Helping Cancer Patients Reduce Psychological Distress with Embodied Conceptual Metaphors in a Serious VR Game

Matthew Dale Lemmond

North Carolina State University

Acknowledgments

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Committee

Matthew Dale Lemmond

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North Carolina State University

Department of Graphic Design and
Industrial Design, College of Design

Submitted in partial fulfillment for the
degree of Master of Graphic Design

Matthew Peterson, Ph.D.
Assistant Professor of Graphic Design
Committee Chair

Derek Ham, Ph.D.
Assistant Professor of Graphic Design
Committee Member

Kermit Bailey
Associate Professor of Graphic Design
Committee Member

Contents

Abstract

38.4% of people in the U.S. will receive a cancer diagnosis in their lifetime. Those facing cancer are likely to experience cancer-related psychological distress. A warped sense of self and one's circumstances is common as well as depression, anxiety, fear, and feeling discouraged. Depressed survivors are twice as likely to die prematurely. Suicide is twice as likely for cancer survivors. Additionally, cancer patients with high levels of distress have a 32% greater chance of dying. Mental activity affects behavior, and behavior can negatively influence physiological and molecular processes like cellular apoptosis, the cell's rate of mutation, immunity, and growth speed.

Cancer is, at least in part, beyond the understanding of even our greatest minds and buried in the essential elements of our biology and as a result, must be undertaken with a broad range of experts beyond traditional medicine. Consequently, it should not be surprising that patients struggle to understand their future with this disease. Cancer is an unknown entity. Fearing the unknown future is a source of distress for cancer patients.

Metaphors help patients make sense of their past, present, and future experiences with cancer. The embodiment of a metaphor refers to the idea that cognition and communication form by physical experience and bodily interaction with a tangible world, as well as giving shape to thoughts and feelings.

VR can visualize metaphors or provide alternative ones that help distance patients from cancer and regaining control over it. Games are inherently metaphorical because the user plays as a character and gains said characters abilities. In addition to the metaphorical benefits of VR, the medium also helps reduce psychological distress.

This investigation mapped cancer patients distress, comfort, and metaphors, and connected it with VR game concepts and interactions. Additionally, this investigation explores the metaphorical presentation of cancer in a VR space.

Problem Statement and Justification

According to the National Cancer Institute (NCI), 38.4% of people will receive a cancer diagnosis in their lifetime (Cancer Statistics, 2018). As of 2017, cancer treatments have the lowest clinical trial success rate of all major disease (Cagan & Meyer, 2017). Cancer is, at least in part, beyond the understanding of even our greatest minds and buried in the essential elements of our biology and as a result, must be undertaken with a broad range of experts beyond traditional medicine.

Cancer-related Psychological Distress. As part of this broader approach, cancer treatment in the last twenty years has expanded to consider and improve the patient's psychological state. Those facing a life-threatening illness are likely to experience what is known as psychological distress: negative emotions that impede everyday activities (Ridner, 2003). A warped sense of the self and one's circumstances is common with psychological distress, and patients commonly experience depression and anxiety as a consequence of their illness (Gundelach & Henry, 2016). Cancer-related psychological distress distinguishes itself as a patients negative emotional response to a cancer diagnosis and includes four attributes: depression, anxiety, fear, and feeling discouraged.

According to Psychology Today, 45% of survivors experience anxiety and 25% experience depression ("Neglecting Mental Health in Cancer Treatment," 2017). As Brower (2014) points out, depressed survivors are twice as likely to die prematurely (p. 1). Abrams (2017) notes that many patients experience Post-Traumatic Stress Disorder (PTSD) and that suicide is twice as likely for cancer survivors as compared to the general population. According to Batty et al., (2017) there is a 32% greater risk of total cancer mortality with patients with higher levels of distress (p. 4). Cancer mortality refers to the number of deaths caused by cancer. Depressed cancer survivors are twice as likely to die prematurely (Brower, 2014).

Psychology is intrinsically behavioral, and behavior can negatively influence physiological (bodily) and molecular processes like cellular apoptosis (cell's self-destruction procedure), the rate of cellular mutation through the discharge of stress hormones, and immunity (your bodies defense system) and therefore the speed at which cancer grows (Cordella and Poiani, 2014).

The Debate. In contrast, according to the NCI, "there is no evidence that successful management of psychological stress improves cancer survival," however, NCI goes on to acknowledge that evidence from experimental research suggests a tumor's ability to grow and spread can be encouraged by psychological stress ("Psychological Stress and Cancer," 2012). Despite the NCI's stance, there is growing evidence that links psychological distress and cancer survival (Cordella and Poiani, 2014).

Cancer as Metaphorical Target. Cancer is elusive, and in part, mysterious to even our greatest minds. Consequently, it should not be surprising that patients struggle to understand their future with this disease. Cancer is an unknown entity. Fearing the unknown future is a source of distress for cancer patients. Of course, there are other sources of dis-

tress like the cost of treatment, unwelcome changes to the body, and having to make immediate decisions that have lasting consequences to name a few, but many, if not all, of these sources of distress point back to the fear of cancer and its unknown consequences for the future.

As previously mentioned, cancer-related psychological distress can distort the image patients have of themselves as well as their cancer, treatment, and circumstances. Metaphors help patients make sense of their past, present, and future experiences with cancer.

In rhetoric, metaphor is an artistic flourish in communication, but in conceptual metaphor theory, metaphor is pervasive and foundational in everyday language and thought (Lakoff & Johnson, 2003). Conceptual metaphor theory posits that our brain maps the source and target domains of an entity or action to understand the world better. For example, cancer (target), is a fight (source).

Metaphorical Value. Part of this investigation was to organize the values of cancer patients using metaphor to describe and think about their experience with cancer. This investigation and supporting research posits that to the cancer patient, metaphor is shielding, playful, communal, a bodily experience, educational, allows for control, and provides perspective. See "Cancer Metaphor: Value" below for more information about these categories.

Embodied Metaphors and 'Playing As' in VR. This investigation asserts that serious games in virtual reality (VR) can improve a cancer patients embodied conceptual metaphor. Embodiment refers to the idea that cognition and communication are formed by physical experience and bodily interaction with a tangible world, as well as giving form to ideas and feelings (Davis, 2012). As Kirmayer (1993) puts it, "Metaphor occupies an intermediate realm, linking narrative and bodily-given experience through imaginative constructions and enactments that allow movement in sensory-affective quality space."

According to Fahlenbrach (2016), "In the most general sense, video games—and also other forms of play, for that matter—can be regarded as metaphoric in that they involve a mode of 'playing as'" (p. 252). The user is 'playing as' a character within the game and gains said characters abilities. In VR, the embodied conceptual metaphor 'playing as' is strengthened by what Jerald (2016) calls "self-embodiment," which is "the perception that the user has a body within the virtual space" (p. 47). Consequently, the user will feel disembodied when they look down to see nothing or the movements of the virtual body do not match their own. Additionally, the embodied conceptual metaphor finds its strength when the character and the narrative they fit into is detailed and well defined. Consequently, the user will feel disembodied when the character they play has little details about their emotional blueprint, physical abilities, support system, or motivations.

VR is a medium that can visualize metaphors or provide alternative ones that help distance patients from cancer and regaining control over it. The design of a VR space can visualize abstract ideas. Our imagination is as a stage where we can visualize and rehearse for alternative roles and scenarios. According to Sadoski & Paivio (2013), "a key feature of human imagination is the ability to rearrange our world or to create new worlds (p. 65)." However, our imagination is limited to our past experiences. For example, you would be more likely to visually imagine the layout of your home than you would the White House because the former is more familiar than the latter. However, in VR you can put yourself in the White House, thus strengthening the embodied experience. For a cancer patient, their unknown future with cancer is a source of anxiety. Additionally, cancer can be mysterious,

IMAGE 1. KIMO BY ONCOMFORT

unpredictable, and unfamiliar to the patient. What if a VR experience helped cancer patients see themselves in alternative roles and scenarios?

VR as Distress Intervention. In addition to the metaphorical benefits of VR, the medium also helps with psychological distress. A mini-review by Chirico et al. (2016) examined 19 articles and concluded that "VR improved patients' emotional well-being, and diminished cancer-related psychological symptoms" (p. 1). 14 of the 19 articles in this mini-review studied VR and anxiety, and four studied VR and depression. According to Dr. Susan Schneider, an associate professor at Duke University School of Nursing and an oncology nurse with 30 years of experience, "by decreasing chemotherapy-related symptoms [like anxiety], virtual reality has the potential to increase compliance with treatments, affect survival, and enhance quality of life" (Schneider et al., 2004, p. 1). In an interview with the author, Dr. Schneider describes VR headsets as "horse blinders" because they block out all the visual stressors.

Kimo, by Oncomfort, is likely the only metaphorical VR game designed for reducing distress in cancer patients. Oncomfort won the 2016 Astellas Oncology C3 Grand Prize for $50,000 ("Oncomfort wins award for helping cancer patients manage anxiety through VR," 2017). See image above.

Literature Gaps. Interestingly, Chirico et al.'s mini-review makes no mention of what the cancer patients can see, hear, and touch in VR. It is not until reading the individual articles that one gets anything about the multimodal content of the VR experience.

Missing from this research is a critical evaluation of the qualities of visual, auditory, and interactive stimuli most likely to reduce negative cancer-related psychological distress. This oversight provides an opportunity to introduce multimodal metaphor into VR as a way for patients to distance themselves from cancer and regain control over their lives. VR provides a diversion from their predicament and offers a new role to play. Using VR in this way provides the chance to change cancer from a negative source of anxiety and depression to a positive opportunity for personal growth.

This investigation proposes that VR games used with patients should be designed not for pure entertainment but the reduction of cancer-related psychological distress by way of embodied conceptual metaphors. Using VR in this way makes it a serious game.

Lastly, little academic research has been published examining the use of metaphor in video games, let alone in VR or serious games (Fahlenbrach, 2016).

Assumptions

Despite the debate, there is growing evidence that links psychological distress and cancer survival (Cordella and Poiani, 2014). This investigation will assume that decreasing psychological distress will improve a cancer patient's compliance with treatment, quality of life, and possibly even survival (Schneider et al., 2004). As Dr. Schneider put it in an interview with the author, survival is cumulative; the more the patient does to cope, the more likely they are to survive.

Furthermore, this investigation will assume that metaphor is a fundamental part of how the brain works and how humans think (Lakoff & Johnson, 2003). While graphic style is important, the examination of which style is best for reducing psychological distress was set aside for this investigation. VR is continuously changing, and as a result, this investigation did not examine the cost, ease, or accessibility of VR.

Additionally, based on the available research, this investigation will assume that VR is something cancer patients are willing to use, and age plays no role in the desirability of VR. See the "Cancer and VR" in the Literature Review for more demographic information. This investigation recognizes that many forms of coping exist for cancer patients. The use of metaphor in VR is meant to be collaborative with other forms like counseling and socialization. Lastly, this investigation acknowledges that VR is not going to cure cancer, but what it can do is reduce the psychological burden of cancer.

Limitations

Limitations identify what this investigation will not do. As a way of limiting the scope, this investigation will not include the use of VR with other, non-cancer life-threatening illnesses. Additionally, as a way of focusing this investigation, this study will not explore AR. Despite the criticism of Susan Sontag in her work Illness as Metaphor (1979), this investigation sees a tremendous value and necessity in exploring metaphorical expression of illness.

Females and females with breast cancer. Women and women with breast cancer play a significant role in the articles examining metaphor-related articles referenced in this investigation (e.g., Harrow et al., 2018; Lanceley & Clark, 2013; Gibbs & Franks, 2002). This emphasis is not surprising when you consider that breast cancer comprises 30% of all new cases in women ("ACS Cancer Facts & Figures," 2018). That is the number one, largest pool of people of any type of cancer in either gender. However, this emphasis is likely misleading when you consider cancer-related psychological distress. According to Chun (2018), breast cancer is number one in another category, curability. Additionally, men are more likely to be diagnosed with and die from cancer in almost every category ("ACS Cancer Facts & Figures," 2018). This gap in research is a clear call for more research that includes participants beyond females with breast cancer.

Cybersickness. Although VR has some reported side effects like nausea caused by motion sickness, this investigation will not consider them because the majority of studies that utilize VR with cancer patients made no mention of side effects or noted that the side effects were insignificant (Chirico et al., 2016, p. 286). Cybersickness caused by VR could significantly impact a cancer patient's psychological distress, which calls for research beyond the scope of this investigation. Lastly, many chemotherapy patients take anti-nausea medications like Zofran®, Ativan®, and Phenergan® which may curb their cybersickness.

IMAGE 2. IMAGES FROM "SEEING IS BELIEVING, AND BELIEVING IS SEEING": AN EXPLORATION OF THE MEANING AND IMPACT OF WOMEN'S MENTAL IMAGES OF THEIR BREAST CANCER AND THEIR POTENTIAL ORIGINS (HARROW ET AL., 2008)

Cancer and Psychology

Psychological Treatment of Patients With Cancer is a comprehensive guide for psychology practitioners who work with cancer patients. This field of study is also known as psycho-oncological practice. This investigation specifically focused on chapter five, Assessment and Treatment of Anxiety (Dornelas, 2018). Behavioral Oncology, Psychological, Communicative, and Social Dimensions is an 816 page, comprehensive guide showing the link between behavior and cancer (Cordella & Poiani, 2014).

Cancer and Metaphor

"Seeing is believing, and believing is seeing": An exploration of the meaning and impact of women's mental images of their breast cancer and their potential origins is a fascinating investigation that explores the mental images patients have about their cancer via artistic materials (Harrow et al., 2008). See images above.

Embodied Metaphor In Women's Narratives About Their Experiences With Cancer provides a detailed list of metaphors used by cancer patients. It describes different, sometimes contradictory metaphors that allow patients to more comprehensively understand their cancer (Gibbs & Franks, 2002). Gibbs & Franks (2002) offers twenty-three distinct metaphors for cancer (p. 13-14).

Metaphors of cancer in scientific popularization articles in the British press examines and categorizes metaphors used by scientific articles in the British media (Camus, 2009). Camus (2009) offers 16 distinct metaphors for cancer (p. 470). The Use of Metaphor in Discourse About Cancer: A Review of the Literature offers positive and negative effects of common cancer-related metaphors like journey and the more popular, military (Harrington, 2012).

Cancer in other words? The Role of Metaphor in Emotion Disclosure in Cancer Patients analyses the distress of cancer patients and how it is metaphorically expressed (Lanceley & Clark, 2013).

One may ask, what are the values of cancer patients using metaphors to describe and think about their experience with cancer?

Cancer Metaphor Test (Domino, 1991)			
Future Optimism	Terminal Pessimism	Foreign Intruder	Natural Disaster
Riding a tiger	Punishment for past sins	A mouth full of sand	Dark clouds
Adrift in a fog	Dead flowers	Oozing slime	The sting of a scorpion
Mushrooms in a field	An arrow that missed its target	Mold on piece of bread	Wine turning to vinegar
A train in a tunnel	Suffocating heat	Tarnished silver	A broken violin
Caught in a storm	The end of a journey	A piercing sword	A thunderclap in fine weather
Flowing lava	Stagnant water	A galloping horseman	A broken promise
Shifting desert sands	A withering rose		
Alone in the forest	Checkmate		
Bubbles in the air	An old man		
White flowers	More bitter than sweet		
10	10	6	6
More >>>	>>>	>>>	>>> Less
Anxiety and Depression			

FIGURE 1. FROM LEFT TO RIGHT, THIS FIGURE SHOWS THE CMT METAPHORS THAT PRODUCE THE MOST (LEFT) TO LEAST (RIGHT) ANXIETY AND DEPRESSION

Metaphor is perspective. Laurence Kirmayer said (1993), healing may occur because "the metaphorization of distress gives the person room to maneuver, imaginative possibilities, behavioral options, and rhetorical supplies" (p. 165). It is a commonly held metaphorical conception that cancer is war. Interestingly, cancer can also awaken positive emotions like hope and gratitude ("Feelings and Cancer," 2018). Metaphorically speaking, for some patients, cancer is a teacher, a wake-up call, a source of growth, a new role in a play, and an agent that clears vision and allows for new understanding (Gibbs & Franks, 2002). For some of these patients, their positive perspective comes from surviving cancer. For others, facing a life-threatening illness like cancer helps them prioritize what is essential in life to them.

Metaphor is shielding. Metaphor can help distance the patient from their distress so they can address their negative feelings from a more comfortable position without being overwhelmed (Lanceley & Clark, 2013).

Metaphor is play. Patients can find "distraction and relief in playing with and parodying metaphor" (Lanceley & Clark, 2013).

Metaphor is control. It is common for cancer patients to mourn the loss of their good health and life they had before being diagnosed. Metaphors can help cancer patients symbolically regain control over their experience with cancer (Cornelissen, Holt & Zundel 2011). As Kirmayer (1992) said, "bodily suffering disturbs the landscape of thought, rendering our previous construction incoherent and incomplete" (p. 329). Metaphor can help us construct new meaning.

Metaphor is communal. Metaphors allow patients to communicate their experience with cancer and relate to the experiences of others as well as healthcare professionals.

Metaphor is a bodily experience. Metaphors not only reflect past experiences and personal background but also filter how they understand their current and future experiences (Gibbs & Franks, 2002). Cancer patients often use the physical components of their body to speak metaphorically.

Metaphor is educational. Metaphors are intrinsically educational because they help cancer patients, and anyone for that matter, make sense of a given action or entity.

The Verbs (action, condition, experience, state, or occurance)			
Active; Action; Doing; Process;		State; Condition; Results;	
Riding	Missing	Full	Dark clouds
Adrift	Suffocating	Mold on piece of bread	Sting
Flowing	Withering	Tarnished	Broken 1
Shifting	Checkmate		A thunderclap in fine weather?
Bubbles in the air			Broken 2
50%	40%	50%	83%
State; Condition; Results;		Active; Action; Doing; Process;	
In a field	Punishment	Oozing	Turning
In a tunnel?	Dead	Piercing	
Alone	End	Galloping	
White	Stagnant		
Caught	Old		
	More bitter		
50%	60%	50%	17%

FIGURE 2. BUILDING OFF FIGURE 1, THIS FIGURE COMPARES CONTAINED VERSUS COUNTERPARTS METAPHORS IN THE CMT.

The Cancer Metaphor Test (CMT) measures how appropriate a metaphor is at eliciting an image of cancer (Domino, 1991). Each metaphor corresponds with one of four major categories: terminal pessimism, future optimism, natural disaster, and foreign intruder. Using the State-Trait Anxiety Inventory (STAI) and the Center for Epidemiologic Studies-Depression Scale (CES-D), Domino et al. (1991), found a striking correlation with higher levels of anxiety and depression, and terminal pessimism and future optimism in Mexican adults. See figure #1. Domino et al. go on to suggest that a global view of anxiety is acceptable, but depression tends to be more culturally specific. Building off the CMT, interviews, and other literature, Tanner's Cancer Metaphor Test (TCMT) includes forty metaphors that describe cancer (Tanner, 1997).

Concerning the CMT, while it is difficult to find universal consistency between all the metaphors to explain the increased anxiety, this investigation has identified some general themes. All four categories use metaphors that are a "state, condition, or result." The metaphors that produced higher levels of anxiety and depression use metaphors that are "active, actions, doing, or a process."

Additionally, this investigation posits metaphors that produce more anxiety and depression tended to be more contained than their counterparts. For example, describing cancer as "shifting desert sands" is much less contained than describing it as a "mouth full of sand." See figure 2.

Cancer and VR

As previously mentioned, Virtual Reality in Health System Beyond Entertainment. A Mini-Review on the Efficacy of VR During Cancer Treatment is a literature review by Chirico et al. (2016) concluded that "VR improved patients' emotional well-being, and diminished cancer-related psychological symptoms" (p. 1). See figure 3 for a detailed breakdown of the variables discussed in this mini-review.

Authors. The work of Dr. Susan Schneider was featured the most with six articles from 1999 to 2011. Participants. In total, the 19 articles examined anywhere from 1 to 137 patients per study. These studies worked with 839 participants, which is an average of 44.2 patients per study. Cancer. The type of cancer the participants had varied widely.

Age. The age ranged from 2 to 85, with an average of 31.2 per study. Concerning age, the 19 articles split almost 50/50 with 51% focusing on patients 31.2 and younger, and 49% concentrate on patients 31.2 and older. Interestingly, this 50/50 age split is not reflective of national cancer averages. Cancer patients who are younger than 34 represent 4% of the cancer population whereas those 34 and older represent 96% ("Cancer facts & figures," 2018). This gap calls for a greater emphasis on older cancer patients.

Games. Some of the VR games used overlapped into multiple studies. For example, Virtual Gorilla and Sherlock Holmes Mystery were used over three studies (Allison, 1997; Schneider et al., 2004). In total, 21 games were used with patients 31.2 and younger, three with mixed age groups, and nine with patients 31.2 and over. Three of the studies neglected to mention the name of the game used. The majority of VR games were immersive.

Psychological Variables. The majority of studies examined multiple psychological variables like anxiety, pain, distress, fatigue, depression, time perception, distraction, mood (or emotional) state, subjective feelings, sedation level, fear, and happiness. Of the 19 articles, the majority (13) focused on reducing anxiety. All 19 articles used a variety of psychological tests like the HADS (Hospital Anxiety and Depression Scale), PFS (Piper Fatigue Scale), and SDS (Symptom Distress Scale) to name a few (Kugaya, 1998; Mc Corkle, 1978; Piper et al., 1998).

Intervention Length. The length of time the patients used VR ranged from five minutes to two hours. On average, the intervention lasted 63 minutes. Intervention Setting. Of the 19 articles, eight studied VR in a chemotherapy setting, seven during a painful procedure, and four during hospitalization.

Author (Year)	Participants	Age				VR Game																						Psychological Variables												Length of Intervention		Setting
Most	Total	Average Age		Age Focus		PlayMotion: Flying	PlayMotion: Drawing	PlayMotion: Sports	PlayMotion: Billiards	Magic Carpet	Seventh Guest	Virtual Gorilla	Barney	Video: Skiing Swiss Alps	Video: Strolling Down Paris Sidewalks	Video: Quiet Mountain Streams	The Hunt of the Diamonds	Sherlock Holmes Mystery	Virtual Forest Walk	Emotional Parks	Walk Through Nature	Titanic: Adventure Out of Time	A World of Art	Oceans Below	Anxiety	Pain	Distress	Fatigue	Depression	Time Perception	Distraction	Mood (Or Emotional State)	Emotional Status	Subjective Feelings	Sedation Level	Fear	Happiness	Average Length		Most
Schneider	839	31.2		Under 31.2	Over 31.2	Under 31.2												Mix				Over 31.2			13	7	6	6	4	2	2	2	1	1	1	1	1	63		Chemo
	Average			51%	49%	21												3				9																Min	Max	
	44.2					This game was used in ___ studies																																5	120	
Schneider et al. (1999)	12	10	17	100%	0%					1	1							1							1		1										40	120	Chemo
Kaneda et al. (1999)	10	16	70	28%	72%																				1												120	120	Chemo
Oyama et al. (2000)	30	29	73	5%	95%														1						1			1	1				1	1			20	20	Chemo
Schneider et al. (2000)	11	10	17	100%	0%					1	1							1												1							40	120	Chemo
Schneider et al. (2003)	16	50	77	0%	100%																	1	1	1	1		1	1			1						78	78	Chemo
Schneider et al. (2004)	20	27	55	15%	85%													1					1	1	1		1	1									45	90	Chemo
Schneider et al. (2007)	123	32	78	0%	100%																				1		1	1			1						45	90	Chemo
Schneider et al. (2011)	137	27	78	8%	92%																				1			1		1							62	62	Chemo
Wint et al. (2002)	30	10	19	100%	0%									1	1	1										1							1				64	64	Pain
Gershon et al. (2003)	1	8	8	100%	0%							1													1	1											5	10	Pain
Gershon et al. (2004)	59	7	19	100%	0%							1													1	1											5	10	Pain
Wolitzky et al. (2005)	23	7	14	100%	0%							1													1	1													Pain
Windich-Biermeier et al. (2007)	50	5	18	100%	0%									1	1	1										1	1							1		45	64	Pain
Klosky et al. (2004)	79	2	7	100%	0%								1													1	1									7	7	Pain
Nilsson et al. (2009)	42	5	18	100%	0%												1									1												Pain
Oyama et al. (1999)	22	33	75	0%	100%														1			1			1			1	1								6	7	Hospitalized
Espinoza et al. (2012)	33	41	85	0%	100%															1	1				1				1		1					1	30	30	Hospitalized
LI et al. (2011)	122	8	16	100%	0%	1	1	1	1																1				1								30	30	Hospitalized
Banos et al. (2013)	19	29	85	4%	96%															1	1									1							30	30	Hospitalized

FIGURE 3. THIS IS A DETAILED BREAKDOWN OF THE VARIABLES DISCUSSED IN THIS MINI-REVIEW.

IMAGE 3. DR. SUSAN SCHNIEDER

In this section the author will discuss methods that informed and shaped this investigation.

Interview: Susan Schnieder

An intricate part of this investigation was interviewing Dr. Susan Schnieder. She is the leading authority on the subject of reducing cancer-related psychological distress with VR. The author interviewed Dr. Schnieder on Friday, September 29th, 2017 on campus at Duke University.

Dr. Schnieder is an associate professor at Duke University School of Nursing and an oncology nurse with 30 years of experience. Of her 53 publication, eight specifically focus on the use of VR as a means of lowering anxiety, distraction intervention, and reducing stress in cancer patients that are receiving chemotherapy treatment. Starting in 1999, she published the seminal article on using VR during chemotherapy treatments titled, "Effects of Virtual Reality on Symptom Distress in Children Receiving Chemotherapy." She was truly ahead of her time. When others were working through hypotheticals, she had data.

Interview Findings

VR screen. She did not use 180 or 360 degrees VR headsets that utilized head tracking. Instead, she used headsets that displayed a flat screen like a movie or television.

Games. VR games included things like deep sea diving and mountain climbing. Although many of her male patients requested it, shooting or hunting games were never allowed by the IRB. Both Dr. Schneider and the IRB (Institutional Review Board) thought, these people are already dealing with real-life blood and guts; they do not need to see that in VR.

Persona. With over 200 types of cancer affecting every part of the body, it is difficult to find commonalities, but some themes emerge. Cancer patients are facing a life-threatening illness. They are making important decisions quickly that have life-long consequences which are a source of distress. Patients are beginning to living past the five-year mark. They seek the experience of other cancer patients. They are anxious. Aside from treatment, some of their tops needs are to relax, to change thoughts, to be distracted, to suspend reality, and to check out. These people are both physical and mental exhausted. While the length of treatment varies widely, generally speaking, IV chemotherapy treatment is typically four to six cycles, every two to three weeks. Fighting is a bad

metaphor because some people will lose. A third of cancer treatments are oral (pills) and targeted. I.e., cancer treatment is moving into the home and away from hospitals. According to Schneider, next to tobacco, being overweight is the second risk factor in getting cancer.

Distraction. Dr. Schneider was initially attracted to VR because she noticed patients that had something to do "did better." She asserted that cancer patients do not read a lot. It's too much for them to concentrate on the page. You may see magazines or short stories, but you don't see them working through a great novel. She suggested that it is easier to focus on leaves and trees than it is to focus on A's and B's. VR allows for a patient to block out the world, unlike a television. It creates a "horse blinder" effect. Before VR, cancer patients would do things like knitting or crossword puzzles.

History. In the 1990s and early 2000s, over 30 hospitals installed and utilized VR equipment during chemotherapy treatments. But because of significant hurdles, they eventually stopped applying the technology. At the beginning of her research, VR equipment cost thousands of dollars. Rather than a technology specialist, nurse's bore the burden of checking the equipment in and out; a person that is already overburdened and does not need more tasks. While not managing the day-to-day, a technology specialist was brought in every week to do maintenance.

This investigation posits that hospital administration is to blame for this problem, not the nurses, nor the technology. If a hospital is going to invest in expensive technology, leadership must invest in a specialist to maintain said tech. Thankfully VR technology has advanced to the point where a specialist is no longer needed. Now all a patient needs is a smartphone and something inexpensive like Google Cardboard.

Another hurdle of note was that the VR headsets blocked a nurse's ability to quickly assess a patient's level of pain or sickness via the eyes. While not discussed in this research, the nurse's ability to remotely monitor a patient's pain and sickness is worthy of investigation.

Survival Phases. According to the National Cancer Survivors group, from the moment you are diagnosed you are a survivor. Schneider asserts that this definition is not a helpful definition for researchers. She recommended that researchers, patients, and doctors should think about survival in terms of phases, not outcomes. All relevant parties should talk about cancer in two phases of survivorship. She calls the first phase the "acute phase" and it encompasses everything treatment-related and phase two, the "long-term phase" involves everything after treatment.

Survival and Quality of Life. According to Dr. Schneider (2004), "by decreasing chemotherapy-related symptoms [like anxiety], virtual reality has the potential to increase compliance with treatments, affect survival, and enhance quality of life" (p. 1). As previously discussed in the investigation, Schneider connects decreased psychological distress with survival. Quality of Life (QoL) is an individual's assessment of physical, mental, emotional, and spiritual well-being. Schneider sees three factors that shift the patients QoL. One, the patient must learn how to cope. Two, the patients should keep active surveillance for cancer recurrence. And finally, the patient should find support for long-term symptoms. These factors lead to better QoL and long-term survivorship. But it is important to note that there is no singular cure. Instead, survival is cumulative. The more the patient does correctly, the more likely they are to survive.

Interview Conclusion

Dr. Schnieder's experience and wisdom impacted this investigation greatly. Specifically, her firsthand knowledge of the patient, their perceived QoL, and needs were paramount to this investigation.

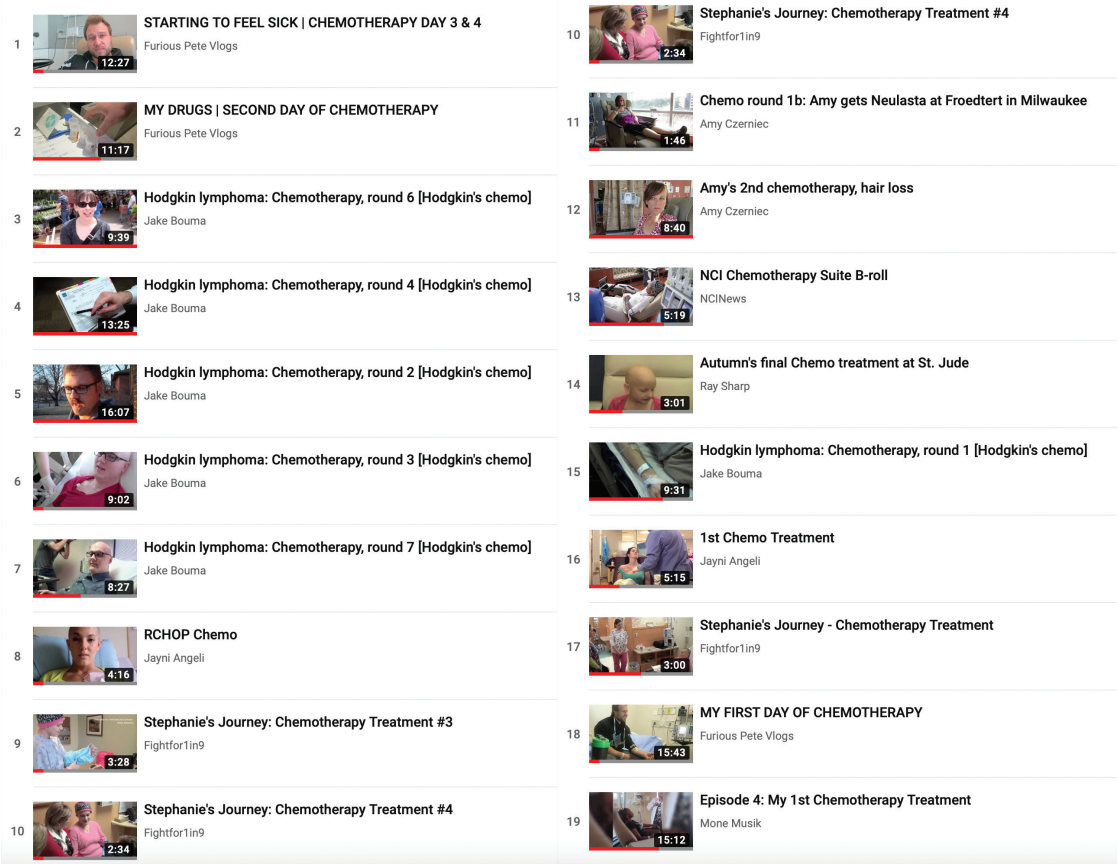


IMAGE 4. FINAL 19 VIDEOS COLLECTED IN OBSERVATION

Observation of Treatment

Having spent an estimated 208 hours over three months in a treatment facility, the author of this investigation has intimate knowledge of the sights, sounds, smells, feelings, emotions, and thoughts that comprise the patient's experience during chemotherapy. While that is a helpful building block, a broader inquiry is needed because a patients experience can vary.

At North Carolina State University, a student pursuing a Masters of Graphic Design should speculate, not conclude. Consequently, gaining access to a treatment facility for research purposes requires a lengthy IRB approval process that fell outside of the scope of this investigation. Fortunately, YouTube is ripe with narcissists ready to share their most vulnerable moments with the world.

The author began to search for and collect chemotherapy infusion videos with a combination of terms like chemotherapy, chemo, infusion, cancer, and treatment. In the process of observing 58 videos that ranged anywhere from three to 16 minutes, the author simultaneously developed a Data Collection Sheet designed to log observations quickly. See figure 4. For a video to qualify, it had to show the patients receiving chemotherapy. Researching in this way allowed the author somewhat of a Fly-On-The-Wall perspective and the ability to catch everything with pause and replay. Ultimately, 19 videos (totaling 135 minutes) logging the experience of seven patients were deemed appropriate for observation. The majority of videos had unrelated preambles and epilogues where patients discussed how they felt before and after treatment.

Of chief interest, the author asked three questions in the Data Collection Sheet. One, what is the architectural and interior design of the treatment facility? Two, how do cancer patients distract themselves? And three, what metaphorical language do cancer patients use to describe their situation?

What is the architectural and interior design of the treatment facility?

The architectural and interior layout of a room can significantly impact a patient's psychological distress. Where would a person more comfortable doze off, a private hotel room or a hostel shared with others? Which is more relaxing, having your own bathroom or sharing one with 40 other people? Which is more cathartic, looking out a window or being surrounded by walls, buried somewhere in the middle of a large building?

57% of the rooms observed were private meaning that patient could not see anyone other than guests they invited into the room with them. 14% of the rooms were semi-private meaning they had their own stall, that mostly separated them from other patients. And 29% of the rooms observed were open meaning there was no privacy from other patients. Concerning amenities, 72% of the rooms had a window view, and only patient (14%) had their own bathroom. All the patients had blankets and pillows as well as room for guests seating around them. The majority (71%) of patients sat in a recliner while some (29%) received chemo while reclining in an adjustable bed. 43% of patients could hear other patients, and based on the given angles, only one patient could see other people. 29% of the rooms observed seemed crowded.

Question	Variable	Detail of Variable	%	Total	Mone	Pete	Jayni	Stephanie	Jake	Autumn	Amy
What is the architectural and interior design of the treatment facility?	Room	Private Room	57%	4		1		1	1		1
		Semi-Private Stall	14%	1	1						
		Open Room	29%	2			1			1	
		Private Bathroom	14%	1					1		
		Window View	71%	5	1	1		1	1		1
	Seating	Pillows / Blankets	100%	7	1	1	1	1	1	1	1
		Reclining Chair	71%	5	1		1	1		1	1
		Adjustable Bed	29%	2		1			1		
		Guest Seating	100%	7	1	1	1	1	1	1	1
	Privacy	Hear Other Patients	43%	3	1		1			1	
		See Other Patients	14%	1			1				
		Seemed Crowded	29%	2			1			1	
How do cancer patients distract themselves?	Distraction	Food / Drinks	100%	7	1	1	1	1	1	1	1
		In Person Conversation (Guest)	100%	7	1	1	1	1	1	1	1
		Phone External Conversation (Viewers)	100%	7	1	1	1	1	1	1	1
		Video (TV, Computer, Tablet)	57%	4	1	1	1		1		
		Sleep	43%	3	1		1		1		
		Anxiety Meds	29%	2	1				1		
		Chewing Gum	29%	2					1	1	
		Game (Analog / Digital)	29%	2			1		1		
		Ice Bag	29%	2	1		1				
		Computer For Work	14%	1		1					
		Foot Massage	14%	1			1				
		Headphones	14%	1							1
		Holding Hands	14%	1	1						
		Phone	14%	1							1
		Toy	14%	1						1	
		Books	0%	0							
		Magazine	0%	0							
		Music	0%	0							
		VR	0%	0							
What metaphorical language do cancer patients use to describe their situation?	Metaphors	Journey	43%	3	1			1	1		
		Fight / Battle / War	0%	0							

FIGURE 4. DATA COLLECTION SHEET WITH OBSERVATION

How do cancer patients distract themselves?

100% of the patients observed were eating, drinking, and having in-person conversation with a guest while receiving chemotherapy. Additionally, 100% of the patients had external conversations with viewers via YouTube and a smartphone. 57% distracted themselves with video on a myriad of devices like TV, computer, or tablet. 43% of users slept at some point in the observation. 29% took medications for anxiety, chewed gum, played a game (analog or digital), and used an ice bag to reduce pain. 14% of patients observed used a computer for work, got a foot massage, used headphones, held hands with a guest, looked at their phone, or played with a toy. Interestingly, no patients read a book, read a magazine, listened to music, or played a VR game.

What metaphorical language do cancer patients use to describe their situation?

Of the patients observed, none used fighting, war, or battle metaphors to describe their experience with cancer. This is interesting because this is widely considered the most popular metaphor to describe an experience with cancer. Interestingly, 43% used journey as a metaphor to describe their experience with cancer.

Observation Conclusion

The author was surprised to find that the majority of rooms observed were private. Private rooms lend themselves to more elaborate VR equipment like sensors and desktop computer. However, VR is constantly becoming more accessible and requires less equipment so this may be less of an issue in the near future. Private rooms may provide a safer space for patients to try VR without the embarrassment of other patients observing them in action. However, open rooms may provide more social opportunities within the game. Factors like socialization and VR limitations will have a direct impact on the design of a VR game.

The author was not surprised to see that patients were not using VR or reading to distract themselves. VR as an intervention is still widely unknown. Additionally, patients not reading is supported by Dr. Susan Schnieder's assertion that reading is too taxing for a cancer patient. Factors like sleep, socialization, and video distraction will have a direct impact on the design of a VR game.

The author was surprised to find the cancer as war played a less significant role in the patients conversation. Cancer as war, battle, or fighting is widely considered the most popular metaphor to describe an experience with cancer. Cancer as a journey has a direct impact on the design of a VR game and calls into questions games like Kimo by Oncomfort.

Other Research Methods

In addition to the interview and observation discussed above, the author also engaged in many other forms of design research like research through design, conceptual mapping, bodystorming and evaluative research with the VR game "Land's End," and metaphorical mapping (see image 5). This investigation was able to identify 19 VR games used in the articles discussed in mini-review (Chirico et al., 2016). Many of the studies overlapped in the games they used with cancer patients and some articles neglected to mention which games they used. See figure 5.

VR Experience	Theme													VR Specific Theme			Article	Participants	Results						
	Rewards	Fantasy	Nature	Walking	New Identity	Fighting Evil	Puzzle	History	Chance	2nd Chance	Hero	Fighting	Flying	Distancing via Otherly Perspective	Regaining Control by Defying Physics	Total Interactive Immersion with Nature		569	Anxiety	Symptom Distress	Fatigue	Distraction	Positive Emotions	Negative Emotions
	8	8	8	7	6	4	3	3	3	3	3	2	2	3	4	5								
Virtual Forest Walk			1	1												1	Oyama, 1999	22			Down		Up	Down
																	Oyama, 2000	30						
Magic Carpet	1	1			1	1			1		1	1	1	1	1	1	Schneider, 1999	12	Down	Down		Perceived Benefits		
																	Schneider, 2000	11				Yes		
Seventh Guest	1	1			1	1	1			1		1			1		Schneider, 1999	Above	Down	Down		Perceived Benefits		
																	Schneider, 2000	Above						
Sherlock Holmes Mystery	1				1	1	1				1						Schneider, 1999	Above	Down	Down		Perceived Benefits		
																	Schneider, 2000	Above				Yes		
																	Schneider, 2004	20	Down	Down	Down			
Virtual Gorilla		1	1	1	1					1				1		1	Gershon, 2003	1	Down	Perceived Benefits		Perceived Benefits		
																	Gershon, 2004	59						
																	Wolitzky, 2005	23		Down				
Titanic: Adventure Out of Time	1	1	1		1	1	1	1		1	1				1		Schneider, 2003	16	Down	No Change	No Change			
A World of Art				1				1									Schneider, 2003	Above	Down	No Change	No Change			
																	Schneider, 2004	Above		Down	Down			
Oceans Below	1		1					1									Schneider, 2003	Above	Down	No Change	No Change			
																	Schneider, 2004	Above		Down	Down			
Barney		1															Klosky, 2004	79		Down				
Video: Skiing Swiss Alps			1														Wint, 2002	30						
																	Windich-Biermeier, 2007	50		Down				
Video: Strolling Down Paris Sidewalks				1													Wint, 2002	Above						
																	Windich-Biermeier, 2007	Above		Down				
Video: Quiet Mountain Streams			1														Wint, 2002	Above						
																	Windich-Biermeier, 2007	Above		Down				
The Hunt of the Diamonds	1	1		1													Nilsson, 2009	42		Down		Perceived Benefits		
PlayMotion: Flying		1			1								1	1	1		Li, 2011	122	No Change					Down
PlayMotion: Drawing		1															Li, 2011	Above						
PlayMotion: Sports	1								1								Li, 2011	Above						
PlayMotion: Billiards	1								1								Li, 2011	Above						
Emotional Parks			1	1												1	Espinoza, 2012	33	Down				Up	Down
																	Banos, 2013	19				Perceived Benefits		
Walk Through Nature			1	1												1	Espinoza, 2012	Above	Down				Up	Down
																	Banos, 2013	Above				Perceived Benefits		
	Rewards	Fantasy	Nature	Walking	New Identity	Fighting Evil	Puzzle	History	Chance	2nd Chance	Hero	Fighting	Flying	Distancing via Otherly Perspective	Regaining Control by Defying Physics	Total Interactive Immersion with Nature			Anxiety	Symptom Distress	Fatigue	Distraction	Positive Emotions	Negative Emotions
VR Experience	Theme													VR Specific Theme			Article	Participants	Results					

FIGURE 5. VR GAMES FROM MINI-REVIEW (CHIRICO ET AL., 2016)

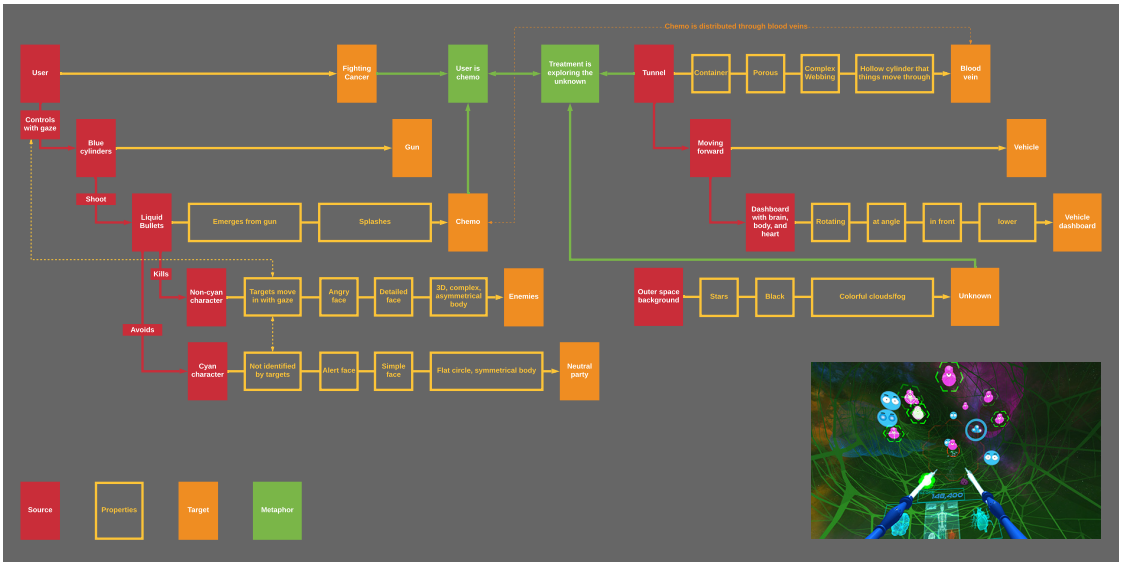


IMAGE 5. METAPHORICAL MAPPING OF KIMO BY ONCOMFORT.

Primary Research Question: How can the design of a serious VR game use multimodal metaphors to transform a patient's embodied metaphorical conceptualization of their cancer from a negative source of anxiety and depression to a positive opportunity for personal growth?

When embodying cancer in a virtual world, one must ask: what are the visual, auditory, and interactive qualities of cancer? These senses are the subject of sub-research question 1. Part of this research is to create a conceptual framework for carefully controlling the meaning of multimodal metaphors to send a consistent message to cancer patients. This framework will be the topic of sub-research question 2.

VR is continuously changing, and as a result, it is difficult to find academic consensus. For example, what senses are specific only to VR? This investigation will organize and summarize the senses that can be stimulated only in VR. Identifying these senses is important because senses are integral to an embodied conceptual metaphor.

In VR, presence becomes stronger by the extensiveness of sensory modalities (Jerald, 2016). Presence controls a users feeling of immersion. Immersion is where the user psychologically feels as though they are somewhere else (Jerald, 2016). He defines immersion as comprised of six parts: extensiveness, matching, surroundness, vividness, interactability, and plot (p. 45).

Extensiveness refers to "the range of sensory modalities presented to the user (e.g., visuals, audio, and physical force)." Matching is the congruency between the user's real body and their virtual body. Surroundness "is the extent to which cues are panoramic." Vividness refers to the quality of resolution. Interactability refers to the user's ability to alter and influence their virtual world and other entities within it. And finally, plot refers to the story or narrative. While all the parts of immersion provide opportunities for metaphor, plot is especially ripe for metaphorical expression.

One more sense of note is proprioception which refers to the user's awareness of their bodies position and movement. Patients who chose to sit can still perceive natural movement because strong visual sensations can overpower proprioception.

Sub-Research Question 1: How might cancer be metaphorically represented in a virtual environment?

Color

There is no universally accepted meaning for any color in the spectrum. However, one can begin to assign meaning to color with a distinct target audience and context. According to Harrow et al. (2008), the colors patients associated with their tumor were red, black, white, yellow, pink, and grey (p. 341).

Warm Tones and Black. On the negative side, black denoted anger, unhealthy, nasty and sinister, and red indicated anger and body tissue. Although patients associated yellow with their tumor, the meaning was unclear. Additionally, Forceville and Paling (2018) analyzed nine short, wordless animations and found two common metaphors: "depression is a dark monster" and "depression is a dark confining space" (p. 1). Echoing this idea of darkness is TCMT metaphors like: cancer is a river of darkness, a haunting shadow, free fall through the black chasm, the dark secret, and thick black tar (Tanner, 1997). Lastly, Domino and Pathanapong (1992) confirm this idea of darkness in the CMT with the metaphor: cancer is a dark cloud.

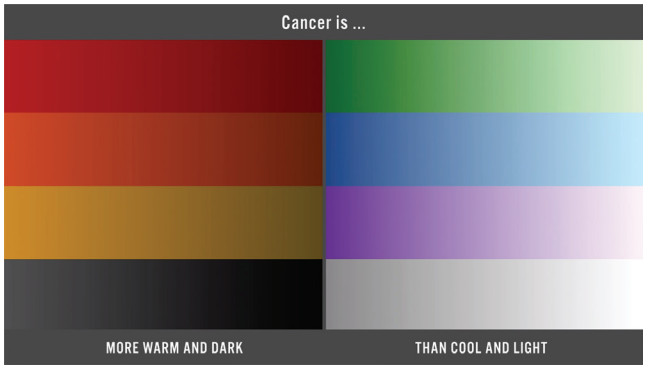
Cool Tones, Pink, and Grey. On the positive side, pink denoted healthy tissue and grey indicated benign or inert tumors. Based on the limited research, this investigation posits that if warm tones are associated with tumors and anger, it will follow that cool tones are associated with non-cancer. Based on the limited research, this investigation posits that if as Forceville and Paling (2018) put it, depression is dark, then relief is a light place. Campus (2009) confirms this with the metaphor: cancer research is a source of light.

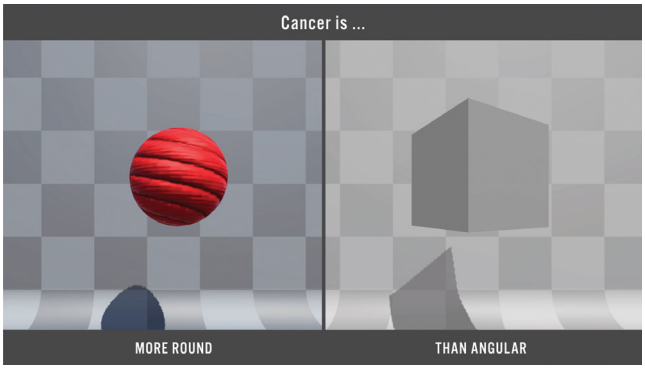
White. White would seem to fit neatly into the non-cancer category. However, patients likely associated it with x-ray images they saw of their tumor or lack thereof. Additionally, Domino and Pathanapong (1992) add to the fogginess in the CMT with the metaphor: cancer is white flowers.

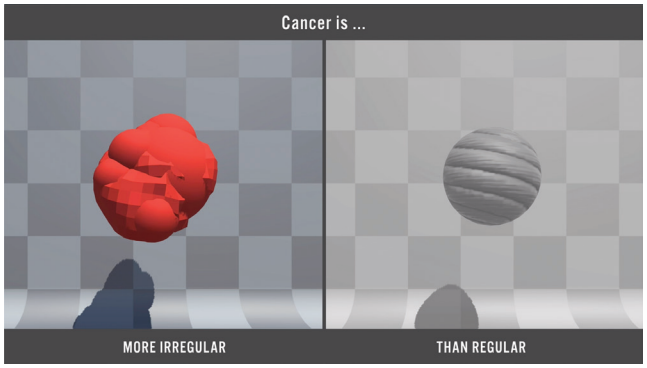
Form

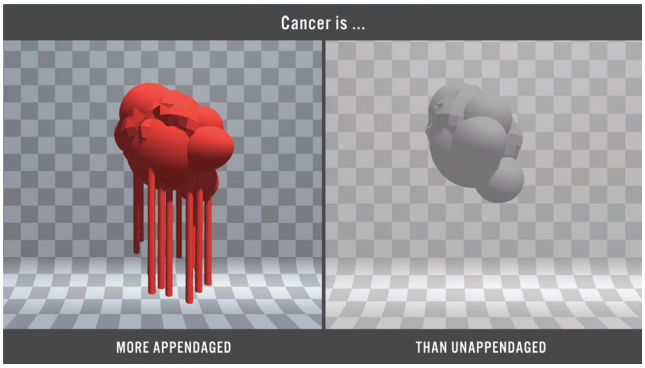
According to Harrow et al. (2008), 10 of the women showed their tumor in 3D form. They found, to symbolize their tumor, patients chose rounded, irregular forms that had ragged or defined edges and were often accompanied by appendages (p. 341). While symbolizing a tumor as an irregular, lumpy mass is fitting, the addition of appendages is unrealistic. Most, if not all, tumors do not have spider-like appendages. Cancer being spider-like is an interesting addition and requires more understanding.

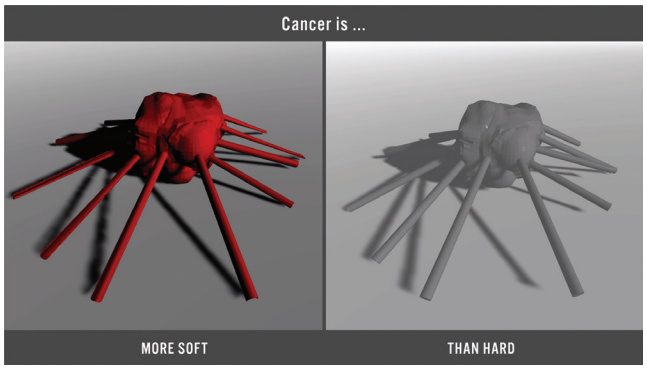
This idea of appendages continues into pop culture as well as other academic research. In his 2015 music video quand c'est ?, Stromae symbolizes cancer as an incalculable web of biomorphic,











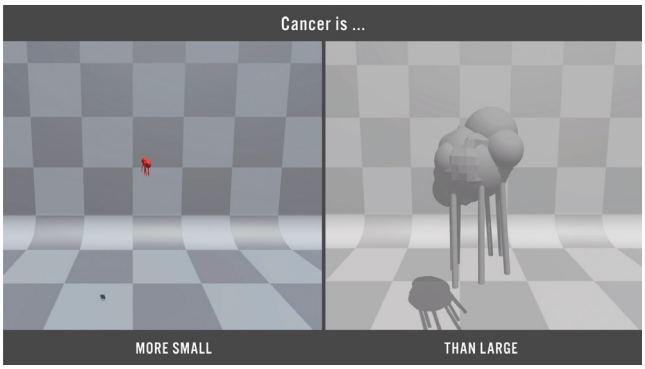


IMAGE 6. SCREENSHOTS FROM VIDEO OF SUB-RESEARCH QUESTION 1

growing vines, that move like a spider and strike like a scorpion (Mosaert, 2015, 3:15). We also see growing, vine-like appendages symbolizing cancer throughout the 2016 video game, That Dragon, Cancer (Numinous Games, 2016). Lastly, the TCMT using this metaphor: cancer is creeping poisoned ivy (Tanner, 1997).

For Harrow et al. (2008), the addition of appendages may symbolize how the patient perceives "cancer's ability to spread or alternatively how they could accept that their cancer could be completely removed" (p. 341).

One of the two broad themes identified by Harrow was cancer is "creature-like." Of the women interviewed, 33% of the participants personified their cancer as not part of their body; they saw cancer as an "independent being," that could grow, move, hide, feed, and spread. This idea of cancer as creature-like is echoed by metaphors in the TCMT and others like: cancer is an alien growth, alien self, enemy within, and animal (Gibbs & Franks, 2002; Tanner, 1997).

Consistency

Consistency refers to the way a substance is held together and typically refers to liquid. Harrow et al. (2008) used consistency a bit more loosely in categorizing patients' symbols of their cancer. They found that patients described their cancer on a spectrum from "soft" to "jelly-like" to "putty-like" to "hard." The provided materials like pipe cleaners, plasticine, and cork undoubtedly influenced the patient's description. Three cancer patients used cork to sculpt their tumor while six used plasticine. One of the two broad themes identified by Harrow was cancer is "substance-like." Below this investigation will discuss the substance-like qualities of conceptualizing cancer.

Soft. The CMT and TCMT support cancer as a soft consistency with the metaphors: cancer is a withering rose, cancer is creeping poisoned ivy, cancer is a river of darkness, and cancer is stagnant water (Domino and Pathanapong, 1993; Tanner, 1997). The CMT also introduces brittleness with the metaphor: cancer is a dead flower. The idea that cancer is a liquid is supported by metaphors like: cancer is a fluid within the self container, and cancer is a dark cloud (Gibbs & Franks, 2002).

Jelly-like or putty-like. The CMT and TCMT support cancer as a jelly-like or putty-like consistency with the metaphors: cancer is flowing lava, cancer is oozing slime, and cancer is thick black tar (Domino and Pathanapong, 1993; Tanner, 1997).

Hard. Cancer being hard is supported by the metaphor: cancer is a machine (Gibbs & Franks, 2002).

No Consistency. One interesting addition to this consistency discussion may be non-consistency which is supported by the CMT metaphors: cancer is shifting desert sand, and cancer is a dark cloud (Domino and Pathanapong, 1993).

Texture

While closely related to consistency, texture distinguishes itself as the feel and appearance of a surface or substance. Harrow et al. (2008) found a variety of textures that patients associated with cancer like smooth, fatty, fuzzy, coarse, rough, and jagged. Six women referenced to texture when sculpting their tumor.

Soft. These metaphors support cancer as a soft, fatty, or fuzzy texture: cancer is a withering rose, cancer is oozing slime, cancer is dead flowers, cancer is bubbles in the air, cancer is stagnant water, cancer is mold on a piece of bread, and cancer is creeping poisoned ivy (Domino and Pathanapong, 1993; Tanner, 1997).

Course. These metaphors support cancer as a coarse texture: cancer is dirty, and cancer is shifting desert sand (Campus, 2009; Domino and Pathanapong, 1993).

Size

According to Harrow et al. (2008), participants described the size of their tumor in using small, common objects like peas and eggs. Some of them had felt their tumor during a home examination while others learned of the size through x-ray images or their oncologist. These CMT and TCMT metaphors support the idea that cancer is small: cancer is mushrooms in a field and bubbles in the air (Domino and Pathanapong, 1993; Tanner, 1997). While the number of tumors is great in these two metaphors, the size of an individual tumor is small.

Concerning size, this investigation posits CMT metaphors that produce more anxiety and depression tended to be more contained than their counterparts. For example, describing cancer as "shifting desert sands" is much less contained than describing it as a "mouth full of sand."

Movement

While Harrow et al. (2008) did not explicitly discuss movement, they did imply movement by positing that tumor appendages may symbolize how the patient perceives "cancer's ability to spread or alternatively how they could accept that their cancer could be completely removed" (p. 341). One of the two broad themes identified by Harrow was cancer is ''creature-like." Of the women interviewed, 33% of the participants personified their cancer as not part of their body; they saw cancer as an "independent being," that could grow, move, hide, feed, and spread. Below this investigation will discuss movement which can be related to the creature-like nature of cancer.

Slow. These CMT and TCMT metaphors support the idea of cancer as slow: cancer is creeping poisoned ivy, cancer is a river of darkness, cancer is flowing lava, cancer is bubbles in the air, cancer is oozing slime, cancer is a withering rose, cancer research is an archaeological enterprise, and cancer research is a quest for the holy grail (Campus, 2009; Domino and Pathanapong, 1993; & Tanner, 1997).

Fast. These TCMT metaphors support the idea of cancer as fast: cancer is a free fall through the black chasm, a train in a tunnel, being caught in a storm, an arrow that missed its target, a galloping horseman, a piercing sword, a stranglehold, and cancer is a scorpion's sting (Tanner, 1997).

Continuous. Cancer continuously moving is supported in the TCMT with the metaphors: cancer is riding a tiger, cancer is being adrift in a fog, cancer is shifting desert sands (Tanner, 1997).

Direction. This metaphor supports the idea that cancer is moving in a particular direction: happy is up, and sadness is down—one must stay up to heal (Gibbs & Franks, 2002).

On the topic of movement, this investigation posits CMT metaphors that produce more anxiety and depression tended to be more "active, actions, doing, or a process", while those that produce less are more "state, condition, or result." See figure 2.

Sub-Research Question 1 Conclusion.

While more research and user testing is needed, this investigation has concluded that cancer is; 1) more warm and dark than cool and light, 2) more round than angular, 3) more irregular than regular, 4) more appendaged than unappendaged, 5) more soft than hard, and 6) more small than large.

Sub-Research Question 2: How can a patient's source of distress, source of comfort, and the metaphors they use to describe their experience with cancer inform the design of a serious VR game aimed at reducing cancer-related psychological distress?

Cancer patients experience distress because of the unknowns of cancer and would identify with questions like the following: Why me? Will the treatment work? Will the cancer come back? Did I do something to deserve this? I've lived a simple life; why did I get cancer? When will the pain go away? Who will take care of my children? Will I live long enough to walk my daughter down the aisle?

A patient guided concept map. Cancer in other words? The Role of Metaphor in Emotion Disclosure in Cancer Patients is an article by Lanceley and Clark (2013) that analyses the metaphorical concepts that patients use for cancer-related psychological distress. Based on the work of Lanceley and Clark, this investigation mapped cancer patients distress, comfort, and metaphors, and connected it with VR game concepts and interactions. See figure 6.

All three participants (Mary, Helen, and Doris), were in their seventies and were experiencing pain. Consequently, it is likely that they would choose to sit during a VR game. Patients who chose to sit can still perceive natural movement because strong visual sensations can overpower proprioception.

Concept 1: Breaking Out of the Hospital and Into Nature

Helen expressed psychological distress when contemplating further treatment and hospitalization (Lanceley & Clark, 2013). She seems to connect the fear of being continually confined to the hospital with her "worst destiny," of being disabled and confined to her apartment. In contrast to this theme of continued confinement, she finds comfort in the idea of controlling her destiny. The metaphor, treatment is jail, seems to fit well with her distress.

Helen's distress and comfort call for a game plot in which she leaves a confined place that resembles the treatment facilities and enters an open-world of endless possibilities. This concept is reinforced by Forceville and Paling (2018) when they say "depression is a dark confining space" (p. 1) which the patient is leaving.

This gaming experience becomes immersive when the user's body movements match their virtual movements naturally in space and the extensiveness of sensory modalities.

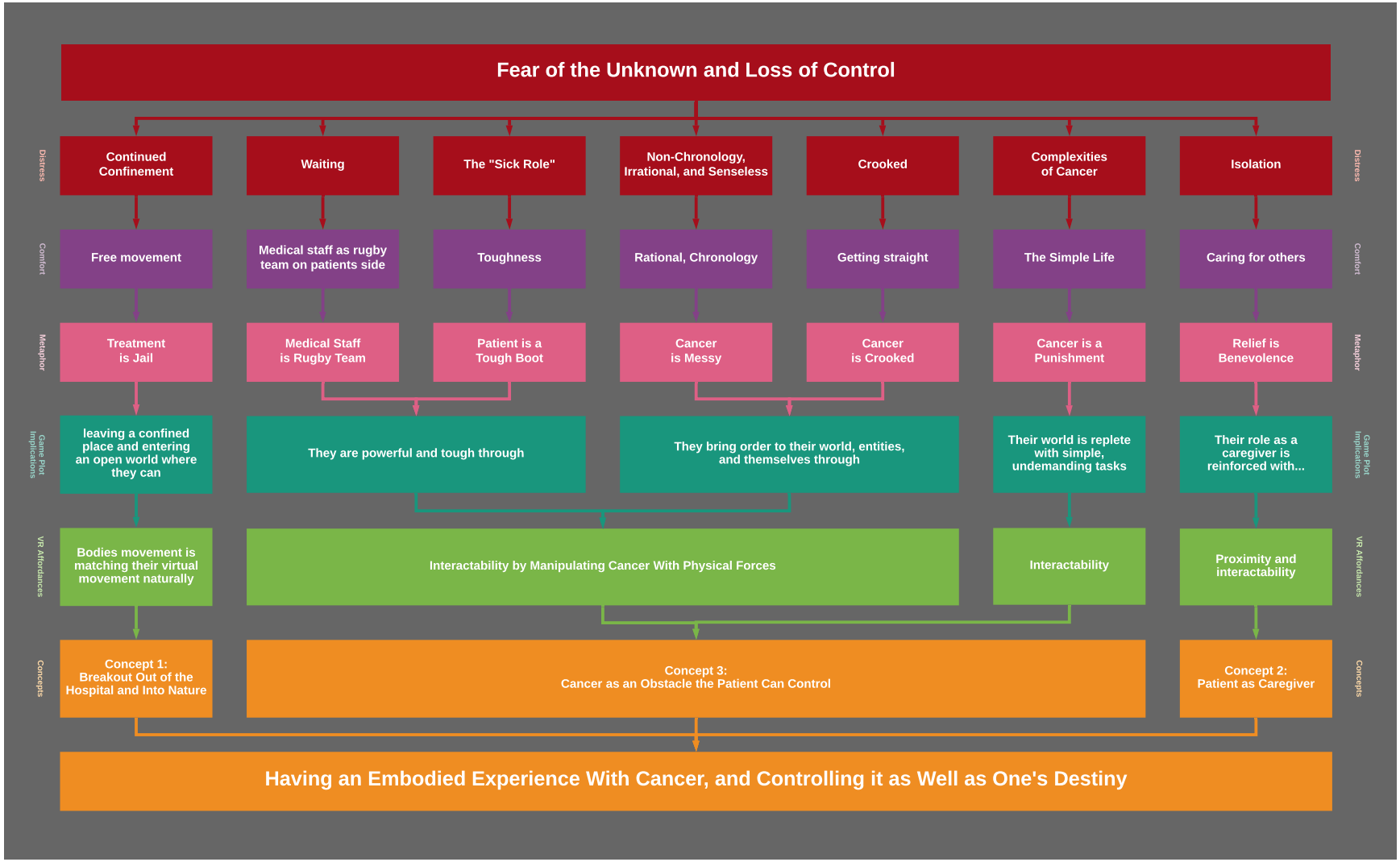


FIGURE 6. CANCER PATIENTS DISTRESS, COMFORT, AND METAPHORS, AND CONNECTED IT WITH VR GAME CONCEPTS AND INTERACTIONS.

IMAGE 7. THIS IS A 3D RECREATION OF A TYPICAL CHEMOTHERAPY INFUSION FACILITY.

Concept 1 Conclusion.

This investigation is not alone in asserting that cancer patients want to escape the hospital. University of Ottawa assistant professor Dr. Justin Sutherland hopes to provide Ottawa Hospital cancer patients with a "mental escape" from their hospital beds (Cotnam, 2019).

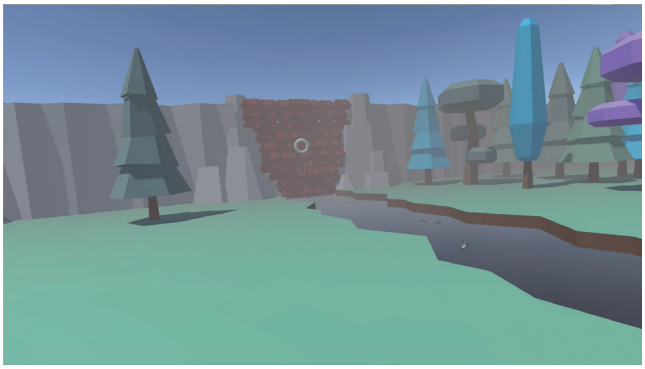
Jennifer Shamess, a cancer survivor and hospital advisor working with Dr. Sutherland, said, "I was in the hospital for about five days at a time, being infused with different chemicals and I spent most of [my] time inside my brain trying to be somewhere else" (Cotnam, 2019). For Shamess, it was mentally exhausting to receive treatment, and she desperately wanted to remove herself from the situation.

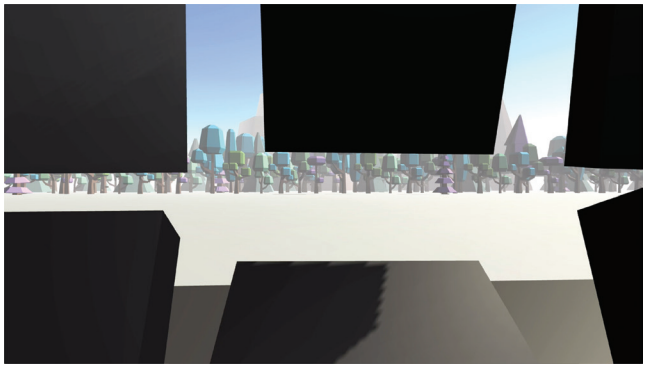
In concept one, the patient is in a familiar hospital setting that is dark and depressing (Forceville and Paling, 2018). These TCMT metaphors support the idea that cancer is darkness: cancer is a river of darkness, a haunting shadow, free fall through the black chasm, the dark secret, and thick black tar (Tanner, 1997). Additionally, Domino and Pathanapong (1992) confirm this idea of darkness in the CMT with the metaphor: cancer is a dark cloud. Using physical force, the patient can break through the wall, thus embodying the experience of being a powerful entity that can move freely.

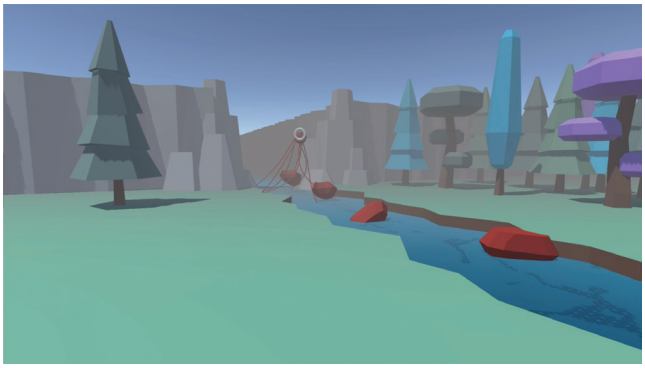
Concept 2: Cancer as an Obstacle the Patient Can Control

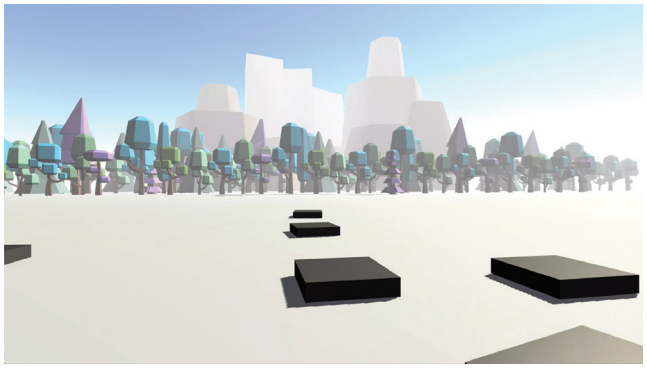
Mary, Helen, and Doris all expressed distress over their loss of control and found comfort in controlling their destiny. The distress and comfort surround the loss of control had multifaceted expressions.

Helen communicated her loss of control through her distress with waiting on test results. She metaphorically compared waiting for results to the suspenseful build-up rugby players feel before an important match. Helen becomes more immersed in this metaphor by describing the medical staff treating her as a strong rugby team. She finds comfort in thinking about the medical staff being tough, strong, and aggressive. Unfortunately, Helen does not see herself as a member of the team. Instead, she is powerless and can only watch from the sidelines.









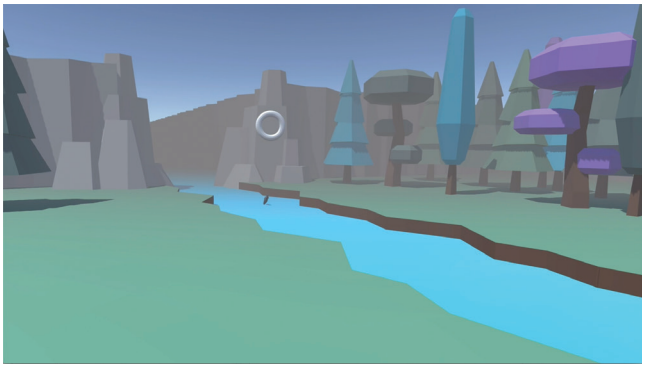


IMAGE 8. SCREENSHOTS FROM VIDEO OF CONCEPT 1

IMAGE 9. SCREENSHOTS FROM VIDEO OF CONCEPT 2 AND 3

Doris communicated her loss of control with her distress with playing "sick role." She is struggling with the incongruence between her current illness and a lifetime of good health. Doris finds comfort in her toughness. She metaphorically describes herself as being "tough as old boots" and is troubled by being in the hospital, which is only for weak people.

Mary communicated her loss of control with her distress over not being able to get straight. She metaphorically connects her physiological problem of not being able to straighten her shoulders with her psychological problem, not being able to straighten out or make sense of her situation with cancer. The metaphor, cancer is crooked, seems to fit well with her distress. Doris also struggled to make sense of her situation with cancer. For her, telling a chronological story may indicate an attempt to bring some semblance of order and rationality to her illness. Metaphorically speaking, cancer is messy. Mary also struggles with the incongruence between the simple life she has led and the complexities of cancer.

These sources of distress and comfort call for a game plot in which the patient is powerful, in control of cancer, and bringing order to their world. This concept becomes VR specific through interactability by manipulating cancer with physical force.

Concept 3: Patient as Caregiver

While Helen was the only patient to express fear about being alone explicitly, both she and Mary expressed comfort with the idea of caring for other entities, like humans and animals (Lanceley & Clark, 2013). This CMT metaphor supports the concept of tending: "cancer is being alone in the forest" (Domino and Pathanapong, 1993).

This distress and comfort call for a game plot in which the patients take on the role of a caregiver and has social opportunities. This concept becomes VR specific through proximity and interactability with other game entities. Interactability is another core element of immersion (Jerald, 2016).

Concept 2 and 3 Conclusion.

Together, concepts two and three explore the metaphor cancer is an obstacle on life's journey (Gibbs & Franks, 2002; Harrington, 2012). The TCMT supports this idea of journey with the metaphor: Cancer is a journey through a maze (Tanner, 1997). Here, the user finds a cancer-like obstacle blocking the flow of water, consequently making the river stagnant. Stagnant water is another metaphor used to describe cancer (Tanner, 1997). The user can remove the obstacle, thus restoring order to their virtual world.

Many games pride themselves on being difficult. How demanding should these obstacles be when the purpose of this game is to reduce psychological distress? This investigation posits that a VR game like this should be replete with undemanding tasks. Baird (2012), suggest that demanding tasks require more encoding of stimuli and thus, create a higher memory load. On the other hand, undemanding tasks are not merely resting, instead are tasks that require less encoding of stimuli and as a result, create a lower memory load.

As discussed in concept 1, Jennifer Shamess is a cancer survivor and working to bring VR to the oncology ward of Ottawa Hospital (Cotnam, 2019). Shamess escaped the visual stress of treatment by "building a cottage" in her mind (Cotnam, 2019). While practically demanding, a virtual cottage could be very undemanding.

Conclusion

As Laurence Kirmayer put it (1993), "if every interpretation of distress is, at root, the invention of metaphors for experience, healing may occur not because a conflict is accurately represented, or even symbolically resolved, but because the metaphorization of distress gives the person room to maneuver, imaginative possibilities, behavioral options, and rhetorical supplies" (p. 165).

This investigation examined the visual, auditory, and interactive qualities of embodying cancer in a virtual world. Additionally, it proposes conceptual frameworks for metaphorically representing a cancer patient's psychological distress and the VR elements that give them room to maneuver around said distress. In part, this investigation presents how the design of a serious VR game can transform a patient's embodied metaphorical conceptualization of their cancer from a negative source of anxiety and depression to a positive opportunity for personal growth.

This investigation acknowledges that VR is not going to cure cancer, but what it can do is reduce the psychological burden of cancer. And in some cases, reducing the psychological burden of cancer can slow or stop the spread and growth of cancer.

Discussion

Building on past research, this investigation broke new ground into reducing cancer-related psychological distress using embodied conceptual metaphors in a serious VR game. Moving forward, this investigation provides a number of opportunities for future design research. Below the author will discuss several next steps for this investigation.

What are the logistical limitations using VR while receiving chemotherapy in an infusion clinic? This investigation should the logistics of a chemotherapy infusion room and how that might impact the design of a serious VR game. For example, users will likely want to sit for the VR experience. How does that impact the design of the serious VR game?

How might other users (friends, family, and survivors) be metaphorically represented in a virtual environment? Making this VR experience social was a common theme throughout this investigation. Any counselor or psychologist dealing with cancer patients will tell them to seek social support. They will also tell you that cancer patients seek the advice of survivors. While many VR games isolate the user, that may not be appropriate for this VR experience. What would that look like in a serious VR game? Could other survivors asset patients on their journey?

While talking about a friend of his who is currently undergoing cancer treatment, professor Derek Ham told the author, "I do not want to watch him talk on YouTube and do the thumbs-up thing, I want to slay a dragon with him." Derek is describing a common desire for those on the sidelines. Friends and family members want to show their support. Perhaps they can in a VR experience? It may even give them a common language they can use in conversation outside of the VR experience.

Along this line of thinking, Dr. Justin Sutherland, who is currently developing VR for cancer patients in Ottawa Hospital, asked an interesting question; what if the patient could go on a vacation with their families (Cotnam, 2019)? A colleague of his, Jennifer Shamess said about her experience with cancer treatment, "it would have been difficult to go anywhere on a vacation, but with this option she could virtually step outside the hospital with a family member. To both escape together somewhere, I think it would be great."

How might this investigation be improved by the collaboration of designers, oncologists, oncology nurses, oncology counselors, and of cancer patients? This investigation can improve tremendously with real insight from all involved parties.

Psychological Terms

Psychological Distress. Those facing a life-threatening illness are likely to experience what is known as psychological distress. Psychological distress is a term that describes negative emotions that impede with everyday activities (Ridner, 2003). A warped sense of the self and one's circumstances is common with psychological distress, and patients commonly experience depression and anxiety as a consequence of their illness (Gundelach & Henry, 2016).

Cancer-Related Psychological Distress. Cancer-related psychological distress distinguishes itself as a patients negative emotional response to a cancer diagnosis. Cancer-related psychological distress includes four attributes: depression, anxiety, fear, and feeling discouraged (Gundelach & Henry, 2016).

Quality of Life. Quality of Life (QoL) is an individual's assessment of physical, mental, emotional, and spiritual well-being.

VR Terms

Presence. In VR, presence becomes stronger by the extensiveness of sensory modalities (Jerald, 2016). Presence controls a user's feeling of immersion.

Immersion. Immersion is where the user psychologically feels as though they are somewhere else (Jerald, 2016). He defines immersion as comprised of six parts: extensiveness, matching, surroundness, vividness, interactability, and plot (p. 45). Extensiveness refers to "the range of sensory modalities presented to the user (e.g., visuals, audio, and physical force)." Matching is the congruency between the user's real body and their virtual body. Surroundness "is the extent to which cues are panoramic." Matching is closely related to self-embodiment, which is "the perception that the user has a body within the virtual space" (p. 47). Vividness refers to the quality of resolution. Interactability refers to the user's ability to alter and influence their virtual world and other entities within it. And finally, plot refers to the story or narrative. While all the parts of immersion provide opportunities for metaphor, plot is especially ripe for metaphorical expression.

Serious Games. A serious game is any game designed for a purpose other than pure entertainment.

Demanding and Undemanding Tasks. Baird (2012), suggest that demanding tasks require more encoding of stimuli and thus, create a higher memory load. On the other hand, undemanding tasks are not merely resting, instead are tasks that require less encoding of stimuli and as a result, create a lower memory load.

Uncanny Valley. Uncanny Valley references the sense of unease or revulsion a user feels when interacting with an almost-human figure.

Metaphorical Terms

Metaphor. Metaphor is a figure of speech that transfers the aspects of one object or action known as the source, and applies it to an unrelated object or action, the target. For example, cancer, the target, is a fight, the source. As Kirmayer (1993) puts it, "Metaphor occupies an intermediate realm, linking narrative and bodily-given experience through imaginative constructions and enactments that allow movement in sensory-affective quality space."

Conceptual Metaphor. Conceptual metaphor theory posits that our brain maps the source and target domains of an object or action to understand the world better. In rhetoric, metaphor is a way of communication, but in conceptual metaphor theory, metaphor is pervasive and foundational in everyday language and thought (Lakoff & Johnson, 2003). For example, cancer, the target, is a fight, the source. Source, Target, and Entity. Conceptual metaphor theory posits that our brain maps the source and target domains of an entity or action to understand the world better. For example, cancer (target), is a fight (source).

Visual Metaphor. Visual metaphor gives the viewer visual cues and requires them to piece the message together. For example, in the Sick Kids Anthem in Figure 1, viewers see a young boy enter a boxing ring where the word cancer looms overhead (Thompson, 2016, 1:30). In this example, viewers are asked to map something familiar with the image of a fighter entering the boxing ring, the source, with cancer as his opponent, the target.

Dual-Coding Theory. Dual-Coding Theory (DCT) proposes that pictorial and verbal information should be understood differently because the brain processes them through different channels (Sadoski & Paivio, 2013). According to Sadoski & Paivio, sensory experiences (modes) form mental representations and encode verbal and nonverbal components (codes).

Multimodal/Multimodality. Multimodality is a theory which looks at how people communicate and interact with each other, not just through writing (which is one mode) but also through speaking, gesture, gaze, and visual forms (which are many modes) (Kress, 2010).

Multimodal Metaphor. A multimodal metaphor distinguishes itself as a collaboration between various senses like the sense of touch, vision, and hearing. Since this is a working concept between the author and his committee, it may be prudent to add the following senses that are relevant to VR: balance and acceleration, proprioception (body orientation), chronoception (sense time passing), agency (control), and recognition memory (familiarity). See the VR section below for the definition of other senses like extensiveness, matching, surroundness, vividness, and interactability.

A few of these senses are common, but others require some explanation. An example of proprioception is when one tries to touch their nose while keeping their eyes closed. Having proprioception means we do not need to see or be conscious of one's finger touching their nose. Chronoception is the sense of how much time has passed. According to Moore (2016), "When we make voluntary actions we tend not to feel as though they simply happen to us, instead we feel as though we are in charge (p. 1)." The sense of agency is a term for the feeling of being in control when it comes to our actions. Recognition memory occurs when one recognizes previously experienced stimuli. Recognition memory happens in the perirhinal cortex, where senses are processed. According to Eichenbaum (2007), "the ability to recognize a previously experienced stimulus is supported by two processes: recollection of the stimulus in the context of other information associated with the experience, and a sense of familiarity with the features of the stimulus." Concerning "multimodal," some sources may use similar terms like audiovisual metaphor, multicode metaphor, and interactive metaphor.

Embodied. Embodiment refers to the idea that cognition and communication form by physical experience and bodily interaction with a tangible world, as well as giving form to thoughts and feelings (Davis, 2012).

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