I, Eva Lutz, hereby submit this original work as part of the requirements for the degree of Master of Design in Design.

It is entitled:
The Flashdraw
A Participatory Methodology for the Design of Icons and Pictograms

Student’s name: Eva Lutz

This work and its defense approved by:

Committee chair: Paul Zender, M.F.A.
Committee member: Todd Timney, M.F.A.
Committee member: Craig Vogel, M.I.D.
The Flashdraw:
A Participatory Methodology for the Design of Icons and Pictograms

A thesis submitted to the Graduate School of the
University of Cincinnati in partial fulfillment of the requirements for the degree of
Master of Design

In the School of Design

by
Eva Lutz
Bachelor of Industrial Design,
University of Cincinnati, 1988
Committee Chair: Paul Zender
Abstract

Humans have been “speaking” with pictures since the beginning of civilization. Developing pictures that speak is a primary task for today’s designers. Research methodologies that reveal how users “see” visual concepts should help designers create more effective visual communication. This study investigates whether a user-generated drawing methodology, the Flashdraw, is an appropriate design research methodology for the design of icons and pictograms. This thesis will document the supporting research to establish the basis for a user-generated drawing methodology, the design, development and testing of the methodology protocols, and present potential areas of implementation for this design research methodology. The Flashdraw is a design research methodology based on an existing research tool, the draw-it technique. The Flashdraw utilizes drawings created by user population(s) to create the visual keywords that fuel the design of a specific set of icons or pictograms. This paper will define protocols for administration of the Flashdraw with adult and juvenile subjects, protocols and tools for the analysis of the collected data, and the incorporation of the analyzed key insights into the design process. These guidelines are based on 3 research studies and over 400 data samples. A proven user-generated visual design research methodology could enable designers to bring users into the design process earlier and help to establish a contextually relevant visual language, which could result in shorter development cycles and higher comprehension rates.
The Flashdraw methodology is a one-question user-generated visual participatory design research methodology. It collects unaided visual responses from users with paper or digital tools and uses a binary analysis tool. Analyzed data is then applied to the design of icons and pictograms.
To my friends and family who made this dream a reality.
# Table of Contents

**Abstract**

**Introduction**

**Chapter 1: Understanding How We See**
1.1. How we see and perceive images
1.2. How we turn objects into symbols
1.3. Communicating with signs, symbols, icons and pictograms
1.4. Researching with visuals
1.5. Analysis techniques for visual research
1.6. Why is user-generated drawing an important methodology?

**Chapter 2: The Draw-it Technique: The foundation for the Flashdraw**
2.1 Phase 1: Using the “Draw-it Technique” as a participatory research methodology
2.2 Seeing is questioning

**Chapter 3: The Flashdraw: Data Collection and Analysis**
3.1. Data collection
3.2. How many questions are needed?
3.3. Phase 2: Flashdraw survey
3.4. Content analysis
3.5. Data collection
3.6. Flashdraw survey findings
3.7. The Binary Content Analysis Codebook

**Chapter 4: Testing the Flashdraw: Collection to Analysis**
4.1. Objectives of research
4.2. Research protocol
4.3. Data analysis
4.4. Developing a visual vocabulary
4.5. Methodologies for evaluating pictograms

**Chapter 5: Design, Preference and Testing**
5.1. Designing icons and pictograms based on Flashdraw data
5.2. Preference testing the designs
5.3. User comprehension in visual research
5.4. Comprehension testing

**Chapter 6: Conclusions**

**References**

**Appendix**
Humans have been communicating with images since the beginning of civilization. If one was to compare the cave paintings of Lascaux with the iconography found on the latest i-phone you would see the gap in visual language is much less significant than the gap found in the technology used to send this information. This constancy in imagery throughout civilization establishes that communicating with a pictorial language is elemental, primal and universal. We are surrounded by images that are constantly communicating simple and complex concepts to us. Humans use pictorial language everyday on our computers, phones, street signs, maps and product communication. Commonly held beliefs in the field psychology, design and marketing indicate that humans have a cognitive preference for pictorial communications versus text-based information. “Images and pictures are meaningful to the youngest sighted child and the least educated citizen, making images extremely useful modes of communication.” (Hope, 2006), p. 9.) Images are more easily remembered than words alone. This is called the picture superiority effect. The picture superiority effect is based on the belief that images are processed differently than words. Images are more easily remembered because the visual cues (the lines, curves, tones, relationships, etc.) of images are more distinctive than words. (Childers & Houston, 1984) Research has shown that the combination of pictures and words together has even greater recall than pictures alone. The picture superiority effect is one of the primary reasons that icons and pictograms are such important communication tools. The creation of images that communicate ideas is the charter of the designer and typically these iconic and pictorial communication elements are created using a visual vocabulary developed by the designer. Designers often research existing designs, pictures, and icons and apply their findings in the creation of these visual languages. How can they be assured that this existing visual imagery is relevant to the user and applicable to the specific design problem? Are there tools and methodologies available for them to use in the research and development stages, and how does the designer confirm the users understanding of their visual language and design solutions?

There are visual research methodologies in use for every stage of the design process and they are frequently used to confirm user preference and comprehension. The following diagram shows where visual design research is typically administered in a representative five stage design process: 1) Defining the problem or concepts to be communicated. 2) Initial research of existing art/design, topics and concepts, 3) Analysis, brainstorming and ideation of creating various icons or pictograms, 4) Iteratively developing and testing design solutions with research subjects using participatory design methodologies (focus groups, preference testing, and interviews), 5) Refining (more testing could be implemented) and sharing the final design solution.

I have divided opportunities for participatory visual design research into three phases and applied this segmentation to the design process. Phase 1 visual research is done prior to the design start and is focused on gathering data and insights that fuel the initial concept creation phase. This research would be conducted in the define, collect and analyze stages. Phase 2 visual research is conducted in the develop stage after initial concepts are generated, and this phase is often iterative in nature. Phase 3 visual research is conducted in the share stage after the design is complete, and it is often focused on testing and confirmation of appeal and comprehension of the final solutions. (See Figure 1.1). A preliminary participatory visual methodology that could be used in Phase 1 or prior to the “Develop” would enable the designer to use their findings to inform their design work versus confirm their design solutions. This should result in less iterative design/research cycles or “churn” in the Develop Stage since the initial concepts were fueled by the design language generated by the users.
There are research methodologies that are being used early in the design process but many of them rely on the use of existing or designer created visual stimuli. Because these images have either been created by the designer, culled from existing image sources, or selected by the user from any existing visual source, i.e. Google images, magazines, personal pictures, etc., these test methodologies may insert a bias based on the images selected or the search words that have been used to locate the images. The draw-it technique, a visual design research methodology currently being developed at the School of Design at the University of Cincinnati, is unusual in visual design research because it asks the sample population of target users to draw images with no visual prompts given, just a written statement. The Flashdraw technique, an evolution of the draw-it technique and the subject of this paper, in addition to the only using a written or oral prompt exclude a post-survey interview. The research subject is not interviewed or prompted to explain verbally or in writing any implied meanings associated with a specific shape or visual representation. This methodology differs significantly from many of the user-generated visual methodologies used in the social sciences such as: draw and write or draw and tell.

The rationale is based on the assertion that since most icons and pictograms are designed to be understood or comprehended without the exhaustive explanations, or taken at face value, the explorative data collection should parallel this logic. The focus of this paper is to explore if data collected with minimum researcher interaction is valid, usable data that can be applied to the design of icons and pictograms. A non-interactive methodology will enable the flash-draw to leverage digital platforms and the utilization of crowd-sourced data collection and analysis. The draw-it and Flashdraw methodologies are at their core visual surveys to which respondents create visual answers. Because the flash-draw methodology does not rely personal researcher/subject interaction interviews or follow-up explanations, it facilitates the collection of data from large diverse global user populations. The user must create the iconic image from their visual memories and cognitive processes. Does this lack of external visual stimuli and researcher interaction create more accurate visual cues from which the designer can create a design language? This paper will explore scholarly research, literature and applied research in an attempt to determine if the Flashdraw, an evolution of the draw-it technique, is a relevant participatory design research tool for the design of icons and pictograms. The outcome of this paper will be a researched protocol for a user-generated drawing methodology, the Flashdraw, and it will explore the visual perceptions of target users groups regarding specifically articulated concepts that are used in consent forms. It will be focused expressly on the design of icons and pictograms and the majority of the research will be focused on three concepts that are commonly found on medical consent forms: blood draw, urine collection and the ingestion of oral medication. For this study the target user is being defined as a U.S. child between the ages of nine and 17.
1: Understanding How We See

1.1: How We See and Perceive Images

To begin an exploration of a visual research methodology it is important to understand how we see and interpret visual stimuli. Do we visually imagine in the same way as we see the physical world? Colin Ware explores the science of perception in *Visual Thinking*. “A visual object is a momentary nexus of meaning binding a set of visual features from the outside world together with the stuff we already know.” (Ware, 2008, p.126). We have a visual working memory; this memory allows us to hold up to three bundles of visual meaning at any time. Ware goes on to explain how this limited storage capacity is a crucial factor to consider when evaluating images. This limited memory capacity is one of the biggest issues with our visual thinking process, and needs to be considered when we are designing visual objects. (Ware, 2008, p.126) We do not remember everything we see. The majority of what we see is actually things we remember from our long-term memory; in fact, approximately 95% of what we see comes from our long-term memory. There are two different kinds of long-term memory information, implicit and explicit. Explicit information makes up the smallest portion of long-term memory. Language and communication systems are part of our explicit long-term memory. Implicit memory is what we remember when we experience or do something. We do not remember the precise information but we remember pieces of it because it leaves a trace or connection with our long-term memory. (Ware, 2008, p. 117.) This 95% of visual memory input is a crucial factor when we are discussing creating common visual languages. If you are viewing an object, ninety-five percent of that visual object is actually being retrieved by what we have stored in our long-term memory. This retrieval includes perceptions we may have of that object which are unique to each person.

In Chapter 8, Ware (2008) explores the theory of creative Meta seeing. Creative meta seeing is created imagery or our visual imagination. Ware discusses the new theory of meta seeing based on the theories of N.J.T. Thomas, a philosopher. Thomas’s theories were one of the inspirations for Ware’s book, *Visual Thinking for Design*. Thomas believes that visual imagery is based on the same processes as normal seeing, so it is often call activity theory. Studies at MIT and the analysis of Magnetic Resonance Imaging (fMRI) support this theory showing that the same parts of our brains that are activated when we are looking at an object or when we imagine an object. (Ware, 2008) Meta-seeing or creative imagery could be virtual imagery that never leaves our heads or physical doodles, scribbles, charts, diagrams, etc. Creative imagery is one of the primary tools of the designer and it is often a creative internalized dialogue that is manifested with imagery versus words. As designers it is crucial that we are able to understand virtual imagery and to build on it by using our intuitive design processing skills to fill in the blanks. (Ware, 2008, p. 150) Virtual imagery is a common practice and not limited to the realm of designers and artists. The theory of creative imagery is a basis for my interest in user-generated imagery. The images created by the research subject are the projections of the virtual imagery they are seeing in their brains. (Kosslyn, Thompson, & Ganis, 2006)

The ninety-five percent of visual information we hold in long-term memory has a tremendous impact on what we see and the meanings we place on it. We process visual information by a series of processes that lead to our understanding of the message. This understanding is based on the perceived information and the contextual user’s knowledge. As stated by Neisser, “Detection is directly related to sensorial abilities, with perception also linked to internal representation allowing to anticipate the reality, while recognition and understanding depend upon previous knowledge and memorized information.” (Bruyas, Le Breton, & Pauzié, 1998)

Research and studies in the area of cognition and visual perception assert that we process visual images differently than words in written or spoken form. (Hope, 2006). The process of seeing visual images is learned in infancy while the ability to perceive the meaning in words, through reading and writing, are learned skills that take years to master and are dependent on a particular language knowledge base.
Visuals are not dependent on a common language; they are dependent on context and shared meaning making.

For the designer to create images that “universally say something” it is imperative that they understand how we create meaning with image and image/text combinations. SFL, systematic functional linguistics, also known as Hallidayan Linguistics (Halliday, M. & Matthiessen, C., 2004) is verbal language based theory that focuses on the meanings of language, the meaning-making systems, and how they are influenced by society and culture. These theories are now being applied to images and image/word combinations by researchers such as, Kress and van Leeuwen, Lemke and O’Toole (Unsworth, 2006). SFL Theory, asserts there are three meta-functions, primary meaning-making functions that impact how we understand images and image/word combinations: field, mode and tenor. The field is the societal context or activity in which the image or image/word combination is being used. The tenor describes the relationship between the people who are using the image or image/word pair a communication tool. Is it a student to teacher, government to citizen, doctor to patient or business to customer relationship? The mode is the channel of mode of communication such as: a digital device application, a business web site, printed magazine, a text book, a consent form, medication insert or an advertisement. (Unsworth, 2006)

These new advances in our understanding of how we see and process images impact how we approach the study and design of visual communication. We perceive, process and understand images differently than words. This ability to easily process images and understand images is one of the reasons why visual communication systems have dominated global communications. (Hope. D., 2006) Early research by marketing professors Childers and Houston (1984) helped to establish the acceptance of the picture superiority effect. They surmised there are three plausible explanations for why the superiority effect exists: incidental redundant cues, relational organization, and stimulus differentiation.

Incidental redundant cues indicate the complexity and depth of visual cues, which lead to more retrieval paths in the memory, more cues equal more paths. Relational organization theory states that the relationship between paired cues or stimulus creates a connective and meaningful relationship between the image cues. This relationship is also extended to spatial relationships or hierarchy of cues. Fundamental to the picture superiority effect is semantic elaboration and elaborative thinking. Elaborative thinking and processing of the visual cues is what aids memory, not additional cues. Deeper connections between cues create stronger links to memory. Stimulus differentiation hypothesizes that the encoding of imagery is more dependable than the encoding of language. The relationships between letters and syllables and words lacks stability and hence reliability. Images yield superior codes, which aid in the differentiation of stimuli leading to better retention and recall. Higher quality cues equal stronger links to memory. (Childers & Houston, 1984) Further research in this field suggests that the combination of pictures and words together is the most effective way to maximize recall. This is because they are remembered using different retrieval pathways and their use together reinforces memory using multiple visual and verbal linkages or cues.

Children perceive information from visual inputs and outputs with little informal training. At three to four months, children begin to make connections with what they see and touch. This visual exploration and expression of our world and self continues as children develop, and it is through the visual that children often communicate. “...At a young age they express themselves in drawing and recognize themselves in photographs.” (Hope, 2006) This ability to process visual stimuli is innate unlike language based skills which take years to develop. At two years, children begin to understand the symbolic nature of objects. They begin to create drawings and understand the content of drawings. (Rakoczy, Tomasello, & Striano, 2005) The way we perceive images is always changing. “Children and teenagers reason primarily through emotions and are therefore highly susceptible to emotional appeals through visuals.” (Smith, Moriarty, Kenney, & Barbatisis, 2004) Our evolving perceptions color the meanings we place on visual images. Past and recent research and theories, such as picture superiority effect and SFL, suggest that our evolving perceptions color the meanings we place on visual images. The question the designer may ask is, “How much do users’ shifting perceptions affect the effectiveness and perceived meaning of my visual designs?”
1.2: How we turn objects into symbols?

Children as young as two years old use behaviors that “involve the capacity to symbolize”. (Rakoczy et al., 2005) When children begin to develop natural language skills they are also learning about symbols. They do this by communicating with another person and within a worldview context. The first kind of symbols children learn is denoting symbols. A denoting symbol makes use of natural meaning. Rakoczy, et al. (2005) give the following example. If I am asked what the weather is like outside, and I see it is raining, I could make a drawing of raindrops, or I could take a picture with my phone to describe the weather, or I could take a person into the bathroom and turn on the shower. (Rakoczy, H., Tomasello, M., & Striano, T., 2005). All of these examples take natural meanings and use devices to create symbols that communicate what it is like outside. They are all denoting symbols. As children continue to develop their language skills, they can begin to engage with other symbol forms. They can create drawings and describe the content of what they have drawn. They can assign meanings to things within the drawing beyond denoting symbolism. When children reach the age of four, most have the ability to state what an object is: for example, a building block is a block, a rectangle and what one pretends it to be, a building. They understand that the other person or communicator has assigned a symbolic relationship to the block. This ability to understand that one thing can symbolize or represent something else allows us to communicate with others using symbolic image systems. It is important to note that while they understand that an object or image can be assigned a different meaning, either by themselves or by others, but it has been suggested by Franquart-Declercq and Gineste, that children do not fully understand the use of metaphor, until they are approximately 10 years old or until they have a strong understanding of language. (Cerchia, 2009) This ability to understand that things can stand for or represent something else is why we are able to communicate with others using symbolic image systems.

1.3: Communicating with Signs, Symbols, Icons and Pictograms

Prior to establishing a methodology for the design of icons and pictograms, it is first imperative to delineate how these terms are being defined in respect to this research paper. Symbols, Icons and pictograms are all signs. A sign is a stimulus pattern that is used to convey a specific meaning. Icons and pictograms are designed to enable easier recall or comprehension of their meaning.

Symbols are defined as “something used for or regarded as representing something else; a material object representing something, often something immaterial; emblem, token, or sign." (www.Dictionary.com, downloaded 9.2.14). Words are symbols, but so are flags, specific fonts when associated with a word (Coke), and mathematical signs. They can be visual or non-visual, artifacts or actions that are designed expressly for the communication of a pre-defined meaning. “Symbols carry non-natural meaning. They are socially constituted for use, by collective normative background practices and individual intentions in performing symbolic actions.” (Rakoczy et al., 2005)

Icons are signs, and they are pictorial images that are used to help users remember, learn, find and recognize information better. “Icons are defined as a pictorial representation, or a sign (word or graphic symbol) whose form suggests it’s meaning.” (http://www.merriam-webster.com/dictionary/icon). They are considered the simplest of signs because they are direct representations of what the stand for. However, it must be noted that icons can carry a significant special meaning because of what they directly represent, such as the Star of David. Yvonne Rogers, in her seminal work “Icons at the Interface: Their Usefulness”, identified four different kinds of icons: 1) Similar icons use analogy to represent and object or action, for example, a wavy line to represent a curvy road; 2) Example icons use examples of images to represent an action or object, for example, a knife and fork to represent a restaurant or a plane used to represent an airport; 3) Symbolic icons use images that are associated but are not direct representations of the more complex concept, for example, the use of the padlock on a web-site to represent a secure web-site or the envelope to represent an email; 4) Arbitrary icons use images that have no direct correlation with what they are representing, for example, the three arrows of
the recycle symbol. Arbitrary icons require exposure and context for their meaning to be learned and remembered. (Rogers, 1989)

Can a symbol have an accidental or arbitrary relationship to what it represents? Kenney states in his book, Visual Communication Research Designs, that people design symbols to communicate something with a meaning other than what it is. That does not keep people from assigning additional meanings to a symbol beyond the intended meaning. Visual pictorial communication designs may combine a variety of symbol systems. (Kenney, 2010) The use of multiple symbol systems allows the designer to take advantage of each system’s strengths and enable a more holistic communication strategy given that some people are visual learners versus auditory learners. (Kenney, 2010)

Pictograms are images or descriptive symbols that are used to communicate a specific concept. The difference between an icon and a pictogram has been debated, so for the purposes of this paper we will use the explanation of differences as defined by Michael Montage, Ph.D., (2013) in his article, Pharmaceutical Pictograms: A model for development and testing for comprehension and utility. Pictograms and icons are both symbols. Icons are viewed as more concrete and definitive as to their meaning while pictograms are more analogous and often use metaphor to convey meaning. Because pictograms can be abstract and often have a level of implied meaning, the comprehension of pictograms requires reasoning beyond mere recognition. Their meaning must be learned. A pictogram has two parts: the graphic symbol or image and the meaning or referent. The referent is responsible for communicating the meaning and implied functions of the pictogram. (Montagne, 2013)p.160) The image is the pictorial representation of an object, place, item, or a specific action or event.

In their book, Reading Images: The Grammar of Visual Design, Kress and Van Leeuwen discuss social context and visual communication on two dimensions: communication and representation. Communication requires the sender/creator/designer of the visual to make their visuals understood by the population within the societal context. They are communicating a specific message concept within the framework of the social structure. However, the respective places of the sender and the intended receiver within the societal order will greatly impact the meaning and the understanding. With representation, the sender/designer creates or uses forms that represent what they have in mind, for example, rectangles for a door or bed; or circles for wheels, suns or plates. But those representations can have multiple levels, for example: circles = wheels = car or circle= sun=day. The sender or designer must choose the most obvious or logical form to represent what they are trying to communicate. (Kress & Van Leeuwen, 1996)

There is a common belief that pictures are a universal language that is understood by all. However as stated by Dowse and Ehlers, studies have found that pictures do not convey the same meaning to different populations, contextual and cultural meanings play important roles in defining the visual language especially with illiterate populations. (Dowse & Ehlers, 1998)

The increased use of pictures, icons and pictograms as communication tools, especially in the field of medical communication, suggests that designers should be researching the visual/ the picture/ the icon/the symbol to understand the impact it has they have on the comprehension of their intended meaning. Humans begin to make associations of visual representation in early childhood and by 9 or 10 they can understand the nuances of metaphor. (Rakocy et al., 2005); Cerchia, F., p. 201) There is also a preference by humans to process picture based information versus verbal based. This preference, picture superiority effect, is why the use of pictures are increasingly being incorporated into all aspects of communication from screen icons, emoticons for texting, and icons and pictograms in medical instructions and package inserts. (Childers & Houston, 1984) But research has also shown that many factors such as, the contents of long-term visual memory, context and culture, can influence the message that is derived by the user. (Ware, C., 2008, p.126). The design discipline requires designers to create images that “speak”. To communicate effectively designers need to understand what “image words” are understood by the target users. To design a visual language the designer must first gain an understand of what is stored in the users long-term visual memory; they must design research protocols that will reveal the 95% not just the 5% and they need to explore researching with user-generated visuals not just
designer-generated visuals. What guidelines or existing protocols exist for researching with user-generated visuals?

1.4: Researching with Visuals

A growing number of research studies are being conducted utilizing user-generated drawing methodologies in the field of visual research. (Pink, 2012) Significant studies are being conducted in the field of medical research; particularly with children, the under-represented, and those with limited subject relevant vocabulary; and specifically in the area of medical communication and literacy. (Houts, Doak, Doak, & Loscalzo, 2006) Early research in the field of patient comprehension has shown that patients consistently cannot read or comprehend the information they are being given. (Montagne, M., 2013) Words alone are not enough to solve this problem, which is why researchers are turning to the incorporation of images to enhance comprehension. The visual aspects of art and drawing as research methodologies provide a vehicle for enhanced expression visually and verbally. (Rollins, 2005).

Gillian Rose explains the three criteria for critical visual methodology, in the book Visual Methodologies:

1) The researcher must take the images seriously. Visual images are profound in their depth of meaning, and the researcher must be open to exploring the multiple levels of meaning that are contained in even the simplest of hand-drawn images.

2) The researcher must think about the social context and its impact on visual objects. In the case of medical research, this may include the environment in which the images are collected (for example, home, office, or hospital room); the severity of the disease; the condition or symptom being researched; and, most importantly, the cultural practices on which images depend to produce meaning.

3) The researcher must acknowledge their own biases or way of looking at images. The researcher must reflect on how they, as a critic, are looking at the images they are researching. (Rose, 2012)

As stated by Researcher Claudia Mitchell, one of the primary issues in visual research is the robustness of the methodologies used. “We must challenge the adequacy of the questionnaire, the interview, and the photograph/drawing/video.” (Mitchell, 2008) After collecting the imagery in the field or the lab, the researcher must begin the arduous task of analyzing the images. Through carefully collected and analyzed data, the researcher can begin to apply this newly found knowledge. The findings may also provide valuable insight into the role of context in the design of test methodologies and protocol such as choosing research subjects and testing facilities, selecting language for the questionnaire, and realizing the role/relationship of the researcher. This approach shifts the designer’s role from creating a visual vocabulary based on design rules to creating a visual vocabulary based on the images or data of the proposed user populations.

Context is Crucial

Context is crucial. It enables the researcher to comprehend the deeper unstated meanings of visual imagery. Understanding the context is paramount when testing created images with research subjects. In a study focused on creating a global language for children, the Pangaea study, images were generated by children and also by a professional illustrator. The research revealed that when the children were shown the professionally generated images, “The pictograms he drew were incomprehensible.” (Takasaki & Mori, 2007) This illustrates the importance of understanding that all visuals are not universal. There is no universal visual vocabulary. The adult professional illustrator failed

---

1 The author has a research-based opinion paper that describes many of these methodologies. It explores some of the current user-generated drawing techniques being utilized in the field, focusing on the methodologies being used for design research versus research in the fields of psychology or the social sciences. This thesis will not repeat this work but will continue to build on its hypothesis that the field of design needs a user-generated drawing methodology that has field-proven use protocols.
to effectively communicate because he did not understand the visual language of the children. The opposite was also found to be true; “some facilitators and staff had trouble understanding the meaning of the children’s drawings” (Takasaki & Mori, 2007) This finding illustrates how crucial it is to design and test within the context of the use and the user group.

J. G. Meunier explores how poorly designed pictograms can complicate the message or even confuse or misinform. In his article he discusses the need for sequence when communicating complex concepts and how the familiarity with a concept impacts comprehension. He discusses the impact of external factors such as context, demographics and the literacy of users and how they impact the comprehension of pictograms. He theorizes that there is a correlation between improved comprehension and an explanation of context. (Meunier, 2008) “Participants in positions of power can force other participants into greater efforts of interpretation and their notion of ‘maximal understanding’ is therefore different from that of participants who do their best to produce messages that will require a minimal effort of interpretation.” (Kress & Van Leeuwen, 1996) Understanding the societal context of the visual, the designer, the sender and the receiver are concepts that must be explored by the designer when creating a visual communication system or establishing a visual language. The designer must understand all of these nuances when asking the question, “What does it mean?”

In the research paper, Do Pictograms Improve Children’s Understanding of Medicine Leaflet Information?, authors Katri Hameen-Antilla, Kati Kemppainen, et al. found that most children ages seven, eleven, and thirteen, understood what the tested pictures were, but that understanding did not help them understand the leaflet information. “Even well-understood pictograms did not help the children understand the leaflet information, although they reduced the need for probing. This study shows that the context in which pictograms are tested makes a difference in the results. (Hämeen-Anttila, Kemppainen, Enlund, Bush Patricia, & Marja, 2004)

In Communicating the New, Kim Erwin writes about the myth of information “transfer” and the need for a shared conceptual space between the sender and the receiver. This shared conceptual space is crucial when communicating complex concepts; however, realistically this shared space is often quite small and limited. This limited, shared space is why concepts and images are often misunderstood. (Erwin, 2013) This limitation is also one of the key reasons why user-generated drawing may be an effective tool for understanding the shared conceptual space of the user population. They can reveal similarities between the populations’ visualizations, which provide the designer with a shared visual language with which to design. Researching context will also reveal significant gaps in understanding among large, diverse user groups. These gaps must be bridged or the designer must proactively expand the conceptual space to effectively communicate the visual subject matter.

Are there similarities that can be found in images generated by different populations? In his journal article, “Tell Me About It: Drawing as a Communication Tool for Children With Cancer,” J.A. Rollins reported that there was little difference in perceptions across cultural and ethnic factors in his international study of children with cancer. (Rollins, 2005) The disease becomes the shared communication space, which transcends cultural and socio-economic divisions. This shared experience space becomes the basis for the visual language that is being defined by the designer. The question still remains if the designer can assume this shared context when designing icons for children with various levels of wellness and exposure to medical facilities and procedures. But the findings could suggest that we can now design locally, nationally or globally if the experiences to be visually represented reside in the shared communication space.

1.5: Analysis Techniques for Visual Research

My literature review revealed that there were two common analysis techniques being used to analyze user-generated images, content and semiotic analysis.

Content Analysis
Content analysis was originally developed for the analysis of written and spoken texts. Content analysis has multiple definitions. (Krippendorff, 2012) For the purpose of this paper I will use “Content analysis is the systematic, objective, quantitative analysis of message characteristics.” (Margolis & Pauwels, 2011) Visual content analysis is the methodical review and analysis of a set of images for the existence of common visual elements and the frequency of repeated visual elements. “As long as the research hypotheses refer to manifest, unambiguous and clearly defined attributes, the content analysis of pictures is a relatively uncomplicated method.” (Margolis & Pauwels, 2011) There are four steps to content analysis: 1) Selection of the images or in the case of the user-generated drawing, establishing the criteria for the generation of images, 2) Devising your categories for coding, 3) Coding the images, and 4) Analyzing the results. (Rose, C., 2012)

Content analysis is one of the fastest-growing techniques in quantitative methodologies, no doubt due to the advancement of computer analytics and the explosion of digital data. It is used to study a variety of communication mediums, for example: television, advertising, video, film, magazine print, artwork and photography. (Margolis & Pauwels, 2011) While the technical advancements that are being applied to content analysis make it one of the most advanced methodologies, manual methods are still being implemented in the field.

Semiotic Analysis

Semiotic Analysis is used when the researcher is investigating the assigned meanings of words, images “signs” and the multiple layered meanings as interpreted by the sender and the receiver within a given context. This could be a first order meaning relationship. A picture of a fox means the animal, a fox. But a fox could also have a second order relationship/system. A picture of a fox means sly or cunning. Semiotic Analysis is used to research and understand the hidden, deeper, multiple or metaphorical meanings that are associated with a sign of a “signified” concept or idea. (Penn, 2000) It is often used to understand how contextual factors (societal standing, gender, nationality, education, environment, communication device) affect the meanings associated with words or images. (Berger, 2013)

Semiotic analysis was recently used as an analysis tool in the study, Cross-sectional Descriptive Study of Pictogram Evaluation by Youth, by Artyom Korenevsky, Régis Vaillancourt, Annie Pouliot, Marine Revol, et al. The process begins with an analysis of existing visuals, by the primary researcher. The researcher begins by searching for Individual component factors. These factors are then analyzed to reveal which are common graphic elements, and then after review and rating by participant’s, components were considered to be key graphic elements. In this research study, there were multiple images or pictograms within 21 pictogram categories. The analysis by the key researcher revealed a set of component factors. The component factors were than inputted into a table of semiotic components. Similar to content analysis a panel of two other researchers reviewed the component factor analysis and then debated until agreement on each component factor was reached. Elements that were represented in over 50% of all pictograms within each category were considered to represent “common graphic elements.” Common graphic elements that were judged by at least 80% of participants to convey the “intended meaning” were considered to be “key graphic elements”. (Korenevsky et al., 2013)

1.6: Why is user-generated drawing an important methodology?

We begin to understand the meaning behind created images and drawings at an early age. In a series of studies by Callaghan and colleagues (as cited in Rakoczy), children as young as three- and four-years old were able to create images that denote meaning (draw a picture of lollipops and balloons) and recognize the meaning in those drawings when they are reviewed later (even though adult researchers did not see the discernable difference). Rakoczy, et al, state, “In sum there is converging evidence that toward their third birthday children (in Western cultures) begin to understand drawing as an intentional symbolic action form.” (Rakoczy et al., 2005). The emotional and symbolic nature of drawing opens a window to the mind and soul of the research subject. Drawing has also proven to be an effective research methodology for a variety of research subjects from the very young to the old and infirmed. Drawing is a universal, multi-cultural, and age-defying communication tool. Those over-arching tenets
are why user-generated drawing methodologies need to be researched and implemented in the field of design research.

Drawing methodologies have been used for years in psychological testing. It is used to test intelligence and creativity. It is used to diagnose and treat trauma in people of all ages and mental abilities. Research has repeatedly proven the value of user-generated drawing methodologies. There is no need to validate those findings here. Sheila Jones used early drawing methodologies in human factors research. Utilizing a user-generated drawing methodology, called the sign production technique, she asked research subjects to generate a set of images from a list of abstract nouns. In her research Jones notes finding “universal visual concepts” that were elemental to even abstract visual concepts. (Jones, 1983)

User-generated methodologies also enable user-generated content to be collected at the very beginning of the design process and should in theory reduce some researcher bias since images are user-generated versus designer-generated. User-generated drawing methodologies switch the paradigm – instead of users evaluating designers’ images, designers evaluate users’ drawings and take this data to fuel their design process. What happens to the design process when this shift occurs? Figure 1.2 shows how the use of a user-generated drawing methodology impacts the “typical” design process. The research phase shifts from deep iterative design, based on the designer’s input in the development phase, to more in-depth analysis in the define stage and less iterative testing in the develop phase. The design focus in this stage shifts from solving/iterating for comprehension to solving/iterating for preference.

![Figure 1.2 Design Process and Research Comparison Diagram](image)

Participatory design research and co-design are changing the face of design and the role of designers and design researchers. The role of the user/consumer or subject has evolved from one who is observed to the “experts of their experience.” (Sanders & Stappers, 2012) One of the roles of the design
researcher is to provide the appropriate tools for the ideation and capture of the “expert user’s experience” as stated by Sleeswijk Visser et.al. (Sanders & Stappers, 2012) Collin Ware has established that approximately 95% of what we see is based on long-term visual memory. This long-term visual memory has been under construction since the day we were born and as we explore and interact with people and our world we continually add to this cache of stored information. (Ware, 2010) The design of a visual communication tool requires deep knowledge of how users see and what kind of visual memories they have stored in their long-term memory and of existing patterns of shared meaning making.

But the validation and use of user-generated drawings as a design research methodology is in its infancy. Tremendous in-roads have been made testing user-generated drawing methodologies in healthcare and social science research. User-generated drawings have been shown to help in the diagnosis of pain, to understand emotions, trauma, stress and user attitudes toward life and death. But there are many areas of design beyond healthcare where user-generated drawing methodologies would be appropriate: branding, strategy, innovation, technology interfaces, etc. This research paper will document the research behind a three stage user-generated drawing research methodology, the Flashdraw, establishing a research protocol that will enable the design researcher to collect, analyze and then apply the data from user-generated drawings directly to the design of icons and pictograms. The proposed implementation strategies of this methodology will include paper and digital formats. This methodology can be administered via digital platform, which will enable the collection of data from a vast array of potential target users. This research paper will explore if this methodology will enable the designer to efficiently and consistently create designs that have a high rate of comprehension among the target users.
Participatory design methodologies have been used for years with substantiated results in various fields including community design (Sanders & Stappers, 2012), human computer Interaction, (where it is now coined “third Space” (Muller, 2003), education (Siozos, Palaigeorgiou, Triantafyllakos, & Despotakis, 2009) and medical research (Backett-Milburn & McKie, 1999) I conducted a data base search to discover what user-generated or participatory drawing methodologies are currently being used in the design process. Specifically those focused on the design of visual communication tools, icons and pictograms. The database search revealed very few participatory design techniques that required the target user/subject to create images without the use of external visual stimuli. It should be noted that user-generated drawing and images are mentioned in methodologies that are commonly used in co-design and participatory design. However, they are considered a generated artifact or object versus the focus of the co-design activity. (Sanders & Stappers, 2012) Utilizing a key-word search on Google Scholar proved to be an exercise in futility. Because design, design thinking, and design research has achieved buzzword status in many arenas the use of keywords proved problematic. Which words are most appropriate for graphic design focused research: user-generated versus co-drawing or co-design versus participatory design? A search of Google Scholar using keywords: design research and user-generated drawing revealed 22,700 results, filtering for Graphic design 16,900, filtering for pictograms 93 of which 2 actually discussed user-generated visual design research methodologies.

What is the impact of participatory design methodologies? Noted academic, designer and author Liz Sanders has extolled the virtues of engaging the user in the design process. “Generative design research gives people a language with which they can imagine and express their ideas and dreams for future experience.” (Sanders & Stappers, 2012)p.14) But with any methodology where we, the researchers, are actively engaged in the process, there is the risk that we will affect the result. Therefore the researcher must strive to find methodologies that are designed to reduce the bias that we insert into our research.

My first exposure to the user-generated drawing was as a first year graduate student at the University of Cincinnati, in a studio led by Professor Mike Zender. He was using a theoretical methodology called the “draw-it technique”. This technique was in use at the University of Cincinnati, in the College of Design, Architecture, Art, and Planning, under IRB protocol 2013-2415, and several faculty members including Professor Zender were exploring it. The draw-it technique is based on the theory of brain icons/mental models (Kosslyn, S.M., 2006), the early theories of visual stereotypes that were established in the field of human factors (Jones, S., 1983) and the belief that there may be universally common visual languages or vocabularies within user groups or populations. (Ware, 2010) For example, if a population knows an element, and the population has a common understanding of this element or concept, then the population will create a common visual representation of this concept when prompted to "draw-it". A door would be represented by a vertical rectangle, perhaps with a round or oval shape added to represent a door- knob or handle. Take, for example, the visual concept of a car. If a group of international graduate students is asked to draw a car, will they create similar images or will there be differences based on demographic factors? Figure 2. 1 shows a sampling of car images generated by a class of international graduate students. The images reveal a striking similarity of visual concepts, with over 90% being represented by an oblong shape and 2 circles. This supports the hypothesis of a universal visual language being used to communicate the concept of a car.
Will the same universal language hold true when the students are asked to draw lunch? Lunch is an example of a common concept, one of the primary meals of the day, but there is variability in the menu and other contextual concepts associated with a meal. Figure 2.2 shows examples from the same group of design students when asked to draw lunch. The drawings now vary substantially as cultural and personal preferences begin to emerge in the visuals. However, even though meal choices vary there are still similarities that emerge, such as: the depiction of main menu item and a drink. When the data is divided based on residency status, International and US students, universal visual concepts do emerge. See Figure 2.3
When the divided data sets are compared dominant visual concepts emerge. In the US data set, 8 of 9 students used a sandwich to represent the primary food item and 6 of 9 students also included a beverage and yet only 1 drawing includes the use of a plate. The international data set also had emerging similarities, 8 of 8 drawing depicted the meal in a bowl or plate, 3 of 8 images used lines to communicate the warmth of the dish, and 5 of 8 drawings depicted the primary food as a mixed main dish. This illustrates the general methodology of the Draw-it technique. Elicit the creation of images from research subjects, and analyze the created images to find commonalities in the visual language revealed within the images.

The theories behind the draw-it technique are similar to the concept of representation that was introduced by Gunther Kress and Theo van Leeuwen. Representation is the use of visual forms to represent a meaning. They discussed their hypothesis regarding representation and its relationship to context. There are different modes of representation, and that “each mode has, inherently, a different representational potential, a different potential for meaning making.” (Kress & Van Leeuwen, 1996). The draw-it technique enables the design researcher to explore the representation within specific contextual spaces such as user population, user environments and specific events or processes.

2.1: Phase 1: Using the draw-it technique as a participatory research methodology

My first application of the draw-it technique on a design outcome was in a graduate studio project as a first year student at the University of Cincinnati. The class was challenged to design a set of icons for a medical consent form for Cincinnati Children’s Hospital Medical Center, using the draw-it technique. Using medical procedure descriptions provided by the Cincinnati Children’s Hospital of Cincinnati, the entire class was required to collect data samples using the draw-it technique. As an older student with children and many friends and family members with children I was uniquely situated to collect data samples from the user population, children age 9 to 17. All of the students were required to collect data using the descriptive questions (supplied by the Cincinnati Children’s Hospital of Cincinnati) and an
approved IRB consent form, but were allowed to design their own test instruments and data collection methods. A representational test instrument, Figure 2.1.1, can be found in the appendix.\(^3\)

The data collection methodology was straightforward:

- Test packets were compiled, and I assembled a set of various pens and pencils.
- Parents were informed of the procedures before the test began and were allowed to remove any questions they felt might be controversial or difficult for their child to understand, for example: urine collection, pregnancy, or parental notification of a child's pregnancy.
- The subjects and their parents were verbally informed of the reason for the drawing exercise: To collect a set of images that describe what it is like to have a particular medical procedure or suffer from a medication treatment side-effect. The drawings are to be used to inspire the design of pictures that would be used to explain these concepts to children at a children's research hospital.
- The children were then given the test instrument and the collection of drawing tools. We read the test question together, and I asked them if they had any questions and if they understood what they were being asked to draw. Additional explanations or descriptions were given if requested. The children were allowed to use any of the provided drawing tools.
- The children were allowed to draw for approximately five minutes.

The data I collected from the children was illuminating. I was surprised at how willing the children were to participate, regardless of gender or age. The images the children produced were colorful, expressive, explicit and surprisingly accurate. When I began to really look and analyze the drawings, I began to see commonalities within each question category and across the images as a holistic set. Figure 2.4 is a data set for medication side effects of nausea, diarrhea, upset stomach and dizziness. Figure 2.5 is a data set of weight gain as a medication side effect. Figure 2.6 is a data set of rash and swelling as a medication side effect.

\[\text{Figure 2.4: Draw-it Data Sample Side-effect 1 (nausea, etc.): 2013 children age 9 to 15}\]

\(^3\) At the time, my IRB for child subjects had not been approved. Given that limitation, I used a population of friends and family for my test subjects. The parents and children were informed of the test protocol and were given a copy of the IRB consent form for review.
Figure 2.5 Draw-it Data Sample Side-effect 2 (weight gain): 2013 children age 9 to 15

Figure 2.6 Draw-it Data Sample Side-effect 3 (swelling/rash): 2013 children age 9 to 15
The drawings were then analyzed to identify the key visual elements that are represented in each data set. Figure 2.7 is a data table of this analysis. The heuristic methodology for the data collection was an adaptation of visual content analysis. Where I (the researcher) became a one-person content analysis team. Key attributes of each image were identified and circled. The images were evaluated for the following factors: 1) Figure Representation - whole body, 2) The use of multiple colors in the drawing, 3) the inclusion of a face in the image, 4) the use of emotion in the image – with facial expression, caption or pictorial elements, 5) The representation of bodily fluids and 6) The depiction of sensory cues with gesture, color or words. The complexity of the children’s images was surprising, and even given the wide age range of the research subjects, nine to fifteen, recurring patterns began to emerge. The images generated by the children were very descriptive, and there was a significant use of gesture lines in the description of sensory inputs. The analysis of the drawing revealed several universal visual concepts with over 86% of the images including a full-body pictorial depiction, 68% of the drawings showing a face and all but one of those faces showing emotional concepts with the facial features. I was surprised by the candid use of color and sensory gestures to communicate the sensory cues associated with urine, excrement and vomit. The children were visually communicating what it was like to see, feel, smell and sense the side-effect symptoms.

<table>
<thead>
<tr>
<th>Question</th>
<th>Data Set #</th>
<th>Full Body</th>
<th>Color</th>
<th>Face</th>
<th>Emotion</th>
<th>Body Fluid</th>
<th>Sensory Gestures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side Effect - Nausea, etc</td>
<td>16</td>
<td>12</td>
<td>10</td>
<td>15</td>
<td>13</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Side Effect - Swelling</td>
<td>7</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Side Effect - Rash</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Side Effect - Weight Gain</td>
<td>7</td>
<td>7</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Urine Collection</td>
<td>8</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Receiving a shot</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Having Blood Drawn</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Parental Notification</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>All</td>
<td>51</td>
<td>44</td>
<td>29</td>
<td>35</td>
<td>34</td>
<td>25</td>
<td>16</td>
</tr>
</tbody>
</table>

Figure 2.7 Draw-it Data Table Side-effects, Urine, Shot, Blood Draw, Pregnancy, and Parental Notification: 2013 children age 9 to 15

2.2: Seeing is Questioning

The data collection and analysis was then applied as the primary input in my design process. I was seeking to answer the question. If I applied the universal visual concepts to my icon/pictogram designs would there be higher user comprehension rates than designs that did not use the concepts? I identified the following visual concepts to be included as variables in my comprehension test exploration.

---

4 The table does include analysis of images not included in the figures 2.4, 2.5 and 2.6, these images can be found in the appendix.
• A human figure should play a primary role in the image.
• Whole or ½ body depiction
• Body fluid should be incorporated (if appropriate)
• A face with features
• The use of emotion appropriate to the “real” experience of the symptom or sensation of the procedure
• Medical props and instruments are understood and well represented by the target user and should be incorporated appropriately in the iconic images.

A set of icons were developed to test the hypothesis that including the identified universal visual concepts that emerged from the data analysis would lead to a higher comprehension rate by the targeted user population. Two sets of icons were developed for each of the following consent form concepts.

• Taking oral medication.
• Giving a urine sample.
• Getting a shot or injection of medication.
• Side effects that could occur from taking a medication
• The concept of pregnancy and the notification of parents of a positive pregnancy test.

Figures 2.8 and 2.9 are representative samples of the icons that were created.

![Figure 2.8: Draw-it Icon: Side-effect Nausea](image1)

![Figure 2.9: Draw-it Icon Side-effect Rash and Swelling](image2)

Additional icon sets were also developed to probe the concept of emotional representation and the depiction of side effects as “sets” of symptoms or as individuals. A compilation of representative data samples and the results of preference and comprehension testing, along with personal interviews and online survey of the icon sets can be found in the appendix section 2.2.1: Phase 1 Research report.

The various design teams in the studio conducted a series of comprehension tests on icons that were influenced by their draw-it data collection. The class as a whole had positive comprehension results on images that were based on the draw-it data. Given my access to children I was the only one who was able to conduct informal preference testing with children. The results of this test suggested that the icon designs that incorporated the majority of the universal visual concepts, were preferred by the research materials.

5 Test instruments for preference and comprehension testing can be found in the appendix 2.1.2-2.1.4.
subjects from the target user group, children ages 9 to 15. My exposure to the draw-it technique,
revealed its robustness as a participatory design methodology that can be used at the very onset of the
design process. It is a tool for the design researcher regardless of their specialty and enables the design
researcher to acquire an understanding of the primary thoughts, images and concepts of the user. Those
concepts are portrayed by user-generated imagery, but they are not necessarily bound by the confines of
graphic design, but rather by the meanings and visual cues/language that are contained within the
images. However the deeper I became immersed in analyzing the research methodology the following
questions emerged:

- How many questions need to be asked to get accurate data collection?
- Given the difficulty of researching with children, can adults be substituted for user-drawing data
collection if they are informed of the contextual parameters?
- Does the researcher need verbal probes after data collection to enable accurate analysis of the
data for use in the design of icons and pictograms?
- Can the image analysis process be designed for efficiency and the removal of implied researcher
bias?
- Can a system of data analysis be designed that would enable a reliable method that could be
tested and replicated across a wide range of topics and user populations?

I realized I wanted to solve for these problems, to design a research process and tools, the Flashdraw,
that could be rigorously proven and universally used. I began designing a research study that could test
the following hypothesis.

*Is the Flashdraw methodology a valid participatory design research methodology and does it support the
assumption that users from a population will create descriptive visual representations (drawings) that
contain visual concepts that are shared by the majority, over 65%, of the population?*

---

6 The scope of the research contained in this study has been contained to the exploration of the Draw-it technique on the design of a set of icons and
or pictograms for use in a medical consent form.
3: The Flashdraw Methodology:  
Data Collection and Analysis

The phase one research had showed great promise for a user-generated participatory methodology but the deeper I became immersed in analyzing the data and collecting data in the field I realized that the current methodology, the draw-it technique, was not appropriate for a user-generated drawing methodology that could utilize a digital platform. My desired implementation method, a digital platform, required data collection that could be done with little to no interaction with the researcher. The basic process design of collect data, analyze data, apply analysis to design, test comprehension of applied design work with target users had resulted in designs with high comprehension scores. A second round of research was now needed to fine-tune the data collection and analysis processes in an attempt to support the Flashdraw methodology as:

The Flashdraw methodology is a one-question user-generated visual participatory design research methodology. It collects unaided visual responses from users with paper or digital tools and uses a binary analysis tool. Analyzed data is then applied to the design of icons and pictograms.

3.1: Data Collection

The initial data collection methodology had performed well. The questionnaire design and the data collection format, as described in Phase 1: Using the draw-it technique as a participatory research methodology, and with accompanying sample question found in the appendix Figure 2.1.1, had proven to be effective at data collection. The research subjects, regardless of age, had little problem understanding the survey design or the question format. However it should be noted, that some older research subjects, adults, did occasionally need assurance that their drawings would be adequate and that no artistic ability was needed. To ensure involvement of a broad research pool I tried to encourage those who were hesitant to participate by stating “the need to get samples from average people, not just artists.”

Question Format Guidelines:

- The question should be written in approachable language for the user.
- The context of the end use of the visual, aiding you the researcher in what you will be creating, should be explained: Who, What, Where, When, How
- Definitions of words, phrases, concepts, treatments, and so forth, should be written in appropriate language for the user if they are not easily understood.
- Test your survey questions with sample users prior to fielding the study to ensure understanding of the test question.
- Allow approximately five minutes per question for completion.

3.2: How Many Questions Are Needed?

My prior experience with collecting data samples for the draw-it methodology left me questioning the overall design of the survey. The basic question format was working very well, but I had administered a variety of different lengths of surveys. I had encountered varying degrees of compliance during my initial research, which appeared to be directly related to the number of questions on the survey and the
perceived completion time. Therefore prior to testing my final protocol methodology, I needed to establish how many user-generated questions should be on a survey to get consistent results?

Phase 2 testing would be focused on the collection of a large data set from the general population to construct a set of control data, n=500. Data would be collected globally, but only data from male and female respondents who resided in the US and were between 18 and 75 years old would be analyzed. It is very time-consuming to solicit, administer and collect data responses on surveys from a large user population. Additionally, phase 1 research had shown some loss of engagement when research subjects were asked to draw more than three images. It was my belief that I would be able to achieve better compliance, a deeper subject pool, and more responses if I could design a test that contained only one user-generated question in each test instrument.

With a new methodology there are no established protocols for the correct length of a survey. Social scientists often ask only one user-generated question but their test design includes an extensive post drawing dialogue with the research subject. My desire to design a user-generated methodology that could be used via mobile devices required me to establish that a short, one question user-generated visual survey would yield relevant data. In a recent study administered by Survey Monkey, approximately 100,000 surveys were analyzed. Survey Monkey is an online survey development company with over 15 million users. Their findings were surprising. Common thinking would support the belief that as the number of questions in a survey increased, the length of the response time would increase in a linear fashion. Contrary to this belief, they found that as the length of the survey increased the time spent on each question decreased. “On average, we discovered that respondents take just over a minute to answer the first question in a survey (including the time spent reading any survey introductions) and spend about 5 minutes in total, answering a 10 question survey. However, respondents take more time per question when responding to shorter surveys compared to longer surveys.” (downloaded 9.22.14, https://www.surveymonkey.com/blog/en/blog/2011/02/14/survey_completion_times/)

3.3: Phase 2 Testing: The Flashdraw Survey

The Survey Monkey study would support a hypothesis that the quality of the response would not be compromised as the length of the survey was decreased. I decided to test this hypothesis by comparing the results of two survey instruments, a single question format, Flashdraw, versus a multiple-question formats. I set up my phase 2 test to understand if there is significant statistical difference between visual data created by respondents to whom were administered a single user-generated question test instrument (Flashdraw Survey) versus those who answered a multiple question (Seven User-Generated Question Survey) instrument. Since my IRB approval for researching with children was still pending I focused Phase 2 data collection and analysis on adults only. If the data were proven to be comparative for both survey formats, I would then have a large database of coded drawings (n=493). I could then use the adult drawings as a control for future research. The testing protocol and the survey instruments can be found in the appendix Section3.1.1 Flashdraw Survey.

The collection of data is just the beginning. To establish a methodology, I also need to define how the data should be interpreted. Because the vision for this methodology included its use by a wide variety of design researchers and the collection of large data sets n<50, a data interpretation protocol needed to be established that would not be overly cumbersome, labor-intensive, or expensive. I began exploring existing methodologies to see if I could implement or adapt one for the analysis of the Draw-it and Flashdraw data sets.

My previous research of image analysis methods revealed two possible directions for the coding and categorizing of the data set, content analysis and semiotic analysis. Content analysis is an established system of analysis that requires establishing criteria for the systematic analysis of audio-visual data. Content analysis can be done by a team of trained researchers or by computers that have been provided with specific search criteria. Semiotic analysis is the analysis of media for the systems, categories, relationships and rules that are contained within. When we read a book or watch a movie we are using semiotic analysis. The credits that role across the screen of a movie are filled with systems and
relationships that add to the depth of meaning of the role and the value of the role the person had on the creation of that film. The skill and experience of the researcher has a direct impact on the depth and sophistication of the applied analysis and it is often difficult for the researcher to be objective since we bring our values and external influences into the process. Since my intention is to remove as much researcher bias as possible, I decided to focus on an analysis method that enabled the removal of the design researcher from a majority of the analysis processing. This method reserves their involvement to the establishment of frameworks based on the design objective and the needs of the design team.

3.4: Content Analysis

Content analysis appeared to be the most appropriate method of image analysis for a design focused user-generated images.

There is a significant amount of research that has been done on content analysis, and it is a widely accepted image coding methodology. In The Content Analysis Guidebook, Kimberly Neuendorf states, “perhaps the most distinctive characteristic that differentiates content analysis from other more qualitative or interpretive analyses is the attempt to meet the standards of the scientific method.” (Neuendorf, 2002, p.10)

Establishing the Criteria for Image Generation

To maintain a rigorous methodology of visual information, the selection of images for a content analysis is critical. Since the Flashdraw creates the images to be analyzed, the focus will be on the formation of the stimulus for image creation, the selection criteria for research subjects and sample collection criteria. To maintain the rigorousness content analysis affords, the researcher needs to establish a strict research protocol. They must define the population, identify and adhere to the specific Draw-it question, and maintain consistent sample collection criteria. This includes the proper development and assembly of testing materials and field kits as defined in the Phase 2 Research Protocol.

Identifying Coding Categories

When using content analysis, it is imperative that proper coding categories are established. The strength of the analysis is based on the relevance and strength of the empirically derived categories. There are five means to create categories for the coding of images. You can use your observers/coders to identify categories or experts not associated with your study can create the categories. Categories can be defined based on logic and reasoning, or you can create new categories after examining currently existing categories to make sure they are unique and exhaustive. And finally, you can create new categories after your initial coding has begun, fine-tuning your categories based on initial coding results.

Coding categories should be relevant to the research question, and the objective of the research, and the content of what is actually in the images, and the context in which the research is being used. (Rose, 2012) The collection of coding categories creates a codebook. Content analysis often starts with formal or objective categories such as: picture size, full or partial body figure, and number of/selection of colors used. The coding then moves to more subjective categories. Subjective categories could include: Does the figure have facial features? Do they show emotions? Is color being used to highlight a specific action or emotion? Categories should include questions concerning people, environments and context. (Margolis & Pauwels, 2011) Other categories for hand drawn images could include questions regarding execution such as use of gestures, facial expressions, or representative color and text. Coding categories must by exhaustive, exclusive and enlightening. They must include all of the information to which the research is pertaining. The categories must be unique and cannot overlap or be repetitive and the coding should produce an illuminating or interesting analysis. (Rose, 2012)

The Coding of Images

Coding is the assignment of descriptors to a set of images and it can be problematic because of the subjectivity of the coders. Coders must be trained in the application of content analysis, the use of the codebook and the definition of the specific code categories. A codebook should contain: instructions to
enable proper sorting by coders, a definition of each theme, guidelines to aid in decision-making, and coding examples. (Kenney, 2010) Proper training of the coders will help to overcome their biases and subjectivity. The images also need to be presented randomly and should be coded by at least three coders. (Margolis & Pauwels, 2011)

Analyzing the Results

Content analysis reliability is based on inter-coder agreement, the percentage of agreement for coding decisions. To calculate this percentage divide the total number of coding decisions made by each coder with the number of agreements made. This sum is adjusted to take into account that you can never have 100% agreement, a correction formula. (Kenney, 2010). After the coding is completed the data is analyzed. Traditional Content analysis uses statistics for analysis and summarization of data.

Code Book Design for Phase 2

The author and two other researchers established the codebook. The codebook team examined a random collection of ten images from the data set. Each researcher evaluated the 10 images looking for recurring coding categories. Each researcher then presented their proposed categories based on the 10 images. The 10 coded images were then viewed by the group as a whole and the merit of each proposed coding category was debated until a preliminary codebook was developed. The preliminary codebook was then tested by coding an additional 10 images, with each researcher coding each image, the coded analysis was then reviewed and the code book was modified as needed based on this analysis. The author then created the final codebook and assembled a coding committee.

Six coders were trained and the code categories were explained by using the original ten images as reference samples. The coders were reimbursed for their efforts by the author. Because of the large sample size n=400+, the codebook was designed to be binary in nature. This coding design made the manual coding and analysis of the large data sets more efficient and allowed the coding team to work with minimal oversight by the author. The removal of the lead researcher/author, from the coding was an attempt to minimize researcher bias in the coding process. The code categories were written to be yes or no determinants and the images were coded for the presence or absence of these criteria. For example: Is there a head? Yes or no? Does the head have facial features? Yes or no? (Facial features are defined by at least one of the following: eyes, nose or mouth). Does the drawing express emotion? (Emotion could be expressed by the use of facial features such as tears, a smiling mouth, a frowning mouth, etc.) This codebook design eliminated the need for each codebook entry to be debated by the committee. The author entered all codes, and if the coded entries were not unanimous, were missing an entry, or had a 2/3 majority, then the author reviewed the image and made the final decision. Each image was coded three times, an odd number, which ensured there would never be a tie. To maintain objectivity the author was not a primary coder of any of the images and only provided coding input for the creation of the coding categories and as a final decision maker.

Data Collection

Data was collected primarily in the US, but additional data was collected in Germany and Korea. The data from foreign countries was collected and coded but is not included in this research paper. The Figure 3.1 shows a breakdown of the data collected throughout this study. Phase 1 data refers to the data that was collected in 2013 during the initial icon project (children only). Phase 2 research refers to the data collected for the Flashdraw Survey research (adults only). And Phase 3 research refers to the final research phase outlined in Chapter 4. Please note: Phase 2- set b data set is 7X the number of respondents since each respondent answered 7 questions.
3.3: Phase 2: Flash Survey Research Findings

The author/design researcher entered all data from the two data sets into the coding spreadsheet and applied additional coding analysis in the event of ties or ambiguous results. Two codebook spreadsheets were developed, one for each data set (Flashdraw and multi-question). Figure 3.2 is section of the codebook spread sheet from the Flashdraw data set. A list of all codebook categories with definitions is included in the appendix in Section 3.1.17.

The data from two questions (side-effect and urine collection) were coded, compiled, and placed into a spreadsheet; and then the two question formats (Flashdraw and multi-question) were compared for each codebook category. A histogram was used to plot the results. (Figures 3.3 and 3.4) Each codebook category is on the x-axis and the response rate percentage is on the y-axis. The graphical comparison shows that while there is variability within the coding categories, the two survey data sets (Flashdraw
versus multi-question) consistently contain very similar visual data content and execution for each question.

Figures 3.3 and 3.6 contain a randomly selected comparison of images from each set of survey data. The responses from both data sets, while not identical, did not show significant differences in the majority of
coded categories, rendering them statistically comparative. Therefore my hypothesis that the draw-it results would be similar regardless of the number of user-generated questions asked was proven to be accurate. Given these results, I would proceed with my Phase 3 research using the Flashdraw or one question survey design.

![Figure 3.5 Phase 2 Image Comparison: Urine](image1)
![Figure 3.6 Phase 2 Image Comparison: Side Effects](image2)
![Figure 3.7 Phase 2 Image Comparison: Blood Draw](image3)
![Figure 3.8 Phase 2 Image Comparison: Oral Medication](image4)

3.7: The Binary Content Analysis Codebook

The analysis of almost 500 images was a time consuming but the codebook proved to be an efficient method of data collection. It enabled the code team members to work remotely, unanimously and with no or very little interaction with the lead researcher, thereby reducing opportunities for researcher bias. But this process did reveal that there were opportunities for improvement. The binary nature of the coding was proven to be effective and allowed for efficiencies which the large data set and limited research resources required. The analysis of this large data –set also revealed that there two primary

---

7 The code-book spreadsheets for the comparative data are not included in this document due to size constraints, please contact the author for more information regarding this data.
types of coding categories those that are common to all drawings and those that are topic and question specific. These observations led me to redesign the codebook to create a universal binary codebook that could be used for all images with a discrete section that would be re-defined based on the research topic and specific research question(s).

This new codebook, the binary content analysis codebook, can be found below, Figure 3.9. The new codebook was divided into 2 sections, demographic/category sorting criteria and content analysis criteria. The content analysis section was organized into three distinct categories: executional, human depiction and question specific. Executional, basic drawing, characteristics are those that could be found in any drawing regardless of the subject matter. The use of color (monochromatic versus multi-color or a targeted color strategy), the inclusion of language (dialogue or descriptors), or the reference to progression or action (action/motion lines, arrows and swooshes and the storytelling strategies or the use of placement and gesture to imply specific actions) are all examples of characteristics that would be considered executional. The second category, human depiction, are coding categories that are unique to drawings that contain humans. The number of people in the image, the use of full or partial body depiction, the inclusion of a face, the emotion depicted, body position and body language (attitude/gesture) are all examples of human depiction characteristics. The last category are those that are topic and question specific. Based on the research topic, medical consent forms for children and adolescents, and the research questions, blood draw, urine collection, side effects, oral medication, the drawing characteristics were selected for analysis reflect the focus of this research and the required outcomes needed from the content analysis. The data collected from this analysis is being used to inform designers regarding the key visual elements, visual key words, to be incorporated into the design of a pictogram or icon for the design. These visual keywords will have a direct influence on the comprehension, understanding and perception of a medical procedure, test or potential side effect. Given these objectives, some examples of question specific characteristics are the presence of body fluid or medical personnel, the expression of pain, or the specific tools or furniture that are incorporated into the image.

Section 3 of the codebook, the topic/question specific section is the only section of the Binary Universal Codebook that should be modified by the researcher when using the flashdraw methodology. The characteristics that are used in section 3 will need to be defined by the coding team members. The Flashdraw Protocol found in the appendix 7.1 outlines some suggested guidelines for the identification of these characteristics by the codebook committee. The most important factor to consider when establishing the coding characteristics for section 3 is that they must be defined to such an extent that they can be answered by a binary or yes or no question. Is the characteristic manifested in the image or not. Obviously each independent coder will determine the presence or absence of this characteristic but the characteristic must be defined and articulated as a yes no characteristic. If the coders find the characteristic in the codebook does not facilitate this, the coding committee should continue branching the characteristic until it can be defined by yes or no, binary answers. New characteristic codes should be tested with an additional ten draw-it images by codebook committee and modified as needed. Depending on the range of characteristics that need to be added for each specific question the primary researcher should determine the need for a question specific versus topic specific Codebook Section 3. The primary researcher can choose to null specific code characteristics if they not pertain to a specific research question within Section 3. However if a large percentage of characteristics are found to apply to just one question of a larger topic set it may be more appropriate to further define section three into a sub-sections. Section 3a would be topic specific and would be used for all research questions and Section 3b would be question specific and would be divided into specific segments that would be assigned to each specific research question within the research topic. For example for the research contained in this paper, the topic would be the procedures, test or symptoms found in a children’s medical consent forms.

Please note that the characteristics contained within each of these categories are based on the content analysis on a very specific set of research questions and just one topic, medical consent forms. Upcoming research will continue to develop the ideal characteristics that should be contained within each of these categories.
hospital consent form and the questions would be: urine sample collection, blood draw, side effects and oral medication.

Figure 3.9 Binary Content Analysis Codebook for the Flashdraw Technique

The preliminary testing protocol for the flashdraw technique can be found in the Appendix Section 7.2. This protocol includes guidelines for survey design, data collection, codebook design, coding, data analysis, data application, preference and comprehension testing. The research behind the data analysis, data application, preference and comprehension testing for the flashdraw technique can be found in the following chapter.
4: Testing the Flashdraw: Collection to Analysis

The results from the Phase 2 testing enabled the further refinement of the Flashdraw technique research protocol. The ability to administer a one-question visual survey would enable administration in a variety of different venues and platforms, in analogue and digital format, while collecting large data samples without exhausting data collection efforts. The goal of the phase 3 testing was to collect data from adults and children with the refined test instrument and to obtain a data set from children in a clinical setting. The data would be analyzed using the binary codebook and the target user group would evaluate images that were generated from data collected from Phase 1 testing.

The surveys were all completed in Cincinnati and were collected one-on-one and also administered in a group setting. The clinical surveys were completed as part of another research IRB in the ADHD Department of Children’s Hospital. The clinical surveys were not administered by the author but were administered by clinical researchers at The Children’s Hospital of Cincinnati.

The following section outlines the objectives of the research, the test instruments and data collection methods.

4.1: Objectives of Research

Purpose: Based on prior research using the Flashdraw methodology and a literature review of user-generated participatory design drawing methodologies, I developed the following hypothesis: Using the Flashdraw methodology for data collection, content coding and analysis, the application of the design criteria from the Flashdraw methodology will result in an initial set of icons or pictograms that will have a comprehension rate of over 67%, the lowest recommended comprehension rate for images based on international standards. The research will also reveal the difference in the imagery of child and adult populations and how they interpret the specific Draw-it questions. It will also identify potential commonalities and inform the researcher if adults could be a possible substitute for children/adolescents, if the adults are informed and understand the context of the images being developed for a child/adolescent target user population.

Materials:

- An IRB Cover Letter
- A set of markers containing one black, one red, one blue, one green and one yellow marker.
- Test Instrument A: A survey form containing three demographic questions, creativity measures scale, one user-generated question (with a space on the page for respondents visual) and one preference question. There will be a total of three Flashdraw test instruments each with a different user-generated question and a different preference question. They will be distributed on a randomized basis.

Methods:

There will be two groups of male and female US respondents, currently residing in Cincinnati, Ohio. A) An adult group with respondents age 18-75. B) A child and adolescent group with respondents ages eight to 17. Clinical respondents were recruited from Cincinnati Children’s Hospital Medical Center. Respondents will be recruited from within and outside the clinical setting and may include patients and non-patients. Both groups will use the same test instruments.

Data Interpretation:

---

9 All data was collected under IRB protocol 2013-2415 from the University of Cincinnati and Cincinnati Children’s Hospital.
The images will be coded using content analysis by a team of three coders. An existing codebook will be used. The existing code book was developed based on the same questions and was developed by a coding committee consisting of the author/researcher and two independent coders using a sample of 10 user-generated images. The coded data from the three representative questions will be analyzed between the two respondent groups, adults and children. A histogram will be used to plot the results. Each question will be on the x-axis and the number of respondents for each technique will be on the y-axis.

4.2: Research Protocol

Recruitment for Participation

There were two participant pools that were recruited: adults between the ages of 18 to 75, and adolescents between the ages of nine to 18 years. Both groups were recruited from within a clinical setting and outside of the clinical setting. The clinical setting participants were recruited under existing IRB approved research studies (ADHD). The following demographic information was collected: age, gender, status (patient, parent of patient, health care provider, or other). The respondents were also asked to complete a creativity measure, which was a modified five point Likert scale (I am very creative, creative, neither creative or uncreative, uncreative, very uncreative). The University of Cincinnati IRB Board approved data collection for this study with adults, children, and adolescents. The test demographic breakdown is shown in Figure 3.1.

Survey Design

After the demographic questions, the survey was divided into two parts or questions: a user-generated drawing portion, and a preference portion. Respondents were asked to complete one question for each portion. The estimated time of completion for the entire survey was an average of 5 minutes. The design of this brief survey was based on the results of the comparative test of the multiple-question and one-question survey formats. (See chapter 3) This survey format is called the Flashdraw. See figure 4.1 for an example survey.

There were three survey designs: 1) Flashdraw question: oral medication/comprehension question: urine collection, 2) Flashdraw question: blood draw/comprehension question: oral medication, 3) Flashdraw question: urine collection /comprehension question: medication injection. Additional surveys can be found in the Appendix figure 4.1.1 and 4.1.2. The survey distribution was randomized throughout all of the participant pools. The Flashdraw participation portion was comprised of a statement describing a medical procedure. The wording of the question was modified with the assistance of clinical researcher Tara Foltz to be less clinical and more child-appropriate. The respondents were then asked to draw (using any or all of the supplied five color markers and placed in the designated image frame) the first image that came to mind that described that procedure. The preference portion was on a second page, (or back-side) of the test instrument. The ordering of the questions was intentional: an attempt to eliminate the undue influence of the images included in the preference question. Respondents were asked to complete the first question before looking at or answering the second question.
The preference question was a multiple-choice question. The respondents were asked to read a simple procedure statement and select from six images or pictograms the one that they felt best described the medical procedure. Although they were asked to select only one, some respondents selected multiple images; surveys with up to two answers were tabulated as correct. Responses with more than two selections were thrown out as invalid. The images or pictograms were selected from a collection of icons/pictograms that had been developed during Phase 1 and based on key learning from the Draw-it technique. However, different coding criteria was used in Phase 1 and there were too many variables within the image set so results from this test should be evaluated for general trends only. The findings of this preference test can be found in this appendix. See figure 4.2.1

4.3: Data Analysis

The data was analyzed using the binary codebook as defined in section 3.7. The following figures 4.2 and 4.3 show the comparative results of the data collected from the adult population versus the child population for the Flashdraw survey question: Procedure Statement: Urine Collection – A person pees into a collection container. Please draw here.

The histogram shows fairly consistent results from both groups with the exceptions of targeted color, inferred action and furniture which show variability of over .20 between the two data sets, adult/children. Given this significant difference the original data was examined and the following trends emerged:

- Inferred action – the adults had a significant number of drawings where the urine was shown as a dotted stream implying motion or action. This may have been in addition to lines or arrows that showed the trajectory or placement of urine into a cup or toilet.

- Furniture – the adults were more likely to incorporate a toilet, urinal or bathroom door into their image versus children.
• Target color – the adults were more likely to use a secondary color when defining the stream or placement of urine into a container. Both data sets had a very significant use of the color yellow to define urine in their images.

Further refined statistical analysis of these specific occurrences should be conducted, especially if the specific factor has a very high rate of occurrence < 60%, such as furniture and inferred action.

Figure 4.2: Flashdraw Phase 3 Results: Urine Collections Adult and Children

Figures 4.4 and 4.5 show the analysis for the Flashdraw survey question: Procedure Statement: Oral medication – A person takes a pill or swallows liquid medication. Figures 4.6 and 4.7 illustrate the analysis for the Flashdraw survey question: Procedure Statement: Blood Draw – A young person gets blood drawn from a vein in their arm.
Figure 4.4: Flashdraw Phase 3 Results: Oral Medication Adult and Children

Figure 4.5: Flashdraw Phase 3 Drawing Samples: Oral Medications Adult and Children
Figure 4.6: Flashdraw Phase 3 Results: Blood Draw Adult and Children

Figure 4.7: Flashdraw Phase 3 Drawing Samples: Blood Draw Adult and Children
Figure 4.8: Flashdraw Phase 3 Compiled Averages Adult versus Children

All questions were then compiled into one histogram to track overall trends in the user-generated images of all survey question regarding consent form procedures. A cursory review of the coded data reveals several key trends.

The user-drawings from the children and the adults were strikingly similar. There were differences, but the data set histograms illustrate a fairly homogenous landscape of peaks and valleys.

There were significant differences in user-drawings based on the question subject matter with some questions resulting in a very high inclusion of a medical implement versus furniture or the use of target color.

There was an almost universal exclusion of secondary people in all images. With the inclusion of medical personnel or parents having inclusion rates of 10% or less. In fact, of the over 500 images collected in my three phases of research, less than five images included a parental image.

Compiled averages show that less than 40% of the drawings were monochromatic and color had significant impact on several of the coding categories.

This data exploration revealed some general trends; however, a more rigorous analysis of the data needed to be completed to identify the key factors that needed to be included within the specific icon designs for each question. To design an exacting research methodology, protocols need to be established for all stages of research including the interpretation of the coded data. There needs to be a repeatable analysis framework that could be applied to the coded data. The framework needed to address the following questions: How does the designer know which information is key to a successful icon design? What are the visual key words of the visual vocabulary the designer should be using? How can the designer confirm that the analysis framework is accurate?

4.4: Developing a Visual Vocabulary

Authors Drowse and Ehlers have defined a set of guidelines for the design of pictograms used in a pharmaceutical context. They list the use of the following factors for successful design of pictograms: 1) Research with the target population, 2) The use of familiar objects and symbols, 3) Design simple realistic pictures with limited content, 4) Use the whole body image, 5) Use background space
appropriately, 6) Use color appropriately, 7) Use scale appropriately. They also defined a list of factors that should only be used with caution when creating pictograms for illiterate populations: 1) Multiple-stage pictures should be used sparingly and alignment of images top to bottom versus left to right may enhance comprehension. 2) Abstract symbols, motion symbols, and perspective symbols can be difficult to understand. They also suggest that all images be pre-tested with the target population. (Dowse & Ehlers, 1998)

The research presented in this paper would suggest that it is not appropriate to just design against a checklist of factors based on a few research studies. The Flashdraw methodology enables the design and development teams to create a unique set of criteria for the development of subject matter specific to the communication needs for specific target populations. I call this design criteria, the visual vocabulary. The following section will outline how the design researcher can use their coded Flashdraw results to create a Visual Vocabulary. It is the authors’ belief that this same analysis (with some modifications) can be used with the draw-it and Flashdraw methodologies. However, since the draw-it technique is often accompanied by follow-up dialogue between the researcher and the subject the coding protocol should be used as a guideline only. The perceptions of how the researcher interpreted the meanings based on this dialogue would not be represented in the coding method outlined above and the data analysis method should be adapted to reflect this additional data.

In a laboratory study of icons conducted by M. P. Bruyas, et al., a series of pictograms (90 in all) were evaluated by 32 subjects ages 23 to 70. The images were displayed on a computer screen and the research subjects were asked to identify the pictograms as quickly and accurately as possible. Each pictogram was modified in multiple ways; the purpose being to test how design complexity and design styling (historic/iconic silhouettes) impacted comprehension, identification time, and accuracy across age segments. The findings revealed that the addition of design elements can “disturb” the quick understanding of an object, impacting recognition time. The reverse was also found to be true: with images that were very simplified being unrecognized. The authors were attempting to understand what “good” elements were essential in the design of easily identified pictorial elements. The authors also confirmed that in the design of elements “a good part of the object can be identified... by its perceptive saliency and also its functional meaning.” (Bruyas et al., 1998) They further distinguished between elements that were essential, useful and neutral. An essential element has to be part of a pictorial symbol for it to be recognized while a useful element enhances the recognition of a pictorial symbol. A neutral element has no impact, positive or negative, on comprehension. For example, wheels on a car are essential or fundamental, while the headlights or windshield would be considered useful, and the color of the car may be considered neutral. However, if the visual concept of the vehicle was a taxicab, the color may become a fundamental/essential or useful element.

The authors go on to the ground these observations to a theory by Rosch. “According to Rosch’s Theory a prototype would be the best example of a specific category or the abstract mental representation of this category held in memory.” Therefore the visual prototype would be created by the most essential elements of the object(s) being recognized. The author’s also suggest that to maximize the similarity of object and visual representation or symbol the design should use typical elements of the object and avoid the use of elements or attributes that could be associated with another object or category. “Rosch and Mervis called this similarity the “family resemblances.” (Bruyas et al., 1998) This concept of fundamental elements is a core concept of the Flashdraw methodology. It is the belief of this author that users using the Flashdraw methodology will reveal these core attributes in their drawings.

Analysis of user-generated images should reveal how users perceive the pictorial elements of the visual concept. After reviewing the coding results and subsequent visual review of the image library the designer should create a list of features and elements, or factors, that need to be incorporated into the visual vocabulary. Instead of nouns and verbs the designer will be identifying the fundamental, useful and neutral elements of the visual vocabulary. I call these three categories the FUN factors. Within these factors core visual concepts will emerge the “visual key words” within each image.

But how does one determine which elements are fundamental versus useful or neutral? Since the analysis of the coded data could be quantified, we can use statistical measures to create a framework for
inclusion of the different factors into each of the FUN categories. Each question or visual concepts should be evaluated separately and FUN factors, visual key words, are specific to each unique visual concept. However, additional analysis of the drawings does reveal general categories that are universal to all drawings and specific question topics. (Figure 4.9 codebook) Below are criteria for the bucketing of coded data into the FUN factors.

Fundamental: Any coding category that has an occurrence rate of over 65%. It is very important to look at the coding percentages for the target population for this category. Target populations may have different definitions of what is fundamental versus large general populations.

Useful: Coding categories that have occurrence rates of 40% or more should be considered useful. The design researcher should also evaluate these factors in relationship to the context in which the completed visuals will be used. Some factors with lower scores may actually have a high degree of usefulness based on the contextual use of the Icon or pictogram. It is very important to look at the coding percentages for the target population for this category when prioritizing which useful factors to explore.

Neutral: These factors should have no impact on the comprehension of the pictogram or icon. Color and style are often neutral factors for the comprehension but not the preference of an icon or pictogram.

Figure 4.10 shows a plot of the FUN factor analysis across the histogram of the composite averages of the coded analysis of the blood draw, urine collection and oral medication questions, the Topic averages. This composite analysis reveals three primary FUN factors: inferred action, full-body and the inclusion of an implement of tool that can be applied to consent form imagery as a whole. The same exercise is then applied to each individual question histogram. The FUN factor analysis data should be used in correlation with a review of a sample of the original images. The researcher should now use this data to populate a visual key word matrix. See Figure 4.11
Complex concepts often require a different kind of visual communication. A simple icon or pictogram will not be able to communicate complex informational concepts. Instead a complex pictogram, storyboard or cartoon strip may be needed. The basic constructs of the fundamental, neutral and useful elements still apply but the designer must understand the essential elements, the linkages between these elements and the discrete pictorial elements or frames. (Rollins, 2005)

After the FUN factors analysis has been conducted and the visual key words have been identified and communicated /outlined in the design brief or problem statement, preliminary concepts should be developed. The designer has now moved into the develop phase of the design process. Multiple solutions will be developed and it is important to confirm that the solutions are still relevant and have a high level of comprehension with your user group. There are many different ways to research user comprehension and preference. In the following section are some key factors that can impact the design of preference testing methodologies.

**Methodologies for Evaluating Pictograms**

Once the designer has created new visuals based on the FUN factor analysis and the visual key word matrix, they should be evaluated by the target user groups to confirm their effectiveness. The evaluation of pictograms is often a measure of the acceptance of the intended meaning. This is often done in an open-ended question interview or a fill in the blank/completion survey question format. Multiple choice testing is also widely used but the methodology is often deemed more appropriate for development/intermediate research phases versus for final evaluation. Rank order is also used but this method does not evaluate the understanding of the images just the underlying comparison to the other images.
There are recommended U.S. and international standards that have been developed for the testing of images, specifically warning signs and pictograms. These standards are developed to determine the comprehension of symbol and the viewers’ users’ ability to remember the intended meaning of the sign or pictogram. The American National Standards Institutes, ANSI, Standard, ANSI Z535.3-2007, American National Standard Criteria for Safety Symbols, is the primary standard used for pictograms. The ISO, International Organization for Standardization, has developed comparable standards for image comprehension testing. The ISO Standard ISO 9186-1 Graphical symbols – Test methods Part 1 Methods for testing comprehensibility, provides guidelines for the testing of warning symbols and provides guidelines and standards for pharmaceutical. Standard 9186 recommend a minimum comprehension rate of 66% of sample subjects. (Montagne, 2015)

“The testing procedure (Z535.3, Annex A) consists of a minimum total sample of 50 users. Answers are coded as correct, wrong, critical confusion (e.g., opposite of correct for safety/hazard symbol meanings or interpretation could cause harm if acted upon), and no answer. The criterion for symbol acceptance is at least 85% of test subjects correctly interpret the icon/pictogram and no more than 5% of subjects are critically confused.” (Montagne, 2013, p.612)

In his article, “Pharmaceutical Pictograms: A Model for Development and Testing for Comprehension and Utility”, Michael Montagne, Ph.D., (2013) discusses how previous methods of testing comprehension for pictograms healthcare and pharmacy are greatly impacted by the medical literacy of the targeted user. He maintains that icons and pictograms are a key-component in the focused re-design of patient information to address the need for increased comprehension, recall and adherence. (p. 609) There have been a variety of pictogram studies, most of them focused in the communication of medical information. Pictograms have been studied with a variety of populations including children, but very few studies have tested the pictograms in their intended context, such as in signage, in an informational leaflet, in a consent form, or in a product package. Montagne also discussed the need for pictograms to be tested for comprehension before their inclusion into information materials. Critiques of past research on medical pictograms has been ongoing. The lack or an international coordination of universal visual concepts for medical pictograms has been noted by some researchers (K.Haneen-Anttila etal. 2004)

In this same research study the authors discuss the importance of iterative development of the individual pictograms with the target populations to achieve the best possible research outcomes. “The use of pictograms is not unproblematic, and the use of single pictograms should always be carefully considered.” (K.Haneen-Anttila etal. 2004, p.372) If a pictogram is found to have a low comprehension rate it should be redesigned or revised and retested before being included in the next stages of research. After a test of basic comprehension in an isolated setting it is recommended that the pictograms should be tested with the target population in the contextual setting.

“The success of pictograms in pictograms as a communication aid in pharmacy depends first on a rigorous design and testing process, and secondly on their diligent application by health professionals trained in their usage.” (Dowse & Ehlers, 1998) If research finding are to be viewed as significant, a high level of research rigor must be found in the study design and execution and in the evaluation of data. Dowse and Ehlers assert several areas of the research process have been noted as being questionable, specifically the design of the study images, the design strategy of the images is often not discussed, the images are just produced for the study with no methodologies utilized in their development, and the need to test with the target population is also stated as a key failure of past research. The omission of the implementers of the pictograms from development and testing is also noted, as is the evaluation of concepts using well-designed, randomized, controlled trials.
5: Design, Preference and Comprehension:

5.1: Designing Icons and Pictograms based on Flashdraw Data

The first three phases of my research were focused on establishing the protocols for the collection and analysis of the data in an attempt to create a coherent system for the design of icons and pictograms. The hope is that by applying the FUN factors to the design exploration, the resulting design solutions will have significant comprehension rates. I now needed to create a test to research if the application of the FUN Factor analysis and the inclusion of visual key words in the visual designs resulted in comprehension rates of 65% or higher.

I took the FUN factor data from Figure 5.7 and designed a set of icons for each test question that incorporated all, some, and one of the FUN Factors. A series of icons were created that including an increasing amount of fundamental factors. The executions were designed to negate any respondent bias based on style with the only difference between images being the number of fundamental factors and their relationship to each other. The purpose of these designs was not to create a final design solution or a great graphical style but to prove that the inclusion of all of the FUN factors will result in icons and pictograms with comprehension rates of 65% or higher.

5.2: Preference Testing the Designs

Comprehension testing was done in two stages. Stage 1 testing was principally a preference test. This preference test confirmed the number of FUN factors that were preferred by users for each of the icon concepts. The Icon designs for each Draw-it question were randomly placed in a strip and respondents were asked to choose the icon they felt best described the initial question. Respondents were made aware of the context in which the icons would be used as part of a consent form, for use by a target audience of children ages 9-15 years old and within a children’s hospital medical facility. An on-line survey was used and adult respondents were screened to be as close to the user population age of 9 to 15 years old. All subjects in test 1 were 18 years old and US residents. Test Icons are in figures 6.1, 6.2, and 6.3. The icons were tested online using Survey Monkey, with a sample size of n= 69. Preference percentages are listed below each image.

![Figure 5.1 Test 1: Preference – Receive an injection of medication](image)

<table>
<thead>
<tr>
<th>Icon</th>
<th>Preference Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>39.13%</td>
</tr>
<tr>
<td>2</td>
<td>7.25%</td>
</tr>
<tr>
<td>3</td>
<td>24.64%</td>
</tr>
<tr>
<td>4</td>
<td>28.99%</td>
</tr>
</tbody>
</table>

Figure 5.1 Test 1: Preference – Receive an injection of medication
The preference testing results aligned with the factor analysis. The images with the most FUN factors on average scored higher than those with less. There were a few exceptions; however, when you analyze these factors against the occurrence percentages you will see that they align to the initial user-generated image analysis. Users did not prefer the addition of the medication bottle on oral medication and respondents preferred a ½ body versus full-body image. Referring back to the analysis full body received a score of 59% with adults but only a 34% with children. Receiving an injection also had some mixed results, but, again, these results paralleled the analysis with respondents unresolved regarding how much body is needed to convey getting an injection. Scores from the FUN factor analysis showed the following occurrence percentages: full body preference by adults was 48%, whereas by children it was 62%. Preference for a face by adults was 47% while by children it was 54%, and a preference for a body part occurred in adults 29% while children were just 19%.

The preference test is just the beginning. In preference testing the respondents are given the answer and asked to pick an image they think best matches that definition. In a comprehension test they are asked to define what the images were designed to communicate. The comprehension of images, and specifically images for use in the communication of medical information, has been extensively researched. The high rates of medical illiteracy have peaked interest in understanding the impact images have on the comprehension and retention of medical information.

**User Comprehension in Visual Research**

**Children and Adults**

Drawing is an effective tool for children who may have limited cognitive abilities or lack the ability to communicate effectively in verbal or written forms. (Rollins, 2005) “Drawings have been viewed as coming from the world of a child and as reflecting the inner emotional life.” (Backett-Milburn, K., & McKie,
What is the role of viewed images in the child’s world? Does it differ from adults? Just as the meaning of drawings evolve and shift as we mature, so is this also mirrored in our comprehension of the visual?

Authors Rosinski, Pelligrino and Siegel present their findings of semantic decision times on the comprehension of pictures with pictures versus pictures with words versus words with words by second and fifth graders in the journal article, “Developmental Changes in the Semantic Processing of Pictures and Words”. They begin their article by restating the assertions of prior researchers who have established the differences in children’s ability to process pictorial versus written information. (Rosinski, Robert, Pelligrino, J.W., & Siegel Alexander, (1977))

“Younger children remember pictures before they begin to learn language. Children will remember faster when they are prompted with a picture versus a prompt with words…. One reason for the advantage of pictures versus words lies in the nature of the relationship between early childhood experience and pictures, words and other referents.” (Rosinski, et al., 1977, p.282)

In this same journal article the recall findings from a previous study by Pelligrino in which he proved that adults recalled picture-picture pairs 185 msec faster than word-word pairs. The results with the children also showed faster memory recall for picture –picture pairs than word- word pairs with the difference being 399 msec with second graders and 242 msec with fifth graders.

In a study conducted by Pangaea, a non-profit research and development project dedicated to creating a global virtual communication playground for children, a test was conducted with approximately 50 Japanese students 9 to 15 years of age. They were asked individually to draw an image of a given concept and then share these images with each other. The findings revealed that there was a 60% initial comprehension rate amongst the children. When they were allowed two guesses, the comprehension rate jumped to 85%. In this same study it was discovered that drawings that had more than one image also had higher comprehension. (Takasaki & Mori, 2007)

The Need for Words and Images?

Significant research links the use of images to effectively communicating or enhancing communication of medical instructions, medication instructions and discharge information. Some research suggests that images alone are not significant in communicating medical concepts. In, The Use of Pictorial Aides in Medication Instructions: A literature review, written by Marra G. Katz, Sunil Kripalani, and Barry D. Weiss, several studies were cited that found an increased understanding of medical instructions when images are combined with verbal explanation. They also noted that overly complex images could lead to confusion versus enhanced understanding. “However, it is important to avoid complex images and provide additional text and oral instructions to ensure proper interpretation.” (Katz, Kripalani, & Weiss, 2006), p. 2365.). They also cite a study by R. W. Morrel, which found that younger subjects 18-22 had better recall when receiving mixed instructions (images and text) than older participants age 59-85, who had significantly higher recall with text-only instructions.

Text and pictograms have been shown to be preferred over text or pictures alone when communicating medical information. (Dowse & Ehlers, 1998) Studies have shown a lower rate of comprehension and recall when images are used alone. Within illiterate populations the use of text is irrelevant but the text can be replaced with verbal narration. Given these findings, it can be assumed that as a rule images should be combined with written or verbal explanation for maximum comprehension and recall.

5.4: Comprehension Testing

The icons, pictograms, and cartoon strips that have been developed based on the Flashdraw FUN factors should be tested with the user population. It is not necessary to test with the same research subjects but a similar population should be used for evaluation. If it is important that supporting populations also comprehend the visual communication elements additional test groups should be used. For example, if the target population is children in a medical facility you may also want to test with parents of children in medical facilities and health care providers who may also come into contact with or
be expected to work with the communication elements. When weighting comprehension results the primary user group should be given precedence since their comprehension is the primary focus of the communication elements.

There are several evaluation methods that can be used with the Flashdraw inspired visual elements. All of these methods will be based on measuring the user population’s understanding of the intended meaning of the communication element or pictogram. The choice of methodology may be determined by the means of test delivery. If you are using an online evaluation tool (for example, Survey Monkey), then short answer, multiple choice, ranking of a set of images from easiest to hardest to understand, a Likert scale, or even a yes/no binary evaluation of an image and the intended meaning would be effective. There are pros and cons with all methods, but it should be noted that with ranking you are only judging comprehensions based on a precedent of understanding the meaning of the set of images. The highest ranked image could still have a very low comprehension rate among users.

If you are using in-person evaluation techniques, all of the previous examples, plus interview with open-ended response, discussion, or discussion/evaluation with co-drawing could be used. In-person evaluation does open up the possibility for a more dynamic participatory design evaluation session to be implemented, with researcher and subject(s) able to create and iterate the icons and pictograms in real-time until a more desirable and better understood pictogram is developed. It is important to note that the moment the user becomes engaged in the iterative design process they are no longer objective and have become co-designers. Given this change, additional testing will need to be conducted to confirm comprehension testing with the target user group. Both on-line and in-person evaluation methods are valid. Ultimately, the desired sample size, evaluation period duration, and number of evaluation iterations will determine which evaluation methodology is the most appropriate.

The goal of comprehension testing is to determine if your target user groups understand the design solution, image, and intended meaning. There are international standards for the evaluation of the comprehensibility of pictorial symbols. “The American National Standards Institute’s ANSI Z535.5 and the International Standard’s Organization’s ISO 3864 advise a comprehension rate of 85% and 67% respectively.” (Montagne, M. 2013,p.612) While these guidelines are suggestions, they are realistic goals that the designer should strive to meet. As suggested previously in this paper, studies have shown that comprehension is increased with the combination of words/text/dialogue and pictures. If the intended use case of the pictures could feasibly accommodate the addition of text or narration comprehension testing should be done with and without the accompanying text.

After the preference test a comprehension test was also fielded on Survey Monkey. The top performing images from the preference tests were included with the addition of a blood draw question. It was my intention to do both preference testing and comprehension testing with children/adolescents ages 9 to 17. However, the availability of these research subjects proved problematic so the preference and comprehension testing was done with a young adult population ages 18-29. Additional preference and comprehension testing will be done with children after publication of this paper. US test subjects ages 18 to 29 were asked to complete a short answer definition of each of the images. The respondents were informed that the images were icons designed to illustrate procedures or treatments for a children’s hospital consent form. Figures 5.4, 5.5, 5.6, 5.7 and 5.8 are the question pages from the on-line survey.
The data was analyzed in three ways. The responses were read and coded with a 0, 1, or 2. Incomplete or irrelevant results were discarded. An “I don’t know” answer or an entire wrong answer is given a 0, a partial answer such as “urine” would be given a 1, and a complete answer “a person giving a urine sample” or “urine test”, “urine sample” would be scored a 2. The totals were then averaged and divided by 2 for the total comprehension percentage. The comprehension percentages for all of the questions were quite high. As noted, unfortunately, I was not able to test with children/adolescents; but given the consistent test results on data with adults versus children, I do feel the data can be used as a general confirmation of comprehension rates with the target user pending the final test results with children/adolescents. Success of the protocol will be any percentage above 67 %. Depending on the standard used, comprehension ratings should be at least 67% to 85%. (K. Hameen-Anttila, et al., 2004, P.376). Following is an analysis of each image with comprehension percentages, word clouds, and keyword analysis.
Receiving a Shot: Comprehension Rate = 94.91%

Figure 5.9: Phase 3 Comprehension Test Results: Shot 1 – Image, % and Word Cloud

Receiving a Shot 2: Comprehension Rate = 96.55 %

Figure 5.10: Phase 3 Comprehension Test Results: Shot - Image, % and Word Cloud

Blood Draw: Comprehension Rate = 89.71%

Figure 5.11: Phase 3 Comprehension Test Results: Blood Draw - Image, % and Word Cloud

Oral Medication: Comprehension Rate = 87.29 %/ pill 23.39% /medication

Figure 5.12: Phase 3 Comprehension Test Results: Oral Medication - Image, % and Word Cloud
Giving a Urine Sample: Comprehension Rate =94.92 %

Figure 5.12: Phase 3 Comprehension Test Results: Urine Collection - Image, % and Word Cloud

The results are shown in the proceeding images. With the exception of oral medication the comprehension rates were all above the highest recommended approval rate of 85%. These results are based on an initial design execution so with iterative design there is a potential for even higher comprehension scores. Given prior research that suggests that the combination of words and images together contribute to even higher comprehension and retention rates, (Dowse & Ehlers, 1998) there is a potential to achieve even higher comprehension if they are tested as a combination of words and images. There was some confusion on the oral medication and the spoon image was noted confusing by some respondents. The aerial view of key elements can be problematic with some forms, and this may be one of the issues. The respondents had a very high comprehension rate for taking a pill (87.29%), but the rate for oral medication or just medication was below 25%. This result also parallels the drawing samples, with very few respondents depicting a liquid medication and the majority including a pill or capsule only. An analysis of the written responses shows confusion on the spoon image and the lack of visual link to medication that is taken in a liquid form. Additional iterative testing should be done to try to increase comprehension on liquid medicine forms. The bottle from the preference test may need to be added in a second test, and a revised spoon as well as spoon mouth interaction should be explored.
6: Conclusions

As designers we spend the majority of our time creating visual information. We use it to communicate our design process, our research, and our concepts. We use visuals to create meaning. Meaning making from visual images involves the analysis and application of developmental patterns, rational associations, unconscious associations, and emotional responses. Visual language has been called one of the most powerful and effective forms of communication because of how it is interpreted and assimilated into meaning making. (Hope, D. 2006) We create visual concepts for our users, but how do we know if we are “speaking “ the user’s language?

Traditional researchers have maintained that participatory evaluation must remain results-based and be verified to be considered significantly relevant in visual research. Participatory evaluations are focused on finding solutions versus identifying problems. I believe that the Flashdraw and draw-it techniques can change this dynamic. Because the central tenant of these participatory methodologies is the creation of an image by the user and then the analysis of a collection of these images, the researcher can identify potential issues in visual communication as well as uncover the shared communication space between various user groups. The researcher can uncover gaps in meaning that may not be uncovered with other visual techniques.

The objective of my research was to develop a rigorous methodology that could explore commonly held visual concepts of users and to create a protocol, so design researchers could replicate it consistently across the globe. Prior researchers have already proved the value of participatory research, so my goal was not to justify participatory techniques but rather to validate user-generated drawing as a participatory design methodology. The creation of visual concepts is a core competency of designers. My research has revealed multitudes of visual design research methodologies that are being used throughout the design process. But contrary to the social sciences, design has not embraced the role of the user as visual creator. This has remained ostensibly the role of the designer. It is surprising that in a book filled with user-generated visual methodologies, The Sage Handbook of Visual Research Methods, the chapter on design research does not mention a single user-generated visual technique. However, there are user–generated visual methodologies being used in the field of design, especially co-design, co-drawing and charrette executions. (Margolis & Pauwels, 2011)

Colin Ware and other visual researchers are exploring how we see, process, and perceive visual stimuli. Their findings have revealed that most of our “visual processing” is not about the new stuff. In fact, it is only approximately 5% of what we see. The majority of information that fuels our understanding of what we see comes from our long-term visual memory. The draw-it technique was designed to reveal this information and to see if there are patterns of similar visual memories or concepts among users. The draw-it and Flashdraw techniques are not intended to create final designs or to dictate a design direction to the designer. The Flashdraw technique was designed to provide the designer with a language of FUN factors and visual key words that if incorporated into their design of icons and pictograms should lead to high user comprehension ratings. I have collected and analyzed over 500 data samples and have consistently found that users produce visual concepts that are universal among the shared user group. My analysis protocol provides guidelines for the categorization of the visual data into three categories: fundamental, useful and neutral. (Bruyas et al., 1998) My phase three testing showed that users preferred concepts that incorporated more fundamental visual language. The final stage of testing comprehension found un-prompted respondent response rates of over 90%, beyond the recommended ISO comprehension rates of 67% to 85%. Additional testing needs to be done and an addendum to this paper will include confirmation of comprehension rates with children. This methodology impacted not only the comprehension rates but also the design process which required less iterative design in the develop phase and hopefully leads to shorter design cycles.
User-generated visuals could fuel the design of visual concepts across the entire sphere of design and innovation. The medical field has already embraced the role of the visual in communicating with patients. Substantive research is being conducted on the use of visuals in medical consent and release forms, instructions, pharmaceutical instructions, and even diagnoses. A recent journal article explored how the images of headaches drawn by children who suffer migraines were more statistically accurate at diagnosing a migraine versus a regular headache than a doctor’s examination and diagnosis. (Stafstrom, Rostasy, & Minster, 2002) (Wojaczynska-Stanek, Koprowski, Wrobel, & Gola, 2008) How many other medical conditions and diseases could be diagnosed based on the imagery of patients gathered across the globe? In the event of national and international emergencies and pandemics, globally generated imagery could be a vital tool in triage materials.

The possibilities are endless. The Flashdraw methodology, based on the draw-it technique opens up the possibility of being able to collect thousands of user-generated visuals from across the world in mere minutes. All that is needed is a cell-phone, a finger, and a team of dedicated researchers. This research process was designed specifically for the design of visual symbols, such as icons and pictograms, but the comprehension rates for the designs that utilized this process were so high that additional testing should be done with more complex concepts such as medical conditions. My research also revealed that the recall and comprehension of words and images used together are much higher. Given these findings, I am developing another comprehension test based on words and text: a written prompt comprehension test. I am also currently embarking on a new study of the application of this methodology to creating diagnostic aides for diagnosis of anxiety in children.

If the researcher seeks to be shown versus to show visuals with research subjects, participatory visual methods must be used. You need these methods so that users can show you, versus just describing to you, what they think, see, and understand. User generated images should never be considered an end product for a design researcher, rather they are the launching point of the design process, “offering a unique (insider) perspective.” (Margoilis & Pauwels, 2011, p.8) The design researcher still needs to analyze, apply and realize the potential that resides within the user images. The Flashdraw methodology was designed to address a need for a rigorously researched user-generated drawing methodology. Hopefully the research contained in this paper provides a starting point for the validation of Flashdraw technique.
References


Sanders, E. B., & Stappers, P. J. (2012). Convivial toolbox: Generative research for the front end of design BIS.


7. Appendix
Symbol Drawing Project

Male  Female  
Age   

Directions:
Draw what comes to mind when you think of the following items

Taking Medicine can make me feel dizzy
Facial Expression probe: Injection
Symbol Reading Project

Male _____ Female _____
Age _____

Directions:
Write down what you think the image means?

I am going to tell you what it might mean, please mark yes or no if you think the image matches the description.

Yes_____ No________
Appendix 2. 2.1: Phase 1 Research report

Children’s Hospital Icon Study

design7061    eva lutz

Research Protocol

Icon Development:
The Icons were developed using a participatory drawing protocol.
Subjects of the appropriate age are asked to draw the icon subject matter.
They are allowed to free-draw for up to 15 minutes and use as many colors as they desired.
Following the initial free-drawing sessions, icons were created that were interpretations of
the images drawn by the study participants.
Iterative prototyping was incorporated; Icons are revised after each round of research
based on quantitative research on successive groups of study participants.

Each successive research round consisted of:
• free-drawing
• unaided icon definition. - they were shown an icon and asked to write what they think it
  might mean.
• Prompted icon definition - they were shown the image and asked to agree or disagree
  with a provided definition.
Free-draw

- Include a figure
- Show yellow urine in a cup
- Explore the addition of restroom or toilet reference

a, b, c Preference Test

100% choose Option c
Free-draw

Side-effect: Taking Medication can cause weight gain

<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
<th>Drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.f</td>
<td></td>
<td><img src="image" alt="Drawing" /></td>
</tr>
<tr>
<td>15.m</td>
<td></td>
<td><img src="image" alt="Drawing" /></td>
</tr>
<tr>
<td>15.m</td>
<td></td>
<td><img src="image" alt="Drawing" /></td>
</tr>
<tr>
<td>13.f</td>
<td></td>
<td><img src="image" alt="Drawing" /></td>
</tr>
<tr>
<td>12.m</td>
<td></td>
<td><img src="image" alt="Drawing" /></td>
</tr>
<tr>
<td>9.m</td>
<td></td>
<td><img src="image" alt="Drawing" /></td>
</tr>
</tbody>
</table>

Free-draw Interpretation

Side-effect: Taking Medication can cause weight gain

- Before and after drawing
- Arrow showing progression
- Weight gain primarily in torso area
An abbreviated survey was posted on Survey Monkey.

The purpose of the survey was to test several hypothesis:
- Is a short answer question, in an on-line tool, appropriate for the age of the target test group?
- Does a simple yes/no response to a given image description verify that the intended meaning is understood?
- Does the new image “style” still effectively communicate the concepts?
- How are the pregnancy concepts received when there is no preparation discussion?
- Total of twelve Respondents

<table>
<thead>
<tr>
<th>f</th>
<th>m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Survey Monkey

Pregnancy

*OA. Don’t get pregnant.*

*OA. Woman is pregnant.*

*Getting a pregnancy test.*
Survey Monkey

Pregnancy and Procedure

If you get pregnant your parents will be informed.

Getting a shot in the arm.

Taking oral medication.

Survey Monkey

Procedure and Side Effects

Taking medicine can cause a fever.

Giving a urine sample.

Taking medicine could make you sick to your stomach.
Survey Monkey

OA: Taking medication can give you a headache.

OA: Taking medication can cause your arm to swell afterward.

OA: Taking medication can cause you to gain weight.

OA: Taking medication could cause side effects.

OA: Taking medication could cause weight gain.
Survey Monkey Analysis

- Is a short answer question, in an on-line tool, appropriate for the age of the target test group?

The questions that required an open-ended response on average showed no greater than 50% agreement with the intended icon definition.

- Does a simple yes/no response to a given image description verify that the intended meaning is understood?

This question can not be answered within the Survey Monkey Test design, however, when looking at the results the majority of the yes/no questions had an average icon comprehension of over 80%.
Survey Monkey Analysis

- Does the new image “style” still effectively communicate the concepts?
  Only a few of the images are getting 100% agreement with the intended icon definition. This suggests that the icon communication design is still not communicating effectively. The use of arrows, clocks, cause and effect, and more complex concepts should be explored in continuing free-draw sessions.

- How are the pregnancy concepts received when there is no preparation discussion?
  There were repeated negative and “polarizing” responses on the pregnancy images. Given the sensitive nature of this subject matter parents should be questioned regarding the appropriate way to communicate these concepts with children of this age. When I was able to introduce this concept verbally first, the responses were much less polarizing. This section may need to have a written or verbal introduction prior to icon review.
3.1.1 The One-Question Draw-it Survey: Flash Survey Research Protocol

**Purpose:** I have found a recent study that shows that the length of a survey may not impact the quality or content of the test results. I have developed the following hypothesis: There will be no significant difference in quality and content of test results for the Draw-it Visual research methodology if respondents are asked to complete a survey with only 1 draw-it question versus a survey with set of seven draw-it questions. The time equivalent of a 5-minute survey versus a 30-minute survey.

**Materials:**

An IRB Consent Form

A set of Sharpie markers; Containing 1 black, 1 red, 1 blue, 1 green and 1 yellow marker

Test Instrument A: A survey form containing 5 demographic questions and 1 Draw-it Question with a space on the page for respondents visual. There will be a total of 7 draw-it Flash test instruments each with a different Draw-it question. They will be distributed on a randomized basis. See appendix for test instruments.

Test Instrument B: A survey form containing 5 demographic questions and 7 Draw-it Questions with a space on each question page for respondents visual. Respondents will only answer the demographic questions on the first page. The order of the question pages will be randomized. See appendix for test instruments.

**Methods:**

There will be two groups of male and female US respondents ages 17-75. A) The respondents will answer 1 of 7 draw-it questions (independent variable), and B) the respondents will answer all 7 draw-it questions (control).

**Control:**

The respondents will answer 7 draw-it questions (control).

**Data Interpretation:**

The images will be coded using content analysis by a team of three coders. A codebook will be developed prior to the coding process by the researcher and 2 independent coders using a sample of 20 draw-it images. The codebook will be modified after initial coding if needed. The researcher will input and interpret any ties or ambiguous results. The data will be inputted into a code-book tabulation spread sheet and then the results from two representative questions will be analyzed between the test group a, those who answered one question versus test group b, those who answered all seven questions. A histogram will be used to plot the results. Each question will be on the x-axis and the number of respondents for each coded data point will be on the y-axis.

**References:** See Content Analysis Section 3.2 and references for the complete list of reference material
Adult Consent Form for Research

University of Cincinnati
Department: School of Design, College of DAAP
Principal Investigator: Mike Zender

Title of Study:
Symbol/Icon Design and Comprehension

Introduction:
This form describes a research project. It has information to help you decide whether or not you wish to participate. Research studies include only people who choose to take part—your participation is completely voluntary. You are being asked to take part in this study because we want to include adults who can comprehend symbols and icons (symbols/icons). Please read this paper carefully and ask questions about anything that you do not understand with the project staff before deciding to participate.

Who is doing this research study?
The person in charge of this research study is Mike Zender, Professor and Director of Graduate Studies, University of Cincinnati, School of Design. There will be other people on the research team helping at different times during the study.

What is the purpose of this research study?
The purpose of this study is to assist designers who are designing symbols or icons (symbols/icons) to be used in various settings. These symbols/icons will help people understand important concepts. We are trying to make sure that people from all cultures and degrees of literacy can interpret the meanings of the symbols/icons being designed. To ensure that these symbols/icons are as effective as possible, we need to know which symbols/icons are not understood. Understanding why a symbol/icon is not understood can help designers create a symbol/icon that is clearer. Once the symbols/icons are completed, they will be offered for use in a variety of settings.

Who will be in this research study?
You may or may not be in this study. Those being asked to take part in this study are because we want to include adults with relevant knowledge of the context in question.

What will you be asked to do in this research study, and how long will it take?
If you agree to participate, you will be shown a series of symbols/icons that have all been designed to communicate a particular topic. Then you will be asked a few questions about the symbol/icon. You don’t need to explain your answers. An incorrect or ‘I don’t know’ answer is just as valuable in this study as a correct answer. The full test will take the approximate amount of time described by the administrator. The research will take place at various locations.

Are there any risks to being in this research study?
There are no risks to you for participating in the study. We do not record any personal data about you, other than your level of medical education.

Are there any benefits from being in this research study?
You will not receive any direct benefit from taking part in this study. We hope that this research will benefit society by improving the design of symbols/icons, thus providing people with alternative ways to receive accurate information.

What will you get because of being in this research study?
You will receive no direct benefit from your participation other than knowing you have helped advance knowledge in design.

How will your research information be kept confidential?
Information about you will be kept private. To ensure confidentiality the following measures will be taken:
1) no personal information will be taken to identify you, and 2) our paper data will be kept in locked filed drawers and electronic data in password protected computer files. Agents of the University of Cincinnati may inspect study records for audit or quality assurance purposes.

How will the information I provide be used?
The information you provide will be used for the following purposes: We will share the summarized results of our data we collect with the designers of the new symbols/icons, to help them make the best and clearest symbols/icons. In addition, we plan to publish the summarized results in professional journals so that other designers might learn from our research on symbols in healthcare.

What are your legal rights in this research study?
Nothing in this consent form waives any legal rights you may have. This consent form also does not release the investigator, Mike Zender, the University of Cincinnati, or its agents from liability for negligence. Participating in this study is completely voluntary. You may choose not to take part in the study or to stop participating at any time, for any reason, without penalty or negative consequences. You can skip any questions that you do not wish to answer.

What if you have questions about this research study?
If you have any questions or concerns about this research study, you should contact Mike Zender at (513) 556-1072 or mike.zender@uc.edu.

The UC Institutional Review Board reviews all research projects that involve human participants to be sure the rights and welfare of participants are protected.

If you have questions about your rights as a participant or complaints about the study, you may contact the UC IRB at (513) 558-5259. Or, you may call the UC Research Compliance Hotline at (800) 889-1547, or write to the IRB, 300 University Hall, ML 0567, 51 Goodman Drive, Cincinnati, OH 45221-0567, or email the IRB office at irb@ucmail.uc.edu.

Do you HAVE to take part in this research study?
No one has to be in this research study. Refusing to take part will NOT cause any penalty or loss of benefits that you would otherwise have. You may start and then change your mind and stop at any time. To stop being in the study, you should tell the test administrator.

OR FOR ONLINE SURVEY
To stop being in the study, close your browser window.
Agreement:
I have read this information and have received answers to any questions I asked. I give my consent to participate in this research study. I will receive a copy of this signed and dated consent form to keep.

OR FOR ON-LINE SURVEY
I have read this information and have received answers to any questions I asked. I give my consent to participate in this research study. By checking the box “I Consent” below I give my consent. I may print this signed and dated consent form to keep.

Participant Name (please print) ________________________________

Participant Signature ____________________ Date ______

Signature of Person Obtaining Consent ____________________ Date ______
Cincinnati Children’s Hospital Icon Study

Please take a few minutes to help us develop icons for a children’s medical facility.

Before you start I need you to answer a few questions about yourself.

1) What is your gender? Male________ Female __________
2) What is your Age? ______________
3) In what country do you live?
4) Do you consider yourself a creative person?

| Strongly Agree | Agree | Neither Agree or Disagree | Disagree | Strongly Disagree |

Instructions:
Please read the statement below and immediately draw the first image that comes to mind when you think of this statement.

Procedure Statement: Blood Draw: This is the process of obtaining blood from a vein in the arm or hand with a needle.

Please draw here.
Cincinnati Children’s Hospital Icon Study

Please take a few minutes to help us develop icons for a children’s medical facility.

Before you start I need you to answer a few questions about yourself.

1) What is your gender? Male_________ Female _________
2) What is your Age? ______________
3) In what country do you live?
4) Do you consider yourself a creative person?

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither Agree or Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

Instructions:
Please read the statement below and immediately draw the first image that comes to mind when you think of this statement.

Procedure Statement:
Urine Collection: Procedure to collect urine for a participant. The participant places the urine into a supplied container.

Please draw here.
Cincinnati Children’s Hospital Icon Study

Please take a few minutes to help us develop icons for a children’s medical facility.

Before you start I need you to answer a few questions about yourself.

1) What is your gender? Male______ Female ________
2) What is your Age? ________
3) In what country do you live?
4) Do you consider yourself a creative person?

| Strongly Agree | Agree | Neither Agree or Disagree | Disagree | Strongly Disagree |

Instructions:
Please read the statement below and immediately draw the first image that comes to mind when you think of this statement.

Procedure Statement:
Oral Medication: Giving a patient medication by mouth in pill or liquid form.

Please draw here.
Cincinnati Children’s Hospital Icon Study

Please take a few minutes to help us develop icons for a children’s medical facility.

Before you start I need you to answer a few questions about yourself.

1) What is your gender?  Male________  Female _________
2) What is your Age?  __________
3) In what country do you live?
4) Do you consider yourself a creative person?

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither Agree or Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
</table>

Instructions:
P Please read the statement below and immediately draw the first image that comes to mind when you think of this statement.

Procedure Statement: Side Effect: Undesired effects of a drug or treatment (ex. vomiting, hair loss, headache, fever, nausea, etc.)

Please draw here.
3.1.7 Flash Test Instrument Question 5: Medical Condition Paralysis

Cincinnati Children’s Hospital Icon Study

Please take a few minutes to help us develop icons for a children’s medical facility.

Before you start I need you to answer a few questions about yourself.

1) What is your gender?  Male________  Female __________
2) What is your Age?  __________
3) In what country do you live?
4) Do you consider yourself a creative person?

| Strongly Agree | Agree | Neither Agree or Disagree | Disagree | Strongly Disagree |

Instructions:
Please read the statement below and immediately draw the first image that comes to mind when you think of this statement.

Patient Condition Description:
Paralysis: A loss of voluntary movement in a body part, caused by disease or injury of the nerves, brain, or spinal cord.

Please draw here.
Cincinnati Children’s Hospital Icon Study

Please take a few minutes to help us develop icons for a children’s medical facility.

Before you start I need you to answer a few questions about yourself.

1) What is your gender?  Male_________ Female __________

2) What is your Age? ______________

3) In what country do you live?

4) Do you consider yourself a creative person?

| Strongly Agree | Agree | Neither Agree or Disagree | Disagree | Strongly Disagree |

Instructions:
Please read the statement below and immediately draw the first image that comes to mind when you think of this statement.

Patient Condition Description:
Perseveration: the pathological, persistent repetition of a word, gesture, or act, often associated with brain damage.

Please draw here.
Cincinnati Children’s Hospital Icon Study

Please take a few minutes to help us develop icons for a children’s medical facility.

Before you start I need you to answer a few questions about yourself.

1) What is your gender? Male________ Female __________
2) What is your Age? __________
3) In what country do you live?
4) Do you consider yourself a creative person?

Strongly Agree | Agree | Neither Agree or Disagree | Disagree | Strongly Disagree

Instructions:
Please read the statement below and immediately draw the first image that comes to mind when you think of this statement.
Patient Condition Description:
Amnesia: Complete or partial loss of memory caused by brain injury or shock.

Please draw here.
### 3.1.10 Code Book Definitions

<table>
<thead>
<tr>
<th>Code Symbol</th>
<th>Code Category</th>
<th>Code Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>NH</td>
<td>Non-human Depiction</td>
<td>A shape drawn to suggest a head and the addition of line, shape, color that suggests at least one of the following facial features, eyes, nose, mouth.</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Face</td>
<td>A shape drawn to suggest a head and the addition of line, shape, color that suggests at least one of the following facial features, eyes, nose, mouth.</td>
<td></td>
</tr>
<tr>
<td>E: +, -, !, ?</td>
<td>Emotion</td>
<td>Emotion is defined as lines, gestures, colors, etc. that suggest any kind of emotions such as tears, smiles, frowns, sweat beads, red cheeks, big eyes, closed eyes, etc. Presence of any emotion plus definition of emotion + = positive, -=negative, ?= unknown, != surprise</td>
<td></td>
</tr>
<tr>
<td>BP</td>
<td>Body Part</td>
<td>Is the person being defined by only 1 body part such as an arm or a leg, or head</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>Monochromatic</td>
<td>Only one color is used through-out the image – can be any of the colors provided in the field kit</td>
<td></td>
</tr>
<tr>
<td>BL</td>
<td>Body Language</td>
<td>Did the respondent use any part of the body to suggest additional meaning or is the body drawn in a static “statue-like” pose: hands on hips, hands upraised, walking posture, etc.</td>
<td></td>
</tr>
<tr>
<td>Pn</td>
<td>Pain expressed</td>
<td>Any word, line, color or symbol that is being used to suggest that the subject in the drawing is experiencing pain, ex: Ouch!, tears, red marks, exclamation marks, radiating circles or lines, red color located on body part, the depiction of a wound, bandage or injury</td>
<td></td>
</tr>
<tr>
<td>CA: 1,2,3,4</td>
<td>Color Accent Colors</td>
<td>What additional colors are used 1 + ?</td>
<td></td>
</tr>
<tr>
<td>P:0, 1,2</td>
<td>People</td>
<td>Number or distinctly different people who are depicted in the image. Multiple versions of the same person do not count as additional people rather this is a story depiction. 0 = no people in the image</td>
<td></td>
</tr>
<tr>
<td>FB</td>
<td>Full-body depiction</td>
<td>Is the majority of the body of the main subject, the object, included in the image, full-body &gt; 50% must include a head</td>
<td></td>
</tr>
<tr>
<td>CBF</td>
<td>Colored body fluid</td>
<td>Is there a body fluid depicted, was color used add meaning yellow urine, red, blood, green, vomit, etc.</td>
<td></td>
</tr>
<tr>
<td>IA</td>
<td>Inferred Action</td>
<td>Does the positioning of the elements suggest that an action of event has happened of will happen in the short term? This could include the use of arrows</td>
<td></td>
</tr>
<tr>
<td>TCE</td>
<td>Targeted Color Accent</td>
<td>Was there a use of color to bring attention to a specific part or element of the drawing, this should not include colored body fluids</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>Story Depiction</td>
<td>Are multiple views or scenes being used to describe the concept</td>
<td></td>
</tr>
<tr>
<td>B &amp; A</td>
<td>Before &amp; After</td>
<td>Is there a before image and an after image or visual element, something that shows a change in</td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Category</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>La</td>
<td>Language</td>
<td>Are words used in any part of the image</td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td>Subject Position</td>
<td>Is the subject standing, sitting, laying etc.</td>
<td></td>
</tr>
<tr>
<td>Fu</td>
<td>Furniture</td>
<td>Is there furniture included in the image – if yes what</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Vehicles</td>
<td>Are there vehicles in the image, if yes what</td>
<td></td>
</tr>
<tr>
<td>AL</td>
<td>Action Lines</td>
<td>Are gesture lines or other visual signs being used to imply motion or and intended action or reaction</td>
<td></td>
</tr>
<tr>
<td>MP</td>
<td>Medical Pro</td>
<td>Is there a medical professional depicted in the image</td>
<td></td>
</tr>
<tr>
<td>BF</td>
<td>Body Fluid</td>
<td>Any referent to a body fluid, fluids includes: blood, tears, vomit, stools, mucous, urine</td>
<td></td>
</tr>
<tr>
<td>MI+T</td>
<td>Medical Implement</td>
<td>A medical tool or an object that is used during a medical procedure, treatment or test, Medical furniture of large test equipment would be included in the furniture category</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Drug</td>
<td>Is there drug or medicine being depicted in the image</td>
<td></td>
</tr>
<tr>
<td>S:1,2,3</td>
<td>Symptoms</td>
<td>Are there symptoms of an illness being depicted, if yes how many different symptoms are being depicted in the drawing</td>
<td></td>
</tr>
</tbody>
</table>
Cincinnati Children’s Hospital Icon Study

Please take a few minutes to help us develop pictures for a children's medical facility. Before you start please answer a few questions about yourself:

1) Are you? Boy______ Girl______
2) How old are you?__________
3) Do you think you are a creative person? Please circle your answer:
   I am very creative I am creative I'm not sure I'm not creative I'm not creative at all

Instructions: Please read the statement below and immediately draw a picture of the first image that comes to mind.

Procedure Statement: Oral Medication
A person takes a pill or swallows liquid medicine.

Please draw here.

Figure 4.1.1 Draw-it Technique Phase 3 Test Instrument 3: Oral Medication and Urine Collection Preference

Please take a few seconds to look at these six images. Please select the one that you feel best describes the following statement.

What it is like to give a urine sample.

Please take a few seconds to look at these six images. Please select the one that you feel best describes the following statement.

What it is like to get a shot of medication.
Flashdraw Technique Research Protocol

**Question Format Guidelines:**
Write the question in approachable language for the user.

Define words, phrases, concepts, treatments, etc. in appropriate language for the user if the terms are not easily understood.

Test the survey questions with sample users prior to fielding the study to ensure understanding of the survey questions.

Allow approximately 5 minutes per question for completion.

**Survey Format Guidelines: Sample Questionnaire Appendix 7.1**

Explain the context of the end use of the visual, from which you the researcher will be creating an icon: Who, What, Where, When, How?

Use demographic questions to confirm target user profile fit.

Determine the number of questions by test instrument. A minimum of one question is needed for valid results.

Place preference or comprehension test questions in the back of the survey, so they are not accessible until all Draw-it questions have been answered and finalized.

**Data Collection**

Traditional Paper Survey –
Assemble field kits.
Prepare test instruments.
Allow a total of 10 minutes for a one-question test, an additional 5 minutes for every additional question.
Randomize one-question test instruments.
Do not administer group surveys if survey takers cannot be isolated in “traditional” test-taking proximities.

Digital Survey – pending

**Coding**

Code Book Guidelines: Binary Code Book Design Figure 3.9
Assemble a committee of three for the modification of the initial codebook, Section 3: Topic/Question Specific.

Codebook Section 1: Executional: basic drawing characteristics that apply to all images. Should be used for all images. No need to redefine.

Codebook Section 2: Human Depiction: Coding categories that are unique to drawings that contain humans. Should be used for all images that contain figures. No need to redefine.

Codebook Section 3: Topic and Question Specific: Coding characteristics that are unique to the research topic and specific research question. Characteristics will need to be defined by the coding team members. See Codebook Modification
Codebook Modification: all three codebook committee members should code <ten draw-it data images for each topic and < three for each specific research question. New coded categories should be added to Section 3. Coded characteristics should be based on yes or no criteria: image has or does not have a certain criteria. Characteristics should be branched until they can be defined by yes or no, binary answers. New characteristic codes should be tested with an additional ten draw-it images by codebook committee and modified as needed. Depending on the range of characteristics that need to be added for each specific question the primary researcher should determine if there needs to be a specific Codebook Section 3 for each image or if a universal section three can be used for each research topic. The primary researcher can choose to null specific code characteristics for each specific research question if they are using a topic specific Section 3.

Coding of Images

Assemble a committee of three coders plus the primary researcher. The primary researcher should demonstrate the codebook categories to the committee using the initial 10 images.

Have all images independently coded by all three researchers into three Binary Content Analysis Codebooks. Compile the codebooks and analyze all the category and characteristic occurrence statistics.

Pull a random sample of 10 original images and compare them to the coded entries to check for coding adherence and consistency with the defined coded categories.

Determine the final coded score for each coding category; this is the responsibility of the primary researcher.

Double check demographic data and isolate, compile, and analyze target user data separately. Compute the percentage of occurrence for each category.

Plot the results graphically for easy identification of key visual aspects.

Pull a random sample of 10 original drawings to confirm the identified visual trends.

**Determination of FUN factors and visual key words**

Consider all categories that have a 62.5% occurrence rating or higher a Fundamental factor.

All categories that have an occurrence-rating o

Give precedence of occurrence to the data from the target user if multiple populations exist.

Do not include Items with occurrence percentages of 10% or lower unless there are secondary requirements that require inclusion.