I, Marnie J Meylor, hereby submit this original work as part of the requirements for the degree of:

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Student Signature: Marnie J Meylor

This work and its defense approved by:

Committee Chair: Paul Zender, MFA

Marnie J Meylor
Design Guidelines for the use of Visualization Strategies in Health Education Materials

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Marnie J. Meylor
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Thesis Committee:
Mike Zender, MFA
Dennis Puhalla, Ph.D.
Oscar Fernández, MFA
Abstract

In today’s specialized medical environment, where patients often consult a variety of healthcare professionals about a single condition, it is becoming increasingly crucial for a patient to be more actively involved in his or her healthcare. This can include many complicated tasks such as understanding a diagnosis, evaluating the risks and benefits of treatments, and comprehending medication side effects. In the United States, nearly half of the population is unable to fully participate in the healthcare system due to language, literacy, and health literacy barriers. However, numerous research studies show that the use of images in health education materials has shown improvement on patient recall, comprehension, attention, and adherence, thereby mitigating these barriers. The visuals used in these studies underwent a visual analysis where key visual communication criteria were evaluated: aesthetics, clarity, legibility, organization, and appropriateness. From this analysis, a series of key visual communication guidelines were developed. This thesis suggests, discusses, and then visually demonstrates these guidelines, while suggesting the potential impact each can have on patient understanding.
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Design Guidelines for the use of Visualization Strategies in Health Education Materials

1.0 Introduction

In today’s healthcare system, it is becoming increasingly critical for a patient to play an active and participatory role in his or her health. This includes a multitude of tasks: understanding a diagnosis and its symptoms, evaluating the risks and benefits of a treatment, comprehending the side effects of a particular medication, being familiar with billing and insurance issues, and countless other related tasks. The intellectual demand for many of these tasks is high for even the most highly educated person (Hill, 2004, p. 5), and, for many, these tasks may prove to be too difficult. Several of these challenges are a consequence of inadequate communication. Studies have shown there are several barriers hindering the communication between healthcare provider and patient. In the United States, there are many people less able to access the healthcare system due to language, literacy, health literacy, and other barriers. These barriers can cause a lack of understanding and may ultimately result in negative health outcomes. Research suggests that the use of images in health education materials can have a positive impact on several dimensions of patient understanding: attention, comprehension, recall, and adherence (Houts et al., 2006). By
increasing patient understanding, it is possible to reduce medical errors, decrease patient anxiety, lower healthcare costs, reduce the burden on translators and healthcare providers, improve patient satisfaction, and ultimately empower the patient. A first step in examining this is to discuss a few of the existing challenges and barriers already present in healthcare communication. This thesis investigates means to improve health care visual communication through a review of research of visual communication material, an analysis of these in light of published principles of good visual communication, and a proposal to use a key set of visual communication guidelines to improve future visual communication health care material development.

The guidelines depicted in this thesis are intended to be used as a resource for both healthcare providers and designers first to recognize and understand the common problems found in traditional visual health education materials, and then be provided with a series of clear and easy to understand suggestions for enhancing the aesthetics, clarity, legibility, organization, and appropriateness of these communication materials, creating materials that are more visually engaging and functional.

2.0 Recognizing the Current Barriers in Health Communication

In order to begin improving the communication process between healthcare providers and their patients, first it is important to understand the primary barriers currently hindering this communication. While there may be many factors influencing the communication process during healthcare interactions, this paper provides a brief background focusing on the language, literacy, and health literacy barriers commonly experienced by patients in the United States.
2.1 Language Barriers

In 2008, according to the U.S. Census bureau, over 24.1 million Americans (8.6% of Americans) over the age of 5 reported speaking English less than “very well” (U.S. Census Bureau, 2008). Spanish speakers, the largest language group other than English speakers comprises 12.2% of the population or over 33.2 million people. Of this group, 47.2% reported speaking English less than “very well” (U.S. Census Bureau, 2008). While length of time in the U.S. among these individuals varies from newly arrived immigrants to those who have been here more than a generation, newcomers are most likely to be unfamiliar with the United States healthcare system and are likely to “lack adequate knowledge to make informed decisions about their own health” (Martinez, 2007, p. 359). Unfortunately, these newcomers, frequently working dangerous jobs and living in poverty, often tend to need health services the most (Martinez, 2007, p. 359).

Language barriers in healthcare can have disastrous effects on the standard care of the patient. According to Glenn Flores (2006), who studies the effects of language communication barriers in the healthcare environment, “Patients who face such barriers are less likely to have a usual source of medical care; they receive preventative services at reduced rates; they have an increased risk of nonadherence to medication” (p.230). Flores also states: “Such patients are less likely than others to return for follow-up appointments after visits to the emergency room, and they have higher rates of hospitalization and drug complications. Greater resources are used in their care, but they have lower levels of patient satisfaction” (p. 230). Additionally, studies have found that patients not sharing the same language as their doctor were also not apt to obtain lifestyle counseling on issues such as exercise, smoking cessation, and diet and nutrition (Greenfield et al., 2007). Moreover, there have been several cases where simple one or two word misunderstandings have had injurious consequences for the patient or patient’s family. In one
instance described by Flores (2006), a Spanish-speaking woman informed the physician that her young daughter had “hit herself” when falling off her bicycle. Misunderstanding two words in this explanation, the physician believed the child was being abused, contacted the Department of Social Services, and had the two children removed from the mother’s possession (p. 229). Other cases have been reported with even more drastic consequences resulting in huge, expensive malpractice settlements (Flores, 2006, p. 230).

One possible solution to these language issues is interpretive services. In one study by Flores (2005) that reviewed a large variety of literature discussing the effects of language interpreter services on the overall quality of patient care, patients who were unable to receive these services often “have a worse understanding of their diagnosis and treatment; more often wish that their provider had explained things better; have more tests done at a higher overall cost; are more likely to receive intravenous hydration and to be hospitalized; are at greater risk of being discharged from the emergency department without a follow-up appointment; often experience delays in treatment initiation, management, and discharge from the hospital; and are least satisfied with their care” (p. 294).

Unfortunately simply having another person in the room sharing the same language as the patient is not enough to fix these issues. It is very common for non-English speaking patients to use “ad hoc” interpreters: friends, family members, children, untrained staff members, or strangers in the waiting room (Flores, 2006, p. 231). According to Flores (2005), this can have the following adverse effects:

“a lower likelihood of having medication side effects explained; a high risk of interpretation errors, omissions, distortions, redundancy, and irrelevant questions; a greater likelihood of committing interpreter errors with potential clinical consequences; decreased satisfaction with care; and distortions in psychiatric encounters associated with overidentification, normalization of pathologies, interpretation errors, and inaccurate assessment of affect and thought processes.” (p. 294)
Using children as translators can have particularly negative effects “including not interpreting perceived embarrassing but important clinical questions and frequent interpreter errors of potential clinical consequence” (Flores, 2005, p. 295).

Qualified interpretive services are essential for conquering language barriers in healthcare; however, these qualified interpreters can be expensive and difficult to find. They must not only be fluent in the patients’ languages, they must also be proficient in medical terminology and issues of patient confidentiality. While many states offer reimbursement to hospitals providing these services, there are many hospitals and clinics that still cannot afford to make these services readily available to patients (Flores, 2006). Because of the difficulty in obtaining quality translation services, the use of additional visual health education materials could potentially be extremely beneficial to both the patient and the healthcare provider by presenting a link between both visual and verbal information as well as providing the information in physical form that can be referenced in the future.

2.2 Literacy and Health Literacy Barriers

Simply speaking the same language as one’s medical provider is not enough to fully comprehend and access the American healthcare system. While there are 24.1 million (U.S. Census Bureau, 2008) Americans unable to fully participate due to language barriers, there are millions more who cannot due to literacy and health literacy barriers. These barriers critically inhibit patients from being able to fully navigate the healthcare system to their utmost advantage and can have overwhelmingly negative affects on health outcomes (Kutner, Greenberg, Jin & Paulsen, 2006).

Literacy and health literacy are interrelated yet distinct barriers affecting many Americans today. It is important to understand that health literacy can affect nearly anyone...
regardless of literacy and education level because it is a combination of skills, both verbal and quantitative. The World Health Organization defines health literacy as “the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health” (“Track Two,” 2009). Health literacy also involves having quantitative abilities, or numeracy, to “locate numbers within graphics, charts, prose, texts, and documents; to integrate quantitative information from texts; and to perform appropriate arithmetic operations on text-based quantitative data” (Schwartzberg, VanGeest & Wang, 2005, p. 5). Adequate literacy and health literacy skills are essential for successfully participating in one’s own health care. The text, Understanding Health Literacy (2005), delineates many of these tasks:

- Functional health literacy also involves accessing, understanding, and applying health information received from other nonclinical sources and settings, such as reading and understanding newspaper and magazine articles about emerging infections disease threats; searching for online health information and assessing its accuracy and credibility; using problem-solving skills to compare the nutrition information of foods in the grocery store; reading and comprehending labels on the thousands of perceived ‘harmless’ over-the-counter drugs; and critically considering the messages within televised advertisements for health care products and services. (Schwartzberg et al., p.4)

These tasks do not solely involve self-care; many people lacking these skills are responsible for the care of others. For instance, parents must care for children by taking them to the physician to be examined and immunized; many adult children are responsible for managing the complex health issues of elderly parents (Kutner, Greenberg, Jin & Paulsen, 2006, p. iv).

Regrettably, when considering the issue of low literacy alone, the number within the United States is staggering. According to the National Assessment of Adult Literacy (NAAL), 30 million or 14% of Americans have a literacy level in the “below basic” category; 63 million or 29% perform at a “basic” level (2003). Population subgroups that showed lowest literacy scores were the elderly, immigrants, ethnic minorities, people with little education, prisoners, and
military recruits (Schwartzberg et al., p.18). While these groups had high levels of low literacy, it is vital to take into account “that the majority of individuals in the United states with limited literacy were white, native-born Americans” (Schwartzberg et al., p.19). These levels are defined by the NAAL as the following:

- Below Basic: more than the most simple and concrete literacy skills
- Basic: can perform simple and everyday literacy activities

Studies have indicated that in order to actively partake in healthcare decisions and to navigate the healthcare system, literacy levels in these two categories are simply not enough (NAAL, 2003).

When assessing the health literacy of Americans, the NAAL (2006) found that “the majority of adults (53%) had “Intermediate” health literacy. An additional 12% of adults had “Proficient” health literacy. Among remaining adults, 22% had “Basic” health literacy, and 14% had “Below Basic” health literacy” (Kutner et al., 2006, p. v).

The following examples depict these two levels:

1. Given the standard grid for body mass index, the “basic” and “below basic” groups would be unable to identify the health weight range for a person of a given height. (Hughes, 2007, p. 450)

2. Based on the information on a prescription drug label regarding the timing of this medication with meals, the subjects in these two groups would be unable to determine an appropriate time to take the medication. (p. 450)

This study also found that those living in poverty had on average lower health literacy than adults not living in poverty (p. v). The study also revealed that: “Adults who were ages 65 and older had lower average health literacy than adults in younger age groups. The percentage of adults in the 65 and older age group who had ‘Intermediate’ and ‘proficient’ health literacy was lower than the comparable percentage of adults in other age groups” (p. v). In fact, 29% of adults over the age of 65 had “Below Basic” health literacy, and 30% had Basic health literacy (p. 12).
This is particularly challenging because the elderly typically have more complicated diagnoses and treatment regimens.

These high rates of low health literacy in the general American population as well as disadvantaged population subgroups are problematic, because “poor health literacy is associated with poor communication between patients and health care providers and with poor health outcomes, including increased hospitalization rates, less frequent screening for diseases such as cancer, and disproportionately high rates of disease and mortality” (p. 1). Further complicating this issue is the difficulty health professionals have in identifying individuals with low literacy and health literacy, because many patients are reluctant and embarrassed to expose their literacy inadequacies (Hill, 2004, p. 4). Many patients refused to disclose their lack of literacy for fear being labeled “stupid” or “incompetent.”

While health education efforts are critical to helping more Americans access their health information and play an active role in their own healthcare, additional efforts must be utilized to ensure active participation by all population subgroups. Multiple studies have shown that the use of visual health education materials has had a positive influence on people with low literacy and health literacy in the attention, recall, comprehension, and adherence to a variety of health instructions (Houts, Doak, Doak & Loscalzo, 2006).

It is important to understand that these barriers do not occur independently — these language, cultural, literacy and health literacy barriers often occur in an amalgamation. When one patient lacks English proficiency, it is not unlikely that he or she lacks the literacy and health literacy capabilities needed to participate fully in the health system.
2.3 Other Barriers

While there is plenty of evidence supporting the use of visualization strategies in reducing the barriers in health communication, there is little doubt that the benefits of their use can also be extended to the broader population. One does not need to be classified illiterate, poorly educated, or have limited language abilities to have difficulty understanding health information. There are many other factors that can hinder understanding and comprehension for even the most educated or intellectual person. Patient-provider interaction is frequently very quick and full of new and often frightening information. Even someone with high language proficiency can be unfamiliar with difficult medical terms, which can become increasingly problematic if he or she is engrossed in his or her own symptoms (Houts et al., 2006, p. 174). Also, the stress and anxiety of a frightening diagnosis can often distract a patient or cause him or her to be overloaded with information. Houts et al. elaborates on these additional complexities:

“This is, in part, caused by the tendency of health professionals to use the same technical terminology and complex sentence structures in communicating with patients that they use in communicating with their professional peers. Another reason is the inherent complexity and uncertainties involved in the topics being discussed. As a result, health professionals may qualify statements and speak in broad generalizations to patients who want specific information that applies to them, personally. At the same time, patients are in a stressful environment where there is a power imbalance, educational imbalance, and where they are fearful of appearing stupid and fearful of rejection or abandonment. As a result, they are hesitant to admit that they do not understand directions or the reasons for medical interventions.” (Houts et al., 2004, p. 177)

These obstacles, in combination with the movement toward shortened hospital stays, the increasing complexity of treatment and discharge instructions, and the rapid proliferation of unverified, self-authored information on the Internet, patients, caretakers, and the general public at large are experiencing a greater need than ever for the improved delivery of health information. One promising solution is the use of pictures in support of text-based and spoken instructions. When an image is well designed, it has the potential to “minimize the extraneous
cognitive demands placed on patients and free up their mental resources to better process important information” (Wilson & Wolf, p. 320, 2008).

One potential solution to these barriers is the use of visuals to communicate health information. These visual have the potential to impact patient understanding on several levels: through increasing patient attention, comprehension, recall, and adherence. The following section will describe these dimensions in greater detail, while discussing the impact several published studies examining the affects of using images to convey health information have had on these four dimensions.
3.0 Criteria for success

If images and visualizations are to be used effectively to communicate health related information, it is important to have criteria to measure success. For judging the effectiveness or ineffectiveness of the use of visualizations in health education material, Houts et al. (2006) delineates four separate dimensions of understanding: attention, comprehension, recall, and adherence (p. 174). These criteria are interconnected, and if one is missing, it could hinder the success of another. For instance, a patient who does not notice his or her instructions cannot comprehend, remember, or adhere to the recommendations given.

These dimensions of understanding health information are closely related to the model of understanding discussed in Richard Saul Wurman’s book, Information Anxiety (2001). This model describes the process of understanding as a “continuum from data to wisdom” (p. 27). The first step of this process is data, which are unconnected signals or factoids that have no context or intent to teach (p. 28). Information is the organization and contextualizing of this data into concepts with meaning (p. 28). This information can then begin to be experienced, analyzed, and explored in a way that produces knowledge (p. 28). This difference between information and knowledge is illuminated:

“What most differentiates knowledge from information is the complexity of the experience used to communicate it. By necessity, knowledge can only be gained by experiencing the same set of data in different ways, and, therefore, seeing it from different perspectives. This is also why education is so notoriously difficult: because one cannot count of one person’s knowledge to transfer to another. We all must build it from scratch ourselves through experience – and not, ultimately, through books. Only through multiple experiences and questioning can we see patterns that mark knowledge’s trail. It is these patterns of information that define knowledge and allow us to not only understand the subjects better, but understand those patterns so that we can use them in different context with different subjects.” (Wurman, p. 29, 2001).

Ultimately, wisdom is considered the optimum level of understanding where “the processes of introspection, pattern-matching, contemplation, retrospection, and interpretation” are
incorporated to form personalized and novel interpretations of knowledge (Wurman, p. 29, 2001).

The following paragraphs explain the four quality measurements used to evaluate the effectiveness of health education materials, as well as their significance to the development of patient understanding and compliance.

3.1 Dimensions for Understanding Health Education Materials

Illustration 3.1: Dimensions of Understanding. This illustration depicts the correspondence between the four dimensions involved in understanding health education materials and the components of the continuum of understanding ranging from data, to information, to knowledge, and then to wisdom.

3.1.1 Attention

In order for health education material to improve patient comprehension, recall, or adherence, they must be noticed first. Attention refers to the material’s ability to draw the users’ interest and
persuade them to interact with the information. While attracting the patient’s attention may seem the simplest element in the communication process, it is an important first step in guiding the patient to perform the most appropriate and beneficial health behaviors.

3.1.2 Comprehension

Comprehension refers to the patient’s ability to understand and grasp the content presented in health education materials. It refers to “the process of interpreting the meaning of words or pictures to understand their collective meaning” (Houts, 1996, p. 178). It is important to distinguish between comprehension and recall because it is possible for one to remember a concept without actually understanding it (p. 178). Several of the studies examining the effect of images used in health education materials fail to make this distinction, and report studying patient comprehension, when in actuality they were studying the patient’s ability to retain the information. While it can be difficult for anyone to understand the complex language and broad generalizations often used in healthcare communication, people experiencing literacy and language barriers are especially at risk for not being able to comprehend their health recommendations (Houts, 1996, p. 177). While simplified language and the use of translation services has shown to improve comprehension to some extent, there is still a need for other methods and combinations of methods to continue this improvement.

3.1.3 Recall

It is not uncommon for a patient to have to manage more than one health condition, treatment, or medication. As health instructions become more complicated, the harder it can be for a patient to remember what action she or he should take. This can make it difficult not only for a patient to
manage his or her own illness, but for a caretaker or family member to manage the illnesses of loved ones. Because most important health information is spoken only once (Houts, 1996, p. 182), it can be extremely easy for a patient or caregiver to quickly forget most of what they have been told. As the illness becomes more complicated or the patient or caregiver becomes more anxious it can become increasingly difficult to remember important information. According to Houts et al., recall needs to be considered in two separate categories: free recall and cued recall. “Free recall occurs when a patient reads or hears information about a health problem and, later, without any pictures or cues, remembers that information in deciding what action to take or to tell to other people” (p. 182). “Cued recall occurs when a patient reads or hears health information with an accompanying picture and later views the same picture to help remember the information” (p. 182).

### 3.1.4 Adherence

Once a message is noticed, comprehended, and remembered, the most critical step is to actually adhere to or comply with the message and perform the advised behavior (Houts et al., 2006, p. 185). In order for a patient to be adherent, he or she needs to be convinced that the behavior is correct, appropriate, and beneficial, and must consistently behave according to the instructions given to him or her. Non-adherence can be extremely costly to the patient, and could result in decreased quality of life, increased healthcare costs, decreased medication effectiveness (Bauman E, Massicotte MP & Ray L, 2007, p. 198). According to the review by the World Health organization there are five dimensions that determine adherence: “Social and economic, health system/health teams, condition-related, therapy-related, and patient-related (Bauman et al.,
When a patient fails to comply with medical instructions, it can be due to a complex interaction of these factors.

The following section is a review of the literature discussing the impact of health education materials incorporating pictures has on these four dimensions of understanding.

3.2 Literature Review

A search of published literature discussing the effect of incorporating pictures in health education materials generated 50 items. Several databases were searched including PubMed, Oxford Reference Online, PsycINFO, Education Research Complete, and WOK Web of Science: Science Citation Index expanded, among others. The following search terms were used: “pictograms, icons, visualizations, images, pictures, and symbols” in “health education, medicine, pharmacy, pharmacology, health promotion, and public health.” Of this literature, most compared the effect on patient attention, comprehension, recall, and adherence between text only instructions and instructions incorporating images.

One health education study that compared the ability of text-based communication materials to attract patients’ attention against materials combining text with images, conducted by Delp and Jones (1996), examined the attention, recall, and adherence of 234 emergency room patients receiving wound care instructions. Half of these patients were randomly selected to receive text only instructions, and the other half received information that included text plus pictures. The text was identical for both groups and written at a seventh grade reading level. Three days after receiving the instruction sheets, the patients received a telephone survey asking whether they read, understood, and followed the instructions. Approximately 12 percent of the patients contacted did not read the instructions; 93 percent of those patients who did not read the
instructions received the text-only instructions (Delp & Jones, 1996). This study also demonstrated that the 97 percent of the patients who received the text + pictures instructions were “very satisfied” with the material, in contrast to 66 percent in the text-only group. 98 percent found the text + pictures instructions “easy to read” as opposed to 64 percent in the other group (even though the text was identical in both groups). Astoundingly, 46 percent of patients receiving the text + pictures instructions were able to answer all of the wound care questions correctly, where only 6 percent gave correct answers in the text-only group. 77 percent of patients receiving instructions with pictures reported to have followed the wound care instructions entirely. 54 percent of those receiving instructions with no illustrations could report the same behavior. (Delp & Jones, 1996, 267-8)

In another study, by Houts, Bachrach, Witmer, Tringali, Bucher, and Localio (1997), participants with low reading levels were presented with a series of two medical action items: “call the doctor if white patches appear on the gums or mouth”, and “rinse the mouth with baking soda after eating” (p. 85). Half of the participants received “pictographs” or pictorial symbols along with spoken instructions; the other half was presented with only spoken instructions. After hearing these instructions, both groups were exposed to distracting music videos, and were then presented with a series of questions testing their recall of the medical instructions. All participants receiving the pictographs had higher recall scores than the subjects receiving only spoken instructions. In fact, the lowest recall score from the participants receiving pictographs was “higher than the highest recall score without pictographs” (Houts et al., 1997, p. 85).

One additional study by Austin, Matlack, Dunn, Kesler, and Brown (1995) that examined the effect of using pictures to communicate wound care information, 54 patients received instructions with pictures and 47 patients received text only instructions. These patients were
later given a ten-question assessment of their comprehension of the instructions. Patients who received wound care instructions with illustrations were “1.5 times more likely than patients without illustrations to choose five or more correct responses” (p. 319). The amount of correct responses varied between demographic groups. For instance, 65 percent of white participants receiving no illustrations selected five or more correct responses on the questionnaire, as opposed to 71 percent of white patients receiving illustrations reporting similar scores (p. 319). The results for the non-white demographic group were more drastic: only 28 percent answered five or more questions correctly with no illustrations, and 58 percent received this score when presented with illustrated instructions (p. 319). This improvement in comprehension for patients receiving illustrations was similarly drastic in the “High school education or less” demographic group and with females. (p. 319).

These images, along with other images collected during this review of published literature, then underwent a visual analysis.

3.3 Categorization of Images from Literature Review

In order to conduct a thorough visual analysis and inventory of the images found within the published literature, three categories materialized: Non-Sequential, Sequential, and Topological. The first category, non-sequential, refers to images that communicate independently, and whose meaning is not entirely dependent upon the temporal or special connection between adjacent images. This visualization method, because concepts need to be communicated instantaneously, can be the most difficult to generate consistent and successful understanding among viewers. Examples of health education materials that utilize this non-sequential method are pharmaceutical warnings or side effect icons.
Illustration 3.3.1: USP Pharmacology Symbol. This illustration is an example of a Non-sequential visualization

Another method used consistently to communicate health concepts is the *sequential* method. This method normally depicts sequential or narrative information, and is closely linked to storyboarding or comic books. It is usually a series of images that have a temporal or spatial relationship to each other. Any type of sequential instruction, like how to treat a wound or how to administer medication would fall in to this category.

![Administration of Insulin](image)

Illustration 3.3.2. Administration of Insulin. This illustration is an example of a Sequential visualization. (*Teaching Patients with Low Literacy Skills*, Doak, Doak, & Root. p. 104)
The last category is the *Topological* category refers to “the way in which constituent parts are interrelated or arranged” (“Topology,” 2005) and includes visualizations that depict an overview or pattern in space or time. This method tends to be the most abstract, but can be a powerful tool for representing any processes, trends, patterns or systems. Some examples of this method used in health education would be a diagram depicting the human digestive system, a medication schedule, or a chart depicting body mass index. These methods do not need to be used exclusively; in fact, it may be more effective to use a combination of methods to communicate a health concept. For instance, when communicating insulin treatment information to a diabetic person or her family member, it may be useful to combine all three methods: the sequential method could be used to demonstrate the injection itself, the non-sequential method could be used to communicate any warnings, side effects, or precautions, and the topological method could be used to give an overview of the body and the locations where the injections can occur.

In the following section, the examples of health education materials using images found during the literature search are categorized based on these three classifications and are then further analyzed in terms of several quality determinants.
Illustration 3.3.4: Diagram of the Three Visualization Categories
4.0 Critique of Health Education Materials

4.1 Analysis Criteria

Once these images were organized into their respective categories, they were then analyzed for their overall quality. Centered on the broad issues of appearance, function, and relevance, these quality judgment criteria include: aesthetics, legibility, clarity, organization, and appropriateness. These criteria are defined as follows:

**Aesthetics** refers to the viewer’s perception of beauty or attractiveness within a work of art or design (Ocvirk, 2005, p. 7). While this complex term is often viewed as highly subjective, the aesthetics within a visual communication piece can be affected by the careful manipulation of design principles and elements, such as visual hierarchy, balance, proportion, rhythm, unity, and variety.

**Clarity** is primarily concerned with the overall usability and intuitiveness of a visual communication piece. It refers to the careful arrangement and organization of visual forms such that it communicates with as little ambiguity as possible. For visual communication to have clarity, it must present its content in a way that is straightforward and natural to viewers.

**Legibility** is controlling the attributes within a visual communication piece in order to make its contents visibly readable or decipherable to the viewer. Several design principles such as contrast, proportion, and economy can impact legibility. The appearance of legibility is also dependent upon the visual and perceptual abilities of the viewer. For instance, designs intended for an elderly audience may potentially require higher contrast and larger type sizes due to vision impairments common within that demographic.

**Organization** refers to the appearance of structure or order within a visual communication composition. This organization is critical when designing because “the organization of content directly affects our ability to receive a message. If the information appears jumbled or overwhelming, many viewers ‘disconnect’ before a transmission is completed” (Visocky O’Grady, 2008, p. 80). This appearance of organization can affect the overall clarity of a piece by allowing a user the opportunity to navigate its content with ease. Careful organization of visual and verbal content through the use of visual hierarchy and grid structures allows viewers to grasp content in a controlled sequence as opposed to overwhelming the viewer with the content all at once. Grid structures are “an essential aesthetic device that will allow the designer to walk the reader through the content, one specific message at a time, without actually being there. Grid systems allow
the designer to create visual clarity through organization, movement, and grouping” (Visocky O’Grady, 2008, p. 98).

**Appropriateness:** Lastly, for an information design piece to be effective, it needs to be appropriate to the audience to whom it is communicating. This refers to understanding viewers’ cultural and educational needs, expectations, and limitations. Designers need to be especially mindful of this particular criterion because, while it can be the most difficult to predict or control, oversights can potentially alienate or offend viewers.

These analysis criteria were chosen because of their hypothesized ability to affect the four dimensions of understanding health education materials (discussed in Chapter 3.1). Because these four dimensions successively build upon each other, adherence, the most difficult level of understanding to achieve, because it requires a viewer’s attention, comprehension, and recall of the information to occur, necessitates the occurrence of every quality criteria. The model below demonstrates (Illustration 4.1) how these quality criteria align with the dimensions of understanding.

**Illustration 4.1:** Correspondence of Dimensions of Understanding with Quality Criteria
4.2 Critique Strata

The health education materials were then analyzed on four separate strata ranging from the elemental level to holistic, macro level (Illustration 4.2.1). These strata depict the careful arrangement of numerous primitive visual forms: color, value, point, line, and shape that constitute representational images that then interact to produce visual compositions, such as those used in health education materials. Considering the full range of strata ensures all relevant visual forms will be evaluated – from elemental primitive forms to complex combinations of these forms.

Illustration 4.2.1: Organizational Strata

These four strata are designated as Graphic Primitives, Interaction of Primitives, Graphic Image Representation, and Image Display Techniques. *Graphic Primitives* refers to the isolated components that combine to create works of design. These primitives can include shape, color, line, volume or texture. *Interaction of Primitives* refers to the initial combination and intersection of these primitives and the range visual and communication effects that result from their interaction. *Graphic Image Representation* refers to the arrangement of graphic primitives in way that creates representational or recognizable pictures, signs, or symbols ranging from highly photorealistic to reductive and minimal. Lastly, *Image Display Techniques* refers to the arrangement or presentation of images on a page or in relation to other images or visual forms.
such as typography. These four strata affect the performance of the analysis criteria in varying degrees. For instance, organization is primarily a function of image display techniques.

These organizational strata affect each of the analysis criteria in varying degrees. The following illustration demonstrates this correspondence in greater detail:

![Illustration](image-url)

Illustration 4.2.2 Dimensions of Understanding with Analysis Criteria and Corresponding Critique Strata

### 4.3 Critical Analysis

Using this organization, the visual examples found during the literature search of health education materials incorporating images were sorted into the three visualization categories discussed in Chapter 3.3: Non-sequential, Sequential, and Topology. The following figures (Illustrations 4.2.3, 4.2.4, and 4.2.5) display the overall criticisms and praises of these examples.
Illustration 4.2.3: Non-Sequential Analysis

CRITICISMS

- No evidence of color use or grayscale (all except O)
- Single value to represent actions or concepts (all)
- Literal representation of actions (A, B, F, H, M, N, R)
- No type to support images (all except P-W)
- No visual hierarchy, everything reads on one visual layer (all)
- Excessive use of boundary lines that overwhelm primary content (A, C-O)
- Excessive use of line to represent form (all except V, W)
- Excessive amounts of type to reinforce images (P, Q, R, T, W)
- Images are oversimplified (A)
- Images are overly representational and contain irrelevant details (B, A)
- Choice of image representation contributes to ambiguity (T, S, H)
- Images are over-cropped (F, G, M, N, Q, T, W)
- Images are taken out of their original context (W)
- Images depict unfamiliar organ shapes (W)

PRAISE

- Uses graphic cues of semi-representational modifiers to represent concept or action rather than a literal representation (J, K)
- Images and Type reinforce each other (U, S, V)
- Appropriate level of graphic image representation is used to communicate concept (J, K)
- Image gives reference to holistic context (J, K, C, R, P)
Illustration 4.2.4: Sequential Analysis

CRITIQUE STRATA

<table>
<thead>
<tr>
<th>GRAPHIC PRIMITIVES</th>
<th>INTERACTION OF PRIMITIVES</th>
<th>GRAPHIC IMAGE REPRESENTATION</th>
<th>IMAGE DISPLAY TECHNIQUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>aesthetics</td>
<td>aesthetics</td>
<td>aesthetics</td>
<td>aesthetics</td>
</tr>
<tr>
<td>clarity</td>
<td>clarity</td>
<td>clarity</td>
<td>clarity</td>
</tr>
<tr>
<td>legibility</td>
<td>legibility</td>
<td>appropriateness</td>
<td>organization</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CRITICISMS

- No evidence of color use or grayscale (all except C)
- Single value to represent actions or concepts (all)
- No visual hierarchy, everything reads on one visual layer (all)
- Excessive use of boundary lines that overwhelm primary content (D)
- Excessive use of line to represent form (all)
- Type is disconnected from images (B, C)
- Text in all caps is hard to read (A)
- Use of fixed-width font is difficult to read (E)
- Images do not demonstrate action or concept, only serve as embellishment (A)
- Repeated images are placed arbitrarily, making them difficult to follow (B)

PRAISE

- Images and type reinforce each other (D)
- Incorporation of cultural context within backgrounds allows viewer to identify with instructions (D)
- Use of image repetition to communicate sequence (C)
Illustration 4.2.5: Topology Analysis

CRITIQUE STRATA

<table>
<thead>
<tr>
<th>GRAPHIC PRIMITIVES</th>
<th>INTERACTION OF PRIMITIVES</th>
<th>GRAPHIC IMAGE REPRESENTATION</th>
<th>IMAGE DISPLAY TECHNIQUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>aesthetics</td>
<td>aesthetics</td>
<td>aesthetics</td>
<td>aesthetics</td>
</tr>
<tr>
<td>clarity</td>
<td>clarity</td>
<td>clarity</td>
<td>clarity</td>
</tr>
<tr>
<td>legibility</td>
<td>legibility</td>
<td>legibility</td>
<td>legibility</td>
</tr>
</tbody>
</table>

CRITICISMS

• No evidence of color use or grayscale (all except C)
• Single value to represent actions or concepts (all)
• No visual hierarchy, everything reads on one visual layer (all)
• Excessive use of boundary lines that overwhelm primary content (A, C, E)
• Excessive use of line to represent form (all)
• Images are oversimplified (E)
• Images are overly representational and contain irrelevant details (A, B, C, E)
• Choice of image representation contributes to ambiguity (E, D)

PRAISE

• Images and type reinforce each other (all)
• Use of image repetition to communicate quantity (C, D, E)
Based on these criticisms and praises, a series of guidelines were collected and organized specifically to address the overall aesthetic, functional, and relevance issues commonly encountered when visualizing health concepts for the general population. These guidelines incorporate suggestions and ideas from an assortment of authors ranging in discipline from information design, visual communication, visual perception, to comic book creation.
5.0 Design Guidelines for the use of Visualization Strategies in Health Education Materials

Based on the criticism and analysis in the previous section, it was apparent that there were consistent visual communication issues that needed to be addressed relating to the broad issues of aesthetics, functionality, and relevance. The following section is a compilation of guidelines or recommendations aimed at improving these materials in order to develop health education materials that achieve the goals of being visually attractive, clear, legible, well organized, and appropriate. The following guidelines are demonstrated by multiple sources from several other disciplines. Nigel Holmes demonstrates many of these guidelines in his book, *Wordless Diagrams*, which, through the utilization of images with no text-based explanations, visually and non-verbally depicts over 100 everyday or not-so-everyday tasks. Some of the visualization techniques Holmes uses, while visually demonstrated but not verbally explained or articulated, can have direct application to improving the visual communication methods used in health education materials and will be demonstrated in a later section. These guidelines will be accompanied with a verbal explanation along with a visual demonstration, not only by Holmes, but also by other designers through examples from outside of the health field.

The following guidelines are organized into the same four organization strata used during the critical analysis in the previous chapter: Graphic Primitives, Interaction of Primitives, Graphic Image Representation, and Image Display Techniques (Illustration 5.0).
When analyzing the existing visualizations used in health education materials, something that was consistently missing or omitted was the use of color. This could also be due to the fact that many of these materials were reprinted in black-and-white journals. However, due to the consistent absence of grey values, which would indicate almost any color conversion, there was little evidence suggesting the use of color in any of the materials. This is unfortunate because color, when used effectively, can have remarkable versatility and effectiveness when communicating visually. And while there are times where printing costs or technology might prevent its use, understanding the different potential uses color can have when representing...
information, as well as the dimensions of information that can be revealed or clarified through its use, make it an invaluable tool for communicating health information.

5.1.1 Introduction to Color

Illustration 5.1.1: A demonstration of the three dimensions of color: hue, value, and saturation

Before suggesting ways to use color more effectively, it is important to first understand some very basic properties of color. Color can be divided into three dimensions: hue, saturation, and value. Hue is what most people refer to as color, or the difference between the colors in the visual spectrum: red, orange, yellow, green, blue and violet are examples of hue. Saturation is the intensity of that hue. Value is the lightness or darkness of that hue. Once these dimensions are understood, they can have infinite possibilities when representing information. However, it is important to first understand their limitations. The first is that hue, or spectrum of colors, is not perceived in a logical, consistent order. In fact if one were to give a group of individuals a set of color chips: red, orange, yellow, green, blue, violet, and ask them to place them in an order, the results will be very different among these people. However, give them a set of gray chips, they will easily and intuitively order these into a light to dark or dark to light ordering (Ware, 2004, p. 128). Because of this, it is important to understand that hue is not “perceptually ordered” (Ware, 2004, 128). The other two dimensions, value and saturation, are simple for people with functioning visual abilities to place in a consistent order: e.g. value: light to dark or dark to light;
saturation: saturated to desaturated or desaturated to saturated. Once there is an understanding of these basics, color can be used strategically in several ways.

5.1.2 **Representational Color**

While it may seem intuitive to use color representationally, or to directly resemble the colors in the environment, this use of color may not have the greatest communication impact. Flight safety instructions are a great example of information design that typically uses color representationally. These instructions often include the passengers’ clothing and hair colors, which can at times be amusing, but do little to enhance the visual clarity of the information being represented. The examples shown below (Illustrations 5.1.2.1) are from Southwest Airline’s 737 Flight Safety Information Guide. Is it relevant that the woman using the emergency exit is blonde and wearing pink shirt? Or the woman securing her oxygen mask: does the viewer need to know that her shirt is violet and her seat is blue? While there are many problems with the color used in this example, the most troubling is that, due to the similar saturation and value of the arrow, the airplane seat, and the woman’s shirt, these items are in direct visual competition with each other, diminishing the legibility and overall communication potential of this image.

Illustration 5.1.2.1: Southwest Airlines Flight Safety Instructions, 2007
This sends a contradicting message to viewers. Which is most important when trying to exit the airplane: the color of the woman’s clothing or the directions for how to get oxygen? In fact, the use of these saturated hues is often in direct visual competition with critical safety information. While this advice to limit the use of representational color could mislead someone to eliminate its use altogether, this is not the case. Simply limiting or being conscientious of the limitations of using color representationally can be a great first step in enhancing colors communicative value and can contribute greatly to creating health education materials that are visually engaging, appear less dated, and communicate quickly and intuitively.

The image below demonstrates how representational color can be used to enhance the clarity and legibility of an existing example of insulin administration instructions. Through the use of low-saturated and low-value skin tones, the hands’ natural appearance is suggested without competing with the high saturation and dark value action information.
Illustration 5.1.2.2: Redesign of administration of insulin instructions (Left image from Teaching Patients with Low Literacy Skills, Doak, Doak, & Root. p. 104)
5.1.3 Nominal or Categorical color

CATEGORICAL (NOMINAL) COLOR

Illustration 5.1.3.1: Example of Nominal Colors

Again, because hue is not perceived in a logical perceptual order, it lends itself very well to establishing different categories of things. According to Edward Tufte in Envisioning Information (1990): “color can be used as a label to amplify the relationship between various information…color can be used to transmit information, to reinforce relationships between information. By using easily differentiated colors, viewers can quickly link related information to each other, can speed identification and recognition of information.” (p. 85 – 87). In the image below (Illustration 5.1.3.2), the consistent exposure of specific hues to represent various commands and precautions allows workers to begin to automatically form automatic associations between various colors and information. For instance, workers understand that when red is used, they should be aware of danger.

<table>
<thead>
<tr>
<th>Color</th>
<th>PMS</th>
<th>Meaning</th>
</tr>
</thead>
</table>
| Safety Red | 485 C   | Danger  
Prohibition Stop |
| Safety Orange | 152 C   | Warning                   |
| Safety Yellow | 109 C   | Caution                   |
| Safety Blue   | 287 C   | Mandatory Action          |

Illustration 5.1.3.2: Nominal Color used for Safety Information. Illustration is from Official Signs and Icons 2, Mies Hora, p. 104.
In another example (Illustration 5.1.3.3) from *The Measure of America: American Human Development Report* (2008), separate hues are used consistently throughout the book to categorize different types of information: money, health, and education. While this book contains many pages of statistical information, the consistent use of vivid hues helps break down and group the information, making it seem less overwhelming and more approachable.

Illustration 5.1.3.3: Nominal Color Example. *The Measure of America*, p. 3.

Some other considerations when using hue to represent different categories of information include having an understanding of the color conventions of the culture being targeted. For instance, in American culture, using blue for hot or green for stop would have disastrous effects because, not unlike other cultures, color conventions and expectations are heavily imbued within American culture: green means go, red means stop; red is warm, and blue is cold. Another consideration when using hue is to account for colorblind individuals. The majority of individuals with color blindness cannot differentiate between green and red, because of this, when representing critical contrasting information; it might not be wise to use those colors.

The following redesign (Illustration 5.1.3.4) uses categorical color to establish separate actions. A saturated red-orange hue is used to represent “do not,” while a saturated blue-green
hue is used to indicate, “go ahead” or “do this.” Because these “stop” and “go” commands are coded with hues that are augmented from pure red and green, the effects experienced by those with red/green colorblindness can be mitigated. This consideration, in addition to the redesigned instructions conforming to American color conventions through the use of (augmented) red and green as stop and go actions, ultimately contribute to the redesigns added appropriateness. Also, by only using color in full saturation to communicate two separate groups of actions, it allows for the actions to form conceptual groups, thereby increasing the clarity of the instructions.

Illustration 5.1.3.4: Redesign of Administration of Insulin instructions (Left image from Teaching Patients with Low Literacy Skills, Doak, Doak, & Root. p. 104)
5.1.4 Ordinal Color

Illustration 5.1.4.1: Example of Ordinal Color

To communicate information that does have a logically perceived order, like intensity or amount, value and saturation can be very useful. In the example below (Illustration 5.1.4.1), darker values of blue are used to communicate states that have the highest amount of educated people. This particular use of color could be especially useful in communicating certain types of quantitative information to patients with low numeracy, or those who have trouble comprehending complex numerical information. In instances where it is important to communicate greater-than or less-than relationships, instead of overwhelming patients with a barrage of numbers or ratios, it could be useful to create an information display that uses dark blue values to indicate the high concentrations of something and the light blue values to indicate the lower concentrations of something. In communicating health information, ordinal color could be used to communicate areas within the United States that have the highest concentrations of people living with obesity. This intuitive method of communicating quantity through value and saturation has the ability to primarily increase the clarity of a visual health education piece.

Illustration 5.1.4.1: Example of Ordinal Color *(The Measure of America, p. 115).*
5.1.5 Hierarchical Color

Because hue and saturation are *preattentively processed* features (Ware, 2004), or are elements that are noticed right away, the strategic use of different hues at varying levels of saturation and value can be used to create a visual hierarchy, where the designer can control the order in which visual elements on a page are perceived. This example below illustrating how to avoid rubbery *coq au vin* uses varying values of black and red to control the order in which the elements of the illustration are perceived. High-value grey and red or light grey and red are used to establish background and context for the image where fully saturated red is used to draw the viewer’s eye to the pertinent details and actions needed like what parts of the chicken should be cooked at what specific temperature. Using color strategically, like the example mentioned above, can present the viewer with layers where information that will appear more organized and less overwhelming. The image below (Illustration 5.1.5.1) deconstructs how color is used in the *coq au vin* example and demonstrates how these layers work. The following section goes into greater detail on using color to establish background information or information structure.

Illustration 5.1.5.1: Example of Hierarchical Color (*Wordless Diagrams*, Nigel Holmes, p. 138)
5.1.6 Structural Color

Another method for using color hierarchically is to create a supporting structure for content. This is especially prevalent in the design of computer interfaces, because the use of color is not limited by printing costs; color is often used as background for the information. This can be particularly useful for organizing and structuring the information. However, it is important to select colors that do not overwhelm or compete with the primary content being communicated. By selecting high contrast colors, or hues that are too similar in saturation or value to the primary information, it may not only make the information less visible, it can add to information clutter and chaos. By selecting background colors that are in low-contrast to each other but very different from primary content, the primary information be supported rather than overwhelmed. In *Visual Explanations*, Edward Tufte states: “Minimal contrasts of the secondary elements (figure) relative to the negative space (ground) will tend to produce a visual hierarchy, with layers of inactive background, calm secondary structure, and notable content” (p. 74). The image below (Illustration 5.1.6.1) demonstrates how this minimal contrast can provide support and organization for the primary content.

Illustration 5.1.6.1: What is a Print? Lithography. This instructional graphic uses subtly-contrasting greens to create supportive structure and grid for the primary graphic and textual information (*The Information Design Handbook*, Jenn + Ken Visocky O’Grady, p. 173).
By establishing a visual connection between the verbal and pictorial content, the insulin instruction redesign below (Illustration 5.1.6.2) demonstrates how the use of a minimally contrasting, high value grey can establish visual structure and contribute to the appearance of visual organization, while not competing or overwhelming the primary content.

Illustration 5.1.6.2: Redesign of Administration of Insulin Instructions (Left image from Teaching Patients with Low Literacy Skills, Doak, Doak, & Root. p. 104)
5.1.7 Other Considerations when using color

TWO COLOR PRINTING

Illustration 5.1.7.1: Two Color Printing Model. This illustration demonstrates the enhanced versatility that can be achieved through the incorporation of a single color in addition to black.

While the use of color does increase printing costs, the communication value it can add when used strategically can make it well worth the extra money. Also, with the increased use of screen displays to show educational materials – mobile devices, websites – the added cost for using color is a virtually a non-issue. Even when four-color printing is not available, simply adding one additional color (Illustration 5.1.7.1) can add enormous flexibility to the amount and dimensions of information that can be communicated.
Summary: The Correspondence of Type & Image Integration to the Analysis Criteria

Mentioned above, Illustration 5.1.7.1 demonstrates how the effective use of color can positively impact all five of the analysis criteria: aesthetics, clarity, legibility, organization, and appropriateness.

Illustration 5.1.7.1: Color’s correspondence with the Analysis Criteria and Dimensions of Understanding

5.2 Use of Semi-Representational Modifiers

Instead of specifically representing an object or an idea, semi-representational modifiers “evoke” an experience, allowing less visually tangible experiences to be represented. (Zender, 2006, p. 187). This can be especially powerful when communicating sensations like pain, itch, hot, cold, fever, or ache. For instance, overlapping a blurred red shape over the image of a human head could be a succinct, yet effective way to communicate fever, rather than a highly detailed image of a person lying in bed with a thermometer in his or her mouth. Because many semi-representational
modifiers are often culturally determined, they should be used judiciously and only with a solid awareness of the viewer’s established visual vocabulary and conventions. For instance, the use of image ghosting may be a well-established way to convey motion in one culture, whereas in another culture, it may not be commonplace.

Illustration 5.2.1: Redesign of Pharmacology Icons. (Left images from “The evaluation of pharmaceutical pictograms in a low-literate South African population” by Dowse & Ehlers, p. 97)

In the above illustration the center image is a locally developed redesign of a USP-DI pictograms (left) created by the United States Pharmacopeia in 1987 (Dowse & Ehlers, 2000, p. 88). Researchers, Dowse and Ehlers (2000), used a “multistage, iterative design process” to develop culturally appropriate images for a largely low-literate South African population (p. 88). In this study, 23 USP-DI symbols were redesigned according to the preferences, and visual culture conventions of the local population. The local redesign (center image) already begins to incorporate the semi-representational modifier, or arrow, to communicate the instructions for where to apply the drops. While this simple change already eliminates the need for excessive cropping on the ambiguously represented ear, as well as the hand holding the ear, it still requires the viewer to make the two-step mental connection between the arrow and ear and the eyedropper. The redesign (right) simplifies this process even further by using the semi-
representational modifier of a directional triangle to orient the eyedropper directly to the ear, “funneling” the dropper into it, thus reducing the original two-step process to one simple mental action.

**Summary: The Correspondence of Semi-representational Modifiers to the Analysis Criteria**

In sum, the use of semi-representational modifiers, by decreasing the need for excessive representation of superfluous visual information through the use of pre-established visual conventions, has the ability to impact the aesthetics, clarity, and legibility of health education instructions using pictures.

Illustration 5.2.2: The correspondence of Semi-representational Modifiers with the Analysis Criteria and the Four Dimensions of Understanding
5.3 Text & Image Integration

Avoid separating words from images; do not make viewers follow a code or a key to interpret information. By integrating words with images, it suggests that the visual information is just as “relevant and credible” as the text (Tufte, 2006, p. 109). Ideally words and images should be used to support each other. This example (Illustration 5.3.1), depicting *How to Spot a Hidden Handgun*, is a great demonstration of how well-placed, concise text can be integrated seamlessly with imagery to clarify visual information, adding emphasis and clarification only where necessary.


Additionally, according to educational psychologist Richard Mayer (2009), this proper integration of type and image can “reduce erroneous processing” when developing instructional material using both images and words (p. 85). This principle, called the Spatial Contiguity Principle, states:
When corresponding words and pictures are near each other on the page or screen, learners do not have to use cognitive resources to visually search the page or screen, and learners are more likely to be able to hold them both in working memory at the same time. When corresponding words and pictures are far from each other on the page or screen, learners have to use cognitive resources to visually search the page or screen, and learners are less likely to be able to hold them both in working memory at the same time. (p. 135)

This direct integration of text and image takes full advantage of how the human mind functions by acknowledging the duality of human information processing: visual and verbal (Mayer, 2009, p. 6).

One excellent source that consistently exemplifies the range of text and image combinations is comic books, which have been dynamically interchanging the two for over a century. These different methods for integration are used to create or enhance a story, adding richness, depth, context, and intrigue to the information presented. According to Scott McCloud, comic book theorist and artist, there are seven different types of text and image combinations. However, the following are three methods of type and image integration that lend themselves readily to health education materials:

Illustration 5.3.2: Type and Image Integration (McCloud, *Understanding Comics*, p. 153 – 155).

Ideally, text and image should complement and support each other in a way that neither could do as well alone. McCloud elaborates on the partnership between text and image: “In comics at its best, words and pictures are like partners in a dance and each one takes turns leading. When both
partners try to lead, the competition can subvert the overall goals…though a little playful competition can sometimes produce enjoyable results. But when these partners each know their roles – and support each other’s strengths – comics can match any of the art forms it draws so much of its strength from” (McCloud, 1993, p. 156). In sum, the effective integration and balance of text and images can be exceptionally useful for clarifying, emphasizing, and lending credibility to visual information.

Illustration 5.3.3: Redesign of Administration of Insulin Instructions (Left image from Teaching Patients with Low Literacy Skills, Doak, Doak, & Root. p. 104)

The image above (Illustration 5.3.3) uses all three of the type and image integration methods discussed in this section. The step-by-step instructions utilize the Duo-specific method because they essentially are communicating the same message simultaneously, one directly reinforcing the other. The combination of type with the image of the syringe drawing air into the
barrel is considered to be an Interdependent relationship because the type is conveying something invisible, air. In this case the type is assisting the image by representing a concept that cannot be easily represented through image. Lastly, Additive integration is employed through the extra use of type to amplify the important caution, “do not shake.”

**Summary: The Correspondence of Type & Image Integration to the Analysis Criteria**

Illustration 5.3.4: The Correspondence of Type and Image Integration with the Analysis Criteria and the Four Dimensions of Understanding

**I N T E R A C T I O N O F P R I M I T I V E S**

**5.4.0 Visual Hierarchy**

Visual hierarchy is the arrangement of images and graphic elements to produce areas of dominance and subordinance. This can be achieved by the careful contrast of size, color, density, and proximity. By strategically creating layers of emphasis and de-emphasis, the reader can intuitively and effortlessly decode visual information. Establishing visual hierarchy is important because, “when everything is emphasized, nothing is emphasized; the design will often be noisy, cluttered and informationally flat” (Tufte, 1997, p. 74). Unfortunately, when analyzing the
examples of existing health education materials in chapter 4.3, virtually none of these examples had any evidence of an intentional visual hierarchy; all visual information, images, containing structure, and text, all compete loudly and at the same visual level. When this happens, an image turns into a visual puzzle, or “crypto-graphical mysteries for the viewer to decode. A sure sign of a puzzle is that the graphic must be interpreted through a verbal rather than visual process” (Tufte, 1983, p. 153). However, when a clear visual hierarchical order is established, “the translation of visual to verbal is quickly learned, automatic, and implicit – so that the visual image flows right through the verbal decoder initially necessary to understand the graphic” (Tufte, 1983, p. 153). Establishing a strong visual, hierarchical organization is important because it directly contributes to the viewer’s perception of information being organized, which has a strong impact on how the viewer absorbs the information: “the organization of content directly affects our ability to receive a message. If the information appears jumbled or overwhelming, many viewers “disconnect” before a transmission is completed (Visocky O’Grady, 2008, p. 80).

In order to begin to understand how to control the visual hierarchy in health education materials, it is important to know that this hierarchy is dependent upon the viewer’s innate ability to preattentively process visual information, where “certain simple shapes or colors ‘pop out’ from their surroundings. The theoretical mechanism underlying pop-out is called preattentive processing because logically it must occur prior to conscious attention. In essence, preattentive processing determines what visual objects are offered up to our attention” (Ware, 2004, p. 149). Beginning to gain an awareness of this order in which certain formal and spatial elements are attended to helps create a sense of what visual elements need additional emphasis or de-emphasis.

Because there are many ways to establish visual hierarchy, this paper cannot be a
conclusive manual on how to control visual hierarchy. However, based on an analysis of the common visual problems found in health education materials incorporating images, the following are two specific suggestions for improving overall legibility and visual hierarchy.

**INTERACTION OF PRIMITIVES**

**5.4.1 Elimination of “Chartjunk”**

A common issue among the many examples of health education materials incorporating visuals is the dominant supporting structures for the information. This can include the outline surrounding an icon, or the frames supporting procedural health information. Edward Tufte refers to these overly dominant containing structures as “chart junk” or “information prisons,” which are generally thick black lines surrounding content that compete with and overwhelm the actual content. For instance, the USP-DI symbol system is a consistent culprit of this offense (illustration 5.4.1.1).

Illustration 5.4.1.1: USP-DI Symbols

The dominant black surrounding structures of these symbols carries more density and visual weight, offering very little emphasis and visibility to the actual internal content itself. This tendency to overemphasize these structures creates visual confusion, and, instead of allowing the information to be perceived in a sequence of layers, creates the immediate visual sensation of
overwhelming and convoluted visual and textual content. As Tufte states: “Why should the trivial task of dividing up the already free-standing elements become the dominant statement of the entire display?” (Tufte, 1997 p. 63)

Tufte gives an alternative suggestion to this: “Every bit of ink on a graphic requires a reason. And nearly always that reason should be that the ink presents new information” (Tufte, 1997, p. 96). If it appears that a large majority of the ink on a page or information on the screen is dedicated to holding, structuring or separating information, it is likely too redundant, and should be minimized. Once these information structures are deemphasized to where they are supportive of the actual content, the designs will become “so good that they are invisible” (Tufte, 1990, p. 33).

Illustrations 5.4.1.2: Marshalling Signals. Tufte’s initial example (left) shows how overly dominant information containing structures can detract from the content. By reducing the appearance of these structures, (right) we can begin to read the information on a series of layers, rather than all at once. (Envisioning Information, Edward Tufte, p. 62).

Illustration 5.4.1.3: Redesign of Pharmacology Symbols. (Left images from “The evaluation of pharmaceutical pictograms in a low-literate South African population” by Dowse & Ehlers, p. 97)
In the symbols above (Illustration 5.4.1.3), both previous versions (left and center images) suffer from an extremely visually dominant surrounding structure that overwhelms the interior content. In the redesign (right) this is mitigated by the use of a subtle grey circle to hold the interior images. This solution provides subtle structural support that allows the primary information to be intuitively visually processed first.

**Summary: Eliminating “Chartjunk” and its Correspondence with the Analysis Criteria**

By adjusting the visual hierarchy so the primary content and actions appear most dominant, and the structural, supportive information appears secondary, viewers will have an intuitive order to follow. This will contribute to the organization of the visual communication piece by providing a subtle structural framework for viewers to follow. Additionally, by not overwhelming viewers with dominant visual structures that visually compete with the main content, overall legibility and aesthetics can be improved.

Illustration 5.4.1.4: The Correspondence of the Elimination of “Chartjunk” with the Analysis Criteria and the Four Dimensions of Understanding
5.4.2 Use of point, line, & shape

The human mind has an enormous ability to perceive differences in visual information from its surroundings. This is to reduce the amount of energy needed to perceive constantly present visual surroundings. If every bit of this information needed to be processed, an enormous amount of energy would need to be extended. Because of this, to save energy, the differences between edges and contours in our environment are sensitively processed. According to Margaret Livingstone in *Vision and Art: The Biology of Seeing*, humans’ ability to detect discontinuities in our visual field directly relate to our ability to understand even the simplest line drawing:

“Line drawings can be excellent representations of reality, yet there are very few lines in real life. There are contours, which are borders between regions of different color or lightness, but there are rarely actual lines, which are thin regions of a different color or lightness than the background. An artist will represent a contour by a line, even though a contour is not a line, and we have no problem interpreting it as it was intended. Even babies, who have not learned the convention of line drawings, have no trouble recognizing line drawings of familiar objects.” (Livingstone, 2002, p. 61)

Because of this innate ability to easily detect the differences in our environment, human beings have an amazing ability to associate the most basic and simple set of lines with mental images. For instance, in the photo below, it is remarkable how two points and two lines can be substituted and an immediately recognizable image of a human face appears.

Illustration 5.4.2.1: Face demonstration
While this ability to recognize extremely abstract objects through the use of simple line drawings can be an incredibly powerful tool for representing information, it should be not be overexploited. And many of the examples of health education materials incorporating visuals are regular offenders of this overexploitation. Because of this, they often appear noisy and cluttered. The reason for not overusing line in representing all information content is directly related to the primary reason why it works so well: again, human vision is designed to be attracted to contrast differences in the visual field. Colin Ware explains the biology behind this: “Edge detector neurons have a positive excitatory relationship with other edge detectors that are nearby and aligned. There is an inhibitory relationship with cells responding to non-aligned features….when light from an edge falls across the receptive fields of positively connected neurons a whole chain of neurons will start pulsing together. They are bound together by this common activity” (Ware, 2008, p. 48). In other words, this excitatory/inhibitory relationship is what makes gives these lines such a dominant and active visual presence. Edward Tufte elaborates on the optical sensations that can happen with because of this response:

“…when we draw two black lines, a third visual activity results, a bright white path between lines. And a complexity of marks generates an exponential complexity of negative shapes. Most of the time, that surplus visual activity is non-information, noise, and clutter… These are not trivial cosmetic matters, for signal enhancement through noise reduction can reduce viewer fatigue as well as improve accuracy of readings from a computer interface, a flight-control display, or a medical instrument. Clarity is not everything, but there is little without it” (Tufte, 1990, pp. 61 – 62).

Due to this “surplus visual activity,” this particular guideline recommends using a combination of point, line, and plane or shape to represent information in order to give visual information content order, hierarchy, and easier comprehension. The example below (Illustration 5.4.2.2, left) demonstrates how the effective interaction of point, line, and shape, along with using hierarchical
color, creates a clear visual order to the information being communicated. When this same image is converted to only using similar in width line to represent content (Illustration 5.4.2.2, right), one can easily see how the visual order and communication is destroyed.

Illustration 5.4.2.2: How to Pass the Port. The example to the left, demonstrating how to pass the port, shows how readability can be enhanced through the combination of point, line, and shape. The image to the right shows how legibility is compromised by only using line to represent information. (Wordless Diagrams, Nigel Holmes, p. 61)

Illustration 5.4.2.3: Redesign of Pharmacology Symbols. (Left images from “The evaluation of pharmaceutical pictograms in a low-literate South African population” by Dowse & Ehlers, p. 97)

Like many of the health education materials incorporating images, the symbols above
Design Guidelines

(Ilustration 5.4.2.3, left and center) use only black line to define the visual content. This creates a design that has little visual hierarchy, lacks readability, and appears very cluttered and busy. By using shape to define the face, surrounding structure, and eyedropper, this visual noise is reduced, allowing the content to appear more decipherable and visually attractive. The image below illustrates how this guideline can affect aesthetics, legibility, and organization of health education materials incorporating pictures.

Summary: Use of Point, Line, and Shape and its Correspondence with the Analysis Criteria

Illustration 5.4.2.4: The Correspondence of the use of point, line and shape with the Analysis Criteria and the Four Dimensions of Understanding

GRAPHIC IMAGE REPRESENTATION

<table>
<thead>
<tr>
<th>GRAPHIC PRIMITIVES</th>
<th>INTERACTION OF PRIMITIVES</th>
<th>GRAPHIC IMAGE REPRESENTATION</th>
<th>IMAGE DISPLAY TECHNIQUES</th>
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5.5.0 Use of different levels of graphic representation and abstraction

When beginning to design health materials that incorporate images, a very important decision
that needs to be made is: how realistic or abstract should my images be? The answer is not always as obvious as one may think. Different variations in image representation, or images that represent the visual appearance of objects in the environment, or abstraction, the reduction of specific visual details from these objects in order to reveal their essential characteristics, have several distinct advantages depending on context and intentions of the visual communication. For instance, when visibility and readability at long distances is critical, it may be judicious to use more abstract, geometric images with very little representational detail. However, the most important lesson to learn from this guideline is that the decision to use highly abstract or representational imagery should be conscious, and truly depends on the function, purpose, communication goals, and practical medium limitations of each message. No set level of graphic representation is appropriate for every project. So, in order to be better equipped to make this decision, it is important to first understand the benefits and limitations of using images that range in representational detail in order to establish a consistent graphic language that is the most appropriate for the specific needs and limitations of the communication tool. This guideline addresses two specific benefits from using different ranges of abstraction or representation: clarity and viewer identification.

### 5.5.1 Abstraction for clarity

Using the proper level of image representation can be an effective tool for strategically offering the viewer just the right amount of information at the right time. Too much representational detail can give an image the appearance of being convoluted, clumsy, or dated, while too little detail can be vague and equally confusing. The example below (Illustration 5.5.1.1) is an excellent demonstration of how just the right level of representational detail can enhance the
speed of image recognition and comprehension. Mies Hora comments on these images’ level of abstraction: “while fairly clear, it is dated, poorly rendered and very illustrative in design. Nora Olgyay’s reductive design… (center) is simpler and more graphic, but suffers from being unnecessarily abstract. The symbol developed… displays a dimensionality that is easily comprehended, illustrative, yet symbolic and contemporary in design” (Hora, 2005, p. 106).

Illustration 5.5.1.1: Safety Symbols. Icons are from *Official Signs and Icons 2*, Mies Hora, 2005, p. 106.

The example below (Illustration 5.5.1.2) demonstrates how the combination of two different levels of graphic image representation can be used to achieve greater clarity. By using the human figure stripped down to its basic geometry, a viewer can instantly grasp the subtle differences in body position that need to be perceived in order to have the perfect form while swinging a club. If this image below were substituted with a series of photos communicating the perfect body position, it would be difficult to read and would take the viewer much longer to differentiate the essential information needed to learn this task. Once this body position has been depicted, Holmes then delves into greater visual detail with specific three-dimensional hand placement information. If this level of illustrative detail were depicted through each of the sequential images below, this information would likely go unnoticed by the viewer, or may be perceived as unimportant.
Illustration 5.5.1.2: How to Swing a Golf Club. In this visualization, the more abstract, repeated figures allow readers to easily detect subtle differences in body position that may otherwise be undetectable if a higher level of representation were used. The detailed image of the hand is used only once to give the reader more specific three-dimensional information about hand placement. (*Wordless Diagrams*, Nigel Holmes, p. 66 – 67).

In summary, using high image abstraction is generally useful for communicating holistic information and representational imagery is useful when it is necessary to represent specific or discrete information.
Illustration 5.5.1.3: Redesign of Pharmacology Symbols. (Left images from “The evaluation of pharmaceutical pictograms in a low-literate South African population” by Dowse & Ehlers, p. 97)

The previous versions of the pharmaceutical icons above (Illustration 5.5.1.3, left and center) both use an unnecessary amount of superfluous detail to define the human ear and head. In the USP-DI Symbol (left), line is used excessively to define the ear, which, with the inclusion of two fingers and an eyedropper, forms a symbol that is hard to reduce and ambiguous in appearance. The locally developed redesign (center), although less ambiguous than its predecessor, still contains facial details that are likely unnecessary to its recognition. The redesign of these two symbols (right) eliminates much of this excessive visual information through the use of the silhouetted human head, and abstracted ear and eyedropper. Because the silhouetted head is plausibly highly recognizable to most people, it provides context to the more visually ambiguous ear. This allows the ear to appear even more simplified, while still remaining recognizable.
Summary: Use of Abstraction for Clarity and its Correspondence with the Analysis Criteria

Abstraction for clarity, by eliminating unnecessary graphic detail, potentially contributes to the aesthetics, clarity, and legibility of health education materials incorporating pictures. By using image abstraction strategically and consistently, it is possible to direct the viewer’s attention through an image, controlling the resolution of the information being received. By judiciously directing a viewer’s eye from areas of holistic information to areas of minute, incremental detail, this can potentially enhance the clarity of a visual communication piece. Also, eliminating excessive and unnecessary visual information, there is less visual competition between pictorial and verbal elements, thus improving legibility and aesthetics.

Illustration 5.5.1.4: The Correspondence of the use of Abstraction for Clarity with the Analysis Criteria and the Four Dimensions of Understanding

5.5.2 Abstraction for immersion

The human brain’s innate ability to assign identity and meaning within even the most abstract images (discussed in Chapter 5.4.2) also has distinct advantages when using human form to visually depict information. This innate advantage is consistently utilized in the world of comics.
Scott McCloud elaborates on the powerful communicative advantage abstracting the human form can have:

[everyone] … sustains a constant awareness of his or her own face, but this mini-picture is not nearly so vivid; just a sketchy arrangement… a sense of shape… a sense of general placement. Something as simple and as basic, as a cartoon. Thus when you look at a photo of realistic drawing of a face – you see it as the face of another. But when you enter the world of the cartoon – you see yourself… The cartoon is a vacuum into which our identity and awareness are pulled…an empty shell that we inhabit which enables us to travel in another realm. We don’t just observe the cartoon, we become it! (McCloud, 1993, p. 36)

Especially when representing sequential information, like how to take a certain kind of medicine, it can be useful to include the setting our background environment in the images. If done cautiously, so it does not overcomplicate the images or take away from primary content, this can be especially useful for establishing the context for the information. Instead of depicting a highly realistic image of a person doing a task, it may be more beneficial to represent an abstract person in a representational environment. This allows a viewer to insert her or himself into the character, and then into a “sensually stimulating world” (McCloud, 1993, p. 42). Comic book artist, Hergé heavily utilizes this technique when creating the story and characters in *The Adventures of Tintin*, a comic strip about a Belgian reporter and his travels. By using a combination of highly detailed and realistic background imagery in combination with an abstract main character, viewers can begin to immerse themselves and experience all that the main character, Tintin, is experiencing. McCloud simply describes this combinatory use of abstract characters and realistic backgrounds: “one set of lines to see, another set of lines to be” (McCloud, 1993, p. 43).
In Illustration 5.5.2.1, Comic artist, Hergé, uses a combination of image abstraction and representation to create the main character, Tintin, and his adventures. Tintin’s minimal and abstract facial features allow readers to insert their own identities and personalities into his character. This, in combination with the realistic depiction of various settings and backgrounds, allows readers to fully immerse themselves into “sensually stimulating world” (McCloud, 1993, p. 43). The model below uses a continuum approach to illustrate this concept. When an image approaches the more abstract end of this continuum, characters and backgrounds become more universal; toward the representational end, they become more specific, targeted, and objectified.

<table>
<thead>
<tr>
<th>abstract</th>
<th>representational</th>
</tr>
</thead>
<tbody>
<tr>
<td>less specific</td>
<td>more specific</td>
</tr>
</tbody>
</table>

- **characters**
  - Viewer see oneself
  - Viewer see another person

- **backgrounds**
  - Can be any context or background
  - Viewers can enter background

In health education, this guideline can be particularly advantageous when eliciting a
particular behavior response from a specific cultural or demographic group. By making images applicable to these people through the depiction of everyday backgrounds, settings, clothing, and objects, people can better identify with the delivered message. In a study by Ngoh and Shepherd (1997), the effects of locally developed visual aids were studied on non-literate patients in rural Cameroon. In order to develop culturally targeted visual aids, health care professionals collaborated with local artists and female community members to create materials that were “clear, acceptable, culturally relevant, and would relate to the patients’ experiences and environment” (p. 250). Patients were divided into three groups: one receiving no visual instructions, another receiving visual instructions (Illustration 5.5.2.2) and a short verbal explanation, and a third receiving the same visual instructions plus an advanced explanation of the “infectious disease process and the function of the prescribed study drug” (p. 252). Patients in the groups receiving visual instructions performed significantly higher in medication comprehension and adherence than the group receiving no visual instruction.

While the images created for this study do have significant hierarchical issues that potentially hinder overall visibility and legibility, it is important to acknowledge the strategic juxtaposition of representational backgrounds and abstract characters to enhance viewer identification. By linking daytime and nighttime prescription schedule information to the typical daily activities of the women used in the study, while creating abstract, yet culturally adapted characters, viewers can associate their own lives and identities with the images.
Illustration 5.5.2.2: Prescription Instructions. This illustration is from “Design, development, and evaluation of visual aids for communicating prescription drug instructions to nonliterate patients in rural Cameroon,” Lucy N. Ngoh and Marvin D. Shepherd, 1997.

In sum, there are three main advantages of strategically using varying levels of image abstraction to aid in viewer identification. Viewers can:

• Be provided with cultural context for the information
• Immerse themselves into the images
• Identify with the characters depicted

Summary: Use of Abstraction for Immersion and its Correspondence with the Analysis Criteria

The summary below shows how using abstraction strategically to create cultural context for viewers can affect the appropriateness of health education materials using images. By creating a visual environment with which viewers can identify and by developing characters abstract enough for viewers to insert their own identities, designers have the opportunity to create health
materials that are not only visually stimulating, but address targeted viewers in their own identifiable domain.

Illustration 5.5.2.3: The Correspondence of the use of Abstraction for Immersion with the Analysis Criteria and the Four Dimensions of Understanding

5.5.3 Other considerations when using image abstraction

There are some specific instances where choosing images that are too representational or photographic can make viewers uncomfortable and actually decrease their confidence or capability to carry out a desired action. In one study conducted by LaBranche, Helweg-Larsen, Byrd, and Choquette at the University of North Florida, participants were measured for their level of erotophobia, or level of comfort with issues pertaining to sex. High levels of erotophobia are associated with high levels of discomfort with sexually related topics or situations. These patients were then presented with self-breast exam (BSE) brochures: half were presented with text only information, the other with photos demonstrating the exam. The women with high levels of erotophobia who were presented with the photographic material “felt less competent in giving themselves BSE and were less likely to claim that they did things to improve their health” (LaBranche et al., 1997, p. 2200).
The results from this study might have been different had the images been less photographic and more abstract. In Illustration 5.5.3 not only is humor and colloquial language used to communicate typically socially taboo or uncomfortable topics, but instead of showing highly detailed images of the aforementioned anatomy, highly abstract shapes made into friendly characters can lightheartedly deliver the important and serious cancer-prevention message.

5.6.0 Use of Multiples and Parallelism

The utilization of multiple, similar images with analogous orientations, scale, perspective, and structure are very valuable for communicating visually. Tufte elaborates on the advantageousness of this image repetition: “Small multiples, whether tabular or pictorial, move the heart of visual reasoning – to see, distinguish, choose. Their multiplied smallness enforces local comparisons within our eye span, relying on an active eye to select and make contrasts rather than on bygone memories of images scattered over pages and pages” (Tufte, 1990, p. 33). This use of multiples has three very distinct advantages when communicating visually: to show simple quantitative information and to visually differentiate subtle spatial or temporal relationships, or to make subtle visual comparisons.

5.6.1 To Show Quantity

The use of image repetition can be directly beneficial in giving a concrete and tangible representation to numerical information. This is especially useful in communicating to people with low numeracy, or who have troubles comprehending quantitative or statistical details. By replacing numbers with small, repeated images, viewers can easily grasp and compare different proportions of information. In the example below (Illustration 5.6.1.1), because the procedure of giving CPR involves several separate groups of numbered tasks, to simplify a portion of the procedure and aid in memorization, Holmes uses 15 small, repeated images of chest
compressions. In the example on the right (Illustration 5.6.1.2), instead of simply showing a percentage, which can be difficult for some to understand, it may be clearer to actually show a series of repeated images with the equivalent proportion visually differentiated from the whole. This allows viewers to directly compare part to whole relationships. For instance, instead of simply stating 11% of Americans over the age of 20 suffer from Type 2 Diabetes, it could be more effective to repeat 100 small people icons and set apart 11 of these icons in a different color.

In a study conducted by Galesic, Garcia-Retamero, and Gigerenzer (2009), one group of older adults and another group of university students were given an assessment of their numeracy skills. These individuals were then given a series of scenarios concerning stroke risk, heart attack risk, hypothetical drug information, and appendicitis screening information. Half of these individuals randomly received a text-based depiction of the numerical information, the other half received “icon arrays,” or visual representations of the risk levels using small repeated images. When these individuals were assessed for their understanding of these risk levels, both younger and older adults with high and low levels of numeracy receiving the icon arrays performed better than their text-based counterparts. This study demonstrates the effectiveness of using repeated images or multiples to clearly convey quantitative information to a wide range of people.
Illustration 5.6.1.1: How to do CPR. *Wordless Diagrams*, Nigel Holmes, p. 41;  
Illustration 5.6.1.2: Image Repetition and Quantity. Illustrates how repeated images can be used to communicate percentages.

Illustration 5.6.1.3: Redesign of Medication Schedule. (Top image from “Using icons to convey medication schedule information” by Morrow, Leirer, & Andrassy, p. 268)

Illustration 5.6.1.3 is a redesign of a prescription schedule using a visual timeline to convey medication dosage information. Instead of using numbers to convey dosage, the images above both use image repetition to explicitly demonstrate how many pills the patient must take.

### 5.6.2 To Illuminate Temporal or Spatial Relationships

By showing a clear connection between the information, the use of image repetition allows a viewer to make quick and intuitive distinctions between bits of information. This is particularly valuable because it allows the viewer to detect and compare subtle changes in position or
sequence within his or her own eye span. Tufte refers to this use of image repetition as parallelism, and remarks not only on its value in communicating visually, but also on how it is best utilized:

Parallelism connects visual elements…Connections are built among images by position, orientation, overlap, synchronization, and similarities in content. Parallelism grows from a common viewpoint that relates like to like. Congruity of structure across multiple images gives the eye a context for assessing data variation. Parallelism is not simply a matter of design arrangements, for the perceiving mind itself actively works to detect and indeed to generate links, clusters, and matches among assorted visual elements. (Tufte, 1997, p. 82)

He also explains the magnitude and versatility this image repetition can have:

Multiple images reveal repetition and change, pattern and surprise – the defining elements in the idea of information. Multiples directly depict comparisons, the essence of statistical thinking. Multiples create visual lists of objects and activities, nouns and verbs, helping viewers to analyze, compare, differentiate, decide... Multiples represent and narrate sequences of motion… Multiples amplify, intensify, and reinforce the meaning of images. (Tufte, 1997, p. 105)

The image below uses similar position, scale, orientation, and structure to allow the viewer to intuitively differentiate the sequential steps involved in tying a bowline knot. Had this image instead used separate viewpoints, scale, image cropping, or colors to communicate the steps involved, it would cause viewers to exert additional mental energy reorienting themselves to each individual image, hence reducing the image’s overall communicative ability.

Illustration 5.6.2.1: How to Tie a Bowline Knot. This Illustration is from *Wordless Diagrams*, Nigel Holmes, p. 62–63
Illustration 5.6.2.2: Redesign of Administration of Insulin instructions (Left image from Teaching Patients with Low Literacy Skills, Doak, Doak, & Root. p. 104)

The image above (Illustration 5.6.2.2) uses image multiples to convey a temporal relationship. The original design displays multiple images at several locations within the composition, with the syringe and insulin bottle represented at unpredictable angles. This causes the viewer to make unnecessary conceptual leaps between the information, needlessly consuming mental energy. By allowing the pictorial content to vertically align with each other, and representing the insulin
bottle from consistent angles whenever possible, viewers can seamlessly access the information with less effort than before. This use of parallelism creates a sense of organization within the composition that was lacking in the previous design.

**Summary: Use of Multiples and Parallelism and its Correspondence with the Analysis Criteria**

The use of the guideline, Multiples and Parallelism, creates a sense of clarity and organization within a composition while enhancing its aesthetics. By using parallelism to communicate spatial or temporal relationships, information is given order and structure, thereby increasing a composition's sense of organization. When health education materials using images appear less chaotic and more orderly, they will likely improve aesthetically. Additionally, by using image repetition or similarity, the utilization of multiples and parallelism allows viewers to make quick local comparisons between pieces of information, while giving an intuitive method to convey quantitative information.

**Illustration 5.6.2.3: The Correspondence of Multiples and Parallelism with the Analysis Criteria and the Four Dimensions of Understanding**
5.6.3 Part v/s Whole

Often when depicting an organ or body part, the shapes may be too abstract or unrecognizable to be represented on their own. The images below are a few among several other examples of health education materials that incorporate images that are too cropped in on their subjects to be easily recognized. Due to lack of context and unnecessary detail, these images were especially confusing for low literate populations, who have likely not been consistently exposed to this type of imagery. When communicating health information, there oftentimes is a need to depict organs within the body. Special caution should be taken with this because their strange, unfamiliar, and organic shapes, along with the fact that they generally are not readily visible, can make isolated illustrations of them very difficult to identify. Ros Dowse (2007), who studies the effect of pharmaceutical icons on low-literate African populations, comments on this issue: “people with poor visual-literacy have difficulty identifying body parts when they are depicted in isolation, detached from the body as a whole, and this was overtly obvious with (Illustration 5.6.3.2 left image). When handed the visual, many people rotate it a couple of times and look at it from all angles in order to try and gain some perspective. It is commonly identified as an orifice somewhere on the body and its interpretation appears to be highly education-dependent… (Illustration 5.6.3.2 center image) however, [the locally developed redesign] provides a context for the body part and directs the viewers attention to the ear by using an arrow as a visual cue” (p. 24). The redesign of these symbols (right) also takes advantage of this graphic device,
however because the ear is more visible when the human head is viewed in profile, the viewer can more distinctly recognize where to dispense the medication.

Illustration 5.6.3.2 Redesign of Pharmacology Symbols. (Left images from “The evaluation of pharmaceutical pictograms in a low-literate South African population” by Dowse & Ehlers, p. 97)

In order to reduce confusion and the need for excess detail, it can be helpful to build a visual connection between the partial, cropped object and the whole object in order to provide the reader with a clear sense of context and location. In the image below, in order to better direct the viewer’s attention to the bottom of the runner’s foot, Holmes uses thin red circles and a line to link the cropped image of the runner’s legs to the full body. Not only does this provide a viewer with overall context for the image, but it is also a useful graphic device for showing only the information that is absolutely necessary and relevant at a given moment.

Illustration 5.6.3.3: How to Run Heel-to-Toe. Illustration is from Wordless Diagrams, Nigel Holmes, p. 56
Summary: Part Versus Whole and its Correspondence with the Analysis Criteria

The proper graphic connection between a partial, cropped image to its holistic visual context can increase the clarity and appropriateness of health education materials using pictures. By providing a concrete frame of reference, precise and nuanced health concepts can be accessible to audiences with low literacy or low visual literacy.

Illustration 5.6.3.4: The Correspondence of the use of Part v/s Whole with the Analysis Criteria and the Four Dimensions of Understanding

6.0 Other Considerations

While these guidelines could potentially increase the efficacy of health education materials, it is critical to note that these visual materials should never act as a substitute for face-to-face, verbal counseling between patient and healthcare professional, especially with low-literate patients (Dowse & Ehlers, 2001, p. 93). These materials are intended to assist with this communication and facilitate patient understanding. Additionally, for the development of these materials to be most effective, it is crucial for the designer to be involved in each phase of the visual instruction development process. This includes the initial content development to research on the intended...
target population. This collaboration between designer and healthcare professional throughout this process will help assure both the accuracy and the proper visual presentation of this information.

7.0 Conclusion & Next Steps

In sum, through the introduction of key visual communication guidelines intended to improve the aesthetics, clarity, legibility, organization, and appropriateness of these materials, it may be possible to enhance the impact health information materials using pictures can have on the four dimensions of patient understanding: attention, comprehension, recall, and adherence. By creating higher quality visual communication materials that are easier to understand, it is possible to accommodate the needs of even more patients with diverse literacy, language, and health literacy backgrounds, ultimately having the potential to improve health outcomes within these groups.

While future research is necessary to validate the efficacy of these guidelines within targeted populations, this paper serves as a vital step toward delineating and identifying which guidelines have the greatest potential to impact patient attention, comprehension, recall, and adherence. Strategically applying these guidelines should facilitate this improvement in the development of future health education materials using pictures.
References


Southwest airlines flight safety instructions (2007).


Appendix A: Guidelines Applied to Redesign of Medication Schedule. (Top image from “Using icons to convey medication schedule information” by Morrow, Leirer, & Andrassy, p. 268)

**BEFORE**

![Before Image]

**REDESIGN**

![Redesign Image]

**GROUND RULE** | **USAGE** | **GROUND RULE** | **USAGE**
---|---|---|---
GRAPHIC PRIMITIVES | Before | After |
Color |  |  |
Representational |  |  |
Categorical | X |  |
Ordinal |  |  |
Structural |  |  |
Hierarchical | X |  |
INTERACTION OF PRIMITIVES |  |  |
Semi-representational Modifier |  |  |
Text + Image Integration | X |  |
Visual Hierarchy |  |  |
Elimination of “Chartjunk” | X |  |
Use of Point, Line & Plane | X |  |
GRAPHIC IMAGE REPRESENTATION |  |  |
Image Abstraction |  |  |
Abstraction for Clarity | X |  |
Abstraction for Immersion |  |  |
IMAGE DISPLAY TECHNIQUES |  |  |
Multiples and Parallelism |  |  |
To Show Quantity | X | X |
To Show Spatial Relationship |  |  |
Part v/s Whole |  |  |
Appendix B: Guidelines Applied to Redesign of Pharmacology Symbols. (Left images from “The evaluation of pharmaceutical pictograms in a low-literate South African population” by Dowse & Ehlers, p. 97)

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Appendix C: Guidelines Applied to Redesign of Administration of Insulin Instructions (Left image from *Teaching Patients with Low Literacy Skills*, Doak, Doak, & Root. p. 104)

**BEFORE**

**ADMINISTRATION OF INSULIN**

**SINGLE DOSE**

1. Be sure hands are clean before starting.
2. Mix insulin by rolling bottle between the palms of the hands... DO NOT SHAKE...
3. Wipe rubber stopper on insulin bottle using an alcohol swab....
4. Fill syringe with air equal to the amount of insulin needed.
5. Push air into bottle, (prevents a vacuum inside the bottle) then turn syringe and bottle upside down.

**YOU WILL NEED**

- INSULIN soap & water
- syringe
- insulin
- alcohol swab

**REDESIGN**

**ADMINISTRATION OF INSULIN**

**SINGLE DOSE**

1. Be sure hands are clean before starting.
2. Mix insulin by rolling bottle between the palms of the hands...
3. Wipe rubber stopper on insulin bottle using an alcohol swab...
4. Fill syringe with air equal to the amount of insulin needed.
5. Push air into bottle (prevents a vacuum inside the bottle)
6. Turn syringe and bottle upside down.

**GROUND RULE**

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