



ORIGINAL RESEARCH PAPER

An Analysis of Heisenberg's Uncertainty Principle in Mark Z. Danielewski's *House of Leaves*

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This study is an analysis of Heisenberg's uncertainty principle in Mark Z. Danielewski's *House of Leaves*. According to Heisenberg, the position and velocity of a particle cannot be measured simultaneously, and an electron exists in an indefinite state. From the uncertainty principle perspective, this study aims to analyze how postmodern techniques cause uncertainty and make readers experience superposition, ambivalent feelings, and indefinite states. As a result of the uncertainty principle, the quantum parallel worlds appear in each part of the novel to a reader's mind. Both post-structuralism and quantum physics rejected reality; however, what mattered was the reader's role (or the observer's role) in deciding to create a single reality. From the frog viewpoint, there was only the reader's reality in parallel worlds, whereas multiple realities emerged from the bird viewpoint. These two viewpoints should not be ignored while analyzing the ontology of *House of Leaves*. Therefore, it can be proved that there is a close relationship between postmodern literature and physics. In the 20th century, scientific discoveries have affected literature. Like any other postmodern works, *House of Leaves* was inspired by quantum physics.

Keywords: Metafiction, Parallel Worlds, Reality, Superposition, Uncertainty Principle.

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Introduction

The researcher has an interdisciplinary look at *House of Leaves*, explains the elements of postmodernism with the elements of quantum physics and tries to bridge a gap between literature and physics. Waugh concisely said about the uncertainty principle in her book *Metafiction*, but she did not examine how the uncertainty principle worked in metafictional novels. This study shows how literary techniques are related to the concepts of modern physics.

Mark Z. Danielewski (March 5, 1966-) is a distinguished postmodern writer. He is the author of the award-winning bestseller *House of Leaves* (2000), the novella *The Fifty Year Sword* (2005), which was performed on Halloween three years in a row at REDCAT, and the National Book Award Finalist *Only Revolutions* (2006).

Danielewski's works are characterized by complicated, multi-layered typographical variations, or page layouts. Sometimes known as visual writing, the typographical variation corresponds directly to the physical space of events in the fictional world as well as the physical space of the page and the reader. In 1988, Danielewski graduated with a degree in English Literature from Yale, where he studied under John Hollander, Stuart Moulthrop, and John Guillory. He was also inspired by Harold Bloom. In 1989, Danielewski moved to Berkeley, California, where he enrolled in an intensive Latin course at the University of California, Berkeley. He then pursued graduate studies at the USC School of Cinema-Television in Los Angeles (About Mark Z. Danielewski, n.d.).

House of Leaves, Danielewski's debut novel, won numerous awards. It was a 10-year-long project. *House of Leaves* was translated into numerous languages such as Dutch, French, German, Japanese, Russian, Polish, Serbian, Spanish, and Greek. It is still taught at universities both in the United States and abroad.

Werner Heisenberg (1901-1976) is known as a prominent figure in quantum mechanics. He liked mathematics and technical gadgets, and his teachers considered him gifted. In 1920, he began his studies at the University of Munich and published four papers on physics within two years. He earned his doctorate in 1923 with a thesis on a problem in hydrodynamics. After receiving his doctorate, he worked as an assistant for Max Born at Göttingen and then spent a year working with Niels Bohr at his institute in Copenhagen. Heisenberg invented matrix mechanics known as the first version of quantum mechanics in 1925. Matrix mechanics was further developed in a three-author paper by Heisenberg, Born, and Jordan published in 1926. Heisenberg is also known for the uncertainty principle, which he published in 1927. He was awarded the 1932 Nobel Prize in Physics for the creation of quantum mechanics. In his later years, Heisenberg assumed various influential positions both in Germany and abroad, giving important lectures on theoretical physics and other subjects (Chodos, 2009).

The uncertainty principle exists in both postmodernism and physics. Closely related to postmodernism, post-structuralism is a late-twentieth-century achievement in philosophy and literary, especially associated with the works of Jacques Derrida and his followers. It originated as a reaction against structuralism, which first emerged in Ferdinand de Saussure's work on linguistics (Gutting, n.d.). Saussure revolutionized the study of language. According to Saussure's most innovative

contention, words are the signs consisting of a palpable sound image (i.e., signifier) and a mental concept (i.e., signified). All signs exist in the chains that connect them to all other signs in a language. In fact, a language works through the interrelationships and interactions of linguistic signs but to name objects by words. The relations between words and things are entirely arbitrary, as Saussure contended. The identities of signifiers are determined by their differences from other signifiers. In a language, according to Saussure, there are no identities but only differences. In other words, the relations of terms allow signifiers to appear to possess identities of their own. Hence, a language is an entirely conventional matter of form but not a natural substance. Derrida carried out his critique of structuralism systems through the deconstruction technique. Denying any centers of truth (e.g., God, humanity, or the self), deconstruction maintains that we can never be certain about our values, beliefs, and assumptions. If this is the case, then we can never be certain about the meaning of a text. Therefore, we can never declare a text to have but more meaning. The "un-decidability" of meaning in a text is the cardinal rule of deconstruction (Bressler, 2012).

According to Heisenberg's uncertainty principle, it is impossible to know both the position and velocity of a subatomic particle. It began to appear that ultimate truths about the natural world were ungraspable. With this realization, a sense of apprehension began to settle over not only science but also humanities (Moffett, 2008). There is a kind of literary uncertainty principle in post-structuralism, for there is no single meaning.

Creation of Uncertainty Principle in *House of Leaves*

A valuable lesson learned from the quantum theory is that measuring a system can create ambiguity rather than recording the property of the system (Busemeyer & Bruza, 2014). Superposition is a principle of the quantum probability theory. According to the conventional probability theory, a system is in a definite state at any moment with respect to possible states. This definite state can change stochastically over time; however, the state is still definite at each moment, and the system produces a definite sample path. By contrast, the quantum probability theory assumes that a system is in an indefinite superposition state at any moment until it is measured. Being in a superposed state means that all possible definite states have the potential for actualization, although only one will be actualized upon measurement. The concept of superposition resonates with fuzzy, ambiguous, and uncertain feelings in many psychological phenomena (Busemeyer, Wang, Khrennikov & Basieva, 2014).

While reading the novel, a reader is in an indefinite state. If the reader and the novel are considered an observer and a quantum system, respectively, it can be stated that the quantum system is in an indefinite state. In fact, the quantum theory allows the reader to be in an indefinite state (formally called a superposition state) at each moment before deciding on reality. The reader is in a superposition state that leaves him/her conflicted, ambiguous, confused, or uncertain about the status. For instance, the reader may become ambiguous about his/her feelings after reading *House of Leaves* because of different techniques such as fragmentation, hypertext, intertextuality, and defamiliarization used by Danielewski.

This interaction leads to a definite state out of an indefinite state. An individual may initially be in an indefinite state about a set of paintings on display; however, if he/she is asked to select one as a gift, then a preference order is constructed on line for the purpose (Busemeyer & Bruza, 2014). Once a decision is made to resolve uncertainty, the state becomes definite as if the wave collapsed to a point like a particle. Thus, quantum systems require both wave (indefinite) and particle (definite) views of a cognitive system. (Busemeyer & Bruza, 2014).

The reader's own choice will determine whether he/she reads sentences in a particular manner, which leads to a plurality of readings (Barton, 2006). At one point during his interview with McCaffery and Gregory, Danielewski remarked, "There are many ways to enter *House of Leaves*." He was actually referring to the process of reading his novel (Hauglid, 2016). In other words, he mentioned that there are multiple interpretations of his text.

Paraphrasing what Danielewski said, Hansen stated "The true protagonist [of the novel] is the figure of interpretation, which is to say, the act of reading, or even, perhaps, the reader herself." (Hauglid, 2016). Danielewski himself alluded to a mysterious "originator" in his text and a dominant voice that created all of the others; however, he declined to address his own mystery in order to let the audience make their own interpretation (Hauglid, 2016).

Creating Parallel Universes through Reader's Decisions

The reader's significant amount of r when it comes to deciding how to read *House of Leaves* raises some interesting arguments. The control given over the reading process makes the reader invest more in the text, for he/she has to make conscious decisions on what to read and what not to read. While Danielewski presents the narratives in his own terms, the reader is free to make his/her experience of his work unique by deciding how he/she approach and interpret the text (Hauglid, 2016).

There are many possible interpretations that the text offers to readers. According to the so-called Copenhagen interpretation (a collection of views about the meaning of quantum mechanics, principally attributed to Niles Bohr and Werner Heisenberg), before the observation of an electron happens or the process of reading a text takes place in literature, nothing meaningful can be stated about the electron or the novel *House of Leaves* because they exist in a superposition of all possible states. Therefore, when the observation is made, the wave function collapses. Each elementary particle will then be found in a specific location rather than in all the possible states predicted by the wave function (Ryan, 2006). Similarly, when the reader makes a decision in literature, he/she reaches to one single meaning and outcome for *House of Leaves*.

Erwin Schrodinger, who considered the idea absurd, exposed a paradox through a celebrated thought experiment (Ryan, 2006). A cat is sealed in a box together with an atom of uranium that has a 50-50% chance of decaying in a certain time span. The decay cannot be predicted, for it is a quantum phenomenon. Now if the decay takes place, a mechanism will be triggered that kills the cat (Ryan, 2006). By the time the box is opened, the atoms will have both decayed and not decayed. In the interpretation that Schrodinger wanted to discredit, the cat will be dead and alive at

the same time: "In order to describe the cat, physicists add the wave function of the living cat and the dead cat - i.e., we put the cat in a nether world of being 50% dead and 50% alive simultaneously" (Ryan, 2006).

While reading *House of Leaves*, a reader can select to read the book in any given fashion. In fact, readers can skip undesired parts, start at whatever point in the text they wish, and choose which voice they want to give the closest attention if there is more than one (Hauglid, 2016). Therefore, the text (like the cat) is in a world of being 50-50%, and many interpretations exist simultaneously.

According to Everett, random quantum processes divide the universe into multiple copies, each of which is for every possible outcome. The cat, consequently, is dead in one parallel universe, is alive in another, and is watched in each universe by different copies of observers or by none at all (Ryan, 2006). In this interpretation, the multiple possibilities described by the wave function are more than possibilities - they are all actual phenomena occurring in different worlds. Hence, Aberg's pronouncement must be reversed into a specific conclusion: "Quantum mechanics is a theory of actualities, not of potentialities ... a theory of possible worlds which are all actual" (Ryan, 2006).

A notion known to physicists as de-coherence suggests that phenomena follow separate courses and never merge again after they split apart. "In the many-world interpretation," writes Kaku, "the wave functions of the dead cat and the alive cat have de-cohered from each other and no longer interact, thereby solving the problem of how a cat can be both dead and alive simultaneously. De-coherence simply explains the cat paradox without additional assumptions such as the collapse of the wave function." (2005)

Yet not all proponents of the many-world interpretation equate the splitting of worlds with a total lack of interaction. De-coherence can be weak or strong. "Weak de-coherence creates slightly different world lines that continue to interact ... , whereas strong de-coherence creates steadily divergent lines." (Ryan, 2006)

As an individual is involved in reading *House of Leaves*, the quantum parallel worlds come into view. In the reading process, each interpretation splits into multiple copies, each of which correspond to every possible result. The first interpretation is in one parallel universe, whereas the second interpretation is in another. They are read in different universes by different copies of the reader or by none at all.

While discussing parallel universes, we need to distinguish between two different ways of viewing a physical theory: the outside view or the bird perspective of a mathematician studying its mathematical fundamental equations and the inside view or the frog perspective of an observer living in the world described by the equations. From the bird perspective, the quantum parallel universe is simple. In fact, there is only one wave function that evolves smoothly and deterministically over time without any sort of splitting or parallelism. The abstract quantum world described by this evolving wave function contains a vast number of parallel classical storylines, continuously splitting and merging as well as some quantum phenomena lacking a classical description. From the reader's frog perspective, each observer perceives only a tiny fraction of this full reality. In this case, the observer can only

see his/her own Hubble volume, and de-coherence prevents him/her from perceiving quantum parallel copies of himself/herself through the process of reading (Tegmark, 2003).

A reader who deviates from linear reading will naturally miss out on several important contexts and events that are essential for a text to make sense. Probably, in response to this model of writing and reading, Danielewski wrote a novel where a linear reading risk is one of the least informative ways of approaching the text (Hauglid, 2016). Due to this model of writing, many possible worlds appear in the reader's mind; thus, he/she has to make the right decision. When the reader faces a question, makes a quick decision, and answers the question, the quantum effects at the neuron level in his/her brain lead to multiple outcomes. From the bird perspective, his/her single past branches into multiple futures. From the frog perspective, however, each copy of the reader is unaware of the other copies, and they perceive their quantum branching as merely a slight randomness. Afterwards, there are multiple copies of readers for all practical purposes. The multiple copies have the same memories up until the point when the question is answered (Tegmark, 2003).

Research Questions

The researcher tries to answer the following questions in the light of Heisenberg's uncertainty principle:

1. Can a definite world be considered in *House of Leaves*?
2. How does the quantum parallel universe justify multiple realities for *House of Leaves*?
3. What are the similarities between a reader of *House of Leaves* and a conscious observer in quantum measurement?
4. To what extent has modern physics affected literature?

Absent Information Creates the Uncertainty Principle

In quantum mechanics, an observer engages with the reader-response approach. Both the reader and the observer determine reality. To Wolfgang Iser, reading is a creative act. The reality of a literary text is never based on copying reality, as reality is a part of it. The ambiguity that needs to be based in the process of reading appears in this discrepancy point between a literary text and the reality. Therefore, ambiguity and emptiness become the basic Iser's terms and the basic conditions of text activity and its reception. By reading *House of Leaves*, the reader continuously fills the gaps emerging at the same time as the relation between individual aspects of the text which are not formulated in the text (Kuić, 2015). Therefore, *House of Leaves* is not an object in itself but is an effect of a reader's process, passing through a set of schemes in the text and filling the gaps. The appellative structure of the text is included in the function of these empty places. Ambiguity is the basis of literary communication, whereas communication is not a finished form but the result of interaction between implicitness and explicitness. By expanding an authentic reading act created among the schematized aspects of the text in the process of reading, Iser thinks that the emptiness, i.e., an "unfulfilled place" which enables some different communications, presents the fundamental asymmetry between the text and the reader. Unfulfilled places have several functions. They enable the

development of an aesthetic subject in a way that they condition a reader's view of both new and previous topics (Kuić, 2015).

Obituary of Johnny's Father

There is the obituary of Johnny's father on Page 585. The reader faces many words that are missed:

Local pilot, Donnie _____, died last Sunday on route _____ when the Mack truck he was in swerved into a ditch and caught fire. Reportedly the driver, who survived, had fallen asleep at the wheel. Throughout his life, Mr. _____ was a dedicated flier. As R. William Notes said of his friend, "Donnie always seemed most at home in the sky." Born in Dorset, Vermont on _____, 19____, Mr. _____'s family soon moved to Marietta, Ohio where he graduated from _____ high school Late last year, Mr. _____ decided to take a job as a pilot for _____ in order to spend more time with his family. Tragically, during the standard physical examination, doctors discovered he had unknowingly suffered some time ago __ probably in his sleep __ a cardiac infarction. (Danielewski, 2000)

Johnny's father's surname, his date of birth, and the place of death are all missed. The editor said, "At Mr. Truant's request, we have omitted the last name of his father as well as several other details." (Danielewski, 2000). From missing words in the obituary of Johnny's father, the reader can infer that Johnny employs pseudonyms in the text.

The absent information could have informed the reader to find connections among the characters in *House of Leaves*. The reader is in an indefinite state due to this absent knowledge that leaves him/her conflicted, ambiguous, confused, or uncertain about the relationships of characters. For instance, the reader suspects that there is a relationship between Johnny's mother, Pelafina, and Zampano (Meijer, 2010). Specific repetitions in the novel, Zampano's poems, and Pelafina's letters suggest the possibility of this relationship. One repetition involves the mention of summertime and root beer (Throgmorton, 2009). In Zampano's poem (That Place), there is a reference to "summer love I and root beer" (Danielewski, 2000). Here Zampano describes a summer in which "some children went down to that place where I and they never came back from." Just a few pages later, in the Whalestoe letters, Pelafina gives Johnny this exhortation: "May your summer be full of root beer, joy, and play." (Danielewski, 2000)

Another probable event for Zampano is not Johnny's father, and he is only a blind man whose manuscript interests Johnny posthumously. Accidentally, his poem connects to Pelafina's letters. Another possibility for Johnny is that he might be Zampano's brother. The whole theory is pretty much based on the idea that there is a connection between the Navidson Record and the real world where Johnny and Zampano live. If it links Tom to Zampano, Karen to Pelafina, and Navidson to Johnny, Johnny can be a replacement for Zampano's brother (Dresden, 2006).

Since the reader makes his/her decision and chooses one of these possibilities, the uncertainty is resolved. For instance, when the reader links Pelafina and Zampano, an unclear state turns into a definite state, and the wave function

collapses. Before making any decisions, the reader is faced with some probable events which can happen simultaneously in the bird perspective, from which the quantum parallel universe and the outcome of each possibility are perceptible. However, but from the frog perspective, only the reader's decision is observable.

Absent Photographs

The following indicates an absence of text denoted by some parentheses that could represent Delial's photograph on Page 421:

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|---|---|
| [|] |
| [|] |
| [|] |
| [|] |
| [|] |
| [|] |
| [|] |
| [|] |

These parentheses play such an important role in the Navidson Record narrative. By not including the image, the reader is allowed to imagine the photograph. In this case, the photograph is said to be the same as Kevin Carter's prize-winning photograph; hence, many of the readers will or can substitute the real-life image into the text. The reader can use the theft's own knowledge to see the image (Barton, 2006).

Danielewski emphasizes the visual perception. He lets the reader visualize the scene in the documentary by allowing the words on the page to mirror the image. The blank space inside the book always represents something that is not absent in the context of the book, thereby being simultaneously present (Barton, 2006). This shows the dual nature of absent photographs like an electron. It is either absent or present simultaneously until the reader chooses to interpret the photograph or not. From the bird perspective, this section of the book splits into two in a parallel universe. Before the reader decides the absent or present photograph, it lies in superposition. Uncertainty is solved after decision-making.

There is another absent image in *House of Leaves*. This image does not appear on Page 526. "Surviving House, Kalapana, Hawaii, 1993" — Diane Cook. In this case, the image is not represented by parentheses but simply by a blank space above a caption reading Surviving House, Kalapana, Hawaii 1993 "- Diane Cook".

The reader cannot be sure whether the absent space represents a photograph or text. The caption certainly suggests a photograph of a house. Zampano is blind; therefore, the image has no significance to him. An explanation for the reliance on the blank space and the absence connecting itself to the narrative is Zampano's blindness (Barton, 2006). The reader is in a dichotomous situation. Zampano is blind and unable to watch the Navidson Record and read its notes. It is difficult to write without being able to see. At the same time, another possibility comes to the reader's mind that Zampano is not blind and has a mental problem like Pelafina. He is a solitary person living in his apartment. His writing includes a dark and cold labyrinth, indicating his attitude towards the world. The absence of an image

conveys Zampano's emotionless towards existence, whereas the blank space represents the empty and meaningless view of life that Zampano feels.

The intuition behind the uncertainty principle is that the reader may become uncertain about Zampano's mental problem after clarifying his blindness. Likewise, after clarifying one possibility, you may become uncertain about another. In other words, the uncertainty principle entails that it is impossible to be simultaneously decided on the matter across both Zampano's blindness and his mental problem.

House of Leaves is written in such a style that contexts, photographs, and Zambrano's notes belong necessarily to Zampano. However, Johnny may interpret Zambrano's manuscript, or the editor may add or omit something (Barton, 2006). The choice is left for the reader to decide among these uncertainties, for there is no actual evidence. In fact, the reader's choice defines the reality of the quantum system.

Missing Pages

Some pages are mentioned in a footnote that was burned in the middle of the words denoted by parentheses representing burnt holes in Zampano's original notes in the context of the narrative. Some of the pages are inked out and burned. They are indicated in the footnote shown by X's:

In another series of notes, Tobe describes Holloway's first love: "At seventeen, he met a young woman named Eliz[]beth who he described to me as 'beautiful like a doe. Dark eyes. Brown hair. ... [].' In Holloway's XXXXXXXX, the relationship ended because he didn't [sic] the varsity football squad. ... Her interest in him faded, and she soon beg[] dating the starting tackle, leaving Holloway broken-hearted with an increased sen[]e of [illegible] and inadequacy." (Danielewski, 2000, p. 328)

These blank spaces create a situation for the reader to make his/her own words. The letters that the reader selects in blank spaces in the middle of the words will create new sentences. Therefore, on one page, we can have one sentence with many substitute words. The reader sticks to the quantum system in which his/her decision about selecting letters can create the reality of the text. In this case, there is not any absence of text; however, there are possibilities that the reader will eventually choose one.

Certain parts of the Navidson Record commentary and the footnotes supplied by Johnny Truant are said to be missing by the editors which amplify the feeling that what is missing could hold the key to the mysteries of the text. The page in the book will always denote how many pages are missing. The reader is then allowed to create at least a part of the text by substituting his/her own ideas of what happened in the missing pages rather than being dictated to what happened. Alternatively, the reader could decide to simply ignore the missing text and skip to the next part (Barton, 2006). Therefore, the reader confronts many possibilities in his/her mind to eventually choose one of them when the quantum system collapses. Based on the reader's decision, the process of reading will continue.

In Footnote 429, there is the information labeled "Missing. - Ed?". However, this is a case of fiction referencing fiction, and the parts of the exhibit were never there in the beginning. The author trivializes a convention that is so often relied upon for

its integrity. Omissions in *House of Leaves* are indicated in the narrative itself. Presumably, pages are missing from Johnny Truant's submission to the editors before publication. "This intertextuality and Danielewski's reliance intend to make the reader notice what is not on the page rather than what is on the page." (Barton, 2006)

Iser discusses the methods used by the readers in order to overcome blockages and omissions. This is particularly relevant in Danielewski's novel where the author draws attention to the gaps in order to emphasize the dynamism of reading:

"These gaps have different effects on the process of anticipation and retrospection and thus on the 'gestalt' of the virtual dimension, for they may be filled in different ways. Hence, one text is potentially capable of several different realizations, and no reading can ever exhaust the fill potential, as each individual will fill in the gaps in his/her own way, thereby excluding various possibilities. As they go on reading, they will make their own decisions as to how the gap is to be filled. In this very act, the dynamics of reading are revealed. By making their decisions, they implicitly acknowledge the inexhaustibility of the text. At the same time, it is this very inexhaustibility that forces them to make certain decisions." (Barton, 2006, p. 38)

The above passage was quoted as it is fundamentally important in realizing the uncertainty principle in the reader-response theory. By adopting one way of reading, the reader excludes the other possibilities. This theory corresponds to the quantum principle of constructing reality from an interaction between the reader's indefinite states.

Danielewski's style lies in the uncertainty principle. The absence of a word, the missing pages, the X's instead of words, and parentheses in the middle of words make reading this novel an active process in which the reader and novel exchange ideas and suppositions. Lack of knowledge and ambiguity put the reader in a superposition state. Being in a superposed state means that all possible definite states have the potential for actualization; however, only one of them will become actual upon measurement (Bruza, Wang & Busemeyer, 2015). In other words, this lack of information makes many assumptions, each of which is in one parallel universe from the bird perspective. These parallel universes have the potential for occurrence. When the reader selects one of these possibilities and one way of interpretation, one of them will become the reality of the novel.

Cruft Makes the Uncertainty Principle

David Letzler classified *House of Leaves* as an "encyclopedic" novel, a category which he described as "large, complex novels, particularly those that incorporate substantial specialized information from science, art, and history." (Hauglid, 2016). After discussing the tendency of such novels to cram large quantities of information often less than relevant information to the enjoyment of the text into their endnotes (or, as is the case with footnotes in *House of Leaves*), he proposed a term for this technique. Letzler named such content the "cruft" of fiction, a word which is used as the slang for superfluous material. In fiction, this sort of cruft serves no particular meaning and explains too much, too little, or both. While he acknowledges that the aforementioned passages of *House of Leaves* contain cruft, Letzler notes that its use

of footnotes mostly aids in the novel's "narrative layering and metafictional events". He is also of the opinion that the cruft that does occur in *House of Leaves* serves as a certain function: "dazzling visual effects" (Hauglid, 2016).

Cruft comes from computer programming, where it refers to poorly designed, overly complicated, or unneeded code. Cruft refers to the surplus, the remainder, and the bits that are "unnecessary" in some sense, even while they remain (Eve et al., 2018). Letzler's cruft theory is clearly applicable to Danielewski's book. Despite the visual appeal they may have, the fact remains that the passages consisting of cruft are virtually unreadable. This is arguably another provocation from the author. Cruft can also be interpreted as forbidding. If a given reader finds no purpose or enjoyment in reading Zampano's word cruft, finding that the footnotes do indeed explain too much or too little, they might find it hard to imagine themselves as the intended readers of the book. As mentioned, this is the message that the book is trying to get across from the dedication page: "This is not for you". It is a discouraging statement emphasized by the use of the word cruft; however, interestingly enough, it can be read as provocative and encouraging at the same time (Hauglid, 2016).

"This is not for you", immediately raises the suspicion that the book is not meant to be read, and, in the literal sense, certain passages of the book are difficult or impossible to read. We can distinguish between two different ways in which this obstruction is presented. First, there are those parts of the book that, in the fictional world in which they were created, have been subjected to attempted omission, both successful and unsuccessful. A recurring instance of unsuccessful omission consists of passages of the Navidson Record, which Zampano attempted to destroy but was more or less completely reassembled by Johnny Truant. Although these passages appear in the book, they are represented by the use of a strikethrough text (refer to Fig. 1). This typographical tool can arguably lend a sense of forbiddance to the text, reminding us that the crossed-out words were not intended to be read and that we are intruding on Zampano's wishes as well as his failure to hide the parts of his psyche that the house corrupted (Hauglid, 2016).

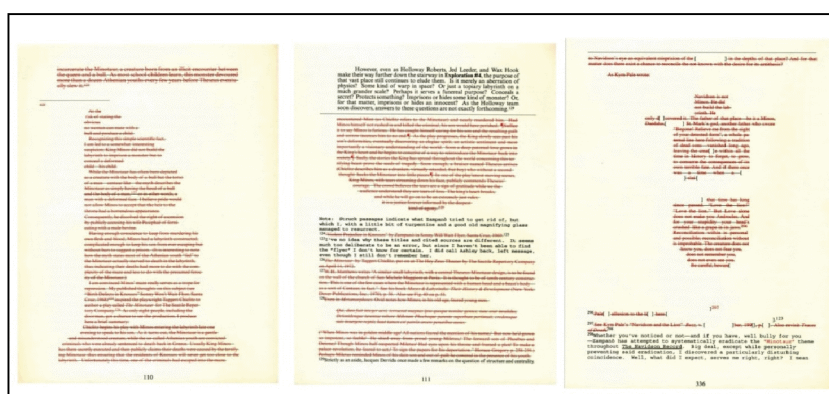


Figure 1: Cruft technique

The lack of information would encourage readers to interpret their own preconceptions and context. If we are to argue that cruft is indeed only a visual effect, we must consider what it encourages as much as what it discourages. While reading *House of Leaves*, the reader is clearly treading on a forbidden territory signified by visually intimidating information that reminds readers of their limitations (refer to Fig.2). However, it also seems that the text uses cruft to encourage readers to work around those limitations (Hauglid 2016). According to Elisabeth Viereck Bell, we are faced with "uncertainty no longer springing from the lack of information but stemming from the information itself." (Letzler, 2014)

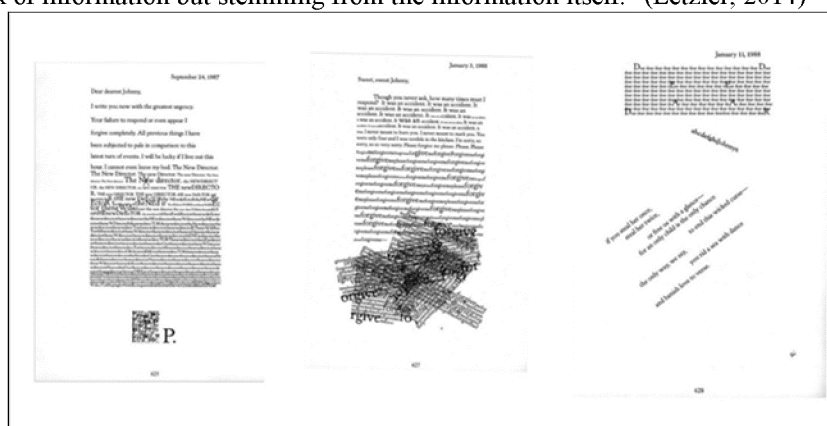


Figure 2: Cruft technique

When a text is uncertain in meaning, it delays the reader in understanding the novel's purpose. Cruft makes the reader face a dilemma. Hence, the reader is left in an ambivalent feeling in each part of the novel, experiencing uncertainty about reading excessive information or ceasing to read more. "In psychology, superposition appears an intuitive way of characterizing the fuzziness (i.e., conflict, ambiguity, and ambivalence) of everyday thoughts." (Pothos & Busemeyer, 2013).

Both reading and ignoring excessive knowledge of the novel can put the reader in superposition with different possible outcomes. "The superposition state of the system before the observation is sometimes viewed as a quantum wave, and the transition from a superposition state to a definite state associated with the observed outcome is often called the collapse of the wave." (Busemeyer & Bruza, 2014). Therefore, from the frog perspective, as the reader decides to read the forbiddance of the text such as excluded words and huge information in footnotes, the indefinite state turns to a definite state with a clear outcome, and the wave function collapses.

From the bird perspective, "Each individual will have a different interpretation of a text simply because no two people think or act alike." (Frigo 4). Someone may decide to read only short footnotes and ignore the long footnotes of the novel. Another reader may read only the text with the appendix and not pay any attention to footnotes. Someone may take no notice of excluded words or disregard typography. Each probability of the reading process can give the novel a new meaning. Each

reader's styles with different outcomes make the quantum parallel universe from the bird perspective.

Conclusion

This study was an analysis of the uncertainty principle in *House of Leaves*. Firstly, the superposition (i.e., definite and indefinite states in the uncertainty principle) was discussed to illustrate how the reader would lie in the superposition state. The text can be interpreted differently from the reader's point of view to explain how the parallel world emerges from the reader's imagination to fill the gaps. After a brief explanation regarding how uncertainty works in *House of Leaves*, the researchers tried to apply this concept to the novel. The blank spaces create the uncertainty principle, which was studied in three sections entitled Obituary of Johnny's Father, Absent Photographs, and Missing Pages. Next, the literary technique of cruft was explained in *House of Leaves* to determine how extra information could create uncertainty in the same way as lack of information. In this case, there were multiple realities; however, the reader eventually selected one of these states. In the case, the wave function collapsed, and the uncertainty was resolved. In the frog viewpoint, the reader's decision can only be seen, whereas the bird viewpoint presented multiple realities, each of which had the potential to happen. Hence, the multiple realities were seen as the quantum parallel universes. The excessive information was then discussed as cruft which functioned in the same way as gaps in the novel. This study indicated that new scientific discoveries of the 20th century affected literature indirectly. Postmodern literature has been developed in parallel to modern physics. These two different fields of study intersect and overlap characteristics.

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بررسی اصل عدم قطعیت هایزنبرگ در رمان «خانه برگ‌ها» اثر مارک ز. دانیلفسکی

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این پژوهش به بررسی رمان «خانه برگ‌ها» اثر مارک ز. دانیلفسکی از منظر اصل عدم قطعیت هایزنبرگ می‌پردازد. بر اساس اصل هایزنبرگ، موقعیت و سرعت یک ذره را نمی‌توان به طور همزمان اندازه‌گیری کرد و الکترون در حالتی نامعین قرار دارد. از منظر این اصل، مطالعه حاضر تلاش می‌کند تا چگونگی ایجاد عدم قطعیت توسط تکنیک‌های پسامدرن و قرار دادن خواننده در موقعیت‌های سوپروپوزیشن (جمع‌پذیری)، احساسات دوگانه و حالات نامعین را بررسی کند. در نتیجه اصل عدم قطعیت، جهان‌های موازی کوانتومی در هر بخش از رمان برای ذهن خواننده متجلی می‌شوند. هم‌پس ساختارگرایی و هم فیزیک کوانتومی واقعیت را رد می‌کنند، اما آنچه اهمیت دارد نقش خواننده یا ناظر است که با تصمیم خود یک واقعیت واحد خلق می‌کند. در جهان‌های موازی، از دیدگاه قوریاغ‌های (مشاهده محدود)، تنها واقعیت خواننده وجود دارد، در حالی که از دیدگاه پرنده‌ای (مشاهده کل‌نگر)، واقعیت‌های چندگانه ظهور می‌کنند. این دو دیدگاه در مطالعه هستی‌شناسی «خانه برگ‌ها» قابل چشم‌پوشی نیستند. با کمک این نظریه‌ها، ثابت می‌شود که رابطه نزدیکی بین ادبیات پسامدرن و فیزیک وجود دارد. در قرن بیستم، دستاوردهای علمی بر ادبیات تأثیر گذاشته‌اند و «خانه برگ‌ها» نیز مانند سایر آثار پسامدرن، متأثر از فیزیک کوانتومی است.

واژه‌های کلیدی: فراداستان، جهان‌های موازی، واقعیت، جمع‌پذیری، اصل عدم قطعیت.

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