REVISING SELECTED WRITTEN PATIENT EDUCATION MATERIALS THROUGH READABILITY AND CONCRETENESS

A Dissertation

by

RHONDA DENISE GOOLSBY

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2010

Major Subject: Curriculum and Instruction

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ABSTRACT

Revising Selected Written Patient Education Materials Through Readability and Concreteness. (August 2010)

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Chair of Advisory Committee: Dr. Mark Sadoski

The current state of much research on written patient education materials (WPEM) suggests that they are written in a manner that is too difficult even for educated patients to understand and remember. Much of the research in this area is focused on modification of the readability of WPEM, which has shown to be relatively ineffective. In this study, an attempt was made to determine if a theory-based method in revising WPEM for improved comprehensibility and memorability was effective.

The effectiveness of three versions of WPEM regarding breast self-exams (BSEs) was examined; the original version without illustrations obtained from the American Cancer Society website, a version that was written at a lower readability level as measured by the Flesch-Kincaid readability formula, and a version with a lower readability level as measured by the Flesch-Kincaid readability formula and the increased use of concrete language as suggested by Dual Coding Theory. The researcher compared the percentage of recall of idea units recalled by 76 participants at two time periods: immediately after reading the randomly assigned version of WPEM and seven days after the initial reading.

The WPEM that contained the lower readability level and concrete language was most recalled by participants both at immediate recall and delayed recall. In fact, the delayed recall of the WPEM that contained the lower readability level and concrete language after the seven-day period was almost equivalent to the immediate recall of the participants in the other two groups. A significant main effect was found for the forms of WPEM, $F(2, 73) = 27.69$, $p = .00$, $n^2_p = .43$ with an observed power of 1.00. A significant main effect was found for time, $F(1, 73) = 161.94$, $p < .00$, $n^2_p = .69$ with an observed power of 1.00. A significant interaction of WPEM and time was found, $F(2, 73) = 5.07$, $p = .01$, $n^2_p = .12$ with an observed power of .80.

Reported levels of frequency of performing BSEs and levels of confidence in performing BSEs were also analyzed using the Wilcoxon Signed Ranks Test in relation to the three WPEM versions over time. Reported frequency was significantly greater after seven days, regardless of form of WPEM (WPEM A, $p = .32$; WPEM B, $p = 1.00$; WPEM C, $p = .74$). Levels of confidence were significantly greater after seven days, regardless of form of WPEM (WPEM A, $p = ..02$; WPEM B, $p = .00$; WPEM C, $p = .00$).

Overall results indicate that combining reduced readability and increased concrete language is beneficial. The writing of WPEMs in a way that patients can understand should be supported by a theory, and infusing Dual Coding Theory in the writing of selected WPEMs may be beneficial for patients.

DEDICATION

When I was a little girl, my grandmother asked me what I wanted to be when I grew up. I answered, “A doctor.” She replied, “Why don’t you become a nurse instead.” I dedicate this dissertation to my grandmother who, although was a woman of her times, was also a woman who believed in me.

I also dedicate this dissertation to my family. The sacrifices they have made, the support they have provided and the love they have given is what has made this possible.

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I would like to thank all of the people who have helped me to achieve this great accomplishment. Without each and every one of you, this would not have been possible.

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Thank you to Alicia for taking the first steps through this educational process so that I could follow in your footsteps as you guided me through certain "landmines."

Thanks also go to my friends and colleagues and the department faculty and staff for making my time at Texas A&M University a great experience. I also want to extend my gratitude to the Texas Center for Adult Literacy and Learning, which provided the fellowship that allowed me to focus on the completion of this project.

Finally, thanks to my mother, Tamra, Brandy, David, Michael, Mahkaila, Ashton, Travis, and Buck for their encouragement, support, patience and love.

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CHAPTER I

INTRODUCTION

Health literacy is a major problem plaguing 90 million U.S. adults (Nielson-Bohlman, Panzer & Kandig, 2004). As professionals, it is up to those in the medical field to convey their information clearly to patients; however, they have struggled to do so. The most cost effective and time efficient manner to convey information regarding health care is to provide written patient education materials (e. g. Adkins, Singh, McKeegan, Lanier & Oswald, 2002; Cooley, Moriarty, Berger, Selm-Orr, Coyle & Short, 1995; Davis, Williams, Marin, Parker & Glass, 2002; Doak & Doak, 1980).

The current problem with such materials is that the written patient education materials (WPEM) are often written at much higher levels than many patients can read, comprehend, and recall (Glazer, Kirk & Bosler, 1996; Mohrmann, Coleman, Coon, Lord, Heard, Cantrell & Burks, 2000; Wallace, Keenum, Roskos, Blake, Colwell & Weiss, 2008; Weintraub, Maliski, Fink, Choe & Litwin, 2004). Previous researchers indicated that rewriting patient education materials at a lower readability level does not prove beneficial (Davis et al., 2002; Foltz & Sullivan, 1996; Lee 1999; Moll, 1986; Stableford & Mettger, 2007). Patients continue to struggle with materials rewritten with a lower readability level. Within this current study, Dual Coding Theory (DCT)

This dissertation follows the style of *Reading Research Quarterly.*

principles were utilized to rewrite patient education materials at a lower readability level and use concrete language at an appropriate level that adults can comprehend, retain, and recall.

The theoretical framework supporting this study is DCT. DCT is a theory of cognition in which verbal, nonverbal, or both verbal and nonverbal influences on memory are explained (Paivio, 1971, 1986, 1991, 2007; Sadoski & Paivio, 1994, 2001, 2004). It has also been used to explain cognitive processes such as reading, which includes decoding, comprehension, and response (Sadoski & Paivio, 2001, 2004) in a more comprehensive manner than other theories, such as context availability theory or schema theory (Sadoski & Paivio, 2001, 2004; Sadoski, Paivio & Goetz, 1991). In DCT, information is represented in memory in two forms; verbal and nonverbal. Information can be represented in verbal form, nonverbal form, or in both forms. The most common form in which information is presented to readers is verbal form (i.e., text). The nonverbal form is typically provided by the reader through mental images created by the reader based on the text being read. These images are primarily created from concrete language, which is language that can invoke images in the mind of the reader (Sadoski & Paivio, 2001, 2004). This language is more easily recalled at a later point in time due to the evocation of such images (Sadoski & Paivio, 2001, 2004). This is not something that is often included or even considered when the healthcare field creates WPEM.

Because of the discrepancy levels between the WPEM and patients, professionals in the health care industry cannot assume that most patients have the skills needed to

comprehend written medical information and patient education materials that are on a high grade level (grades 9 and above). Moreover, difficulty comprehending some form of written medical information also affects patients who have higher levels of educational attainment and reading abilities. In 2006, Davis, Wolf, Bass, Thompson, Tilson, Neuberger, and Parker found that even educated patients had difficulty understanding prescription drug labels. Davis et al. (2006) found that people of adequate reading levels had difficulty accurately understanding prescription labels and demonstrating proper prescription usage.

The state of current research regarding written patient education materials is focused mainly on the readability of the materials. Frequently, those materials are written at a much higher level than the reading abilities of those to whom these materials are given (e. g. Adkins et al., 2002; Cooley et al., 1995; Davis et al., 2002; Doak & Doak, 1980). While in some cases lowering the readability level of the written material has been shown to be beneficial (Adkins et al., 2002; Doak & Doak, 1980; Gannon & Hildebrandt, 2002; Trifiletti, Shields, McDonald, Walker & Gielen, 2006; Wolf, Davis, Shrank, Rapp, Bass, Connor et al., 2007), it has not always been successful (Davis et al., 2002; Foltz & Sullivan, 1996; Lee 1999; Moll, 1986; Stableford & Mettger, 2007).

For example, in recent breast cancer research, information pamphlets have been found to be written at 7.5 to 11.2 Flesch-Kincaid grade levels (Friedman & Hoffman-Goetz, 2006). Breast cancer is the second most common form of cancer in women. In 2005, 186,467 women were diagnosed with breast cancer, and 41,116 women died from breast cancer (U.S. Cancer Statistics Working Group, 2009). Therefore, information

pamphlets related to breast cancer have obvious importance. However, when the National Assessment of Adult Literacy reports the average U.S. adult reading level at an eighth grade level, and Medicaid recipients are reported to read at a fifth grade level (Kutner, Greenberg, Jin, & Paulsen, 2006), there is quite a discrepancy between the readability of these common pamphlets and the reading ability of the target population.

In this study, a comparison of WPEM was conducted. Included were WPEM that were in the original format that are provided to patients in medical settings, a version rewritten at a lower readability level, and a version rewritten at a lower readability level and using more concrete language.

Research Questions

Four research questions are addressed in this project. While the main focus of the questions was on the effects of patient education materials as measured by percentage of recall of idea units, another purpose was to evaluate the effects of the materials on 2 selected patient behaviors as reported by the participant.

1. Do individuals who receive different patient education materials differ in recall?
2. Does recall differ over time?
3. Is there a significant interaction of written patient education materials and time?
4. Do individuals who receive different written patient education materials differ in reported level of frequency of breast self-exams (BSEs) and reported level of confidence in performing BSEs?

CHAPTER II

REVIEW OF LITERATURE

This chapter consists of a comprehensive overview of the literature that is pertinent to this topic. The literature review covers the topics of health literacy, Dual Coding Theory and the use of concrete language, readability, readability and health literacy, readability and recall, and memory in reading comprehension. Each topic is reviewed in regards to the current state of research and pinpoints vital information that is significant to this study.

Health Literacy

According to the report titled *The Health Literacy of America's Adults* (Kutner et al., 2006), based on the results from the 2003 National Assessment of Adult Literacy, literacy is defined as "using printed and written information to function in society, to achieve one's goals, and to develop one's knowledge and potential" (p. 2). Health literacy, as defined by the Institute of Medicine of the National Academies, is "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions" (Nielson-Bohlman et al., 2004, p. 2). One's literacy level has a direct effect on one's health (e.g. Baker, Wolf, Feinglass, Thompson, Gazmararian & Huang, 2007; Barrett & Puryear, 2006; Davis et al., 2006; Dewalt & Pignone, 2005; Kelly & Haidet, 2007; Koo, Krass & Aslani, 2003, 2005; Manning & Dickens, 2006; Mika, Kelly, Price, Franquiz & Villarreal, 2005; Stableford & Mettger, 2007; Trifiletti et al., 2006; Weiss & Coyne, 1997; Wolf et al., 2007).

Health literacy is not only influenced by the level of literacy or education of a patient (e.g. Davis, Crouch, Wills, Miller & Abdehou, 1990; Gazmararian, Baker, Williams, Parker, Scott, Green et al., 1999; Logan & Schwab, 1996; Paasche-Orlow, Parker, Gazmararian, Nielson-Bohlman & Rudd, 2005; Turner & Williams, 2002), but it is also influenced by, but not limited to, gender (e.g. Baron-Epel, Balin, Daniely & Eidelman, 2007; Foltz & Sullivan, 1996; Lee, 1999), race (e.g. Eiser & Ellis, 2007; Lloyd, Ammary, Epstein, Johnson & Rhee, 2006), culture (e.g. Doak & Doak, 1980), age (e.g. Clark, AbuSabha, von Eye & Achterberg, 1999), native language (e.g. Gazmararian et al., 1999), socio-economic status (e.g. Manning & Dickens, 2006), and geographic location (Mika et al., 2005).

The 2003 National Assessment of Adult Literacy included approximately 19,700 adults who were aged 16 or older living in households or prisons. The results were that 14% of the participants were at below basic levels, 22% were at basic levels, 53% were at intermediate levels, and 12% were at proficient levels of health literacy. These results translate to "about 90 million (47 percent) U.S. adults cannot accurately and consistently locate, match, and integrate information from newspapers, advertisements, or forms" according to the Institute of Medicine (Nielson-Bohlman et al., 2004, p. 60). This means that approximately 90 million U.S. adults cannot fully comprehend or have difficulty doing so and do not have the necessary basic skills to fully participate in today's society. The National Adult Literacy Survey (NALS) divided those who took the survey into five different levels. The levels were ranked in ascending order with the lowest being NALS

Level 1 and the highest being NALS Level 5. Approximately 90 million U.S. adults fell into the NALS Level 1 or NALS Level 2 categories of the NAAL.

Of the approximately 90 million who have limited literacy skills, approximately 42 million were ranked as NALS Level 1. Adults in NALS Level 1 can do little more than the following:

- "can perform simple and routine tasks using uncomplicated materials
- have trouble with tasks requiring them to locate or match several pieces of information in moderately complicated texts
- can solve simple math problems when the numbers and the operations are provided but find it difficult to solve the same problems when they must locate the numbers and the operations in a piece of text
- likely be able to locate the words *child, children, pediatric* on a package of cold medicine for children. However, would not be expected to be able to read a chart in order to identify how much syrup is recommended for a child who is 10 years old and weighs 50 pounds." (Nielson-Bohlman et al., 2004, p. 61).

Another 50 million of the approximately 90 million adults with limited literacy skills ranked in the NALS Level 2. "Most of the adults in NALS Levels 1 and 2 are 'literate'; however, adults in Level 1 are at a severe disadvantage and adults in Level 2 are disadvantaged, in relation to the demands of twenty-first century life" (Nielson-Bohlman et al., 2004, p. 62).

There are certain populations, defined throughout this literature review, who experience lower levels of literacy more than others. Of the approximately 90 million

U.S. adults with limited literacy skills, "the largest proportion of American adults with limited literacy are native-born Caucasian speakers of English. Over half of the people with NALS Level 1 skills are Caucasians, and about 57 million Caucasian Americans have limited literacy skills" (Nielson-Bohlman et al., 2004, p. 62). Others in the group that have limited literacy skills include those who are poor, minorities, adults over the age of 65, and residents of the southern and western regions of the United States. Also included are those who do not have a high school diploma or who have obtained a GED. The NALS was only assessed in English, which gives a significant disadvantage to those who were non-native English speakers and did not provide complete data in regards to the populations affected by a lack of adequate health literacy in other languages. However, often times those who offer health services speak English and possibly a second language, but this is not always the case. Cultural and ethnic minorities scored low on the survey.

While many researchers have demonstrated that educational level and attainment have a direct effect on health literacy levels, it is important to point out that even well educated individuals often have difficulties with health literacy. In the text *Health Literacy: A Prescription to End Confusion* (Nielson-Bohlman et al., 2004, p. 67), a nurse is quoted from her piece titled, "Confessions of a Health Illiterate" as to having advanced degrees in nursing and being successful in her occupation within the health field, and yet, she still had difficulty fully understanding all with which she was presented. She tells how she had been trained and reads on a college level, and even though she is thought to have advantages due to her training and skills, she struggles at

comprehending the written patient education materials she is given by her health care providers. This indicates that even those with adequate or superior literacy skills, and trained in the field of medicine, can be at a disadvantage.

In 2006, Davis et al. found that even educated patients had difficulty understanding prescription drug labels. They assessed 395 participants using the REALM (Rapid Assessment of Adult Literacy in Medicine) and five prescription labels. Of the participants, 19% read at or below the sixth-grade level (low literacy), 28.6% read at the seventh- to eighth-grade level (marginal literacy), and 52.4% at the ninth or above grade level (adequate literacy). Davis et al. found almost half of the patients at all literacy levels (46.3%) misunderstood one or more of the prescription label instructions. Also, while 70.7% of patients in the low literacy level were able to correctly state instructions regarding prescription dosages, only 34.7% in the low literacy level were able to demonstrate comprehension by accurately demonstrating the number of pills that should be taken. In the marginal literacy level, the ratio was 84.1% and 62.8%, respectively.

Dual Coding Theory and the Use of Concrete Language

Dual Coding Theory (DCT) was developed as a way to explain verbal and nonverbal influences on memory (Paivio, 1971, 1986, 1991, 2007; Sadoski & Paivio, 1994, 2001, 2004) and has since been extended throughout various cognitive processes, including reading, which includes decoding, comprehension and response (Sadoski & Paivio, 2001, 2004).

According to the DCT, information is represented in the memory in two forms, either verbal or nonverbal. While these are two separate and distinct codes, information can also be represented in both codes (Sadoski & Paivio, 2001, 2004). Information can be presented to a person in either verbal form, nonverbal form or both forms. In reading, the most common example of information being represented in both codes is one in which the verbal information is provided and mental images are created. For example, when an unillustrated story about Little Red Riding Hood is told or read, images are typically produced within the listener or reader's mind in regards to the characters and events within that story. Just the title of the story Little Red Riding Hood can evoke images based on the memories that have been made due to such images. While we often associate the production of imagery with stories, creating mental images occurs in any situation in which a reader is presented with concrete language. In essence, the images that are created in the mind of the reader are due to such concrete language, which is language that can invoke images in the mind of the reader (Sadoski & Paivio, 2001, 2004).

When mental images are created based on concrete text, information is easier to comprehend and recall in future instances (Gambrell & Bales, 1986; Gambrell & Jawitz, 1993; Horne, 1993; Long, Winograd, & Bridge, 1989; Sadoski, 1983, 1985; Sadoski, Goetz, & Fritz, 1993a, 1993b; Sadoski, Goetz, & Rodriguez, 2000; Sadoski & Paivio, 2001, 2004; Sadoski & Quast, 1990). In their 1993b study, Sadoski et al. investigated the comprehensibility, interestingness, familiarity, and recall of both concrete and abstract text and found that concreteness was most highly related to comprehensibility and recall.

When information is represented in both codes, verbal and nonverbal, there are more associations with that information, allowing the reader to comprehend better due to more pathways of association to the information, and the reading is more easily understood allowing recall to be easier at a later time.

Another aspect of the DCT is the conceptual peg hypothesis. In this hypothesis, it is theorized that individuals retain information in their memory in a system that is almost like a set of pegs for hanging things. A mental image serves as an effective peg. All things that are associated with a concept get "hung" on their appropriate peg. Concrete language can assist in the recall of such concepts by evoking the "peg" image (Anderson, Goetz, Pichert, & Halff, 1977; Paivio, 1991).

In regards to written medical information, one study, which included the use of DCT, has been used in the creation of written medical information materials. Clark et al. (1999, p. 561) utilized abstract and concrete language and graphics in rewriting medical information. Their research hinged on comparing pamphlets that contained abstract language and abstract graphics, concrete language and abstract graphics, and concrete language and concrete graphics. It was found that concrete language and concrete graphics were most recalled. Immediate recall was successful, but recall after 30 days was less successful. However, it was also found that "the more concrete nutrition education print materials are, the greater the opportunity for coding, retrieving and recalling the information after initial exposure to the materials" (Clark et al., 1999).

Davis et al. (1990) recommended including concrete language within written medical information and patient education materials. However, this was simply a

recommendation based on an evaluation of patient educational levels and a reading comprehension assessment administered to participants. Davis et al. did not test the effects of implementing concrete language in written medical information and patient education materials.

Readability

Readability is a widely debated topic in the field of reading. Estes (1994) provided a general definition of readability: "readability refers to the ease or difficulty a reader might predictably encounter in comprehending the information and ideas in text" (p. 978). There are many formulas that help predict readability, such as the Gunning-FOG, SMOG (Simple Measure of Gobbledygook), Fry, Flesch-Kincaid, Flesch Reading Ease, Cloze and Lexiles. Each of these provides a numerical measure that is indicative of a level that is supposed to be comprehensible to all who are able to read and comprehend on the specified level. The numerical measure is typically calculated using a mathematical formula that takes into account the number of syllables and sentences in a reading passage. Klare (2002) refers to the readability formulas as predictive devices that "provide quantitative, objective measures of reading difficulty" (pp. 684).

While over 30 readability formulas are available to assess the difficulty of text (Meyer, 2003), the formula utilized in this study was the Flesch-Kincaid Grade Level and the Flesch Reading Ease readability formulas, because they are widely used and have been adopted by common word-processing programs. The Flesch-Kincaid Grade Level readability formula uses the average number of words per sentence and the average number of syllables per word to calculate the readability of a text. The level is

given in the number of years and months of education in schools in the United States needed to comprehend the text. The Flesch Reading Ease readability formula is very similar to the Flesch-Kincaid Grade Level formula. In calculating the Flesch Reading Ease, the number of syllables per 100 words and average sentence length are counted. Scores are reported using a 100-point scale. Higher scores indicate that the text is easier to understand (Gillen, Kendall, & Finch, 1977; Kellerman & Weiss, 1999; Klare, Rowe, St. John, & Stolurow, 1969).

Both the Flesch-Kincaid Grade Level and the Flesch Reading Ease readability formulas can be found in Microsoft Word and other word processing computer programs. The use of these two readability formulas through the employment of a computer program allows ease and efficiency when calculating readability of a text (Mikk & Elts, 1999). The use of word processing programs also eliminates human error. Since affixes are a factor in the Flesh readability formulas, evaluators often derive different numbers when calculating the readability of a single text (Dale & Chall, 1948), and the use of technology helps remove such human errors (Klare et al., 1969).

Many of the measures of readability are comparable and can be used interchangeably (Klare, 1963). However, readability is simply a prediction device. The number that is provided from the calculation is simply stating that, generally, a person who reads on or above the indicated level can read this text with comprehension and understanding. However, one has to keep in mind that readability formulas are "objective." This is a very important word as it points out that readability does not take a person's characteristics into account when reporting the results from the calculation.

(Manzo, 1970; Meyer, Marsiske & Willis, 1993; Mikk & Elts, 1999). Readability does not take into account that a reader may not have a background in such a topic that provides context pertaining to the text. It also does not take into account specialized vocabulary (Manzo, 1970). It simply focuses on the number of syllables and words within a given amount of text. It is not sensitive to the readers' characteristics (Meyer et al., 1993; Mikk & Elts, 1999).

Readability and Health Literacy

Currently, researchers indicate that the readability levels of written patient information cover a wide range, but are often found to be at levels too high for the average population (Beaver & Luker, 1997; Gannon & Hildebrandt, 2002; Glazer et al., 1996; Murphy, Chesson, Berman, Arnold, & Galloway, 2001; Rudd, Moeykins, & Colton, 1999; Singh, 2003; Spadaro, Robinson, & Smith, 1980; Wallace et al., 2008; Wallace & Lennon, 2004; Weintraub et al., 2004).

Galloway, Murphy, Chesson and Martinez (2003) reported that 47% of their participants had completed the twelfth grade; however, their health literacy assessment indicated that those same participants scored an average reading level of seventh to eighth grades. The focus of Galloway et al. was to compare the reading comprehension levels of patients to the readability of WPEM. The readability levels of the WPEMs were found to range between ninth and twelfth grade level. Fitzmaurice and Adams (2000) conducted a systematic literature review in which they indicated that written medical information is "good" if it fell at the grade level of 11.5 or less. This is rather disturbing

when the average reading level of U. S. adults is 8th grade or less (Doak, Doak, & Root, 1996; Kutner et al., 2006).

The act of simply lowering the readability level of written medical information is a factor that some researchers claim has a positive influence upon patient understanding and comprehension of written medical information (Adkins et al., 2002; Rudd et al., 1999). Freda, Damus, and Merkatz (1999) suggested that the appropriate manner in calculating the reading grade level for an adult is to subtract six years from the last grade they completed. The researchers found that the reading level of written medical information averaged between the seventh and ninth year, third month grade levels, and that written medical information should be written at the sixth grade level in order to reach as many patients as possible. This indicated that simply lowering the readability level of a pamphlet would provide enough benefit that the majority of adults could comprehend the written patient education materials. In a study conducted by Davis et al., (1990), the researchers found similar results. They found that a patient's reading level is on average three to four grade levels below their indicated educational attainment level, and there was a five- to seven-year discrepancy between the reading comprehension of an average patient and the ability levels needed to read written medical information. In one study researchers found that a pamphlet written at the sixth grade level was as beneficial as a video (Partin, Nelson, Radosevich, Nugent, Flood, Dillon et al., 2004), and researchers in another study found that providing patients with a pamphlet at a lower grade level is as beneficial as providing patients with a pamphlet and a video (Eaden, Abrams, Shears & Mayberry, 2002).

The use of "plain language" or "simplification of written materials" is recommended in writing medical information. However, this should not be the only tool being used in making written medical information more accessible to adult readers (Davis et al., 2002; Lee 1999; Stableford & Mettger, 2007). Researchers have indicated that lowering the readability level does not improve patient recall (Davis et al., 2002; Foltz & Sullivan, 1996; Lee, 1999; Moll, 1986; Stableford & Mettger, 2007). While researchers in many studies demonstrate the idea that lowering the readability level will be the solution to all of the problems with written patient education materials, this is not the answer in its entirety.

Readability and Recall

Readability has been linked to recall; however, the link has only been found to be moderate. Researchers in several studies demonstrate this notion. Sadoski (1999) evaluated the correlations between the following variables: readability, familiarity, concreteness, interestingness, comprehensibility, and recall. In regards to readability and recall, and according to Sadoski (1999), only a marginally significant correlation of -.30 was found.

Miller and Kintsch (1980) conducted a study in which participants read four paragraphs and recalled as much as they could from those paragraphs in a free-recall format (write as much as you can remember). Miller and Kintsch stated that whereas "word frequency and sentence length are important predictors of reading time and readability, they have little effect on recall" (1980, p. 347).

In reference to WPEM, there are several studies in which the focus was on readability and recall. Handelsman and Martin (1992) evaluated the effects of readability on the impact and recall of written informed consent material. Participants received a packet that contained either no consent form, a consent form written at the fourth grade level, or a consent form written at the tenth grade level. Similar to the studies that were not focused on WPEM, there was a trend for the consent form with the higher readability level to be less recalled than the lower readability level consent form.

Friedman and Hoffman-Goetz (2007) discovered similar results as Handelsman and Martin (1992). Using printed information about breast cancer, prostate cancer and colorectal cancer, researchers assessed the readability using the SMOG readability formula and found them to be written at and beyond high school reading levels. Participants read gender specific cancer information (i.e., women read about breast cancer, while men read about prostate cancer) and all participants read about colorectal cancer since it is not a gender-specific cancer. Comprehension and recall was assessed using the Cloze procedure, and four to five questions were asked during an interview to probe recall. In this particular study, a significant negative correlation ($r = -.44$, $p = .019$) was found between readability and the Cloze comprehension procedure. This indicated that the higher the readability level, the poorer the comprehension.

Memory in Reading Comprehension

Memory plays a large role in comprehension (Engle & Conway, 1998). When one is asked to read, there is typically a purpose for the act, and typically the reader must retain the knowledge gained from the reading in order to complete a task,

whether it be sooner or later, as “retention is an integral part of mental activities” (Towse, Hitch, & Hutton, 2000).

There are many theories regarding memory and tasks associated with memory (Barrouillet, Bernardin, & Camos, 2004). However, the idea that will be pertinent to the current study is that of time-related decay of memory traces. Memory, or knowledge, decays as soon as attention is switched, and becomes even more decayed over a period of time (Barrouillet et al., 2004). In order to combat the decay of memory or knowledge, one must “refresh” the knowledge through rehearsal or repeated exposure, and if refreshing is not done, the results suggest poorer recall (Barrouillet et al., 2004).

Part of this study involves DCT’s aspect of memory known as the conceptual peg hypothesis. According to DCT theorists, memory is associative, and images serve as effective memory “pegs” or retrieval devices (Sadoski & Paivio, 2001, 2004).

Researchers in the area of WPEM have shown that remembering the information read has been a challenge. Such researchers indicate that when the readability level of a pamphlet is lowered, retention of information over time still decreases. Blinder, Rotenberg, Peleg and Taicher (2001) found that after one week, knowledge level decreased, and Eaden et al. (2002) found that knowledge level decreased over a period of a month. Clark et al. (1999) found that after a single reading and a time lapse of 30 days, participants struggled with being able to recall any information. The participants in all studies discussed (Blinder et al., 2001; Clark et al., 1999; Eaden et al., 2002) showed a decay in retention over time, and it should be noted that very little gets remembered without a review.

Reduced readability level does not necessarily mean that the information is more easily retained than the information that is found in written medical information at a higher readability level. A strong, associative connection must be made for the reader to retain information for an extended period of time. The conceptual peg may provide such a connection for much verbal material.

CHAPTER III

METHODOLOGY

Participants

The sample consisted of 76 female undergraduate and post-baccalaureate teacher education students ranging from ages 19 to 29 at Texas A&M University. The participants were mostly native English speakers, while 4% (three participants total) were non-native English speakers. First languages other than English included Urdu (one participant) and Spanish (two participants). One participant of the 76 had experience with finding noncancerous lumps in the breast. All other participants had no experience with breast cancer. The participants in this study were enrolled in an undergraduate education class. This sample was one of convenience.

Instrumentation

Instruments included a consent form (Appendix A), the Nelson-Denny Reading Test (Form H), an initial questionnaire (Appendix B), one of three possible versions of WPEMs (Appendices C, D, and E), a Free Recall Sheet (Appendix F), and a follow-up questionnaire (Appendix G). Each instrument is discussed later.

A pilot rating study was also conducted to determine levels of concrete language included in the pamphlets. Sixteen graduate students agreed to participate in the study. These graduate students were all female and were not familiar with this study. They were presented with the three different pamphlets, a definition of concrete language and a rating scale. The provided definition of concrete language was, “concrete language

allows the reader to create images in their mind of what they are reading." The rating scale ranged from 1 to 5, with 1 being defined as "no concrete language at all" and 5 being defined as "very concrete language."

The means and standard deviations for the concrete language rating for each WPEM can be found in Table 1. Table 1 also includes the Flesch-Kincaid Reading Level and Flesch Reading Ease Level of each WPEM.

Table 1. Descriptive Statistics of WPEM

	Readability			Concrete Language Rating	
	FK Level*	**FRE Level****	**Number of Words**	**Mean**	**Standard Deviation**
WPEM-A	6.6	76.5	234	1.80	.86
WPEM-B	3.5	90.5	235	2.80	.78
WPEM-C	3.4	91.1	236	4.47	.64

*Flesch-Kincaid Reading Level
**Flesch Reading Ease Level

After consenting to participating in the research, the participants completed the "Participant Information Sheet," a brief informational questionnaire asking their age, native language, and information regarding the participant's history with BSE and breast cancer. The question regarding the participant's history of breast cancer allowed responses that ranged on a scale from zero to four. The questions regarding frequency of the BSE and level of confidence both ranged on a scale from zero to three. The follow

up questionnaire, given on day three, inquired about the participants' frequency of and level of confidence in performing BSEs one week after reading the assigned pamphlet

The Nelson-Denny Reading Comprehension Assessment, Form H, is a widely used standardized assessment that is used to measure student ability in vocabulary, reading comprehension, and reading rate. For the purposes of this study, vocabulary and rate were excluded. The comprehension portion is comprised of seven reading passages and 38 questions. Each question has five answer choices. This portion of the assessment includes a time limit of 20 minutes. The KR-20 reliability for the Nelson-Denny Reading Comprehension Assessment, Form H is .88 (Brown, Fishco, & Hanna, 1993).

Each participant then received a randomized BSE pamphlet. One version was language without illustrations (Appendix C) from the original pamphlet obtained from The American Cancer Society. The original pamphlet is written at a Flesch Reading Ease of 76.6 and a Flesch-Kincaid Grade Level of 6.6. The second version of the original pamphlet was rewritten to a lower readability level (Appendix D). This pamphlet is readable at a Flesch Reading Ease of 90.3 and a Flesch-Kincaid Grade Level of 3.5. The third version of the original pamphlet was rewritten using concrete language to evoke mental imagery combined with a lower readability level (Appendix E). This pamphlet is readable at a Flesch Reading Ease of 91.1 and a Flesch-Kincaid Grade Level of 3.4.

Data Collection Procedures

The researcher collected data on three different days with seven days between each meeting. Day one took approximately 30 minutes, while days two and three took approximately 20 minutes each.

Day One

The researcher was introduced to the class, and the researcher gave a brief overview of the study. The researcher answered any questions that participants had and reminded them that they had the right to withdraw from the research at any time without consequence.

Packets that contained two copies of the consent form, a copy of the Participant Information Sheet, and the Nelson-Denny Reading Test were given to each student. Students were instructed to pull out the consent form. The researcher reviewed the consent form, instructed students to sign the consent forms if they chose to participate, and to return one copy to the packet and keep the second copy for their reference. Participants who chose to participate were then told to pull out the Participant Information Sheet from the packet, complete it, and return it to the packet. Participants were then instructed to pull out the Nelson-Denny Reading Test. The participants were informed that the Nelson-Denny was a timed test, and that they would receive 20 minutes to complete the assessment. The researcher read the test instructions to the entire group. Prior to beginning the assessment, the instructor solicited questions from the class. No questions were asked. After the 20-minute time limit, the researcher told

the participants to stop and to return the assessment to the packet. The researcher then collected all packets from participants.

Day Two

Seven days later, the participants received a packet of materials. Each packet contained one of the three versions of the WPEM (Appendix C, D, E) and a Free Recall Sheet (Appendix F). The packets were distributed in random order in the following manner. The researcher first counted the number of participants in the study. Then, the number of participants was divided by three. The original number of packets was 84, allowing exactly 28 packets of each version of the WPEM. Once an equal amount of packets was counted out, the researcher then cut up 84 pieces of paper, each containing either a number one, number two, or a number three. These numbers were put into a container and a number was randomly drawn for the ordering of the packets.

Prior to distribution, the participants were instructed that they would pull out their pamphlet and read it carefully. They were then told that their next step would be to replace the pamphlet in the packet and then pull out the other sheet of paper and follow the instructions at the top of the page. The instructions at the top of the page informed the participants that they would write all they could recall from their pamphlet. These instructions were repeated by the researcher to ensure compliance. The researcher collected all packets once the participants completed the tasks.

Day Three

Seven days later, participants received another packet. This packet included the Free Recall Sheet (Appendix F) and the Patient Information Follow-Up sheet (Appendix

G). The group was instructed to complete both sheets that were in the packet. The Free Recall Sheet provided participants with the same recall instructions as the previous sheet did seven days prior. The Follow-Up Sheet was used to assess the participants on level of frequency of and level of confidence in performing breast self-exams after having read the pamphlet. Once participants completed both tasks, they returned them to the packet The researcher then collected all packets.

Scoring, Interrater Reliability, and Data Analysis

Free recall from Day Two, which is referred to as immediate recall throughout the study, was information that the participants were able to recall immediately after they read the BSE pamphlet. Three raters, who have expertise in grammar instruction, read 20% of the responses and independently rated them for the percentage of idea units (discussed next) found in each response. The purpose of having three raters was to assess interrater reliability, which is discussed later in this section. Free recall from Day Three, referred to as delayed recall throughout the study, was the information that the participants were able to recall after seven days.

Student recall responses were rated according to idea units. Idea units are components of the text that are "sentences that contain one or more items of information" (Le Bigot & Rouet, 2007). The idea units for recall were based on simple structural grammar with clause kernels and their semantic modifiers as the idea units. For example, the first sentence in WPEM-B (modified for readability level only) reads, "Lie down placing your right arm behind your head." Within that sentence are four idea units. The first idea unit is the independent clause kernel "lie down." In that idea unit, it

is implied that *you* will *recline*. The next idea unit is "place arm." Again, *you* is implied, and it is telling the reader that they are to do something with their arm. The next idea unit is "right." This identifies which arm the reader will be placing. The last idea unit of that sentence is "behind your head." This idea unit is a prepositional phrase that gives the location of where to place the arm. The idea units provided by the participants' free recalls were calculated by assigning one point to each idea unit recalled, adding each individual response and calculating a percentage to give a total score. Verbatim recall was not required; responses that accurately captured the gist or meaning of the idea unit were counted as one point. Either the full idea unit was included and a point was awarded or no points were awarded. Participants could not include partial idea units to receive credit. Percentages of recall of idea units were used because each WPEM contained different numbers of idea units. WPEM-A included 79 idea units, WPEM-B included 80 idea units, and WPEM-C included 73 idea units. Idea units for each version of the WPEM can be found in the Appendices.

The immediate and delayed recall scores were based on the percentage of idea units given by each participant. Interrater reliability was calculated using Predictive Analytic Software (PASW) 18. Three separate raters each independently scored a randomly selected 20% of the recall responses. They achieved an overall Interrater alpha reliability of .99, which was derived from all ratings from all three raters. Means and standard deviations of the raters' scorings can be found in Table 2 and correlations between the raters can be found in Table 3.

Table 2. Descriptive Statistics of Raters' Scoring for Interrater Reliability

Rater	Mean	Standard Deviation
Rater A	19.64	6.09
Rater B	21.12	6.78
Rater C	19.64	5.78

Table 3. Correlation between Raters' Scoring for Interrater Reliability

	r
Rater A x Rater B	.97
Rater A x Rater C	.98
Rater B x Rater C	.96

The immediate recall and delayed recall data were analyzed using a two-factor Analysis of Variance (ANOVA) (3 WPEM groups x 2 recall times) with repeated measures on the last factor. Mauchly's Test of Sphericity was used to check for sphericity, however, sphericity was met since there are only two levels of the repeated variables. Main effects were analyzed and interpreted if they were not involved in an interaction. Interactions were analyzed by running Bonferroni's post hoc for significant simple main effects (SMEs). In analyzing the results of the SMEs, Wilks' lambda was used for the interpretation. The level of frequency and level of confidence data were analyzed using Wilcoxon's Signed Ranks Test. This analysis was chosen since the intervals on the questionnaires were not interval scale.

The statistical package, PASW18, was used to analyze all the data. Conclusions of this study are reported using tables, numerical and graphical techniques, and narrative format.

CHAPTER IV

RESULTS

The results of the statistical analyses utilized to answer the research questions are presented in this chapter. The results regarding the comparison of the Nelson-Denny Reading Assessment scores are reported first. This is followed by the analyses of the recall data. In regards to the recall data, mixed-model ANOVAs were reported and the data were further probed using simple main effects tests (SMEs). The data regarding the level of frequency of performing BSEs and participants' confidence levels were then analyzed using Wilcoxon's Signed Ranks Test.

The statistical package, Predictive Analytics Software, PASW18, was used to analyze all the data. The following questions were addressed:

1. Do individuals who receive different patient education materials differ in recall?
2. Does recall differ over time?
3. Is there a significant interaction of written patient education materials and time?
4. Do individuals who receive different written patient education materials differ in reported level of frequency of breast self-exams (BSEs) and reported level of confidence in performing BSEs?

Comparison of Nelson-Denny Reading Comprehension Assessment Scores

Participants were assessed using the Nelson-Denny Reading Comprehension Assessment to ensure that all participants were adequately literate and that the groups receiving the different forms of the written patient education materials (WPEM) were

comparable. The raw score mean of the assessment was 63.80 and a standard deviation of 8.60 with a minimum of 42.00 and a maximum of 76.00. The raw scores were converted to grade equivalents using a conversion table provided by the Nelson-Denny Reading Comprehension Assessment. The mean grade equivalent was 16.1 and the standard deviation was 2.35, with a minimum of 10.0 and a maximum of 18.9.

Although WPEMs were randomly assigned, the raw scores were then analyzed for differences in the groups receiving each form of WPEM to ensure that each group was comparable in reading ability. The descriptive statistics of the results of the Nelson-Denny Reading Comprehension Assessment in raw scores can be found in Table 4.

Table 4. Summary of Descriptive Statistics for Raw Scores of the Nelson-Denny Reading Comprehension Assessment

WPEM	n	Mean	Standard Deviation
A	27	62.59	8.77
B	24	63.58	8.51
C	25	65.44	8.65

A between-groups design was used to analyze the raw score results between the different forms of WPEM. The assumption of homogeneity was probed. Levene's Test of Homogeneity resulted in $F(2, 73) = .06$, $p = .94$ indicating no significant difference in the variances of the groups.

A one-way analysis of variance (ANOVA) was used to probe the means for the raw scores obtained for the three different groups who received the WPEMs. The results of this analysis are shown in Table 5.

Table 5. Summary ANOVA of Raw Scores of the Nelson-Denny for WPEM

Source	Type III Sums of Squares	df	Mean Squares	F	*p*	Partial eta squared	Observed power
WPEM	107.59	2	53.80	.72	.49	.02	.17
Error	5458.51	73	74.77				
Corrected Total	5566.10	75					

The results indicated no significant differences, $F(2, 73) = .72$, $p = .49$, $n^2_p = .02$, with an observed power of .17. The effect size is very small. These results show that the sample of participants had ample reading comprehension ability for the task and that their reading comprehension ability did not significantly differ between the experimental groups.

Recall

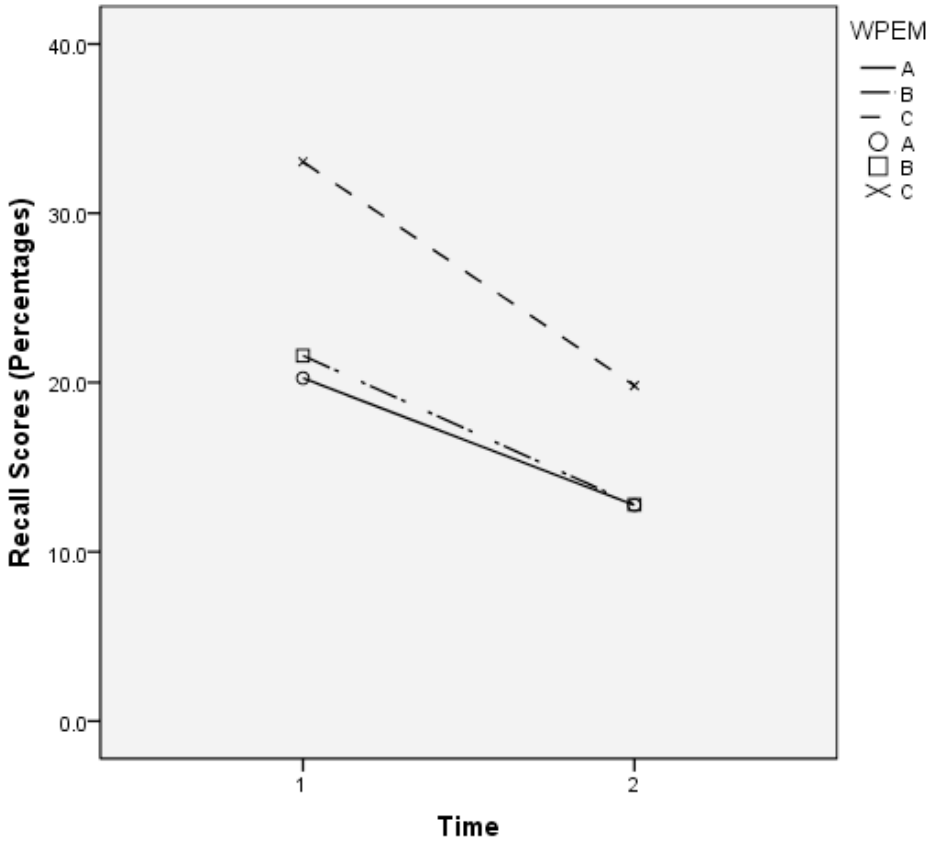
The first three research questions are addressed in the following data analyses regarding the effects of the various forms of WPEM on recall. WPEM-A is the written patient education material provided by the American Cancer Society website. WPEM-B is the written patient education material written in a lower readability level. WPEM-C is the written patient education material written in a lower readability level and using more concrete language. The descriptive statistics for immediate recall and delayed recall by

form of WPEM can be found in Table 6. In Figure 1, recall at Time 1 and recall at Time 2 for each form of WPEM are presented.

Table 6. Summary of Descriptive Statistics for Time 1 and Time 2 Percentage of Recall of Idea Units by WPEM

Time	WPEM	n	Mean	Standard Deviation
Time 1	A	27	20.26	5.24
	B	24	21.59	5.60
	C	25	33.04	9.45
Time 2	A	27	12.76	4.29
	B	24	12.79	5.25
	C	25	19.82	6.63

Figure 1. Means Percent of Immediate and Delayed Recall for Each WPEM



Differences in the means for immediate recall and delayed recall by form of WPEM were probed using a two-factor factorial ANOVA with repeated measures on the time factor. Mauchly's Test of Sphericity was used to test for sphericity and sphericity was satisfied (1.00). Table 7 displays the results of the ANOVA.

Table 7. Summary of ANOVA of Time for WPEM

Source	Type III Sum of Squares	df	Mean Square	*F*	*p*	Partial Eta Squared	Observed Power
WPEM	3103.24	2	1551.62	27.69	.00	.43	1.00
Error(Time)	4090.57	73	56.04				
Time	3671.31	1	3671.31	161.94	.00	.70	1.00
Time*WPEM	229.86	2	114.93	5.07	.01	.12	.80
Error(Time)	1654.94	73	22.67				

A significant main effect was found for the forms of WPEM, $F(2, 73) = 27.69$, $p = .00$, $n^2_p = .43$ with an observed power of 1.00. The effect size was large. A significant main effect was found for time, $F(1, 73) = 161.94$, $p < .00$, $n^2_p = .69$ with an observed power of 1.00. The effect size was large. A significant interaction of WPEM and time was found, $F(2, 73) = 5.07$, $p = .01$, $n^2_p = .12$ with an observed power of .80. The effect size was small. Bonferroni's post hoc test was used to locate the specific points of difference. The results of this test are found in Table 8.

Table 8. Summary of the Bonferroni Post Hoc Results for the Simple Main Effects of WPEM at Time 1 and Time 2

Time	(I) WPEM	(J) WPEM	Mean Difference (I-J)	*p*
1	A	B	-1.33	.88
		C	-12.78	.00
	B	A	1.33	.88
		C	-11.45	.00
	C	A	12.78	.00
		B	11.45	.00
2	A	B	-.03	1.00
		C	-7.06	.00
	B	A	.03	1.00
		C	-7.03	.00
	C	A	7.06	.00
		B	7.03	.00

A significant difference was found in immediate recall means between WPEM-A and WPEM-C ($p = .00$) and WPEM-B and WPEM-C ($p = .00$). No significant difference in immediate recall was found between WPEM-A and WPEM-B. This can be seen graphically in Figure 1. A significant difference was found in delayed recall means between WPEM-A and WPEM-C ($p = .00$) and WPEM-B and WPEM-C ($p = .00$). No

significant different in delayed recall was found between WPEM-A and WPEM-B. This can also be seen graphically in Figure 1.

The results of the Bonferroni post hoc test therefore indicated that recall for WPEM-C was significantly different than recall from WPEM-A and WPEM-B in both immediate and delayed conditions. WPEM-A and WPEM-B did not significantly differ in the immediate recall condition nor did they significantly differ in the delayed recall condition.

SMEs were used to analyze form of WPEM at Time. The results can be found in Table 9.

Table 9. Summary of Simple Main Effects for WPEM at Time

WPEM		Value	*F*	Error df	*p*	Partial Eta Squared	Observed Power
A	Wilks' lambda	.69	33.50	73	.00	.32	1.00
B	Wilks' lambda	.64	40.99	73	.00	.36	1.00
C	Wilks' lambda	.43	96.41	73	.00	.57	1.00

Using Wilks' lambda as the test statistic for scores at each form of WPEM, it was found that there are significant differences for each WPEM at Time. Within WPEM-A, a significant difference was found, $F(2, 73) = 33.50$, $p < .00$, $n^2_p = .32$, with an observed power of 1.00. Within WPEM-B, a significant difference was found, $F(2, 73) = 40.99$, $p < .00$, $n^2_p = .36$, with an observed power of 1.00. Within WPEM-C, a significant difference was also found, $F(2, 73) = 96.41$, $p < .00$, $n^2_p = .57$, with an observed power of

1.00. There was a significant difference between Time 1 and Time 2 at all forms of WPEM.

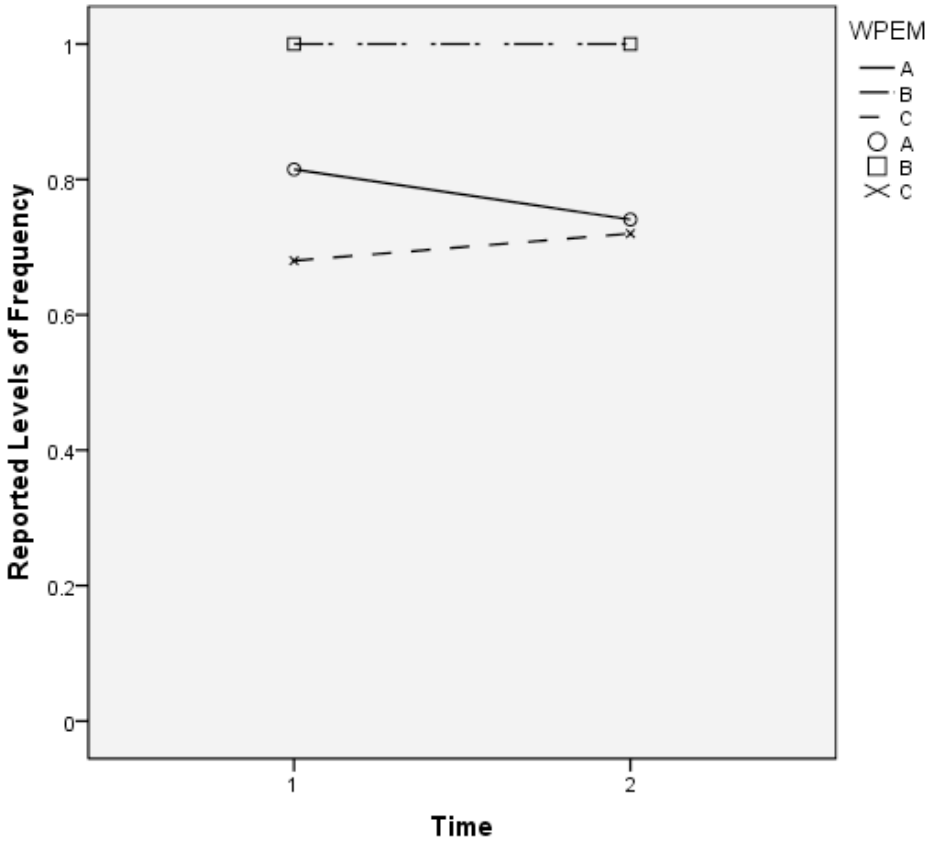
Level of Frequency and Level of Confidence

Participants were asked about the level of frequency which they performed BSEs on a scale of zero to three, with zero indicating that they never perform breast exams and three indicating that the participant performed breast exams often. The participants were also asked how confident they felt about performing the exams on a similar scale also ranging from zero to three (Research Question 4). Both questionnaires were administered before and after reading the WPEM. The data for these dependent variables were analyzed using Wilcoxon's Signed Rank Test. Descriptive statistics of reported level of frequency of performing BSEs for WPEM at the two time intervals can be found in Table 10. The means of level of frequency of performing BSEs for WPEM at the two time intervals can be found in Figure 2.

Table 10. Summary of Descriptive Statistics for Reported Level of Frequency of Performing BSEs

Frequency	WPEM	n	Mean	Standard Deviation
Time 1	A	27	.81	.79
	B	24	1.00	.83
	C	25	.68	.69
Time 2	A	27	.74	.66
	B	24	1.00	.72
	C	25	.72	.68

Figure 2. Means of Time 1 and Time 2 Levels of Frequency of Performing BSEs



Alpha reliability of the level of frequency data was .88. Frequency data was analyzed according to the WPEM type using the Wilcoxon signed ranks test. The results can be found in Table 11. There was no significant difference found between Time 1 and Time 2 for any WPEM.

Table 11. Wilcoxon Signed Rank Test for Level of Frequency for Form of WPEM

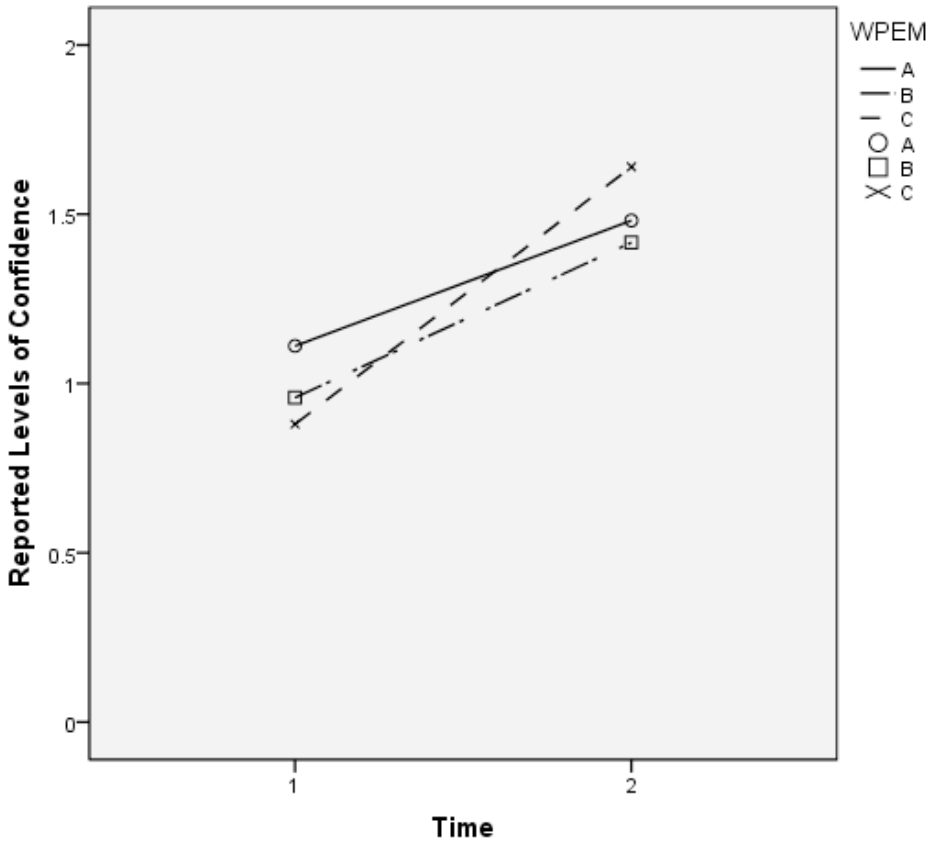
WPEM	*p*
A	.32
B	1.00
C	.74

Confidence levels for performing BSEs were also assessed in the initial questionnaire and in the follow-up questionnaire. The descriptive statistics of the reported confidence levels can be found in Table 12. The means of WPEM at Time can be found in Figure 3.

Table 12. Summary of Descriptive Statistics for Reported Levels of Confidence in Performing BSEs

	WPEM	n	Mean	Standard Deviation
Time 1	A	27	1.11	.85
	B	24	.96	.75
	C	25	.88	.60
Time 2	A	27	1.48	.64
	B	24	1.42	.78
	C	25	1.64	.57

Figure 3. Means of Immediate and Delayed Levels of Confidence



Alpha reliability on the confidence level data was found to be at .69, which is marginal. The reported confidence levels of participants in performing BSEs from Time 1 and Time 2 were analyzed using the Wilcoxon Signed Ranks Test. The results are located in Table 13. There was a significant difference found between Time 1 and Time 2 for each form of WPEM.

Table 13. Wilcoxon Signed Ranks Test for Level of Confidence for Form of WPEM

WPEM	*p*
A	.02
B	.00
C	.00

CHAPTER V

DISCUSSION AND SUMMARY

The final chapter includes the conclusions from the study, limitations of the study, recommendations for further research and a final summary. Within the conclusions, each research question is addressed.

Overall Conclusions from the Study

"Tens of millions of U.S. adults are unable to read complex texts, including health-related materials. Arcane language and jargon that become second nature to doctors and nurses are inscrutable to many patients" (Nielson-Bohlman et al., 2004, p. xi). Health literacy involves the inability of many adults, even reasonably educated adults, to understand written health-related information. A key issue in health literacy is to find ways to write patient information text in a way that is more comprehensible and memorable. To date, efforts to do this have met with limited success.

One possible reason is that these efforts have not been guided by scientific theories of cognition in literacy. The principles of one such theory, DCT, were applied in this study (Sadoski & Paivio, 2001, 2004). The DCT principles involved making language incrementally more comprehensible and memorable by (a) reducing readability (i. e., word and sentence length) and (b) increasing the use of concrete language in order to evoke mental images in the mind of the reader. Based on these principles, three different WPEM versions were constructed and evaluated (WPEM-A, WPEM-B, and WPEM-C). WPEM-A was unmodified text without illustrations from a written patient

education material on BSE. WPEM-B had reduced readability levels. WPEM-C had reduced readability levels and increased use of concrete language. Effects were tested on the immediate recall (i.e., comprehension) and delayed recall (i.e., retention or learning) and both level of frequency and level of confidence toward BSE.

Immediate and Delayed Recall

The first three research questions were framed on the three different types of WPEM and the effects each type had on recall. The results indicated that participants who received WPEM-C that was modified by reducing readability levels and using concrete language recalled a greater percentage of idea units after the initial reading (immediate) and after a seven-day period (delayed). During immediate recall the group receiving WPEM-C was 12.78 percent higher than the group receiving WPEM-A, and 11.45 percent higher than the group receiving WPEM-B. During delayed recall, the trend was the same. Participants in the group receiving WPEM-C recalled a higher percentage of idea units than the participants in the groups receiving WPEM-A and WPEM-B by a little over seven percent each. The results of the Nelson-Denny Reading Comprehension Assessment indicated that all the participants had strong reading skills and that even though all the participants were good readers, recall scores were still lower when participants were given WPEM-A and WPEM-B.

As shown in Figure 1, the decline of recall between immediate recall and delayed recall for WPEM-C is greater than the immediate recall and delayed recall of WPEM-A and WPEM-B, indicating an interaction. However, the participants in the group for WPEM-C were still able to recall a significant amount more than those in groups for

WPEM-A and WPEM-B after a week. In fact, the participants in group WPEM-C recalled almost as much in delayed recall as did the participants in groups WPEM-A and WPEM-B at immediate recall.

This finding is pertinent to the field of medicine and efforts to improve WPEM. The results with WPEM-C were more successful than other efforts to improve WPEM have been. The effects of concrete language were large. This was predicted by DCT, an established cognitive theory, and therefore, should be broadly applicable in improving WPEM as it has been in other fields.

The finding that concrete language (WPEM-C) was the most recalled is also supported by previous research in medicine. In the Clark et al. (1999) study, the WPEM that consisted of both concrete graphics and concrete language was found to be more successful in immediate recall in comparison to WPEM that contained abstract graphics and/or abstract language. In the present study, WPEMs contained no graphics. When images are created based on concrete text alone, information is easier to recall in future instances.

DCT has also shown to be effective in comprehension and recall in other fields. For example, in their 1993b study, Sadoski, Goetz, and Fritz investigated the comprehensibility, interestingness, familiarity and memorability of both concrete and abstract text and found that concreteness was most strongly related comprehensibility and recall. Other researchers have shown that the images created from concrete text have been helpful in comprehension (Gambrell & Bales, 1986; Gambrell & Jawitz, 1993;

Horne, 1993; Long, Winograd & Bridge, 1989; Sadoski, 1983, 1985; Sadoski, Goetz & Fritz, 1993a, 1993b; Sadoski, Goetz, & Rodriguez, 2000; Sadoski & Quast, 1990).

It should be noted that memory decays as soon as attention is switched, and decays more over any period of time (Barrouillet et al., 2004). This trend can be altered if the information is "refreshed" through rehearsal or repeated exposure (Barrouillet et al., 2004). As can be seen by the present study, information was still recalled after a seven-day time period without repeated exposure, but much more information was recalled by participants who received WPEM-C (see Figure 1). WPEM-C contained concrete language that the participants could relate to and from which a higher percentage of idea units were recalled. The conceptual peg hypothesis asserts that memory is associative. Creating relevant images in the reader's mind allows the reader to make an association between the images and related information. This allows that information to be more easily recalled later.

As many researchers suggest, lowering the readability level of WPEM is a common strategy (e.g. Adkins et al., 2002; Wolf et al., 2007). Lowering the readability level alone was utilized in this study (WPEM-B, which was modified only by reducing the readability level of the original WPEM-A). This was not very successful here (see Figure 1).

Davis et al. (1990) found that a patient's reading level is on average three to four grade levels below their indicated educational attainment level, and there was a five- to seven-year discrepancy between the reading comprehension of an average patient and the ability levels needed to read written medical information. However, in this study,

participants read, on average, at a 15.8 grade level (third year of college, eighth month), and ranged from second year of college to post-baccalaureate levels of college. However, participants still struggled with recall when the readability level was lowered. For the participants in this study, reducing readability was not a factor in improving comprehension or recall of WPEM.

Other researchers have also indicated that lowering the readability level does not improve patient recall (Davis et al., 2002; Foltz & Sullivan, 1996; Lee, 1999; Moll, 1986; Stableford & Mettger, 2007). While many researchers have suggested that lowering the readability level will be the solution to all of the problems with WPEM (as discussed in the literature review), this is not the answer in its entirety.

Level of Frequency and Level of Confidence

The level of frequency of performing BSEs was reported by participants before they received a version of WPEM and at the meeting in which delayed recall was collected. The results indicated that there was no significant difference in the level of frequency of performing BSEs for any WPEM. Participants did not report performing the BSE significantly more or less frequently after they received the provided WPEM than they did prior to receiving the WPEM. This could be because one week was not enough time for participants to make a change in their level of frequency in performing BSEs. Current medical professionals recommend performing a BSE once a month. This is discussed later in the limitations.

Levels of confidence were also reported by participants before they received a pamphlet and at the meeting in which delayed recall was collected. The results indicated that confidence levels did rise after receiving the WPEM for each group.

Limitations and Recommendations for Future Research

The following list reflects major limitations encountered during this study. These limitations can be evaluated in future research.

1. *Sample*. One limitation of this study is the sample. While the point was to have educated participants to show that even those who are educated struggle with WPEM, the sample had little diversity and was one of convenience. The majority of the participants were native English speakers, very similar in age, and were all good readers (as indicated by the Nelson-Denny Reading Comprehension Assessment). Perhaps the version with reduced readability alone (WPEM-B) may have had more effect with those of more limited literacy. Future researchers could include more diverse participants, participants who are non-native English speakers, participants of a variety of ages, and participants who are less educated and less literate.
2. *WPEM and Graphics*. In this study, the WPEM did not include graphics. While text revision does not necessarily need graphics to be effective (as indicated by this study), graphics that are pertinent to the reading can support the mental images that readers form. Future research could expand on this study by including WPEM that contain graphics and analyze the possible differences between WPEM with graphics and WPEM without graphics.

3. *Frequency*. There was no significant difference between the reported level of frequency of performing BSEs before receiving a form of WPEM and seven days after receiving a form of WPEM. Doctors and most medical literature regarding BSEs encourage patients to perform BSEs once a month. The time period between the initial report of level of frequency and receiving a form of WPEM to the follow-up report of frequency was 7 days. Perhaps this was not a reasonable amount of time in which to look for change. Future researchers could extend the amount of time between the initial report of level of frequency and receiving a form of WPEM to the follow-up report of level of frequency.
4. *Confidence*. Levels of confidence increased overall regardless of form of WPEM with this particular sample. Future researchers could include an investigation as to why the confidence levels did not rise significantly in the group that received WPEM-C in comparison to the groups that received WPEM-A or WPEM-B. A limitation of the Wilcoxon is that interaction is not tested. It is assumed that levels of confidence would rise when participants are presented with WPEM-C as opposed to WPEM-A or WPEM-B because there was a significantly higher percentage of idea units recalled at both the immediate and delayed data collections.

The need for research in this area is critical. The majority of past research has relied solely on lowering the readability level of WPEM, and that continues to be

ineffective. This study has shown that an alternative, effective, and theoretically-based method may be available.

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APPENDIX A

CONSENT FORM
Improving written patient education materials through readability and concreteness

Introduction
The purpose of this form is to provide you information that may affect your decision as to whether or not to participate in this research study. If you decide to participate in this study, this form will also be used to record your consent.

You have been asked to participate in a research study that assesses your reading comprehension and recall for different formats of a breast self-exam pamphlet The purpose of this study is to find a more effective method to write such health care pamphlets. You were selected to be a possible participant because college level students have attained a particular level of education. Your level of education meets the criteria needed for this study. This study is being sponsored/funded by TCALL (Texas Center for Adult Learning and Literacy).

What will I be asked to do?
This study will take place on 3 days with 7 days in between each meeting.

If you agree to participate in this study, on Day 1 you will be asked to sign the consent form and complete a form that asks some background information. You will then be given a reading comprehension assessment.

On Day 2, (7 days later) you will receive a packet that contains a pamphlet explaining how to perform breast self-exams. You will have the opportunity to read your pamphlet After reading your pamphlet, you will report in writing what you remember about the information in the pamphlet

On Day 3, (7 days later) you will return and receive another packet You will report what information you can remember about your pamphlet, and you will also answer some follow up questions in regards to the pamphlets.

What are the risks involved in this study?
The risks associated in this study are minimal, and are not greater than risks ordinarily encountered in daily life.

What are the possible benefits of this study?
A possible benefit of participation is an increased understanding of how to perform breast self-exams. The possible benefit to society is an improved method of writing patient education materials that can be more easily comprehended and recalled than the current materials.

Do I have to participate?

No. Your participation is voluntary. You may decide not to participate or to withdraw at any time without your current or future relations with Texas A&M University being affected.

Will I be compensated?
There is no compensation for participating in this study.

Who will know about my participation in this research study?
This study, its data, and participants are confidential. The records of this study will be kept private. No identifiers linking you to this study will be included in any sort of report that might be published. Research records will be stored securely and only Rhonda Goolsby will have access to the records.

Whom do I contact with questions about the research?
If you have questions regarding this study, you may contact Rhonda Goolsby, 979.219.4664/979.845.7807, rhonda2000@tamu.edu or rhondagoolsby@gmail.com.

Whom do I contact about my rights as a research participant?
This research study has been reviewed by the Human Subjects' Protection Program and/or the Institutional Review Board at Texas A&M University. For research-related problems or questions regarding your rights as a research participant, you can contact these offices at (979)458-4067 or irb@tamu.edu.

Signature
Please be sure you have read the above information, asked questions and received answers to your satisfaction. You will be given a copy of the consent form for your records. By signing this document, you consent to participate in this study.

Signature of Participant: _____ **Date:** _____

Printed Name: _____

Signature of Person Obtaining Consent: _____ **Date:** _____

Printed Name: _____

APPENDIX B

PARTICIPANT INFORMATION SHEET

Name:_____

Age:_____

My first language was:_____.

Breast Self Exams

Please check all boxes that apply to you:

- ☐ (4) I have had treatment for breast cancer.
- ☐ (3) I have had breast lumps diagnosed as cancerous.
- ☐ (2) I have had breast lumps diagnosed as **non**cancerous.
- ☐ (1) I have found breast lumps.
- ☐ (0) I have never found lumps in my breasts.
- ☐ (0) I would prefer not to answer this question.

Please check the box that best describes you:

- ☐ (3) I perform breast self-exams often.
- ☐ (2) I perform breast self-exams occasionally.
- ☐ (1) I perform breast self-exams rarely.
- ☐ (0) I perform breast self-exams never.
- ☐ (0) I would prefer not to answer this question.

Please check the box that best describes you:

- ☐ (3) I am very confident that I can perform breast self-exams well.
- ☐ (2) I am confident that I can perform breast self-exams well.
- ☐ (1) I am somewhat doubtful that I can perform breast self-exams well.
- ☐ (0) I am not at all confident that I can perform breast self-exams well.
- ☐ (0) I would prefer not to answer this question.

APPENDIX C

BREAST SELF-EXAM (ORIGINAL)

- Lie down placing your right arm behind your head. Examine breast tissue while lying down, not upright. When lying down the breast tissue spreads evenly over the chest wall and it is as thin as possible making it much easier to feel all the breast tissue.

- Use the finger pads of the three middle fingers on your left hand to feel for lumps or masses in the right breast. Use overlapping small circular motions of the finger pads to feel the breast tissue.

- Use three different levels of pressure to feel all the breast tissue. Light pressure is needed to feel the tissue closest to the skin; medium pressure to feel a little deeper; and firm pressure to feel the tissue closest to the chest and ribs. If you're not sure how hard to press, talk with your doctor or nurse. Use each pressure level to feel the breast tissue before moving on to the next spot.

- Move around the breast in an up and down pattern starting at an imaginary line drawn straight down your side from the underarm and moving across the breast to the middle of the chest bone (sternum or breastbone). Examine the entire breast area going down until you feel only ribs and up to the neck or collarbone (clavicle).

- Repeat the exam on your left breast, using the finger pads of the right hand.

APPENDIX D

BREAST SELF-EXAM (READABILITY)

- Lie down. This exam is done when lying down, not when standing up. When the body is lying down the breast tissue spreads to an even thickness on the chest. This makes it easier to examine all the breast tissue.

- Put the right arm behind the head. Use the ends of the first three fingers on the left hand to feel the right breast. Feel for masses or thick lumps in the breast. Move the ends of the fingers in very small circles to feel all the breast tissue. Overlap the circles.

- Use three different levels of pressure to feel all the breast tissue. Use light pressure to feel the tissue at the top level. Use medium pressure to feel a little deeper. Use firm pressure to feel the tissue at the rib cage level. If you are not sure how hard to press, ask your doctor or nurse to show you how to do it. Use each pressure level to feel the breast tissue before moving on to the next part of the breast.

- Do the small circles up and down all the way across the breast. Start at your underarm and go down until only ribs can be felt. As you move across, go up and down from the clavicle to the lower rib cage.

- Repeat the exam on the left breast. Use the fingers of the right hand.

APPENDIX E

BREAST SELF-EXAM
(READABILITY AND CONCRETE LANGUAGE)

- Lie down. Do this exam while you are on your back, not standing up. When you are lying down your breast tissue spreads out thin and even over your chest. This makes it easier to feel around in your breast.

- Put your right arm behind your head. Use the finger pads of the first three fingers on your left hand to feel for lumps in your right breast. They might feel like hard little beans or peas. Move your fingertips in circles as big as a dime to feel the breast tissue. Overlap the circles making sure you cover all of the breast.

- You press three different ways to feel all your breast tissue. You press lightly to feel the tissue closest to the skin. You press a little harder to feel the deeper flesh. You press firmly to feel the tissue down close to the bones. If you are not sure how hard to press, ask your doctor or nurse. Press each different way to feel all your breast tissue before moving to the next spot.

- Do the dime-sized circles up and down across your breast. First, begin at your underarm and go down until you feel only ribs. Then, go from your ribs up to your collarbone. Go up and down like a lawn mower.

- Repeat the exam on your left breast, using the finger pads of the right hand.

APPENDIX F

Participant Name: _____

BREAST SELF-EXAM - RECALL

Please write all of the information you can remember from your pamphlet

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APPENDIX G

PARTICIPANT INFORMATION SHEET
FOLLOW-UP

Name:_____

Breast Self Exams

Please check the box that best describes you:

- ☐ (3) I perform breast self-exams often.
- ☐ (2) I perform breast self-exams occasionally.
- ☐ (1) I perform breast self-exams rarely.
- ☐ (0) I perform breast self-exams never.
- ☐ (0) I would prefer not to answer this question.

Please check the box that best describes you:

- ☐ (3) I am very confident that I can perform breast self-exams well.
- ☐ (2) I am confident that I can perform breast self-exams well.
- ☐ (1) I am somewhat doubtful that I can perform breast self-exams well.
- ☐ (0) I am not at all confident that I can perform breast self-exams well.
- ☐ (0) I would prefer not to answer this question.

APPENDIX H

WPEM-A IDEA UNITS

Bullet 1:

- Lie down
  - Place arm
    - Right
  - Behind your head
- Examine tissue
    - Breast
  - While lying down
    - Not upright
- Tissue spreads over chest wall
    - Breast
  - When lying down
- It is thin
    - As possible
  - Making it easier
    - Much
  - Feel all tissue
    - Breast

Bullet 2:

- Use finger pads
    - 3 middle fingers
  - hand to feel lumps/masses
    - left
  - breast
    - right
- Use motions
  - of the finger pads
    - Overlapping
    - Small
    - Circular
  - Feel tissue
    - Breast

Bullet 3:

- Use levels of pressure
    - 3 different
  - To feel all tissue

        - Breast
- Pressure is needed
        - Light
    - To feel tissue
    - Closest to skin
- Pressure to feel
        - Medium
        - Deeper
        - A little
- Pressure to feel tissue
    - Firm
    - Closest to chest and ribs
- Talk with doctor/nurse
    - If you're not sure
        - how hard to press
- Use each pressure level
- Feel the tissue
        - Breast
    - Before moving
    - to the next spot

Bullet 4

- Move around the breast
    - Up and down pattern
- Start at line
        - Imaginary
    - Drawn down your side
        - Straight
        - From underarm
    - Moving across the breast
        - To the middle of the chest bone
        - Sternum
        - Breastbone
- Examine the area
        - Entire
        - Breast
    - Going
        - Down
    - until you feel ribs
    - Up to the neck
        - Collarbone
        - Clavicle

Bullet 5:

- Repeat exam
    - On breast
        - Left
- Using finger pads
    - On the hand
        - right

APPENDIX I

WPEM-B IDEA UNITS

Bullet 1:

- Lie down
- Exam is done
    - When lying down
    - Not standing up
- Tissue spreads even
        - Breast
        - Thickness
    - On chest
    - When body is lying down
- This makes it easier
    - To examine tissue
        - Breast

Bullet 2:

- Put arm
        - Right
    - Behind the head
- Use the ends of fingers
        - First three
    - On hand
        - Left
    - To feel
        - the breast
        - Right
- Feel
    - Masses and lumps
        - Thick
    - In the breast
- Move fingers
        - Ends of
    - Circles
        - Very
        - Small
    - To feel all tissue
        - Breast
- Overlap the circles

Bullet 3:

- Use levels of pressure
    - Different
    - Three
    - Feel all tissue
        - Breast
- Use pressure
    - Light
    - Feel the tissue
    - At the top level
- Use pressure
    - Medium
    - To feel deeper
        - A little
- Use pressure
    - Firm
    - To feel tissue
    - At the rib cage level
- Ask the doctor or nurse
    - To show you
    - How to do it
    - If you are not sure
        - how hard to press
- Use pressure level
    - Each
    - To feel tissue
        - Breast
    - Before moving on
    - To the next part of the breast

Bullet 4:

- Do the circles
    - Small
    - Up and down
    - Across the breast
- Start at underarm
    - Down
    - Until ribs felt
- Go up and down
    - From clavicle
    - To the lower rib cage
    - As you move
        - Across

Bullet 5:

- Repeat exam
    - On breast
        - Left
- Using finger pads
    - On the hand
        - Right

APPENDIX J

WPEM-C IDEA UNITS

Bullet 1:

- Lie down
- Do this exam
  - While you are on your back
  - Not standing up
- Tissue spreads out
    - Breast
    - Thin
    - Even
  - When you are lying down
  - Over your chest
- This makes it easier
  - To feel around
  - In your breast

Bullet 2:

- Put your arm
    - Right
  - Behind your head
- Use finger pads
  - First, three fingers
  - On hand
      - Left
  - To feel for lumps
  - In breast
      - Right
- They might feel
  - Like beans
  - Peas
      - Hard
      - Little
- Move fingertips
  - In circles
  - As big as a dime
  - To feel tissue
      - Breast
- Overlap the circles
  - Cover all of the breast

Bullet 3:

- Press different ways
    - 3
    - To feel all your tissue
        - Breast
- You press lightly
    - To feel tissue
    - Closest to the skin
- You press harder
    - A little
    - To feel flesh
        - Deeper
- You press firmly
    - To feel tissue
    - Down close to the bones
- Ask your doctor or nurse
    - If you are not sure how hard to press
- Press each different way
    - To feel all your tissue
        - Breast
    - Before moving to the next spot

Bullet 4:

- Do the circles
    - Dime-sized
    - Up and down
    - Across the breast
- Begin at the underarm
    - Go down
    - Until you feel only ribs
- Go from the ribs
    - Up to your collarbone
- Go up and down
    - Like a lawnmower

Bullet 5:

- Repeat exam
    - On breast
        - Left
- Using finger pads
    - On the hand
        - Right

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