sensorimotor content, effectively appeal to the reader's reservoir of memories of prior embodied experience enabling him to pre-simulate the future. Because science fiction can depict vivid body states, it can effectively push the reader to simulate corporeal conditions in accordance with his own equivalent acquired experience.

This paper stresses how the close reading of the science fiction makes the reader's mind swarm with imaginative projections and brain images of both the human body and its physical actuality. Thus, the embodied simulation approach to the reading experience of science fiction constructs broader dimensions of the literary impact through engendering more effective receptiveness and responsiveness. The researcher reveals how science fiction plays wire the reader up to the character through addressing the former's accumulations of bodily experience, recalled from the memory and brought to the instantaneous perception through the process of simulation whenever the reader finds common elements with the anguish and vulnerability of the character. Thus, embodied simulation generates intersubjectivity based on inter-corporeality involving the bodily experience of the character and its echo in the body of the recipient. Beyond words either literal or literary, there is a whole world flowing with significances, thoughts and sensations which become possibly conceptual when the reader processes them through the mechanism of embodied simulation.

## LITERATURE REVIEW

### Embodied Simulation Approach to Linguistic Data

The embodied simulation approach to linguistic data as developed by Benjamin Bergen explains that when one reads a descriptive passage, he tends to visualize the scenario illustrated in the text and activate brain circuits which control muscles actually used to perform the very same actions. Bergen defines simulation as "the creation of mental experiences of perception and action in the absence of their external manifestation. That is, it's having the experience of seeing without the sights actually being there or hav-

ing the experience of performing an action without actually moving" (Louder 14). He explains that simulation with text-based material refers to "the notion that language users construct mental experience of what it would be like to perceive or interact with objects and events that are described in language" (Bergen, Embodiment 142). The key implication drawn from this is that embodied simulation can arise from the reader's bodily interactions with the world implicitly or explicitly depicted in the read text. Gibbs and Colston also point out the role of embodied simulation in language comprehension; one of the key ideas in empirical work on embodied thought and language is that "people's cognitive and linguistic performances are guided by embodied simulation processes" (114). Accordingly, human beings tend to perceive linguistic data in terms of approximation to the body, relative to space, shape, colour and sensual impact.

Vittorio Gallese points out: "The discovery of mirror neurons and of other mirroring mechanisms in the human brain shows that the very same neural substrates are activated when these expressive acts are both executed and perceived" (Mirror 520). This discovery is crucial for the understanding of language because it reveals that the motor system can be activated not only when people perform action but also when they read language describing corporeal or kinetic experience. Paul Armstrong also emphasizes the embodied and simulative aspect of language comprehension arguing that if language signifies action that enables simulative experiences, mirror neurons are involved in the process of reading in which representation is linguistically mediated (How 151). This suggests that what one reads can leave an impression on his face and shape his bodily reaction. We can remember situations in which body language, including gestures and facial impressions, is activated simultaneously in the company of reading texts and how these gestures can mimic the uttered words. For example, when you read aloud to listeners that someone is ascending stairs, spontaneously you are likely to raise your hand and vice versa with descending. This spontaneous mimicry reveals underlying simulation processes which reinforce the understanding of significance beyond words.

George Lakoff explains: "Our brains evolved to allow our bodies to function in the world, and it is that embodied engagement with the world... that makes our concepts and language meaningful" (Forward x). This suggests that engaging embodied simulation allows the reader to recognize the spatial and contextual dimensions of textual data conveyed in linguistic terms, so it generates an effectual interaction between body, mind, text and context. Therefore, visuospatial perception is crucial here as it refers to the ability to interpret visual information in the text, describing the location of objects and their relation to the space, through the capacity of embodied simulation.

Some experiments have been conducted to prove that readers can experience an embodied simulation for linguistic or verbal resources that are either abstract or metaphorical. Many language theorists argue that word meanings are connected to mental phantasmagorias because readers tend

to develop simulated representations in their minds out of their literary experiences. Rolf Zwaan, Robert Stanfield and Richard Yaxley conducted some experiments to measure the perceptual impact of language comprehension on embodied simulation. Their studies support the idea that

people activate perceptual symbols of referents during language comprehension, even when the perceptual characteristics are merely implied rather than explicitly stated. Moreover, our results show that the sentential context has a strong and rather immediate impact on the nature of the mental representation. (170)

This proves that readers spontaneously envision mental projections of what they read or what verbal expression suggests about embodied experience. Accordingly, the comprehension of linguistic data involves an effective connection between its physical subtleties and conceptual significance, generating a dynamic embodied reaction to the text.

Using the fMRI scanner to examine the response of subjects to fictional experience, Mbemba Jabbi and her team discovered that the concept of 'simulation' plays a crucial role in the understanding of imagination and social perception. "For actions, simulation accounts of imagination propose that we can accurately imagine what it feels like to perform actions because common brain areas are involved in the execution and imagination of these actions" (Jabbi et al.1). Moreover, Rolf Zwaan, Lawrence Taylor and Mirte de Boer conducted an experiment examining the engagement of the motor system during the language comprehension of narrative context. Their findings reveal that the occurrence of motor resonance is not tied exclusively to (main) verbs, but rather to the interpretation of larger units of text such as sensory representation (147).

Accordingly, the researcher argues that a close text-based reading is capable of spurring embodied simulation which instigates the imagination of the reader through sensory-motor modules to reenact what the mind receives from the linguistic material into mental imagery. Thus, the perception of a linguistic input includes an embodied dimension, and consequently the reader imagines himself physically inhabiting a scenario relevant to the words and actions he reads in the text.

### **The Theory of Embodied Simulation and Interpretation of Literary Experience**

Embodied simulation is defined as a mental mechanism by which the actions, emotions and sensations of others are mirrored or echoed in the mind of the recipient, activating the same brain circuits which are responsible for performing the same actual activity. Lakoff and Johnson indicate that cognitive science discoveries prove that "the physical language in the news story activates a mental simulation of physical action, using neural control structures" (583). Keith Oatley also argues that the scientific studies examining the psychological reality of embodied simulation processes can explain how people interpret fiction drawing a conceptual connection between embodied simulation and literary appreciation. Oatley indicates, "Fiction is the simulation of selves in interaction" (618). In "The Function of Fiction,"

Mar and Oatley point out, "Readers of novels, filmgoers, and theatergoers all undergo simulations of events" (137). Accordingly, embodied simulation makes the reader inhabit the fictional world and generate empathic interaction with the characters' physical and emotional experience. Similarly, Roel Willems and Arthur Jacobs confirm, "Engaging with fiction is a natural and rich behavior, providing a unique window onto the mind and brain, particularly for mental simulation" (243). These studies are pivotal because they suggest that reading and understanding fiction spontaneously entails embodied simulation processes. Gallese explains that "a common underlying functional mechanism – embodied simulation – mediates our capacity to share the meaning of actions, intentions, feelings, and emotions with others, thus grounding our identification with and connectedness to others" (Embodied Simulation 78). Accordingly, the empathic engagement with characters in drama involves an embodied simulation process through which literary works can recreate a full human sensorium in a state of mental immersion.

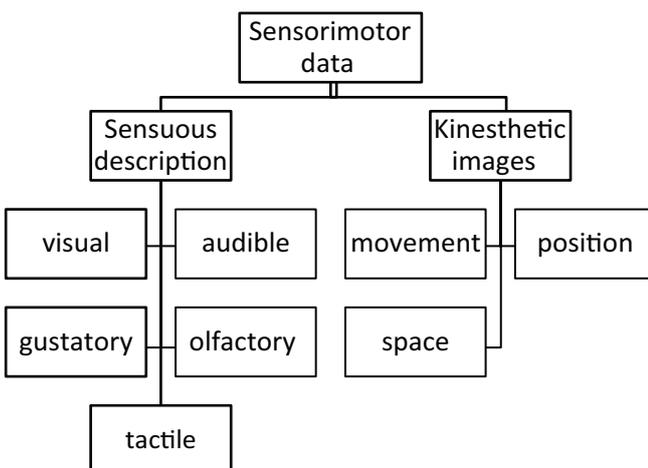
Though the outcome of embodied simulation differs from one recipient to another due to the cultural background and experiential repertoire, cognitivists confirm that there are significant commonalities which Alan Richardson calls "embodied universalism" (151). George Lakoff and Mark Johnson also suggest that the mind is embodied in such a way that "our conceptual systems draw largely upon the commonalities of our bodies and of the environments we live in. The result is that much of a person's conceptual system is either universal or widespread across languages and cultures" (6). Thus, they reveal that embodied cognition plays a role in everyone's perception and creation of meaning. Gibbs also point out, "Embodied simulation processes are not optional... but are an immediate part of people's moment-by-moment processing of linguistic meaning" (224). He argues that the theory of embodied simulation "asserts that there are important commonalities between recreational and critical understandings of literature" but reveals that the ultimate output of embodied simulation processes can vary considerably in the concluded concepts and abstract messages beyond the sensorimotor data and physical representation in the text (Gibbs 222). Thus, reading and interpreting literature involve similar embodied simulation processes in the readers' mind, but similar cognitive processes may create different interpretive products (Gibbs 236). Moreover, it is noteworthy that embodied responses always occur involuntarily and precede conscious intervention, but they are always reconsidered, moderated and adapted when they are tackled consciously (Rokotnitz 117).

Accordingly, there is an innate tendency to simulate the actions we watch in performance or read in textual material. This simulative capacity for "motor equivalence allows us to utilize our shared motor schemata to interpret the actions of others" in real life and in fiction (Rokotnitz 122). The reader's mind is always engaged in scanning his stored experience to simulate an image which matches what the textual material describes. This study explains how the

literary text forcefully enables the reader to project himself physically into the fictional world, so it addresses the mind and conveys its conceptual message by appealing to the reader's body and perception through the process of embodied simulation. Accordingly, the researcher argues that the significance of a dramatic work is determined to a great extent by its embodied impact, emphasizing how its textually inspired physical aspect spontaneously echoes in the reader's mind via the capacity of embodied simulation. Thus, the understanding of the linguistic material of fiction becomes more effective when language is able to vividly simulate in the reader's mind perceptual and motor experience equivalent to what is illustrated by the very same linguistic content.

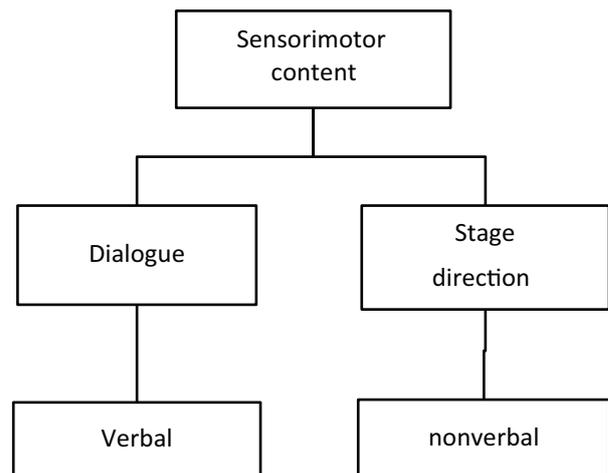
### CLASSIFICATION AND DISTRIBUTION OF SENSORIMOTOR DATA IN THE DRAMATIC TEXT

Sensorimotor data refers to all sorts of inputs which are perceived by the nervous system, then processed by the mind and conceptualized into a legible thought. In the dramatic text, the sensorimotor data can be classified into two types, sensuous description and kinesthetic images. The sensory system receives visual, audible, olfactory, gustatory, and tactile data. Kinesthetic data is related to the reader's awareness of the characters' position and movement of the body, so it appeals to the reader's motor system. Both sensory and motor inputs coordinate in the reader's perception in order to create a comprehensive projection of the characters' bodily experience in relation to their movement within the space (Figure 1).



**Figure 1.** Classification of sensorimotor data in the dramatic text

Sensorimotor data is distributed into verbal expressions uttered by characters in the dialogue, haupttext and nonverbal demonstration of movement, gestures or place indicated in the stage direction, nebentext. Both are expressed in the linguistic medium of the text. Raymond Gibbs argues that reading the text involves an embodied engagement which "does not just constitute our reactions to literature, but shapes the very process by which linguistic meanings are interpreted" (221).



**Figure 2.** Distribution of sensorimotor content in the dramatic text

Via the sensory nervous system, sensorimotor data is transformed from the physical world depicted by the text to the mind of the recipient in which data is managed and interpreted, concluding comprehensive concepts and automatically maintaining the body of the reader in a proprioceptive contact with the physical experience of the characters and their relation to the surrounding environment. Accordingly, everything we read in the linguistic content of the text is always filtered through our sensory and motor systems.

### RESEARCH METHODOLOGY

This study applies the embodied simulation approach to linguistic data to the reading and appreciation of science fiction drama. It adopts embodied simulation theory as its analytic paradigm focusing on the works of George Lakoff and Mark Johnson (1999), Benjamin Bergen (2012), and Raymond Gibbs and Herbert Colston (2012). The researcher collects sensorimotor data from the concrete and kinetic language used abundantly in two science fiction plays and analyzes it in the light of embodied simulation theory. Then, this paper relates the suggested embodied simulative response to the thematic content. Thus, it analyzes the textual information which can be translated spontaneously into equivalent simulation of mental images and empathic projection in order to generate deeper understanding of the fictional text and create a contact with the represented bodies, sensations or thoughts. The paper studies how the close text-based reading of science fiction drama promotes embodied simulation which enables the reader to constitute mental representations in the inward eye corresponding with the sensorimotor data collected from the text. Sensorimotor data is perceived by the nervous system and sent to the mind. Then, embodied simulation is adopted as a conduit through which sensorimotor data is processed by the mind into concepts or abstract values as shown in Figure 3. Accordingly, the researcher detects the translatability of the perceptual and concrete input into conceptual or abstract output through the process of embodied simulation.

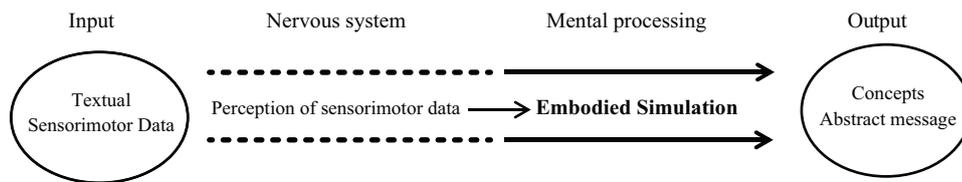


Figure 3. The transformation of sensorimotor data into concepts via embodied simulation

## TEXTUAL ANALYSIS

### Embodied Simulation in Nachtrieb's *Boom*

Nachtrieb's *Boom* takes place in a museum existing in a distant future, where Barbara directs two very lifelike automatons who enact the struggle of Jules, a marine biologist, and Jo, a journalism student, in an underground research lab after the rest of human life has been destroyed by a giant comet which has struck the earth. Barbara sits in a control station with giant levers and switches which can control the performance of the automatons. Barbara represents a race of human beings who have evolved from fishes which have survived the comet impact. Barbara acts "as emcee, stage manager, dramaturge, chorus, and musician for this exhibit-performance" (Schildcrout 4). Her presence in the performance and control over the automatons' actions emphasizes the fact that Jules and Jo's presentation is a mere simulative reenactment of the last moments of the life of the last two survivors of an extinct human species. Thus, the exhibit-performance of Jo and Jules is a simulation of a prehistoric world of human beings appealing to the embodied simulation of the reader. The performance enables the reader to draw a mental image of how the world will most likely appear just before its apocalyptic collapse. It takes the reader millions of years forward to imagine the near future world from a retrospective point of view.

Jo comes to Jules's small subterranean laboratory on a university campus in response to an online advertisement for an encounter that promises sex to change the course of the world. Jules who is homosexual intends to use Jo as a research subject in a biological experiment intended to reproduce human beings and save humanity from extinction. Jo is thirsty for sex only for the sake of pleasure and bodily gratification and indifferent to reproduction.

The play abounds with a remarkable, gradual accumulation of bodily terminology appealing to the reader's capacity of embodied simulation. The words "body" and "flesh" are uttered recurrently by the characters. The emphasis of the linguistic content in both dialogue and stage direction is on the expression and description of the character's physical affliction and vulnerability, deepening the reader's receptiveness of their experience. The sensuous and tangible experience, described by the semantic content and syntax, merges bodily perception with the underlying conceptual values, such as despair and helplessness dominant in the futuristic world illustrated by the play. The stage direction indicates a plentiful nonverbal sensorimotor content: "Jo kisses Jules actively, aggressively, may be pressing him against a wall, Jules is frozen, stiff, not responding" (Nachtrieb 13). The ac-

tion verbs "kiss" and "press" are put in contrast with sensory adjectives describing Jules' reaction, "frozen" and "stiff". Both activate the visual and kinesthetic system in the reader's nervous system conveying a resonant sense of the body in action. This implied contradiction in sensorimotor data makes the reader virtually perceive what it would be like to experience the incongruence of such situation in which the male feels threatened and withdraws from the advances of the female. This reversal of normative gender roles reflects the queerness of their corporeal existence. The play reveals a female body pressed by sexual urge but frustrated because of its existence in a collapsing world devoid of all means of survival and gratification.

The vision system is spontaneously activated in the brain to create a virtual visual experience of what the physical interaction between Jules and Jo would look like. Moreover, the reader is predisposed to use his brain's motor system in order to simulate what it would feel like to chase, kiss, push, jump on and shrink from a fellow human being. In other words, embodied simulation engrosses the reader into the whole circumference of the physical experience of the character. Brian Lowe stresses this simulative receptiveness indicating that the comprehension of language and therefore the creation of meaning necessarily involve the creation of mental imagery (47). Bergen also points out, "Meaning, according to the embodied simulation hypothesis, isn't just abstract mental symbols; it's a creative process, in which people construct virtual experiences—embodied simulations—in their mind's eye" (Louder 16). Accordingly, the reader is expected to perceive meaning by creating an embodied, imaginative projection that mirrors the intense corporeal experience that the playwright depicts.

In her speech, Jo uses a series of tangible nouns, "kissing", "body contact", "sex" and "intensively significant coupling" (Nachtrieb 14), indicative of her sense of physical deprivation and longing for real body interaction. The sensorimotor content of these verbal expressions in the dialogue - alongside nonverbal remarks, such as facial impression, gestures and kinetic activity suggested by the stage direction - also engages the reader in a simulative experience in order to perceive how it would feel like to be possessed by sexual urge and then sexually frustrated. Nachtrieb anticipates a future when the most basic needs of human beings are insatiable and denied because of physical impotence or abnormality.

In the stage direction, the playwright focuses on their kinesics, corporeal interaction and reaction, using a series of adjectives evoking concrete experience, such as "Frozen", "stiff" and including many action-related verbs in present tense, such as "Jo instantly collapses", "Jo jerks" "Jules shakes Jo gently" (16), "Jo wobbles"(25), "Jo and Jules

freeze” (30). Understanding the sensorimotor component of these action verbs involves an implicit embodied simulation of their signified motion, activating the brain circuits which perceive and perform the very same actual activity. Thus, language here is understood in terms of motion. This strengthens the absorption of the reader into the experience of the characters suggested by the text through a process of imaginative reenactment which characterizes embodied simulation. Moreover, the simulative proprioception intensifies the reader’s awareness of the position and movement of the characters’ bodies within the space, indicated by these action verbs. Gallese and Sinigaglia stress this simulative response; “When processing action-related linguistic expressions, listeners or readers reuse their own action representations in bodily format” (516). In the perception of language referring to sensorimotor data, the reader’s sensorimotor cortex is automatically activated in much the same way as if he were performing the represented actions and perceptions himself (Kuzmičová 276). Thus, the functional mechanism of embodied simulation underlying this sensorimotor content allows the reader to project himself in the fictional world of the characters. Therefore, during the aesthetic experience of fictional worlds, “our experience is almost exclusively mediated by a simulative perception of the events, actions and emotions representing the content of fiction” (Gallese, Neoteny 325).

The dialogue between Jules and Jo is full of bodily insinuations and sensorimotor content appealing to the simulative capacity of the reader, making him sense what the characters’ bodily experience looks like. Jo’s early linguistic remarks include action verbs in imperative form: “Take off your pants”, “Make me believe in life” and “Listen to your instincts” (Nachtrieb 12 - 14). Here, the verbal statements illustrate thirst for corporeal satiety and subtly indicate the deprivation of afflicted bodies. However, Jules frustrates her and confesses that he thinks that he is impotent. The dialogue also abounds with frequent affirmative bodily statements, such as “young flesh staggering”(13), “I love body contact”, (13), “We are the kind of people ... whose bodies are cursed” (30) and “We are a sprig” (32). These affirmative semantic statements about the bodily experience reduce the human body to a petty thing, “experiment”, “flesh”, “sprig” or “substance”. Even the last message of Barbra about the substantial existence of human beings is broken by open-ended ellipses. “The world will just keep on spinning and moving and changing and adapting and everything that we are, our substance, will always always.” (52 – 53). This statement connotes the inevitable decay and vanishing of the human body in face of the ever-changing power of the world. However, the open end, the future auxiliary and the adverb of frequency suggest that corporeality will go on possessing and influencing all human beings despite its vulnerability. Therefore, we should not ignore our bodies and their urges. In addition to bringing the reader into close contact with the existence of the characters and their sense of their bodies, these examples instigate his mind to simulate the physical actuality of vulnerable human beings in face of immense and collapsing world.

Numerous sensorimotor statements indicate either interrogative or negative avowals concerning the characters’ sense of their bodies. Jo says: “I am not a creator and caretaker of spawn” (33), and “I am not your experiment” (34). Jo’s longing for no-string sex and her queer choice not to reproduce are emphasized by recurrent negative remarks related to her body. She is merely interested in a temporary physical pleasure which leads to no consequent burdens. Moreover, Jules’s speech includes recurrent wondering about the existence of the human body; “Is there a purpose to our form and substance?” (18) and “Is that what your body is telling you?” (49). These enquiries reflect his confusion and doubt in his substantial being. Jules is skeptical about the nature and abilities of his body because of the lack of opportunities to gratify or examine his natural instincts. Therefore, through appealing to the reader’s embodied simulation, these bodily implications instigate the reader to visualize a virtual experience of the existence and condition of the human body in the futuristic world.

The portrayal of Jo’s character is intended as a manifestation of the most basic physical needs of every human being which have become hardly attainable. Jo goes online to escape from her monotonous life, searching for a partner in random sex which she regards “as the last glimmer of hope in a decaying society” (19). This is why her verbal and bodily communication includes many sensorimotor clues appealing to the capacity of embodied simulation which generates an empathic engagement with her deprivation and suffering. She indicates that all people’s desires are frustrated in the actual world, so they withdraw into isolation and keep themselves occupied with the virtual world of online chatting.

Jo: ... No past. No future. All that matters is the moment.

They meet to fulfill each other’s carnal need, to find a moment of freedom, release, of sensory bliss that makes them forget how mother fucked up everything is. (19)

Jo’s point of view reflects deviation from the normative sex function because sex is practiced as a means of escapism from the frustration of their life not as a mechanism of reproduction.

The simulation of the subterranean lab with dysfunctional experiments, the existence of impotent man with a vigorous woman and the outer world unfit for survival constructs a virtual mental image of a barren devastation with no hope of procreation. The simulation of this image deepens the reader’s understanding of man’s vulnerability and feebleness in a collapsing futuristic world. Jules’ expectation comes true. “A comet hits the planet Earth and is somehow simulated... Jo and Jules are frozen... A gesture of chaos and terror maybe toppling a few things” (26). A low roar grows louder and louder into a thunderous boom. The stage then becomes dark and silent, with only the fish tank still set alight. Both Jules and Jo survive the comet impact. The use of light and sound effects, flames, dust and kinetic signs of shaking instigate the reader to feel what it is like to experience this apocalyptic and traumatic experience.

Whenever Jo tries to open the lab door to get out of this entrapment, Barbra flips a lever and Jo looks like she’s getting an electrical charge shooting through her. As a result, “Jo instantly collapses as though she has just been un-

plugged" (16). When Barbara flips the switch up, Jo jerks awake. Here, the sensorimotor data, including action verbs obviously related to body state, generates a simulative perception of Jo's recurrent collapse which reflects her frailty and loss of self-control over one's body. The play shows the reader how it is like to fail to gratify one's basic physical demands and to have his body controlled by a superior power. Jules subjects Jo's body to several experiments in an attempt to inseminate her using artificial methods. However, all his experiments fail, and Jo protests saying "I am not a factory. I am not your experiment" (44). The reader intuitively suffers and gets the impression that technology can neither substitute nature nor satisfy corporal urges. Jo has a tendency of abstinence from the world, so she is reluctant to submit to Jules' experiments of procreation and indifferent to the preservation of their kind. Jules knows that it is not right to try and impregnate his post-apocalyptic cohabitant against her will and eventually confesses his failure. Jo is no longer eager for sex as she is overridden by her hunger and physical deterioration. The food supplies have almost run out, and they are entrapped in the lab because the outside world has become unlivable. The play reduces the existential condition of the two human beings to the basic physical preoccupations and compulsions of their body.

The following stage direction swarms with sensorimotor content, stimulating the mechanism of embodied simulation. "Jo flies onto Jules in another kiss. For both of them, this kiss and contact of desperate, urgent need to fill a void of lifelong loneliness" (50). Jo and Jules embrace and kiss each other in the last moments of their life. They find comfort in this inter-corporal contact which compensates for the emptiness of their actual bleak life. The sensory nouns, "kiss" and "contact," as well as action verbs, "flies onto" and "fill," imply the characters' longing for real sense of their bodies and convey their corporeal experience to the reader through appealing to his capacity of embodied simulation. While the last two human beings perish after opening the lab door, the fishes kept in the lab survive initiating a new form of life on the planet.

Through raising the reader's simulative responsiveness to the character's physical affliction, Nachtrieb shows that "technology is insufficient" (42) as biological experiments and artificial insemination can neither substitute the actual sensual experience nor gratify the natural bodily instincts. Here, technology and experiments fail to sustain procreation, and queer sexuality also represents a threat to the continuity of human life. Through promoting the reader's simulative response, the play raises a warning against deviation from the nature of the human body and highlights the call: "Listen to your instincts" (14). Nachtrieb's comedy, *Boom*, envisions the inevitable elimination of the human life on earth due to the failure to naturally gratify the needs of the body. Reproductive heterosexuality and normal physical gratification represent the only remedy to the common symptoms of psychological and mental withdrawal from the actual world.

### **Embodied Simulation in The Nether**

In *The Nether*, Haley infuses science fiction in the tradition of detective drama. The play traces the investigation conducted by Morris, a female nether detective, in order to interrogate users of a computer-simulated realm called the Hideaway which is set in the Victorian era, projecting an attractive world of prosperity and elegance. Morris has two men brought in for interrogation, Sims and Doyle. Sims, the administrator of the Hideaway, creates this site as a cyberspace where one can act out any fantasy no matter how deviant it is. Sims defends the idea of the Hideaway arguing that it is better to give free rein to abnormal desires in the virtual world than to release them in the real one. As every visitor of this site can be whoever he chooses to be, Doyle decides to adopt the role of a seductive prepubescent girl, called Iris, who is ready to answer the pedophilic desires of the other visitors. Woodnut, a visitor of the virtual realm, is in reality the avatar of inspector Morris who is disguised as a man in simulation in order to investigate the activities practiced in the Hideaway. However, Morris fails to resist the corporal life-like temptation and simulation in the virtual world and indulges into sex, violence, dancing and ecstasy with Iris. The paper traces the simulated experience of these characters and its demonstration in the textual sensorimotor data and examines how the capacity of embodied simulation is potentially activated in response to this content.

The description of the Hideaway and interrogation room includes a rich inventory of sensorimotor and spatial terms which stimulate the mind of the reader to construct a mental replication of the setting and activate his simulative proprioception, creating an awareness of the position and movement of bodies within the space; this guarantees better ambient comprehension of the play context. The setting of this realm is a Victorian house with a surrounding charming garden from which delightful fragrance arises and soft sound of piano is heard. "The flickering light and soft sound as they sway in the sun and wind is almost overwhelming" (Haley 7). The Hideaway throws the visitors into a dreamy state of pleasure. Morris indicates that the hideaway "is more than that ... It's sound, smell and touch. The Hideaway is the most advanced realm there is when it comes to the art of sensation" (22). The adjectives, "flickering" and "soft," alongside nouns, "smell" and "sound," create olfactory, tactile, audible and visual images instigating the reader to construct a multifaceted mental projection of the Hideaway. Thus, the Hideaway offers a full sensory life whose aspects do not only enthrall the member characters but also make the reader feel the seductive pull of the Hideaway through evoking their capacity of embodied simulation. The play highlights the sharp contrast between the vibrant world of the nether and the bleak, depressing atmosphere of the real world which is represented by the grim interrogation room, devoid of any embellishments. The conversation suggests that beyond this grayish room lies a bleak, tedious world where prosperous nature and clear sky have vanished and become extinct.

The play abounds with sensorimotor linguistic data in both dialogue and stage direction describing the physical experience and motor activities of the visitors of the Hideaway,

activating in the reader's mind the mechanism of embodied simulation. Thus, the linguistic content of the text affects the composition of the reader's embodied simulation. Papa who is the avatar of Sims "enters as Iris runs in, breathless. He catches her, spins her around in the light. She shrieks with laughter. He puts her down, and she wobbles in circles" (16). The frequent use of present action-related verbs here creates an air of immediacy, engages the reader and stimulates his mind to imagine the activity signified by the text. Thus, in this literary experience, the reading of the action-related data involves the simulation of the very same action in the mind's eye of the reader.

The argument between Morris and Doyle about the influence of embodied simulation of the virtual reality includes numerous sensorimotor data with intense bodily implications. Morris sees that embodied simulation is a form of cybernetic disembodiment which cuts people off the actual world. Thus, the total immersion in the virtual world threatens to turn people into "a permanent shade" or "bodies" which are "unrecognizable" and as a result the "suicide rate is high" (23). The use of these sensory words involves the reader into a simulative imagination of losing one's identity and existence into cybernetic absorption. Thus, Morris regards this type of cybernetic disembodiment a threat to the existence of mankind. However, she acknowledges the power of simulation in producing a substantial influence on the practitioner's actual perception of his surrounding world. She indicates, "Sensation is our gateway. To understand the rules of the world" (22), so indulgence in the virtual experience can change the way people sense their existence. Morris also indicates, "People meet as physical beings in the Nether" (23), so this simulative experience is not a mere imaginative practice with no tangible consequences. She believes that virtual simulation does provide sensation and affect perception, but the material experience it produces is fake and illusory.

On the other hand, Doyle acknowledges that the Hide-away is a form of cyberspace disembodiment, but he emphasizes that it reinforces the human communication in a new approach. Although Doyle argues that the virtual reality is a mere fantasy, he admits that it provides the participants with "contact" which has no "physical barriers" (23). Visitors may communicate with anyone, through any form they choose, and "this communication - this experience of each other - is the root of consciousness" (23). Thus, there is a kind of negotiation between this virtual, disembodied experience and actual, conscious embodiment. Here, the emphasis of linguistic data in this dialogue including abundant sensory terms is on the simulative contact and embodied experience of virtual reality which is, according to Philip Brey, "an immersive, interactive three-dimensional computer-generated environment in which interaction takes place over multiple sensory channels and includes tactile and positioning feedback" (362). Thus, this simulative contact includes an engaging interaction and a tangible effect not a mere shallow watching. Accordingly, this hypothesis opposes the point of view that embodied simulation in the virtual reality is a disembodied experience which has insignificant influence on

the perception of users. Doyle argues: "Can't you see what a wonder it is that we may interact outside our bodies? It's as revolutionary as - discovering fire!" (Haley 23). These words indicate the transcendent capacity of interpersonal communication between people through simulative imagination which admits no physical barrier. Doyle refers to the human body as a mere "bag of flesh" (23) and believes that virtual simulation allows one to transcend the limits of corporeal actuality which is utterly frustrating in this futuristic world. It enables Doyle to simulate the role of prepubescent girl and Morris the role of a male guest in the virtual realm. The reversal of roles emphasizes Doyle's idea about the transcendent power of the capacity of simulation. The descriptive emphasis on embodied experience in the virtual realm through the use of recurrent sensorimotor terms - either verbs, "interact," "communicate" or nouns, "bodies", "sensation," "flesh" - instigates the reader to imagine how it exactly seems like to lose one's self and body in a computer-generated simulation.

Although Morris and Doyle embrace different attitudes toward virtual simulation and its consequences, both admit its powerful mental impact. Doyle sees that the power of virtual simulation lies in its ability to reconstruct interpersonal contact in a new domain which is not as bleak and frustrating as the actual futuristic world. Morris sees that virtual simulation intensely involves the participants' physical senses resulting in people absenting themselves from the actual life and developing an abnormal way of perceiving the world. She also acknowledges that through this engaging simulative experience, people are enticed by "sensations they can no longer experience in the real world" (29). Thus, she confirms the power of embodied simulation which can generate a tangible experience, compensatory for the loss of bodily gratification in the actual world.

The play stresses the captivating impact of embodied simulation as a gateway to the perception of the surrounding world and as an outlet to imagination, but it warns that excessive computer-generated simulation should have reasonable parameters otherwise it can lead to a complete exile or withdrawal from the actual life. The argument whether virtual simulation has positive or negative outcomes remains unsettled, but all sides in the play acknowledge its evident embodied impact and consequent immersion. This goes with experiments in embodied cognition and mirror neurons which have proved that the human mind is capable of sharing the others' state through appealing to the recipient's repertoire of embodied experience and through the activation of equivalent brain circuits in the brain. By adopting a double vision that looks *simultaneously* at the power of simulation and at the materialities that produce it, we can better understand the implications of articulating cyberspace disembodiment together with embodied actualities emphasizing the consequent functional communication (Hayles 47). Thus, this play stresses the tangible reciprocity between embodied human participants and disembodied virtual avatars eliminating the separation between actual embodiment and cyberspace disembodiment. Thus, the visitors of the virtual world build higher levels of empathy with their avatars

through embodied simulation, strengthening the sensory aspects of experience. Now there is no specific point when virtual world experiences are purely separated from those of actual life and vice versa (Vicdan and Ebru 17-18). This idea is pointed out by Sims who confirms the concreteness of the virtual simulated model of the Hideaway, indicating: "Just because it's virtual doesn't mean it isn't real ... As the Nether becomes our contextual framework for being, don't you think it's a bit of date to say it isn't real?" (Haley 13). Thus, the virtual world shapes the human as the human shapes the virtual world. Woodnut also confesses that in the nether he likes "to have ... these materials ... to hold onto. Something tangible" (34). These statements, equipped with embodied terms, emphasize the concrete dimension of the experience of embodied simulation.

During interrogation, Doyle indicates that through the Hideaway which offers opportunities of unconditional simulation, "members cast off the limitation of physicality and become pure spirit" (38). Here, the play sheds light on the immense capacity of embodied simulation which enables the mind to perceive an engaging counterfeit of the actual world and gives free rein to imagination to soar to new horizons. Through computer simulation in the nether, members try to look truly like themselves because there is not any inhibition. Therefore, they lead "A life out of consequence" (52). This indicates the irresistible power of simulation which can have viselike grip upon the mind of human beings. Like the visitors of the nether captivated in the simulative virtual realm, the reader feels entangled and unable to leave the Hideaway which activates embodied simulative experience suggested by the text and its sensorimotor content. This affinity between reading literature and the capacity of embodied simulation is emphasized by Jonathan Gottschall who argues that fiction is a form of "virtual reality technology that specializes in simulating human problems" (59). In order to imagine the experience of the Hideaway visitor, readers need to transform the textual written material into an embodied simulation mimicking the characters' experience and sensations. Like a flight simulator, fiction projects readers into intense simulations of problems that run parallel to those they face in reality, so it reinforces their integration into complex social contexts (Gottschall 58).

Woodnut's speech includes significant sensorimotor terms promoting interpersonal embodied simulation. When Woodnut gives vent to his repressed, psychological troubles, he confesses, "my father was a shade" totally absorbed into the nether (Haley 52). When he was a child, his father "never looked" at him and "never touched" him (52). In the processing of the language we read, the recurrent negation of action-related verbs allows the reader to feel the deprivation of tangible tenderness and absence of inter-corporeal communication which are the main factors for Woodnut's submission to the temptation of the virtual world and search for recompensing gratification which he finally finds in the alternative experience of simulation in the Hideaway. The stage direction also includes a plenty of sensorimotor words. In the nether, Iris, the artificial character, stands on Woodnut's "feet and they waltz" (33). Woodnut spins her round.

"She shrieks with delight. He puts her down and she wobbles"(33). It is this embodied contact that provides the visitor of this site with comfort and gratification for which they long. The sensorimotor words which appeal to the reader's senses and motor system such as, "waltz", "spins", "shrieks" and "wobbles" enables the reader through the mechanism of simulation to perceive how this physical experience seems like. Woodnut confesses his admiration for the computer technologies which "have created tools for our imagination" through engaging embodied simulation which can recreate imaginative projections in the form of lively mental images. He refers to embodied simulation as "magic" which "can sweep us away" by giving "materials. to hold onto. Something tangible" (35). This statement, heavily pregnant with sensorimotor content, absorbs the reader into a shared experience of embodied simulation, stressing the captivating power of this cognitive capacity.

The play illustrates an imaginary future world when the internet or the nether gradually becomes the "contextual framework for being," a virtual space where "People should be free in their own imagination!" (31). When users enter the site of the Hideaway and adopt a character, "[t]hey believe themselves to be real" (32). Therefore, it invites the reader to imagine how it is like to have one's body completely absorbed into a virtual world through the mechanism of embodied simulation. Thus, the simulation of the characters in the Hideaway resonates in the mirror of the reader's simulation within the fictional work as whole. The mechanism of simulation urges the reader to project himself into the situation illustrated by the text so that he can become a part of this virtual experience. This is why fiction is regarded as a simulative interaction between the reader or audience and characters, generating an empathic response. Thus, embodied simulation allows the reader to share the others' states as though he himself undergoes the same experience.

Visitors of the Hideaway are enabled through embodied simulation to taste a variety of life pleasures which have become inaccessible in their bleak, actual world. They can have sex, give vent to their violent propensity and enjoy flourishing nature which has become extinct in their present life. Exquisite virtual children are available to satisfy all the desires of the visitors even if they are deviant. Children are not real human beings but a computer-generated sham or a cybernetic façade of a presumably compliant adult. People who seek out repellent, erotic excitement can find simulated gratification in this virtual realm. Thus, all what is impossible in the real world is possible in the virtual one on the nether.

The researcher points out that in this one-act play, the term "body" is repeated ten times, and parts of the body, such as hands, face, cheeks, lips, legs, etc., are used recurrently indicating a sensory experience. Terms with direct corporal significance, such as "physical", "physicality", and "materials", are used by all characters in order to stress the embodied side of simulative imagination in the nether. Moreover, verbs, describing physical activities, are also numerous. This emphasizes the abundance of sensorimotor terms in science fiction drama which have propensity to stimulate the mental mechanism of simulation.

In this play which is heavily equipped with corporeal experience, the readers are expected to respond - through their embodied simulative capacity - to the physical insinuations suggested by the dramatic text. The reader's embodied simulation depends on the mirror resonance system in the brain which responds to the sensorimotor data acquired from the text. In their experiment, Mbemba Jabbi, et al. used fMRI scanner to discover the response of research subjects to visual and written mediums. The results show that both mediums affect subjects powerfully activating the same workspaces of the brain. This is why reading a book and watching a movie can both make subjects develop empathic response and share the same experience which the character goes through (Jabbi, et al. 4). This stresses the power of reading or watching drama in spurring embodied cognition. Accordingly, reading *The Nether* engages the reader, through appealing to his capacity of embodied simulation, into an imaginary virtual world dedicated to the gratification of subjective inclinations through make-believe simulation.

The play shows how embodied simulation practiced through some internet sites can provide participants with illusory gratification and enthrall them in a virtual world threatening to generate an increasing rejection of the actual life and live experience. The play raises a warning that the growing prevalence and irresistible allure of the virtual activity on the internet gradually drives many people to renounce the experience of the real world for the sake of computer-generated substitute. This leads to the decadence of the actual world offline as Morris, the detective, anticipates "a mass migration into the nether" (Haley 30). Through this warning, the playwright envisions an apocalyptic tragedy caused by the enthrallment and control of the nether over the mind of many users.

Haley indicates that although corporeal desires and inclinations may be intimidating, abnormal or disgraceful, ignoring or repressing them is not an effective solution. Deprivation of gratification drives people to adopt artificial simulation as a substitute for actual experience. The play appeals to the reader's capacity of simulation in order to enable him to interpersonally appreciate these pressing physical demands of the characters and their quest for gratification even if it is an imagined and simulated counterfeit. The play calls for inhabiting our bodies which we sometimes tend to ignore. We should respect our bodies with their demands and urges. No intellectual power or social restraints can curb body urges. Although the performance is shocking arousing our natural revulsion to people who seek deviant desires, it urges the reader to empathize with the characters' physical affliction and deprivation.

Through addressing the reader's capacity of embodied simulation and constructing a virtual experience in his mind analogous to that of the character, the play questions man's future position in the cybernetic space and urges the reader to wonder where fantasy and reality separate in a future world where the demarcating lines between simulated cyberspace and reality are blurred. It raises unanswered controversial issue whether virtual embodied simulation - no matter how immoral it appears - can be acceptable or not. Some

may argue that as long as these fantasies remain fantasies, there is no harm. However, in the light of recent researches in embodied cognition, experiments prove that mental simulation plays a tangible role in the perception and activation of brain workspaces, so the extent of its influence is still open to farther studies.

## CONCLUSION

The paper proves that close and attentive reading of science fiction is capable of generating simulative mental images which maintain an empathic engagement and develops a deeper understanding of the conceptual message. Although reading science fiction is a silent activity, the reader is enabled to envision the here-and-now of an imaginary world inspired by the textual material through the activation of embodied simulation. Thus, he feels how it is like to have the same experience of the characters, so the actions, sounds and sights he reads are echoed in his sensorimotor modules deepening his receptiveness. Typical of science fiction drama, there is an intense emphasis on the sensorimotor data which depicts materiality of matters and the characters' corporeal experience in both dialogue and stage direction. Since the capacity of embodied simulation is spontaneously reactive and sensitive to sensory words and motor descriptions which appeal to the sensorimotor systems of the recipient's brain, the paper proves that science fiction effectively generates a highly simulated involvement with the text in the reader's mind. Science fiction includes certain conditions which facilitate this simulative experience, including sensuous description, physical portrayal and concrete treatment of things. The more sensorimotor terms are available in a text, the more it is capable of stimulating embodied simulation. Moreover, since science fiction always focuses on the vulnerability, evolution or metamorphosis of the human body, the paper illustrates that it is distinguished in its appeal to the capacity of embodied cognition.

The two playwrights show a profound attentiveness to the notion of the body as a discourse which aims at sharpening man's sense of his corporeal existence and urging him to examine the relationship between bodies, concepts and the world. They bring the human body to the center of the text, mainly depending on terms and statements pregnant with corporal significances which entail embodied simulation in the reader's response and reinforce intersubjectivity in order to guarantee an interactive engagement with the character. Thus, embodied simulation enables the reader to project himself into the physical affliction of the character. They urge the reader to respect the human body and its desires and recognize that deprivation and neglect of natural urges lead to deviant propensities and pursuit of gratification in substitutive, unnatural methods. This aberration represents a threat to the continuity of human life. Moreover, the capacity of simulation enables the readers of science fiction to envision images of objects or scenarios that do not necessarily exist in their real life and perceive the world as it might be in a futuristic image. It allows the readers to come in close contact with imaginary situations and places which are impossible to experience firsthand.

Embodied simulation draws a perceptive link between the embodied experiences of the characters denoted by sensorimotor content of the text and the overall conceptual significance of the play. Thus, it merges the concrete and the abstract in a coherent whole. Accordingly, it shapes and reinforces the reader's conceptualization of the material dissolution and senselessness of the collapsing future worlds through the recognition of the afflicted human bodies. Moreover, the reader depends on embodied simulation to develop empathic engagement with the characters, discerning their potential mental states which motivate them to perform certain actions. Accordingly, by recreating a simulative mental image of the characters' embodied experience, the reader can infer why the characters behave in certain way and recognize the conceptual message beyond their activities.

Embodied simulation in the two plays is also intensified by a dual frame of representation encompassing a play within a play. Morris in *The Nether* and Barbara in *Boom* act as presenters or stage managers who introduce the internal frame and guide the reader to the spot of representation. Morris' investigation into the simulated activities of the visitors of the cyberspace of the Hideaway and Barbara's control over the simulated performance of the human automatons in the lab strengthen the simulative engagement of the reader with the character. The presence of both Barbara and Morris between the two frames forms a tie between the characters' virtual simulation and the reader's embodied simulation with the characters.

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## REFERENCES

- Armstrong, Paul. *How Literature Plays with the Brain*. The Johns Hopkins University Press, 2013.
- Bergen, Benjamin. *Louder Than Words: the New Science of How the Mind Makes Meaning*. 1<sup>st</sup> ed., Basic Books, 2012.
- , "Embodiment, simulation and meaning." *The Routledge Handbook of Semantics*, edited by Nick Riemer, New York: Routledge, 2016, pp. 142-157.
- Brey, Philip. "Virtual Reality and Computer Simulation." *The Handbook of Information and Computer Ethics*, edited by Kenneth Himma and Herman T. Tavani, New Jersey: John Wiley & Sons, Inc, 2008, pp. 361- 384.
- Gallese, Vittorio. "Mirror Neurons, Embodied Simulation, and the Neural Basis of Social Identification." *Psychoanalytic Dialogues*, vol. 19, no. 5, October. 2009, pp. 519-536.
- Gallese, Vittorio. "Embodied Simulation and its Role in Intersubjectivity." *The Embodied Self. Dimensions, Coherence and Disorders*, edited by Thomas Fuchs, Heribert Sattel and Peter Henningsen, Schattauer, 2010, pp. 78-92.
- Gallese, Vittorio. "Neoteny and social cognition: A Neuroscientific Perspective on Embodiment." *Embodiment, Enaction and Culture*, edited by Christoph Durt, Thomas Fuchs and Christian Tewes, MIT Press, 2017, pp. 309-332.
- Gallese, Vittorio and Corrado Sinigaglia. "What is so special about embodied simulation?" *Trends in Cognitive Sciences*, vol. 15, no. 11, November. 2011, pp. 512-519.
- Gibbs, Raymond and Herbert Colston. *Interpreting Figurative Meaning*, Cambridge University Press, 2012.
- Gibbs, Raymond. "Embodied Dynamics in literary Experience." *Cognitive Literary Science: Dialogues between Literature and Cognition*, edited by Michael Burke and Emily Troscianko, Oxford University Press, 2017, pp. 219- 238.
- Gottschall, Jonathan. *The Storytelling Animal: How Stories Make Us Human*. Mariner Books, 2013.
- Haley, Jennifer. *The Nether*. Northwestern University Press, 2015.
- Hayles, Katherine. *How We Become Posthuman*. University of Chicago Press, 1999.
- Jabbi, Mbemba, et al. "A common anterior insula representation of disgust observation, experience and imagination shows divergent functional connectivity pathways." *PLoS One*, vol. 3, no. 8, August. 2008, pp. 1-8.
- Kuzmičová, Anežka. "Literary Narrative and Mental Imagery: A View from Embodied Cognition." *Style*, vol. 48, no. 3, 2014, pp. 275-293.
- Lakoff, George. Forward. *Louder than Words*. By Benjamin Bergen, Basic Books, 2012. ix -x.
- Lakoff, George and Mark Johnson. *Philosophy in the Flesh: the Embodied Mind & its Challenge to Western Thought*. Basic Books, 1999.
- Lowe, Brian. *Moral Claims in the Age of Spectacles: Shaping the Social Imaginary*. Palgrave Macmillan, 2018.
- Mar, Raymond A., and Keith Oatley. "The Function of Fiction Is the Abstraction and Simulation of Social Experience." *Perspectives on Psychological Science*, vol. 3, no. 3, 2008, pp. 173 192. *JSTOR*, URL: [www.jstor.org/stable/40212243](http://www.jstor.org/stable/40212243).
- Nachtrieb, Peter Sinn. *Boom*. Dramatists Play Service, 2009.
- Oatley, Keith. "Fiction: Simulation of Social Worlds." *Trends in Cognitive Science*, vol 20, no. 8, August. 2016, pp. 618-628. *Elsevier*, doi: 10.1016/j.tics.2016.06.002.
- Rokotnitz, Naomi. "Between Faulty intellects and Failing Bodies: An Economy of Reciprocity in Wit and 33 Variations." *Affective Performance and Cognitive Science*, edited by Nicola Shaughnessy, Bloomsbury, 2013, pp. 117 – 135.
- Richardson, Alan. *British Romanticism and the Science of the Mind*. Cambridge University Press, 2003.
- Schildcrout, Jordan. "Refusing the Reproductive Imperative: Sex, Death, and the Queer Future in Peter Sinn Nachtrieb's *boom*." *The Journal of American Drama and Theatre*. vol. 27, no. 1, Winter. 2015. <

- journal.org/2015/03/06/refusing-the-reproductive-imperative-sex-death-and-the-queer-future-in-peter-sinn-nachtriebs-boom/>
- Seymour, Laura. “‘Her Silence Flouts Me’: Stillness in *The Taming of the Shrew*.” *Cognitive Humanities*, edited by Peter Garratt, Palgrave Macmillan, 2016, pp. 113–131.
- Vicdan, Handan and Ebru Ulusoy. “Symbolic and Experiential Consumption of Body in Virtual Worlds: from (Dis) Embodiment to Symembodiment.” *Journal of Virtual Worlds Research*, vol. 1, no. 2, Nov. 2008, pp. 1-22.
- Willems, Roel and Arthur Jacobs. “Caring About Dostoyevsky: The Untapped Potential of Studying Literature.” *Trends in Cognitive Sciences*, vol. 20, no. 4, April. 2016, pp. 243–245. *Cell Press*, doi:10.1016/j.tics.2015.12.009.
- Zwaan, Rolf, Robert A. Stanfield and Richard H. Yaxley. “Language Comprehenders Mentally Represent the Shapes of Objects.” *Psychological Science*, vol. 13, no. 2, Mar. 2002, pp. 168-171. *Sage Journals*, doi: 10.1111/1467-9280.00430.
- Zwaan, Rolf, Lawrence J. Taylor and Mirte de Boer. “Motor resonance as a function of narrative time: Further tests of the linguistic focus hypothesis.” *Brain and Language*, vol. 112, no. 3. March. 2010, pp. 143-149.