MPC MAJOR RESEARCH PAPER

Intuitive Versus Theoretical Approaches to Visual Communication to Facilitate Knowledge Transfer

Dianne Nubla

Dr. Janice Fung

The Major Research Paper is submitted
in partial fulfillment of the requirements for the degree of
Master of Professional Communication

Ryerson University
Toronto, Ontario, Canada

September 14, 2011

MPC MRP Author's Declaration Page

I hereby declare that I am the sole author of this Major Research Paper.

I authorize Ryerson University to lend this MRP to other institutions or individuals for the purpose of scholarly research.

Signature _____

I further authorize Ryerson University to reproduce this MRP by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

Signature_____

Abstract

During the start of the 2002-2003 Ontario youth hockey season, Hockey Canada lowered the age of allowable bodychecking from 12-13 years of age to 9. Dr. Michael Cusimano, a neurosurgeon from St. Michael's hospital, investigated the neurological impact of this rule change on youth players in an effort to educate hockey parents on the dangers of bodychecking. Using Dr. Cuismano's research data, the investigator created three information graphics through three different design approaches: intuitive, theoretical and content-theoretical. Through a 5-Step practical-based methodology, the investigator sought to understand whether Dondis' basic elements of design and Gestalt theory would guide the design process to create a visual solutions geared towards educating hockey parents.

The theoretical checklist played played an important role in the creation of the theoretical and content-theoretical designs. Furthermore, the process determined that richness of data generated a more robust design solution. When comparing the three designs, it is evident that there is a continual evolution, with each new design extracting strong graphical elements and colour schemes from its predecessor. A blind test was conducted on Dr. Cusimano to determine the success of the visual solutions for the intended target audience. Selected designs included the intuitive and content-theoretical solutions, which Dr. Cusimano felt best represented his research and effectively captured the attention of hockey parents.

This experimental design provides a solid foundation, which can be taken further; the three recommendations made by the investigator are to experiment with data-driven parameters, examine the impact of culture on the information design process or hold a focus group with hockey parents to test the impact of the three information graphics created.

Dedication and Acknowledgements

I would like to dedicate this MRP to my mother, Bernardita Nubla. She has instilled in me the positive values and unquenchable appetite for knowledge, which have allowed me to become the person I am today.

Dr. Janice Fung has been the ideal thesis supervisor; her insightful comments, creative perspective and persistent motivation has only helped better my MRP in every way. I would also like to thank Gillian Mothersill for her continual support and keen eye for detail. I extend my genuine gratitude to the department of Professional Communication and Dr. Michael Cusimano.

Finally, I would like to especially thank my partner, Brandon Segmiller, for his unwavering support and encouragement. His enthusiasm and loving nature made a normally bumpy process much smoother.

Table of Contents

List of Tables

List of Figures

List of Charts

List of Appendices

Intuitive Versus Theoretical Approaches to Visual Communication to Facilitate Knowledge Transfer

Introduction

North American culture moves in a fast-paced environment and its information exchange is no exception. The instantaneous availability of information is a convenience; however, its rapid nature can be overwhelming to absorb. The interpretation of information is handled in a simultaneous, tentative and fast-processing fashion (Pettersson, 1989). A human being's memory is circuited through modes of visualization; information presented via a picture-word combination is superior to words or pictures alone (Pettersson, 1989). Visual experiences are subject to an individual's interpretation and even simplistic pictures can cause different associations; however, once amalgamated with text, which often hold definite definitions, messages are strengthened to create optimal conditions for presenting information in a memorable and comprehensive manner.

Research Background

In hockey, violence is a norm. During the start of the 2002-2003 season, Hockey Canada lowered the age of bodychecking from 12-13 years of age to 9 (Marchie et Cusimano, 2003). Though this policy was reversed in May 2003, four major Canadian hockey leagues still allow bodychecking at 9 years of age on an "experimental" basis (Marchie et Cusimano, 2003). Dr. Cusimano, a neurosurgeon for St. Michael's hospital, has conducted research connecting serious neurological damage to bodychecking, especially at such a young age.

For the purposes of this MRP, the investigator's non-expert knowledge in the field of neurology will provide an unbiased approach to Dr. Cuismano's work. The investigator completed the design three information graphics: one intuitively and two theoretically designed, directed towards hockey parents. Through these designs, complex information was simplified by appealing to an individual's visual senses. The creation process also helps emphasize the effectiveness and usability of Dondis's basic elements of design and Gestalt theory.

Why an Information Graphic?

An information graphic uses design elements, such as lines, shapes, and colours, integrated to produce a visual narrative (George-Palilonis, 2006). This project, it will simplify scientific language and bypass pages of complex data to instantaneously provide the viewer the information they desire. During our initial, informal interview, Dr. Cuimano had indicated that he wanted a deliverable that is simplistic, friendly, and easy-to-understand. These end-goals have been kept in mind during the investigator's design process.

Target Audience and MRP's Goals

Hockey parents are the chosen target audience because their children face the risks associated with the sport. In heightening parents' awareness and knowledge, they will have the power to collectively petition to change the policies surrounding Ontario's current, minimum age for body checking in children's hockey. Overall, this project aims to understand the knowledge translation process of information graphics through the use of visual communication theories. The

investigator seeks to further its collection of academic "dialogue" in this relatively new field. The investigator's methodology will not only add to her preexisting design portfolio, but also honour the "theory to practice" foundations of the Master of Professional Communication program. In this experimental design project, the investigator will follow a linear practice-based methodology to answer: *How will Dondis's basic elements of design and Gestalt theory guide the design process and will the outcome of a theory-based visual solution address the target audience's needs better than the" driver" approach?*

Literature Review

The aspiration to bridge the gap between science and the public through clear lines of communication is only a recent phenomenon. In *Science in Public: Communication, Culture and Credibility* the public reception and understanding of science is examined. Traditionally, scientists were isolated in laboratories with an understanding of that was their designated location of work. However, new generations of young researchers are equipped with the knowledge and training to intelligently, and consciously, communicate the results of their work to the public, straying from scientific jargon and highly technical language with the outside world (Gregory et Miller, 2000). The lines of communication have been opened between these two groups of individuals with expanded individual effects in commerce, culture and democracy (Gregory et Miller, 2000).

The Committee on the Public Understanding of Science (COPUS) is a network dedicated to connecting individuals passionate about advancing the public

understanding of science, stated, “many personal decisions…would be helped by some understanding of the underlying science” (Gregory et Miller, 2000). By providing citizens with a clearer understanding of science, they become knowledgeable of matters that affect themselves, their friends and family members. Empowered by access to information encourages the public to seek additional scientific information more frequently. For example, learning more about chronic or inherited diseases assist individuals to make informed decisions that can lead to improved results and benefits to their daily lives.

Bauer (2008) investigates the dissemination of information for the purposes of public education, exploring the transformation of science’s formerly well-established theoretical models into practical, relatable experiences. Within the multidisciplinary field of science communication, Bauer (2008) highlights how there are growing pressure to commercialize scientific research and its findings to the public. He explores the hazards of science communication leading away from science writing and journalism and into the realm of public relations; thus increasing the risk for fraud. Alternatively, the paradigm for science communication welcomes a skeptical public as it promotes public scientific literacy and a positive image of science; whereas knowledge consumers are able to think beyond the information simply provided to them.

Visual Communication

Visual graphics have desirable attributes in enhancing the understanding of risk with quantitative support. Through the visual layout of information, graphics

reveal a data pattern that may otherwise go undetected when interwoven into written text. Examples of excellent graphical representations are line graphs in conveying data trends and pie charts and divided bar graphs for depicting proportions. These graphics are an example of an information graphics (Lipkus & Hollands, 1999). Weinstein and Sandman (1993) note that the criteria for evaluating risk messages that can be considered require extra precaution are:

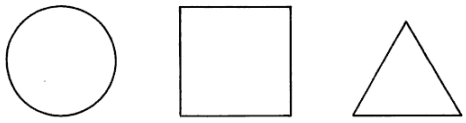
> (1) Comprehension (Does the audience understand the content of the communication?);
> (2) Agreement (Does the audience agree with the recommendation or interpretation contained in the message?);
> (3) Dose-response consistency (Do people facing a higher dose of a hazard perceive the risk as greater and/or show a greater readiness to take action than people exposed to a lower dose of this hazard)?
> (4) Hazard-Response consistency (Do people facing a hazard that is higher in risk perceive the risk as greater and/or show a greater readiness to take action than people exposed to a hazard that is lower in risk?);
> (5) Uniformity (do audience members exposed to the same level of risk tend to have the same responses to this risk?);
> (6) Audience-Evaluation (Does the audience judge the message to have been helpful, accurate, clear, etc.?); and
> (7) Types of Communication Failures (When different types of failures are possible, are the failures that occur generally of the more acceptable variety?).
>
> (Weinstein and Sandman, 1993, pg.103)

Effective Execution of Visual Communication

Dondis' Design Elements in Effective Communication

Dondis (1974) claims that composition is the most crucial step involved in visual problem solving and the results of the compositional decisions carry strong implications for the impact of message the viewer receives. Composition is the stage of the design process where the designer can exercise the strongest control over the communication of the message and presents the greatest opportunity in setting the tone conveyed. In visual composition, there are no absolute rules; however, there is a great understanding involved in terms of creating certain arrangements towards

organizing and orchestrating visual meanings. A composition is a result of a designer's input and design decision. The basic elements of design communication, outlined in Table #1, act as a means for knowledge and expression. Visual elements such as the line, colour, shape, direction, texture, scale, dimension and motion comprise of the raw materials of visual information that designers draw upon for the development of visual communication (Dondis, 1974).

Line	• Dots close to one another; they cannot be individually recognized. • Fluid, restless that articulates form – "a dot in motion" (44). • Essential for previsualization. • Can express different moods, such as loose and undisciplined (sketch illustrations) or mechanical and linear. • Clearly expresses the intention of the designer – his/her personal feelings, emotions and vision.
Colour	• Coordination of tone with added components of chroma; considered the most emotional and expressive visual element. • Has three dimensions that can be defined and measured: hue, saturation and brightness.
Shape	• "Lines describe shape" (44). • There are three basic shapes: circle, square and an equilateral triangle – each containing a unique character and characteristic to attach meaning, associations and the viewer's own psychological and physiological perceptions.  FIGURE 3.13
Direction	• Thrust of movement incorporating and reflecting the character of basic shapes: "…the square, the horizontal and vertical (3.18); the triangle, diagonal (3.19); the circle, the curve (3.20)" (46). • The visual directions are perceptually associated with a meaning and act as a valuable tool in making visual messages. • "All directional forces have great importance to

	compositional intention toward final effect and meaning" (47).  FIGURE 3.18 FIGURE 3.19 FIGURE 3.20
Texture	• Optical or tactile: surface characteristics that serves as a "…stand-in for the qualities of another sense, touching" (55). • Adds substance through minute variations of surface material – serves as a sensitive and enriching experience for the viewer.
Scale	• Capacity of visual elements to modify or define one another. • Established by relative size of visual clues and relationships to the field of environment. • Visual results are fluid and absolute as they are subject to many variables of modification.
Dimension	• Representation of dimension also dependent on illusion: can be felt and seen.
Movement	• Both implied and expressed. • Can be used "…to describe compositional tensions and rhythms in visual data when what is being seen is fixed and unmoving" (64).

Table #1: *Dondis' (1974) Visual Elements of Design*

Perception in Visual Communication Through Gestalt Lenses

Dondis (1974) attributes Gestalt psychology to contributing valuable research and experimentation in areas of perception, data collection and searching for significance in visual patterns, as well as aiding in the search for how the human organism sees and organizes visual input and articulates visual output. Gestalt theory is rooted in examining an individual's subconscious tendency to organize bits of information into "wholes" and Smith (2005) argues that the basic laws of Gestalt

are rooted in striving towards the simplest, most regular, symmetrical structure perceived in a given situation. The Gestalt theory outlines an integrated, articulated structure where constituent parts are in dynamic interrelationships with one another and as a whole (King & Wertheimer, 2007). The principles of Gestalt theory are organized with distinct characteristic cases, detailed in Table #2.

Similarity 	• Law of "Similarity" • Perceiving objects similar to one another as belonging together if similar in features, such as shape, colour or texture.
Proximity 	• Law of "Proximity or Nearness" • Group items together in accordance to their nearness or proximity to one another.
Continuation 	• Law of "Good Continuation: • Items are grouped together on the basis of "…their continuity in following a consistent, lawful direction, items that are natural successors in a series will be seen as belong to that series" (155).
Closure 	• Law of "Closure" • "Tendency to perceive a complete or incomplete part or whole so as to attain maximum stability, balance, or symmetry in the entire configuration" (155).
Figure-Ground	• Figure serves as the focal point, the stimuli, of the visual piece, which attracts the viewer's spontaneous concentration. • Ground helps define the figure and give it meaning.
Symmetry	• Symmetry improves grouping as ambiguous design elements can be seen as "good" or "interesting" when presented in a balanced and harmonious manner.

Table #2: *Gestalt Elements of Design*
Graphic Source: Spokane Falls Graphic Design Education, 2011
Content Source: King & Wertheimer, 2007

Planning Production

As previously examined, perception is always organized; therefore, humans perceptually construct relationships, grouping, objects, events, words, and people naturally. Pettersson (1995) states that when informative visuals are produced, it is always a good idea to attempt to "visualize" information in an effort to materialize the effective synthesis of words and pictures. The author further explains that visualization is a composite task and that there are four distinct stages in production of information graphic materials from visualization to finished products:

1. Visualization
    a. Synopsis: Defining the message
    b. Idea Conception
    c. Integration
    d. Graphical Design
2. Creating the Original
    a. Text
    b. Drawing
    c. Photography (if needed)
3. Creating the "Master"
    a. Text
    b. Drawings
    c. Photography
    d. Master
4. Run
    a. Copies

O'Grady & O'Grady (2006) provides a design approach more academically- and commercially-geared as they strongly incorporate elements of research, in addition to internal resources when discussing the designer and client design process.

DESIGNER

- First Steps:

    - A Brief
    - Ask the right questions
    - Investigate why
    - Define problem
- Research:
    - Research needs
    - Focus on the user/audience
    - Observe user/audience behavior
- Planning:
    - Account for internal resources, people and information
- Communication:
    - Relationship needs to be a two-way street between both parties
    - Predetermine review stages
    - Ensure all parties are on board
- Implementation:
    - Stay involved
    - Establish project assessment procedures

CLIENT

"The Design Process" as explained by the Design Council
(O'Grady & O'Grady, 2006, p.76)

Information Graphics Examined

The root of the word "information" derives from the Latin noun "information", meaning "conception" or "idea," therefore, it has been long synonymous with "data", "details" and "facts" (Pettersson, 1995). Though the term "information" varies in its definition, it is an important concept covering and often overlapping through a number of disciplines, such as the field of communications technology or areas of linguistic dimensions (Pettersson, 1995).

In George-Palilonis (2006), the important skills and theoretical foundations needed to strategically create information graphics, ranging from diagrams, charts to maps are detailed. George-Palilonis (2006) outlines the essential roles of research

and writing skills in graphics reporting, which traditionally falls into the field of journalism. Utilizing a broader perspective, Hembree (2006) examines the role of a graphic designer and how their client's needs/desires can sometimes overpower their vision, whereas information graphics (a subset of graphic design) primarily focuses on providing the best representation for a batch of information; often sourced from quantitative data supported by evidenced research (Hembree, 2006).

Information design is both the art and science of preparing information in a way that can be utilized by individuals with efficiency and effectiveness (Horn, 2000). Information design increased in popularity during the 1990s as an umbrella term to describe the creation of "…communication by words, pictures, charts, graphs, maps, pictograms, and cartoons, whether by conventional or electronic means" (Passini, 2000, p.84). According to Passini (2000), Graphic design is traditionally associated with the design of information, prioritizing aesthetical appearance, whereas the field of information design values content as well as form.

Raskin (2000) argues that "information design" does not exist and that the title is a misnomer, as information itself cannot be designed; instead it is in its modes of transfer and its representations that can be shaped. Information overload is stressful, as the mind doesn't know how to organize and categorize the wealth of verbal, written and visual information received on a daily basis. Hansen (2000) states that accessing, reflecting and storing information in a way that can easily retrieved and applied to everyday problems can be a time-consuming and frustrating process. Information design provides an escape from the complexity, disorder and information overload occuring from the traditional linear, sequential

thought processes often provided through verbal and written communication (Hansen, 2000). Thus, the field of information design requires the holistic and systematic conceptualization to allow graphics to transform the viewer's understanding of an issue and to an extent, free them from the narrow translations of word, label and classification systems (Hansen, 2000). It is human nature for humans to need to understand complexity, thereby apparent disorder makes it important for an individual to extend their ability to think both visually and systematically as a means of envisioning information presented to them as a whole (Hansen, 2000).

Information graphics are often presented to the public readers through a variety of media, such as newspapers, magazines, online publications and other media portals. George-Palilonis (2006) stresses the need for the designer to note the textual and visual references of their sources. Though artistic abilities can be an added asset, it is the ability to spot good visual references and replicate them into the design that makes the information graphic effective and easily understood. George-Palilonis (2006) further notes that one of the biggest mistakes made by inexperienced graphic reporters is simply not using their sources to their potential. Therefore, it is essential to understand the possibility of each source and properly use them in accordance to the context of the intended visual narrative.

Psychological Considerations

In *Exploring the Elements of Design*, Evans and Thomas (2008) explore the relationship between psychological foundations and visual communication –

specifically how they are used and understood by designers to communicate to their intended audience(s). Psychological foundations "…include how people behave, how they think, how they feel and how they interact with one another (Evan and Thomas, 2008, p. 194). This reinforces the point that although designers are primarily interested in visual perception, a viewer's five senses are triggered when experiencing visual communication. American neuroscientists Antonio Damasio and Joseph LeDoux discovered evidence of "feeling-based" of human response systems of unconscious cognitive processing and emotion as integral to good decision-making (Newton, 2005). Information, as processed by our eyes – through vision – has a major influence over an individual's decision-making process and for determining how to act, or react, to stimuli (Newton, 2005). Visual communication can act as a primary way of knowing, allowing visual intelligence to cultivate sophisticated understanding of how images and graphics affect our daily lives (Newton, 2005).

Information graphics have the ability to directly appeal to an individual's cognitive senses by appealing to their analytical reasoning processes. Styhre (2008) outlines humans' sensual relationship with their perception of the outside world and the role of visual organization in enhancing their cogitative capacities. Linear communication and perceptive differences are encountered when coding text versus images; texts are abstractions of images, interpreted to explain their ideas through linear communication (Styhre, 2008). Images are representations of the world and and Vilém *Flusser's* theory of "idolatry" where "human beings 'cease to decode images and instead project them, still encoded into the world 'out there'" are

examined (Styhre, 2008, p. 216). Thus, it can be argued that images act as maps to knowledge transfer. Altogether, information graphics combines the conceptual thinking provided through texts with the creative potential of images to create a dynamic relationship to both obscure and clarify social reality (Styhre, 2008).

In 1988, IFRA Institute in Darmstadt, West Germany organized an "infographics" workshop with twenty journalists, artists and graphic designers from different newspaper companies. The participants were divided into eight working groups, with two to three persons in each; computer equipment was provided, in addition to a common theme. The workshop concluded with an evaluation of the information graphics provided and each graphic was assessed from a criteria of ten and a combined five grade numeric and verbal scale, from "1 = not satisfactory" to "5 = very good". "The ten criteria were: 1 = legibility of text, 2 = legibility of image, 3 = foreground (should be clear and distinct), 4 = background (should not be disturbing), 5 = text-image (should be clear), 6 = location of places and/or events, 7 = documentation of facts and/or explanations, 8 = presentation of statistics, 9 = editorial comment/s, and 10 = overall aesthetic value" (Pettersson, 1995, p.81). The results proved that the criteria were assessed subjectively, concluding that subjects have different opinions about the effectiveness of respective information graphics and one design cannot be expected to please all viewers (Pettersson, 1995).

Methodology

Design Tools

For the purposes of this experimental design process, the investigator chose to use Adobe Illustrator as the fundamental software to create the information

graphics. True to its name, Illustrator incorporates a number of drawing tools that accommodate artistic spontaneity to create detailed designs as it allow for the precise control of colour, text and artwork in the creation of dynamic illustrations (Smith et al., 2010). Adobe Photoshop was also used to change file formats of graphical elements, primarily the hockey players, to increase their overall print resolution. The main benefit of using Adobe Creative Suite is the ease of integration between individual applications; therefore, the investigator can easily transport files from Photoshop into Illustrator and vice versa (Smith et al., 2010). The design tools and content include the following:

- Raw Data *(Dr. Cusimano's Open Source article with the integration of my grounded theory analysis)*
- Design Journal
    - Incorporates sketches of design ideas and jotted notes of my thought process
- Adobe Illustrator CS5
- Adobe Photoshop CS5
- Theoretical Design Checklist (See Charts #1 & 2)*

*Only used for second and third (two theoretical) designs.

Design Journal

Prior to and during the creation of the three designs, preliminary sketches and written notes were recorded in a journal by the investigator in an effort to record her cognitive process throughout the design experiment. This was later used to provide an accurate analysis of her creative visual process. Pages of transcribed thoughts provided an instantaneous documentation of the rationale for the design decisions and were later referred to during the analysis stage of the experiment.

The challenge for any designer is to draft a description of their design so that the target audience will understand its intention. This is especially true when creating information graphics, as a wealth of data and description are involved (de Ridder, 2007). A design journal helps ease this process by acting as an organization vehicle. Recording initial thoughts allowed the investigator to remain accountable for her decisions and justified the relevancy of visuals and content used in the information graphic, creating purposeful decision-making in the design process. Visual note taking, such as sketches complemented with brief descriptions, visualized and annotated the basic thought behind the action and insight to decision-making based on intuition. Fraser and Henmi (1994) state that sketches provide a visual dialogue that enrich the creation process as it multiplies an individual's thought to lead to new ways of seeing and understanding by creating a chain of associations. The authors claim:

> Just as an author inserts his or her conceptual presence into a drawing through a mode of seeing, interpreting, and changing a scene, drawing tools impose a material influence. Drawing thus intervenes between an author and these ideas being considered, becoming an effect a third presence. In this presence, drawing is not a transparent translation of thought into form, but rather a medium which influences though just as thought influences drawing.
> (Fraser & Henmi, 1994, pg. viii)

This further emphasizes the usability of using design tools, such as a hand-drawn sketches or constantly evolving designs on computer illustration programs to arrive at visual language solutions using quantitative and qualitative data.

Creating a Step-by-Step Experimental Design

The Markus/Maver Map is composed of three planning functions: analysis, synthesis and evaluation, illustrated in Figure #1. This design process is prevalent in the fields of engineering, architecture and design (Lawson, 2006). Eva Jiricna, a renowned architect, claims that her design process begins with outlining the details of the project, then she creates a layout from the generated ideas of the brainstorming session (Lawson, 2006). The accuracy of the Markus/Maver map is tested on a subjective basis, which varies from designer to designer and from project to project. What may seem like a fundamental decision for one project may simply be considered a minor detail for another. Therefore, Figure #1 is a dynamic process that can be adapted and altered – it is not a firm route through the beginning and end of a whole process but serves as a navigational guide. The designer has agency to take the map and mold it to his/her own.

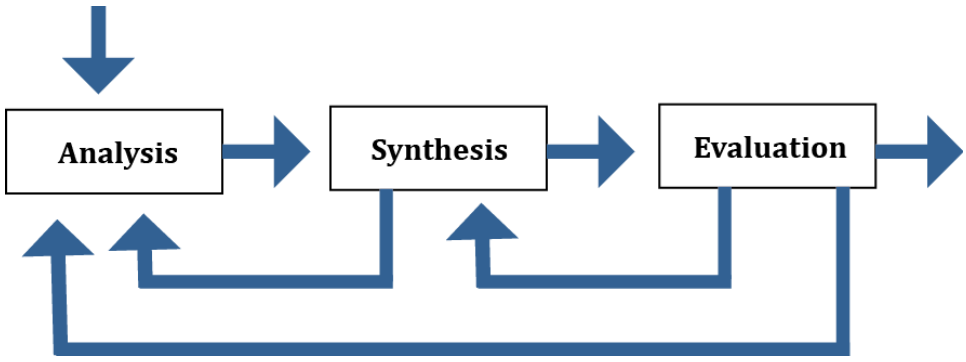


Figure # 1: *Markus/Maver Map of a Generalized Design Process* (Lawson, 2006)

In contrast to the Markus/Maver Map, Jane Darke's Map (seen in Figure #2) consists of a model of generator-conjecture-analysis. This methodology allows the designer to first decide what they believe are the important aspects of the design-

problem, develop a rough design on this basis and then examine it to assess if the design achieved its overall goals. The first step consists of the primary generators or organizing principles, which can be stretched throughout the whole design process. However, designers can gradually achieve an understanding of their design problem and therefore have the ability to not cling to major design ideas and themes (Lawson, 2006). The conjecture and analysis processes allows for the continual examination of the evolving designs in terms of their ability to achieve the overall design goal. As previously mentioned, it is important that the investigator remember that pre-existing and tailor-made step-by-step methodologies/maps should not be read too literally as any visual diagram only serves to simplify the highly complex mental process where flexibility in design must be accommodated.

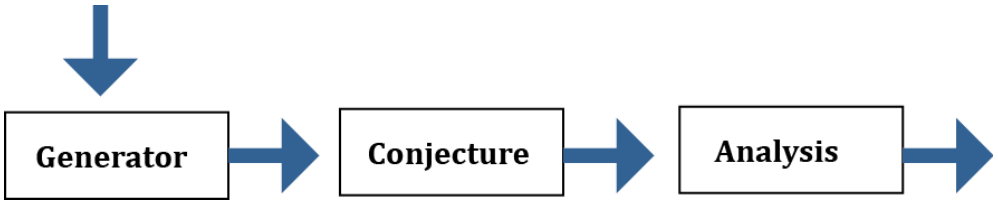


Figure #2: *Jane Darke's Design Process Map* (Lawson, 2006)

Using a combination of the Markus/Maver and Darke Maps, the investigator was able to chart her design process from beginning to end; "mapping" a creation process consists of designating a sequence of distinct and identifiable activities occurring in a predictable logical order (Lawson, 2006). Thus, a linear, practical-based methodology was used for efficient results and to prevent overlap and/or gaps in planning and final outcome. On the whole, utilizing a step-by-step

experimental design approach allowed for sequential design solutions and the experiment progressed.

Keeping the Research Question in Mind

This MRP's practice-based methodology is outlined below and seeks to answer the investigator's main research question: *How will Dondis's basic elements of design and Gestalt theory guide the design process and will the outcome of a theory-based visual solution address the target audience's needs better than the driver approach?* The experimental research approach is broken down into the five steps below for the collection of primary and secondary data. Each step will need to be completed before proceeding to the next. This ensures that the previous section will be able to relate and build to the next.

STEP ONE: Analysis and Interpretation

STEP #1:
Grounded Theory

The two documents that were be analyzed were:

- Dr. Cusimano and his team's article entitled, "Effect of bodychecking on rate of injuries among minor hockey players" published in the April 2011 edition of Open Medicine Journal;
- a press release issued from St. Michael's hospital.

Why These Documents?

The *Open Medicine* article is designated as a media deliverable for St. Michael's Hospital as the raw data for the design of the information graphic. Understanding

the use of medical language and tone allowed for the investigator to determine how to best represent the medical research in visual format. Furthermore, the press release targeted the same audience as the information graphic, hockey parents of youth hockey players, placing further importance on the document analysis.

Grounded Theory Analysis

The grounded theory analysis used operationalized concepts (Appendix #4). The investigator was able to assess the use of nouns, which allowed for medical research findings to become facts, as well as the use of "team-based" pronouns, which provided the reader with confidence in knowing that the study was conducted in a multi-disciplinary environment.

Summary of Grounded Theory Analysis of Both Documents

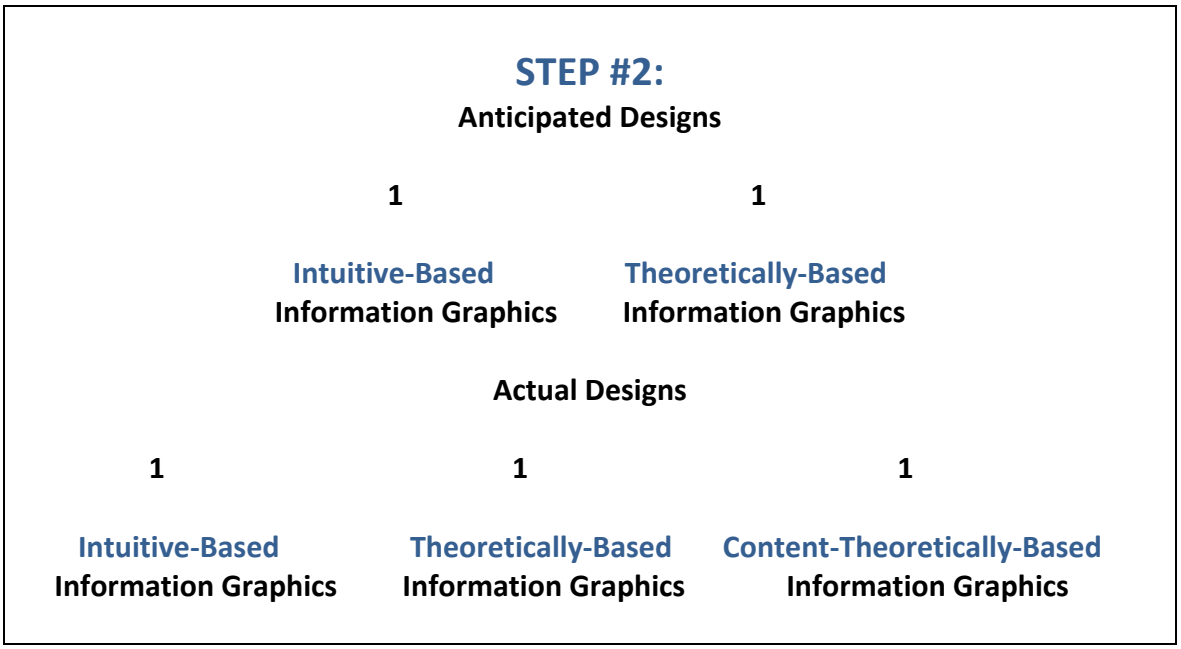
As a whole, the press release places the article's findings as the first noun of its sentences; thus, still aligning to the original article's language formatting. Similarities between the construction of the press release and the article's interpretation section can be clearly seen through the presence of evaluative/judgmental statements in later portions of the section. In both documents, research findings were heavily presented beforehand to "set the stage" before personal opinions were incorporated. However, unlike the Open Medicine article, the press release uses Dr. Cusimano, the lead supervisor of the study and a prominent figure in the hospital, as the voice of these statements. His credibility and authority emphasizes the message.

Open Medicine Article	St. Michael's Press Release

- Layout fits into scientific report genre.
- Little jargon used.
Results Section
- All six paragraphs contained sentences that used research findings/information nouns.
  o Complemented by passive verbs, implies that because they have already occurred, facts are being presented.
- "We" coded three times.
  o Highlights team-based approach.
Interpretation Section
- Heavy use of additional research.
  o Short lit-review presented.
  o Presented early in preparation for evaluative/judgmental statements – which appear in the later paragraphs.
- Belittling language used when describing Hockey Canada and their actions.
	- Used many pronouns to describe Dr. Cusimano and his team as opposed to featuring the research findings as the first noun in its sentences.
	  o Meant to shine the "limelight" on St. Michael's.
	- Targets lay audience as its primary audience.
	  o Evident through lack of jargon and mention of celebrity hockey players who have recently been injured due to bodychecking.
	- Uses Dr. Cusimano as lead supervisor of the study, a prominent figure in the hospital.
	  o His credibility and authority furthers the research message.

Table #3: *Summary of Findings*

STEP TWO: Design Process



Prior Software Experience

The investigator's graphic design experience allowed her to comfortably utilize the design elements. Tentative sketches kept in the design journal were essential building block later incorporated into the digital design. This Linear approach allowed for an easy transition of visual elements established on paper to computer graphical elements later finalized on screen utilizing an intuitive decision-making process for the composition.

Intuitive Design

The Intuitive Design process began with a careful examination of the raw data, Dr. Cusimano's *Open Medicine* article. The grounded theory analysis served as a tentative framework to determine the content and shape the "tone" of the design.

Once the content (important statistics and information) was extracted from Dr.Cusimano's printed article, the investigator began to create possible designs for the intuitive design solutions through sketches. The importance of the information was based on its "marketability", towards keeping the hockey parents as the lay target audience focusing on the types of statistics that would interest them the most. The investigator opted for a tentative drawing that created the shape of the design, which could later be easily reconfigured utilizing the computer graphic software. This allowed for a better understanding of how separate design elements would come together as a whole leaving room for flexibility and inspiration throughout the decision-making process. Nonetheless, initial sketches and the maintenance of a list of important aspects incorporated by the design provided documentation of the process and a focus for the investigator in order to create the best representation of the data.

Similar to the purpose of a design journal, design sketches became a medium for dialogue throughout the design process by acting as a physical manifestation of the designer's *way of thinking*; versatile in its use from the inception of a project to final detailing and evaluation (Smith, 2008). Sketches convey intention and meaning and can be compared to "…theories of play, memory, imagination, and fantasy" (Smith, 2008, pg. 2). Overall, the journal sketches served a recording of the investigator's initial design intention – only one to two hand-drawn sketches of each of the three designs were created, as the investigator was comfortable transferring and detailing elements using graphic software. Constant alteration of the design

layout on screen can also be considered design sketches that evolve through their transformations.

As designs molded from one form to another, the investigator continued to take notes of strategic design changes and their relations to the overall design concept. The flexibility of the each software's tools, especially Adobe Illustrator, enabled the investigator to confidently mold her designs as needed. Flexibility and creating a piece that "feels right" is a major benefit of the intuitive design process – it is natural and a sense of freedom is felt as the information has precedence on visual forms.

Theoretical Design

Following a linear, practice-based methodology, the creation of the theoretical design proved to be a systematic approach that followed after and used aspects from Intuitive Design in conjunction with a theoretical "checklist" drawn from Dondis' and Gestalt psychology. These checklists can be seen in Charts #1 and #2 below.

	Line
	Colour
	Shape
	Direction
	Texture
	Scale
	Dimension
	Motion
	Complexity
	Symmetry

Chart #1:
Dondis' Basic Elements of Design Checklist (✓)

	Figure and Ground
	Similarity
	Proximity or Contiguity
	Continuity
	Closure
	Symmetry

Chart #2:
Gestalt Principles of Design Check-List (✓)

Content-Theoretical Design

The creation of the (Content-Theoretical) design was primarily based on the incorporation of additional data later retrieved from the article, seen in Figure #3. The design goal was to emphasize the comparison of the "before" and "after" numerical statistics of bodychecking injuries after rule changes by Hockey Canada. The increase in data contributed to a more informative, robust design where elements from previous iterations were incorporated and improved upon.

Table 3: Comparison of bodychecking injuries, by minor hockey league division, before and after the rule change allowing bodychecking in the Atom division*

	Timing†; no. of bodychecking injuries‡		
Division	Before rule change	After rule change	OR (95% CI)
Novice	44 (149)	65 (221)	0.99 (0.63–1.57)
Atom	158 (518)	243 (495)	2.20 (1.70–2.84)§
PeeWee	549 (1002)	831 (1452)	1.10 (0.94–1.30)
Bantam	546 (1031)	990 (1785)	1.11 (0.95–1.29)
Midget	320 (627)	714 (1272)	1.23 (1.01–1.49§
All divisions	1617 (3327)	2843 (5225)	1.26 (1.16–1.38)§

OR = odds ratio, CI = confidence interval.

* Source: Canadian Hospitals Injury Reporting and Prevention Program.

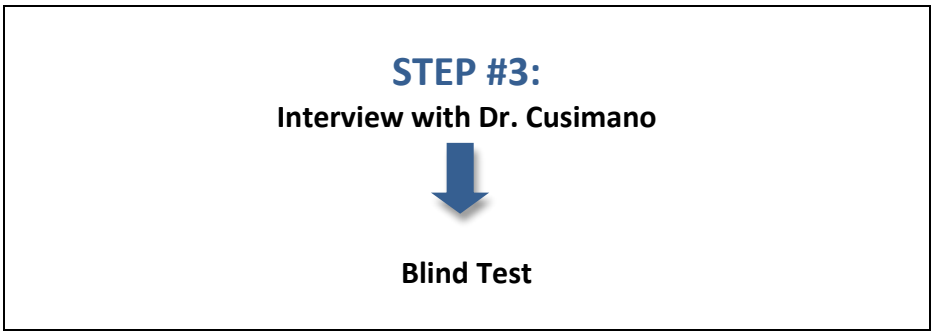
† Date delimiting "before" and "after" varies by hospital, because minor hockey leagues in Ottawa and Kingston did not adopt the new rule until the 2001/2002 season; see text for further explanation.

‡ Value within parentheses refers to the total number of injuries (both bodychecking-related and non-bodychecking-related) used to calculate the OR.

§ Significant at the 0.05 level (2-tailed).

Figure #3: *Table #3, Found in Dr. Cusimano's Results Section of His Online Article* (Cusimano et al., 2011)

STEP THREE: Conducting a Blind-Test Interview



As seen above, STEP #2 consisted of designing three information graphics, which was followed by Step #3, where the designs were then presented to Dr. Cusimano in a "Blind Test" during STEP #3. The questions that were discussed informally during the interview in order to determine which design Dr. Cusimano would choose from a professional perspective are shown below.

Anticipated Interview Questions:

- Please take some time to look at the two information graphics in front of you.
- Let's examine the first information graphic (intuitive design).
    - What do you think of it in terms of the information hierarchy?
    - What do you think of it in terms of the visuals?
    - Does it highlight your research well? Why or why not?
    - What are its strengths?
    - It's weaknesses?
    - What are its possibilities?
    - What are its threats?
- Let's move onto the second information graphic (theoretically designed).
    - What do you think of it in terms of the information hierarchy?
    - What do you think of it in terms of the visuals?
    - Does it highlight your research well? Why or why not?
    - What are its strengths?
    - It's weaknesses?

- What are its possibilities?
- What are its threats?

- When placed side-by-side, which design do you think will be the most understandable/attractive to hockey parents?
  - Why?

STEPS FOUR AND FIVE: Post-Interview Work and Analysis

STEP #4:

Revise Dr. Cusimano's chosen information graphics.

STEP #5:

Analyze my design process.

After the interview process with Dr. Cusimano, the investigator carried out recommended changes to the chosen design(s). In order for the revised design(s) to be used as promotional material for St. Michael's Hospital and to media they must adhere to the hospital's branding standards. The ongoing investigator's journal was used to engage in Step #5 of the linear practice-based method provided valuable insights behind decision-making throughout the design process for all three visual solutions (See Appendix #1-3).

Analysis of Intuitive Design

Intuitive Design (Design #1) Elements Breakdown

The creation of the Intuitive Design was driven and inspired by the designer's instinctual sense of layout. Through a Grounded Theory Analysis, prominent information was highlighted. Dr. Cusimano's *Open Medicine* article contained a mix of quantitative and qualitative information. Quantitative statistics provided an immediate impact while qualitative research provides the support to leverage the research informing the target audience – hockey parents. Numerical data is easier to visually represent; thus, the Intuitive Design's shading and graphical elements, such as arrows, accommodated this representation and the integration of specific sentences from Dr. Cusimano's added support to reinforce the visual communication. Overall, three sets of information, seen in Figure #4, were selected based on their ability to best represent Dr. Cusimano's research findings and visual "mold-ability".

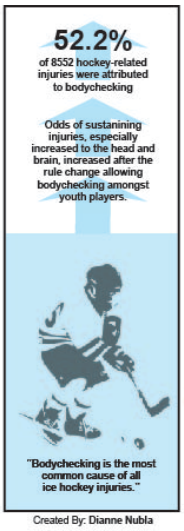


Figure #4: *Thumbnail of Intuitive Design (Design #1)*

St. Michael's Hospital's branding elements heavily influenced the colour scheme and font choices of the Intuitive Design. The synthesis of the design concepts, outlined in Table #4 below, are mainly focused upon the hockey player graphic, blue shading, use of the rectangle shape and arrows to attract the reader's attention and encourage them to thoroughly assess the graphics.

Design Element Choices	Rationale

Colour Scheme: Light Blue, White and Black	• Light blue is part of St. Michael's Hospital colour palette.
	  ○ Light blue meant to lead the eyes: starting from the big chunk at the bottom (hockey player graphic and quote), lead by the arrows to the research information above.
	  ○ Simplicity with a clean, crisp design was one of the design goals.
	  ▪ Black text is the easiest to read.
	  ▪ White background provided contrast to facilitate reader-friendliness.

Ariel Font	• The default font used by St. Michael's Hospital to brand the corporate deliverables. • Statistic (52.5%) was set as the biggest text and hierarchically placed at the top (instituting most important) as it contained the main impactful information in the infographic. • Text font size kept relatively small to add to simple feel of the design. The small size also allowed for more research information to fit proportionally (in comparison to the arrows and hockey player graphics). ○ Body quality facilitated reader-friendliness in creating easy-to-read text.
Youth Hockey Player Graphic	• Instant recognizable image to encapsulate whom the research is representing. • Black and white hue of the graphic matched the colour scheme of the design and allowed the blue colouring to "pop". • Outline quality of image accommodates different sizes (can easily be made smaller or bigger) without affecting web/print resolution.
Arrows (Going Up)	• Strategically placed behind the text. ○ Acts a "pathway" to lead the reader's eyes to

	the research text.
"Paneling"	• Acts as a separation – prevents overcrowding of graphics and text to provide a smooth, gradual transition to encourage the reader to process the information slowly in small chunks as opposed to an overwhelming portion.
Portrait Alignment	• The height of the youth hockey player graphic determined the orientation of the design – allowed information to flow logically.
Rectangle	• Enclosed the graphics in a compact manner. • Allowed the graphical elements to flow easily and emphasis how they are individual parts belonging to one, large design.

Table #4: *Design Elements Choices for Intuitive Design*

Notable Observations

The main change incorporated into the computer-illustrated design was a rectangular border to enclose the graphics – this addition was made by the investigator unknowingly to provide "closure" to the information graphics. Furthermore, the investigator's prior internship with St. Michael's Public Relations department allowed her to select the Arial font and use a specific blue shade that will easily pass the organization's branding criteria. The usage of a bold font was important as it allowed Dr. Cusimano's research to become a prominent element of the design as opposed to simply blending into the background. The creation of panels through shading the lower portion of the graphic created a separation to allow the division of the information to accommodate reader-friendliness. This prevented the creation of clusters of information that could overwhelm and visually irritate the reader. The position of the graphic instantly captured the reader's attention and the arrows allowed the reader's eyes to more upwards, a technique

that the investigator unknowingly created to add a "build-up" of anticipation to encourage the viewer to read further.

The Intuitive Design's portrait alignment created a "compact" feel as it was chosen to contain the graphical elements; its width was determined by the size of the hockey graphic. Because of this adjustment, the textual elements were incorporated above and below the hockey player to create a smooth placement within the information graphic's encompassing borders. Overall, the goal of the Intuitive Design was to enhance Dr. Cusimano's extracted research data through a clear, clean and simple graphical representation.

Analysis of Theoretical Design

Theoretical Design (Design #2) Elements Breakdown

Prior to the start of the experimental project, the investigator anticipated the incorporation of theoretical aspects of design to be a forceful process – one that would hinder the organic-feel of design creation. However, as the investigator began to create her Theoretical Design utilizing checklists, the design process was systemized and formed easily based on the set guidelines. The investigator focused on adding elements lacking from the initial Intuitive Design.

The Theoretical Design is creatively spearheaded by Dondis's elements of design and Gestalt theory checklists, seen in Charts #1 and #2 of the Methodology section. As the prior Intuitive Design contained important information from Dr. Cusimano's published article, in addition to the same design elements, such as shapes, font type and size, and colour scheme, they were simply extracted and used within the Theoretical Design. The main difference was the incorporation of a

second youth hockey player graphic to showcase a theoretical element overlapped in both the Dondis and Gestalt theory's checklists: symmetry. Shading created a distinct separation in the vertical alignment of the landscape layout. The separation also created a slight complexity to the design and captured the reader's attention. The hockey player graphic illustration added a dimension of fluidity and motion; the addition of a second one beside the original (used in the Intuitive Design) served to enhance the "recharge" of the statistic quality of the textual information.

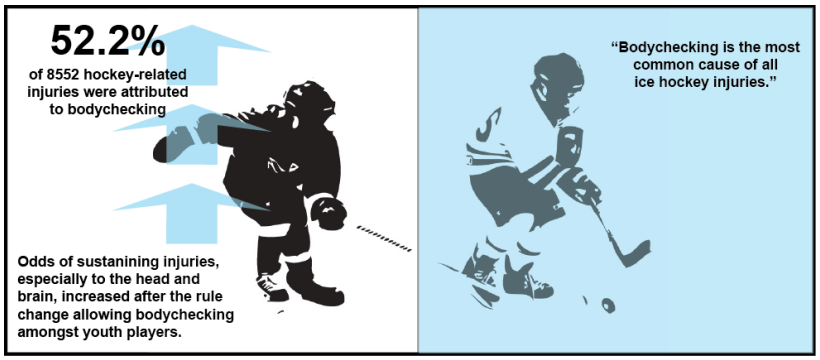


Figure #5: *Thumbnail of Theoretical Design (Design #2)*

	Theoretical Elements	Impact on Design
Dondis's Basic Elements of Design	Shape	• **Rectangle Shapes** ○ Left Rectangle (white) ○ Right Rectangle (blue) ○ Creates strong division – the split in the middle creates a graphical representation of the "52.5%" statistic.
	Direction	• **Arrows** ○ Located in left rectangle. ○ Emphasizes the bottom left-hand size information block; speaks of the odds rising.

		• Eyes meant to follow a "Z" pattern: start with the top left-hand corner (with impactful statistic), move towards quote (top right-hand corner) then progress towards the bottom right-hand corner. o The arrows allow the reader to restart this cycle.
	Texture	• **Hockey Player Graphics** o An optical texture of black-and-white features creates interest and encourages the viewer to investigate the design further.
	Complexity	• **Text and Graphic Interplay** o Coming together to visually communicate a complex image simplified.
Dondis's Basic Elements of Design & Gestalt Principles of Design	Scale, Similarity and Proximity	• **(Similar) Scale, Similarity and (Close) Proximity and Similarity of Hockey Player Graphics** o Highlighted the connection between the two sides though they were in different colours – emphasized that they were part of a whole (design).
	Dimension & Motion and Continuity	• **Hockey Player Graphics Featured "Gliding"** o Allows the viewer to feel that the design elements are seen in "mid-action" – giving the feeling of activity and movement.
	Symmetry	• **Division: White and Blue Rectangles (containing a respective hockey player graphic)** o Provides balance and harmony to the design.
Gestalt Principles of Design	Figure and Ground	• **Figure: Information (text)** o Acts as the stimuli in the design. • **Ground: Hockey Player Graphic** o Acts as an interesting

		background to capture the reader's attention.
	Closure	• **Large, Encapsulating Rectangle** o Brings the graphical elements together to create one, cohesive design. o Outlined with 3pt. border to contrast white and blue backgrounds to provide a crisp and clean look.

Table #5: *Design Elements Choices for Theoretical Design (Design #2)*

Notable Observations

Charting the design elements in Table #5 above showcases the distinct theoretical overlap of Dondis' and Gestalt graphic elements of:

- scale, similarity and proximity;
- dimension & motion and continuity;
- symmetry.

The hockey player graphics, in their similar sizes, close proximity and organic lines that denote movement and motion are a focal point in the Theoretical Design. Furthermore the graphics, complemented with the use of colour, which can be considered as shading if printed in black and white due to its transparent nature, helps reinforce symmetry into the information graphics to provide balance and harmony that calms the reader's eyes. Thereby, the reader is encouraged to visually explore the graphical elements of Theoretical Design.

Analysis of a Second Theoretical Design (Design #3)

Problem-Solving: An Emergence of a New Design

A few days prior to the investigator's scheduled interview with Dr. Cusimano, she revisited his original article posted on the *Open Medicine* website to ensure that all relevant information were accounted for in the two designs. Upon further investigation, the investigator noticed attached tables that were meant to complement the article's *Results* section. Dr. Cusimano's published article was the basis of the Grounded Theory Analysis and the newly discovered tables were not printed in the body of paper. Thus, they were not considered during the creation of the Intuitive and Theoretical designs.

Upon further investigation of the Tables, one entitled "Table 3: Comparison of bodychecking injuries, by minor hockey league division, before and after the rule change allowing bodychecking in the Atom division" (as seen in Figure #6) proved to be specifically interesting as was highly relevant to the topic of the two prior information graphics. According to the investigator, Table 3 contained the relative, comparative information the previous designs were lacking. The experimental design's Methodology served as a step-by-step process, which allowed the creation of the Intuitive Design to be free from bias. Redesigning the two prior designs after the discovery of new design information was not an option. The lack of substantial information was a barrier to creating a more complex (and intricate) design during the initial sketch and computer illustration process. On the whole, the emergence of new information is an opportunity the investigator took to create a third design using one of the strongest attributes of an information graphics to create a design

solution characteristically responding to the complex, multi-dimension challenge of selecting visuals that will best represent the data (Lawson, 2006).

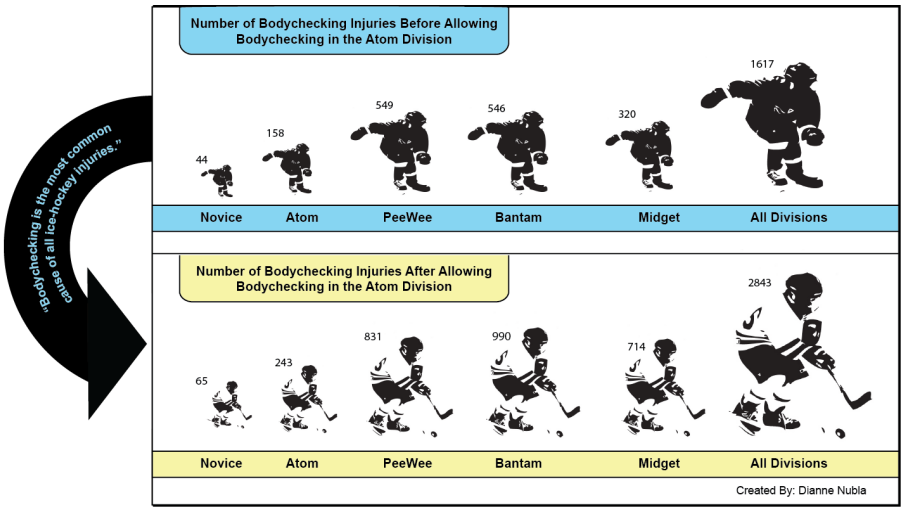


Figure #6: *Thumbnail of Content-Theoretical Design (Design #3)*

Content-Theoretical Design (Design #3) Breakdown

The Content-Theoretical Design is driven by its large, quantitative raw data set. After assessing the new information to visually communicate, the investigator decided that Dondis and Gestalt's theoretical element of scale would become a strong determinant in shaping the information design. Visually depicting numerical systems is a dynamic process as they impose rules on how the numbers work as we move along the scale (Lawson, 2006). The two different, but similar hockey player graphics (previously used in the first Theoretical Design) were isolated and multiplied in their respective panels to visually illustrate ratio differences of the compare-and-contrast nature of the raw data in an effort to spark the reader's imagination. Using the two hockey player graphics accommodates "jointing," which creates simplicity fewer graphical elements are used, the stronger their relative

connections (Lawson, 2006). Table #6 below highlights theoretical design elements used in connection to their overall impact on the Content-Theoretical Design.

	Theoretical Elements	Impact on Design

Dondis's Basic Elements of Design	Colour	• **Light Blue**
		  ○ A part of St. Michael's Hospital branding. Contrasts well with the bold, black text and white background.
		• **Yellow**
		  ○ Considered one of St. Michael's "side-colours" allowed for branding projects.
		• **Black and White**
		  ○ Black Bold Text: easier to read.
		  ○ Black Regular Text (numerical data): allowed the information to be different and stand out (the only non-bold text in the design).
		  ○ White background: simply and clean (looks good printed black & white or in colour).

	Lines	• **Linear and Straight**
		  ○ Clean, crisp lines to lead the reader's eyes from left to right side of the page easily.
		• **Organic and Fluid**
		  ○ Online of the hockey players: adds to their "movement" and fluidity.

	Shape	• **Rectangle Shapes** ○ Long rectangle to allow the reader's eyes to easily transition through respective progression of data set. • **Rounded-Rectangle**

		(Containing Before/After Titles) o Rounded feature stands out from the straight and linear orientation of the horizontal lines of the page – attracts the reader's eyes.
	Direction	• **Large Arrow (Left Hand Side)** o Provide a natural transition from "before" to "after" panel.
	Texture	• **Hockey Player Graphics** o Optical texture of black-and-white features create interest and encourages the viewer to investigate the design further.
	Complexity	• **Interplay Between Text and Graphic** o Simplifying a complex table (seen in Figure #6) into a dynamic graphical representation. o Upon first glance, the different sizes of the hockey players, accommodating statistical numbers and labels come together to present a wealth of information.
Dondis's Basic Elements of Design & Gestalt Principles of Design	Scale, Similarity and Proximity	• **(Similar) Scale, Similarity and (Close) Proximity of Hockey Player Graphics** o Scale visually depicts their graphical representation of the data – out of the three designs; scale is the most meaningful in the third design. o Similarity and proximity of the hockey player graphics in their respective panels showcases how the individual figures/statistics

		are connected to illustrating a trend in the data set.
	Dimension & Motion and Continuity	• **Hockey Player Graphics Featured "Gliding"** o Allows the viewer to feel that the design elements are seen in "mid-action" – giving the feeling of activity and movement. o Statistic position on the top left-hand corner of each hockey player graphic allow the reader to feel like the information is "gliding" with the graphic.
	Symmetry	• **Division: White and Blue Rectangles (containing a respective hockey player graphic)** o Provides balance and harmony to the design.
Gestalt Principles of Design	Figure and Ground	• **Figure: Hockey Player** o Is the centre-point (different sizes draws the reader's attention). • **Ground: Information** o Compliments the hockey player graphics and allows it to "flow" with the layout.
	Similarity	• **Panel Designs: Before and After** o Similar with the exception of colour and hockey player graphic: slight differences allowed reader to connect that the two panels were related but contained different information.
	Proximity or Contiguity	• **Proximity of the Hockey Player Graphics Relative to One Another (In Their Respective Panels)** o Highlights their connection (illustrates the same similar sets of data).
	Closure	• **Large Rectangle**

		○ Large, encapsulating rectangle to enclose different panels to become one, unified design. ○ Outlined in a 3pt. line to provide a clean and noticeable border.

Table #6: *Design Elements Choices for Content-Theoretical Design (Design #3)*

Notable Observations

Table #6 above features several graphical elements and the similar visual impacts to the two previous information graphics. As previously mentioned, scale had an influential role in visually communicating the quantitative data set. Another strong design element was the utilization of rules to clearly create a straight path for the viewer's eyes to seamlessly assess the scale-based evolution of the data from left to right. The use of organic lines, primarily found in the youth hockey player graphics, easily capture the reader's attention as they provide contrast to the design's long horizontal frames. This is important because magnetizing the reader's eyes to the hockey graphic allows them to look at the numerical, statistical value, located on its top left-hand corner. According to Dondis (1974), this positioning is the least stressful to the reader's eyes – naturally gravitating to the hockey player graphic, paired with an instant reaction to look at the statistical data. The reader then actively analyzes the data sets from the "before" and "after" columns, the results after the implementation of Hockey Canada's bodychecking rule are made visible.

Findings

Considering the Importance of Raw Data

The raw information selected for each of the three designs highly influenced the complexity of their text and graphic interplay. The strength of an information graphic is driven in the organization of data and the creation process of the third Content-Theoretical Design demonstrated that a certain amount of content is needed to create a robust, intricate design. When compared, the simplicity of the initial two designs, which showcased more in-depth results than the former, differed greatly from the complexity of the third Content-Theoretical Design. Overall, quantitative data is easier to visually represent because there are pre-existing design "templates," which can be used to organize the data, such as the creation of graphs, charts, tables, etc. However, the textual explanations embedded in the design allowed qualitative data to be made visible, which leaves little to no room for the reader's subjectivity to fill in the "missing gaps."

There were six tables available within Dr. Cusimano's online *Open Medicine* article. However, the investigator only chose one that best communicated the intended message – to inform hockey parents of the harmful effects of Hockey Canada's rule change. Working with more than one table would over complicate the process, as there would be "information overload." This conscious decision by the investigator indicates the significance in obtaining adequate information that can be used to visually convey a message; too little information will leave gaps in the interpretation and too much information will cause confusion and overwhelm the audience.

Comparison of Design Processes

Intuitive Versus Theoretical Design Processes

As previously mentioned in the *Analysis of the Theoretical Design* section, the main design elements, in terms of colour schemes, graphics, font, and raw data (qualitative and quantitative information) were extracted from the Intuitive Design; acting as a draft in the creation of the Theoretical Design. Creatively, there was little altered, with the exception of layout design. Hence, the visual appearance of the Intuitive Design heavily determined the design of the Theoretical information graphics. Additional similarities and differences of both processes are outlined in Table #7 below.

Similarities	Differences
• Layout was determined by **"playing"** with the graphical elements on Adobe Illustrator CS5. • Incorporated the **same graphical elements**, colours and information.	• Intuitive design acted as the foundational **"creative guide"** in the creation of the theoretical design. • **Theory checklists** helped streamline the creation of design #2 in an efficient manner. • There was more "second-guessing" of design/layout decisions in the intuitive design; thereby, a more **analytical approach** was taken in its creation.

Table #7: *Similarities and Differences Between the Intuitive and Theoretical Design Processes*

Intuitive Versus Content-Theoretical Design Processes

The similarities between the Intuitive and Content-Theoretical (i.e. the second theoretical) design processes outweighed their differences. This was mostly due to the fact that both can be considered more experimental in their design

approaches as the first was primarily based upon intuition and "gut-reaction" and the second being a reaction to the first with the use of theoretical visual design knowledge. In comparison, the creation of the Content-Theoretical design is based upon instinctive and theoretical foundations, which guided the overall process to ease in creation. Visual language theory and principles improved upon the intuitive layout and allowed for more detailed content to emerge in the design. Table #8 below further summarizes the main similarities and differences found in the Intuitive and Content-Theoretical design processes.

Similarities	Differences
• **Initial sketches** did not resemble the final design concept on Adobe Illustrator CS5. ○ The refinement of layout was highly dependent on the quantity of information (especially for Design #2) as it is the raw data that needs to be visually accommodated. • **Major graphical elements** (youth hockey players) used served as the focal point to attract the reader's attention. Their purpose was to capture the viewer's interest and entice them to "visually browse" through each design's concrete information (statistics and facts).	• **Theoretical checklist** to serve as a foundation of what elements to incorporate. • The ability to use the prior two designs as "**drafts"** to extract their strengths and incorporate them into the third design. • Content-Theoretical design was driven by **heavy quantitative data**, which was needed to illustrated the comparisons of two distinct data sets: "before and after".

Table #8: *Similarities and Differences Between the Intuitive and Content-Theoretical Design Processes*

Theoretical Versus Content-Theoretical Design Processes

The most significant difference between the Theoretical/Second and Content-Theoretical/Third Design was their use of the Dondis and Gestalt's theoretical checklists. In the creation of the Theoretical Design, the checklists were used *prior* to creation to assess the missing theoretical elements of the Intuitive Design, which acted as a primary draft. Thus, the checklists were influential in determining the Theoretical Design's overall creative look and concept. In comparison, the Content-Theoretical Design's raw data heavily determined the look of its visual aesthetics. The checklists were used *after* creation to help find areas that can be "touched-up" and theoretically strengthened. A summary of the main similarities and differences of the two theoretical designs can be seen below.

Similarities	Differences

• **Ease of design**: pre-existing graphical elements and creative processes were extracted from its previous designs (didn't have to "start from scratch").
• Majority of design decisions were made when creating **computer-illustrated design**.
• **Landscape orientation**.
	• Use of the **theoretical checklist.**
	  ○ Theoretical Design: used before its creation.
	  ○ Content-Theoretical Design: used as a guide to "touch up" after its creation.
	• Theoretical Design heavily relied on the Intuitive Design for **creative inspiration.**
	• **Raw data:** Content-Theoretical was driven by quantitative numbers whereas Theoretical had a balance of both quantitative and qualitative.

Table #9: *Similarities and Differences Between the First and Second Theoretical Design Processes*

Investigator's Reflection

When the three designs are placed side-by-side, it is evident that the Content-Theoretical Design (Design #3) features an evolved, complex graphic. The quantitative richness of the data and graphics allows for Design #3 to emphasize the importance of obtaining quality content in order to create a robust design, which can clear and concisely visually communicate a range of quantitative data. The comparison between the previous designs also highlights how each act as an "extension" from one to the other by extracting stronger graphical elements and colour schemes from prior "draft." Figure #7 below illustrates how each design becomes an inspiration for the next.

Figure #7: *Evolution of Designs*

As Design #3 captures the strengths of the two previous designs, the investigator felt that it served as the best representation of Dr. Cusimano's research and empirical evidence. The information graphic features hard statistical information to inform hockey parents of youth bodychecking by "showing" as opposed to "telling." Therefore, the later addition of more detailed and specific data allowed for an improved and more informative design altogether. It created a complex interplay between the graphical and textual elements in an effort to leverage the strengths of an information graphic as a communication device.

Overall, the experimental design methodology and execution successfully completed the intended goal of applying Dondis and Gestalt theoretical elements to create a comprehensive and finalized information graphic encapsulating Dr. Cusimano's research through the creation of the Content-Theoretical Design.

Dr. Cusimano's Interview and Investigator Observations

For the purposes of this experimental research project, Dr. Cusimano acted as client for the design process. The, the investigator decided to steer from my question-heavy interview agenda to allow for more casual conversion that encouraged him to freely express his feelings and thoughts of each design. In addition to being a neurosurgeon at St. Michael's Hospital, Dr. Cusimano is also a professor for the Department of Surgery for the University of Toronto. His teaching background was strongly evident in his critiques of the design; he identified and clearly discussed the strengths, weakness and possible improvements through a natural progression with only a few questions of clarification from the investigator.

The designs were presented to Dr. Cusimano one-by-one, starting from Design #1 to Design #3. Before commenting on each, Dr. Cusimano took a few minutes to allow his eye to wander around respective design elements. The investigator felt that this was effective in allow him to clearly articulate his initial reactions before providing his critiques. His comments in regards to each of the designs can be seen in the chart below.

Design #1: Intuitive Design Comments	• The first design presented to him. • He claims to "like it" and it "grabs the information…adds to the written content".

(Design found in Appendix #1)	• He's concerned about the placement of the 52.5% graphics as it might be misrepresenting the information (eludes to the percentage raising due to the arrows). ○ However, his concerns subsided when he read the supplementary information found below the percentage text. • Approves of the graphics chosen (hockey player) and choice of information. • Likes that there is a clear direction for the eye to follow (start from the bottom, anchored by the youth hockey player graphic, then guided by the arrows to the relevant information above leading to the impactful statistic, situated at the top).
Design #2: Theoretical Design Comments *(Design found in Appendix #2)*	• The first design was taken away and the second design was presented to him. • With the realization that the second design contained the same information with one added (youth hockey-player) graphic, there seem to be less of an impact/surprise. • He claims that the "visual capture the eye as well". • Likes that it contained the same important, relevant information as the first design. • Concerned about the orientation of the design – feels that the horizontal orientation is miscued. • Compares the two design and felt that #1 was more "clear and concise" as it "flowed a lot better" – the viewer's eyes were allowed to make their natural progression through the graphic (from bottom to top). Claims that #2 was "more confusing than the first one". • Was concerned about the positioning of the arrows, felt that they (negatively) influenced where the viewer's eyes were attracted to and there is no smooth progression to them to easily glide through the design's information.
Design #3: Content-Theoretical Design Comments *(Design found in Appendix #3)*	• The second design was taken away and the third design was presented to him. • As he glazed at the graphic longer than the previous designs, looked more impressed and initially responded with "interesting". • He described it as "novel" and " chalk-full of data" by the illustration of increasing injuries. • One aspect that he was concerned about was the presentation of the odds ratio of the data.

	○ He feels that the information can be incorporated; it would need to be further tailored to be used for a scientific audience – but can be used during one of his presentations, as long as he is present for further clarification. ○ From a scientific perspective, the graphic can be considered "not accurate", additional information is required to demonstrate relevance. ○ Thought that the table (found in his article • However, overall, he feels that a lay audience can "understand it quite well".

Table #10: *Summary of Dr. Cusimano's Comments of the Three Respective Designs During Our Interview*

Dr. Cusimano's Top Selection(s)

Once Dr. Cusimano was finished critiquing the third design, all three graphics were laid out in front of him and he was asked to choose one design which best represented his work. Table #11 outlines his top selection(s).

Design #1: Intuitive Design *(Found in Appendix #1)*	**Rationale:** • Made an impact visually. • Graphical elements were compact (contained inside rectangle). • There was a clear direction for the eyes to follow (from bottom, starting from the hockey player, led by the arrows to the top where the important information was found), • Gets the point across well – good for press release meant for the general public. • Contains overarching data that encompasses research well. • Vertical layout makes it neat and compact. • Can be easily understood by lay audience.
Design #3: Content-Theoretical Design *(Found in Appendix #3)*	**Rationale:** • Contains lots of information. • Interesting to look at – makes information come to life, encourages the viewer to stop and

	look/read further. • "More elaborate" compared to the two other designs, viewer needs more time to digest the information. • Cannot standalone with a scientific audience, good to use in a lecture (incorporated into a Powerpoint presentation) where an explanation can be provided to support conclusions. • Can be easily understood by lay audience.

Table #11: *Dr. Cusimano's Top Pick(s) and Rational for Decisions*

Dr. Cusimano's Intuitive Design surprised the investigator, as it was "Draft #1" of the three designs. However, the rationale behind his decision was logical after closer inspection of the Intuitive Design's flow of information. The hockey player graphic pulls the reader to start from the bottom of the portrait-oriented information graphics, the arrows then leads them to important clusters of information near the top then eventually highest point to the design's main statistic (52.5%), which seeks to generate an immediate impact. When evaluating the designs prior to Dr. Cusimano's interview, the investigator lost sight of the Theoretical Design's weakness due to ease of creation. The theoretical checklists provided a premature feeling of "security", as the thoughts of incorporating theoretical design elements into the design were though to instantly make the graphic "visually work." Thus, the investigator was unable to fully analyze the reader-friendliness of its graphical layout from a practical perspective.

Dr. Cusimano's choice of the Intuitive Design also emphasized the importance of simplicity when delivering information to a lay audience. He mentioned a significant attribute of information graphics that the investigator did

not personally consider prior to their interview time. Information graphics, especially the Content-Theoretical Design, contain a wealth of information – their complexity may take the designer longer to design and subsequently take the reader longer to digest. Visual literacy does speed the "digestion" process as it displays important concepts and content through a visual narrative. However, information design alone does not take away from the complexity of the raw data and readers still need to spend time with the graphic to appropriately comprehend its intended message.

Following the interview, the investigator asked, "Which design best represents your research to a lay audience, specifically hockey parents?" Dr. Cusimano gave rationale to his top two choices being the Intuitive (Design #1) and Content-Theoretical (Design #3) were both reader-friendly from a lay audience perspective and emphasized that his research was clearly communicated in an easy-to-understand manner. Hypothetically, hockey parents who come across these information graphics, if/when released by Dr. Cusimano, will naturally be interested in research relating to potential risk in their own child(ren)'s health. Therefore, working to gain parents' understanding of the research and creating an impact as opposed to attracting their attention should be the primarily focus. According to Dr. Cusimano, both the Intuitive and Content-Theoretical Designs (Designs #1 & #3) were able to achieve this goal.

An Area That Can Be Improved Upon: Communication

Ironically, there was little communication between the investigator and (design) client during the experimental process with the exception of the initial meeting and blind-testing interview. The investigator was simply given Dr. Cusimano's research paper, left to find the important information through a grounded theory analysis. During their interview, Dr. Cusimano had mentioned areas where information was lacking and/or alternative research could be incorporated. If Dr. Cusimano had provided the investigator with the specific information he felt should be incorporated prior to the designs, she would be able to focus her immediate attention to creating its visual representation as opposed to "trying" to find this dataset. Thus, clearer lines of communications between the two parties provide the designer a strong direction to follow to efficiently creating a design that best suits the purposes of the information graphic.

Conclusion

Post Evaluation of Experimental Design

Though the experimental design successfully incorporated theoretical best practices into its design processes, its foundational work can be expanded upon. The investigator suggests three different directions of interest this project can be tested to further its analysis and findings. The first is to experiment with data-driven parameters, creating another three information graphics through:

1. quantitative and qualitative datasets (combination);
2. quantitative (only) datasets;
3. and qualitative (only) datasets.

This will further investigate the type of information that best utilizes the information graphics medium. The investigator's second suggestion is to analyze the design considerations needed when disseminating information graphics to different cultures. This research will explore the layout configurations needed to suit diverse cultures whilst attempting to convey the same message. Finally, her third suggestion is to assemble a focus group, composed of the target audience (hockey parents) and present them with the three information graphic designs. This will allow the investigator to gain first-hand knowledge of their immediate (and transparent) impact of the information graphics. A focus group facilitates idea generation where questions regarding the designs' strengths, weaknesses and possible areas of improvements can be asked through synchronous communication and face-to-face conversations.

Concluding Thoughts

In this paper, an investigation of the design of information graphics was conducted in order to deliver medical research to a non-expert audience, namely parents of children who play hockey. The use of information graphics may be considered a relatively new field and draws underlying principles from visual language theory and Gestalt psychology; however, it draws its underlying principles from a number of disciplines, emphasizing the versatile use of the medium. Using a linear, practice-based methodology, the investigator successfully completed and tested three information graphic compositions, whereby intuitive decision-making and theoretical principles came into play. Design based on intuition encapsulated

the initial design phase and created a preliminary "mock-up" of the design where elements were then transferred to the theoretical compositions. With additional information gleaned from the medical article, a more robust and complete design evolved to form the final information graphic most appropriate for the selected target audience. It was observed that skills required by a successful designer included adaptable conceptualization of ideas; use of a variety of visual elements; flexible problem-solving approaches.

Overall, the purpose of an information graphic is to organize a considerable amount of information in a visually appetizing manner; thus, its execution needs to be carried out in an equally strategic approach. This experimental design highlighted the importance of intuition in spearheading the creation of a design and the use of theoretical concepts to amplify clear message delivery and impact. The intuitive and theoretically design processes are interwoven, their borders often overlap and one only strengthens the other. Through this MRP, the use of visual language theory, such as Dondis and Gestalt psychology, was explored and evidence gleaned from the research demonstrated that by utilizing best practice theory designers could improve or stimulate intuitive creativity. The balance between intuition and application of theory is often left to the designer, but as the investigator learnt throughout this experimental design, incorporating both approaches can result in more comprehensive visual solutions and strategically speak to specific target audiences.

Works Cited

"The Gestalt Principles." *SFCC Graphic Design*. Web. 21 July 2011. <http://graphicdesign.spokanefalls.edu/tutorials/process/gestaltprinciples/gestaltprinc.htm>.

Bennett, Audrey. *Design Studies: Theory and Research in Graphic Design*. New York: Princeton Architectural, 2006. Print.

Cheng, Donghong. *Communicating Science in Social Contexts: New Models, New Practices*. [Dordrecht]: Springer, 2008. Print.

Crowe, Norman, and Paul Laseau. *Visual Notes for Architects and Designers*. New York: Wiley & Sons, 1984. Print.

Cusimano, Michael D., et al. "Effect of Bodychecking on Rate Injuries among Minor Hockey Players." *Open Medicine* 5.1 (2011): 57-63. Print.

Dorst, Kees. *Understanding Design: [175 Reflections on Being a Desinger]*. Amsterdam: BIS, 2006. Print.

Evans, Poppy, and Mark Thomas. *Exploring the Elements of Design*. Clifton Park, NY: Thomson/Delmar Learning, 2008. Print.

Fahnestock, Jeanne. "Accommodating Science: The Rhetorical Life of Scientific Facts." *Written Communication* 1986 3.3: 275-96.

Frascara, Jorge. *Designing Effective Communications: Creating Contexts for Clarity and Meaning*. New York: Allworth, 2006. Print.

Fraser, Iain, and Rod Henmi. *Envisioning Architecture: an Analysis of Drawing*. New York: Wiley, 1994. Print.

George-Palilonis, Jennifer. *A Practical Guide to Graphics Reporting: Information*

Graphics for Print, Web & Broadcast. Oxford: Elsevier/Focal, 2006. Print.

Gregory, Jane, and Steve Miller. *Science in Public: Communication, Culture, and Credibility*. Cambridge, MA: Perseus Pub., 2000. Print.

Hansen, Yvonne M. "Graphic Tools for Thinking, Planning, and Problem Solving." *Information Design*. Massachusetts: MIT, 2000. 193-220. Print.

Hembree, Ryan. *The Complete Graphic Designer: a Guide to Understanding Graphics and Visual Communication*. Gloucester, MA: Rockport, 2006. Print.

Horn, Robert E. "Information Design: The Emergence of a New Profession." *Information Design*. Massachusetts: MIT, 2000. 15-34. Print.

King, D. Brett., and Michael Wertheimer. *Max Wertheimer and Gestalt Theory*. New Brunswick: Transaction, 2007. Print.

Lawson, Bryan. *How Designers Think: the Design Process Demystified*. Oxford: Elsevier/Architectural, 2006. Print.

Lester, Paul Martin. *Visual Communication: Images With Messages*. California: Thomson Learning, 2000. Print.

Newton, Julianne H. "Visual Ethics Theory." *Handbook of Visual Communication: Theory, Methods, and Media*. New Jersey: Lawrence Erlbaum, 2005. 429-44. Print.

Passini, Romedi. "Sign-Posting Information Design." *Information Design*. Massachusetts: MIT, 2000. 83-98. Print.

Pettersson, Rune. *Visual Information*. Englewood Cliffs, NJ: Educational Technology Publications, 1993. Print.

Ridder, Jeroen De. *Reconstructing Design, Explaining Artifacts*. Nederland: Delft

University, 2007. Print.

Smith, Jennifer, and AGI Creative Team. *Adobe Illustrator CS5.* Hoboken, NJ: Wiley, 2010. Print.

Smith, Kendra Schank. *Architects' Sketches: Dialogue and Design*. Amsterdam: Architectural/Elsevier, 2008. Print.

St. Michael's Hospital. Public Relations. *Brain Injuries Rise Sharply in Minor Hockey after Bodychecking Rules Relaxed: Study*. *What's New*. 15 Mar. 2011. Web. <http://www.stmichaelshospital.com/media/detail.php?source=media_releases/2011/20110315_mr>.

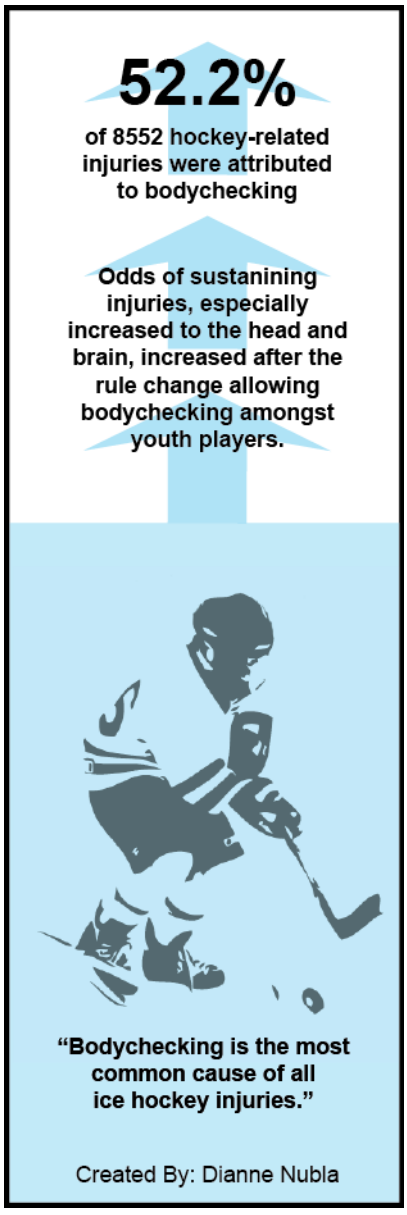
Tizon, Natalia. *Art of Sketching*. New York, NY: Sterling Pub., 2007. Print.

Ware, Colin. *Information Visualization: Perception for Design*. Amsterdam: Elsevier, 2009. Print.

Weinstein, Neil D., and Peter M. Sandman. "Some Criteria for Evaluating Risk Messages." *Risk Analysis* 13.1 (1993): 103-14. Print.

Appendix #1

Intuitive Design
(Design #1)

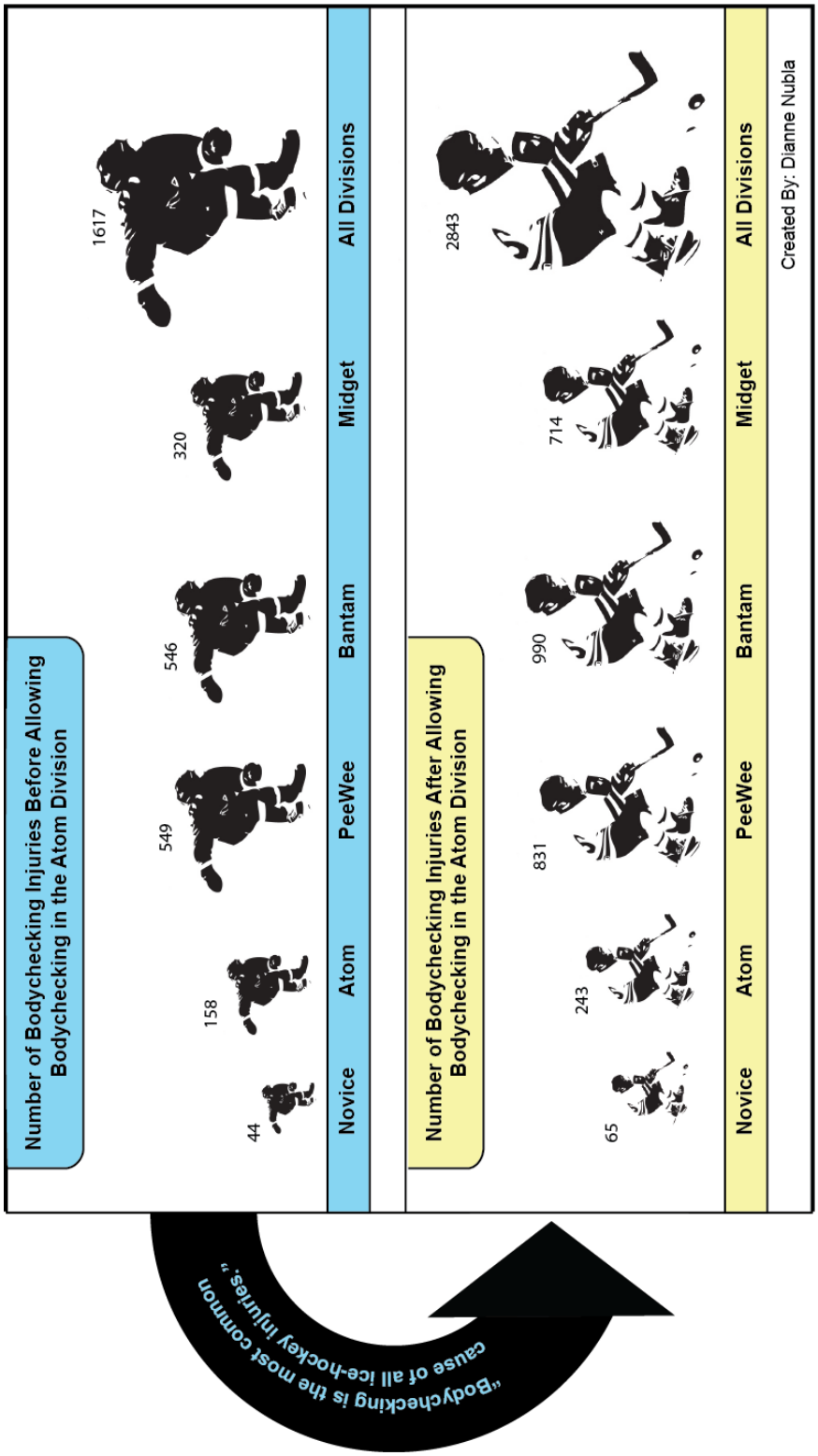


Appendix #2

Theoretical Design
(Design #2)

Appendix #3

Content-Theoretical Design
(Design #3)



Appendix #4

Operationalized Concepts for *Open Medicine* Article & St. Michael's Press Release

Concept	Type & Example	Code
Noun To streamline the coding process, only the first noun of each sentence will be analyzed.	Using the primary /secondary research findings as the noun. *Examples:* "The remaining 8552 hockey-related injuries represented…" "Manual coding of 10% random sample of hockey related injuries (n=855) revealed…" *(Open Medicine Article)*	Highlighted
	Plural pronouns to represent Dr. Cusimano and his team. ***Examples:*** "We excluded…" "We could not determine…" *(Open Medicine Article)* "The team examined…" (Press Release)	Highlighted
	Drawing upon additional, related academic work that have conducted similar studies. ***Examples:*** "In a previous study…" "The authors of another study found…" "Willer and colleagues found…" *(Open Medicine Article)*	Underlined
Evaluative/Judgmental Language	The use of pejorative language to persuade the reader of their stance. ***Examples:*** "From these studies, it is clear that learning to bodycheck at a younger age does not reduce a player's odds of injury…" "Such traumatic brain injuries should be priority concern for…" *(Open Medicine Article)*	Highlighted
Relatable Association	The use of known or relatable examples/prominent figures to connect the reader with the information presented. ***Example:*** "…Pittsburgh Penquins captain Sidney Crosby and Montreal Canadiens' Max Pacioretty suffered serious concussions…" (Press Release)	Highlighted