CREDIBILITY OF HEALTH INFOGRAPHICS: EFFECTS OF MESSAGE STRUCTURE AND MESSAGE EXAGGERATION

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ABSTRACT

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In an era of misinformation facilitated in large volumes through social media, infographics act as a bite-sized visual medium created for the express purpose of spreading complex information in an easy-to-digest format. The popularity of visual content on social media is increasing every day, and as a first step to curb the spread of visual misinformation online, it is vital to understand how people determine its credibility. This is because credibility often acts as a precursor to behaviors and most existing literature focusing on credibility either delves into text-based content or the design of platforms.

An acknowledged gap in credibility research is message credibility. Credibility research has, instead, often focused on the ever-popular source credibility, with volumes of it exploring both, offline and online source credibility. Where misinformation can reach people through many different ways, the internet has exacerbated its effects, in that the source of a message may not, in fact, be a viable option for people to use in order to determine credibility. A large volume of content on the internet is visual (as opposed to text-based), and this dissertation delves into how past credibility research can be applied to more visual messages.

Considering an infographic to be a single message, determinants of message credibility were mapped onto a visual platform (infographics). Through two studies – one focusing on the structure of the message and the other on exaggeration of its message – the credibility of three health infographics were determined.

The results indicated that the structure of the health infographic did indeed play a role in its message credibility determination. The importance of this structure is discussed through the lens of its importance in creating a narrative for the health infographic. Message exaggeration was also found to have an effect on message credibility, thus indicating the possible effect of having unbiased or opinionated visual messages. The moderating effect of prior assumptions about manipulated content were also found. Findings and implications are discussed.

This dissertation is dedicated to the memory of my grandmother. *Nani*, your passion for and faith in education reverberates through generations and will forever.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

Our contemporary times are often described as an era of misinformation. However, mis (or even dis) informed content being spread is not a recent phenomenon. O'Connor and Weatherall (2019) begin their 2019 book regarding the age of misinformation by discussing an ill-informed "fact" that was believed to be true from the 14th through the 17th centuries. Why then, are we today discussing misinformation as the most recent epidemic? According to evidence, social media is the answer.

The undeniable growth and popularity of social media is evident through the growth in its users over the past decade. Where 10% of the US population had a social media profile in 2008, that number has grown to 77% in 2018 (Edison Research & Salesforce.com, n.d.).

Social media affords creation and exchange of user-generated content (Kaplan & Haenlein, 2010). What used to be a platform for connecting with contacts for simply social reasons, is now one of the largest sources of news for most people. Over 63% of individuals now get their news from Facebook and Twitter (Shearer & Gottfried, 2017). This spread of information covers all topics including current affairs, politics, and health.

Of this information spread through social media, a large amount is in a visual format. Social media sites dedicated to posting and sharing only visual content, such as Instagram, Pinterest or Snapchat are especially popular with younger audiences (We are social, n.d.). These forms of visual media also play a role in spreading health information. People share images of healthy diets and habits, share their own personal experiences navigating through specific health conditions, such as diabetes, and organizations can share informational public service announcements (PSAs) or infographics of data or ideas to convey information in a way that is

easily understood to inform the public. These compact forms of visual media are especially easy to share and spread (sometimes virally) online with wide reach.

Infographics in particular, while especially popular in social media, have been around in different forms for decades. For example, data visualizations in the news have always compiled large volumes of content into easy to interpret graphs or charts for their readers/viewers (Krum, 2013). Therefore, they spread concise information through visuals which have been known to impact attention, comprehension, recall, intention, and behavior change (Houts, Doak, Doak, & Loscalzo, 2006), both offline and online. Such information can be processed through dual processing theories of information (such as the Elaboration Likelihood Model (ELM) (Petty & Cacioppo, 1986a) or the Heuristic-Systematic Model (HSM) (Chen & Chaiken, 1999)), or a single route (as explained by the unimodel (Kruglanski et al., 2006)). In the case of online infographics, individuals possibly even utilize cues and heuristics provided by affordances of platforms (as suggested by the MAIN model (Sundar, 2008)). These theories describe how in the presence of large volumes of information which an individual does not engage with deeply due to lacking interest or knowledge, users make quick and snap judgments based on superficial cues accessible to them. In a similar vein, people also use heuristics provided through cues in technology to make snap judgments about the credibility of the information they face (Sundar, 2008). While some health information could be difficult to follow, health infographics make it easier to consume by condensing and compiling the information (Siricharoen & Siricharoen, 2018). But when such information is incidentally accessed, through social media for instance, credibility judgments become especially important. This is because credibility acts as a "pre-understanding" of information (Pettersson & Aktiebolag, 1998) (akin to a sort of 'automatic activation'). However, social media does not provide the traditional cues that other online

platforms may offer, for instance information regarding the source might get lost due to the sharing and re-sharing of content. In such situations, users need to focus on the message itself in order to determine its credibility.

Returning to the discussion of health infographics, while it is important to explore their credibility, this is also the area that has been least looked into. Past research has largely focused on infographic research around what attracts users to infographics or what about them leads users to process information more easily (Dunlap & Lowenthal, 2016; Wansink & Robbins, 2016). Considering an infographic to be a single message composed of both text and visuals but presented in a visual format (e.g. an image file as opposed to text), this dissertation attempts to understand message viewers' credibility perceptions by adapting past message credibility framework that have considered only textual messages and apply them to a more visual format, like infographics.

Metzger, Flanagin, Eyal, Lemus, & Mccann (2003) examined credibility in the context of online environments and discussed *source*, *medium*, and *message* credibility. Source credibility usually refers to the information source, such as an author or a speaker (Hu & Sundar, 2010; Luo, Luo, Schatzberg, & Sia, 2013; Spence, Lachlan, Westerman, Spates, & Spence, 2013). Media credibility refers to the medium through which the information is spread and is dependent primarily on technological features of the media. Lastly, message credibility, focuses on how elements of the message itself effect people (Metzger et al., 2003).

Message credibility, however, happens to be the most neglected form of credibility in research. The complex nature of determining the effects of message credibility has often led its companion, source credibility, to be the focus of plenty of credibility research (Metzger et al., 2003). However, due to the complex layers of online information that can lead to the loss of

original sources with sharing and re-sharing of content, focusing on the message itself has become more important than ever. Therefore, this dissertation treats infographics as a single message (since they are a single piece of media communicating one idea or message), in order to focus on their credibility.

In their discussion, Metzger et al. (2003) identified four determinants of message credibility – *message structure*, *message content*, *language intensity*, and *message delivery*. *Message content* cannot be standardized in such a way as to test its effects because different messages would contain vastly different types of content. *Message delivery*, meanwhile, is covered from the perspective of a spoken message, for instance, the speed of delivery, politeness, and qualifiers would all reduce credibility, whereas a confident and powerfully spoken message would increase credibility. This indirectly is dependent upon the source of the message. Therefore, these two determinants, it can be argued, are not dependent upon the stylistic elements that compose a visual message online. Meanwhile *message structure*, and *language intensity* play a role in creation of the message itself. Message structure refers to how the message is organized, i.e. well-organized messages are more credible than unorganized ones. In the context of a visual message, viewing the content should convey the coherent narrative the message is trying to depict. Language intensity refers to the intensity or opinionated language's effect on credibility. Therefore, less opinionated language was perceived as more credible. Modifying unbiased spoken language to an unbiased representation of the facts, this dissertation alters language intensity, into a more appropriate *visual intensity* meant specifically for visual content (further explained as *message exaggeration*, elaborated below).

Two studies were conducted as a part of this dissertation – one to study message structure (Study A) and the other focusing on message exaggeration (Study B). Message structure was

operationalized through the presence of navigation aids, such as arrows, numbering, etc., whereas message exaggeration was manipulated primarily through the graphical data visualizations within the infographic (message exaggeration). Health infographics of three topics were created and manipulated according to these credibility determinants that are persuasive in nature and suggest health behaviors to their viewers – HPV vaccination, bone marrow donation, and colon cancer screening.

The findings of this work have implications for social media users online, as well as organizations that create health infographics for online platforms with the express reason of educating their audiences. Additionally, the findings can also be applied to a context of mis-and-disinformation outside the confines of social media where infographics still play an important role, such as in visualizations in news publications. From a theoretical stand-point, it also adapts and applies a text-based credibility assessment to a visual medium, thereby providing for future research in the ever-growing landscape of visual communication and media. Finally, the findings of this study can also be applied to health conditions of different topics and eventually be expanded to include different kinds of visual media, beyond infographics alone.

CHAPTER 2: LITERATURE REVIEW

Visual Communication and Social Media

2.1 Misinformation

Discussions about misinformation, are by no means new. Historically, stories about long lasting misinformation in centuries past serve as anecdotes to elaborate on these occurrences (O'Connor & Weatherall, 2019). Commonly regarded as information that is incorrect, misinformation tends to lead people to being misinformed by believing incorrect information (Scheufele & Krause, 2019). Another commonly discussed form of incorrect information spread is disinformation. Disinformation is sometimes regarded as an intentional spread of false information (as opposed to accidental), however, the distinguishing lines between these terms are often unclear (Scheufele & Krause, 2019). For instance, the intentional spread of misinformation by the tobacco industry in order to hide detrimental health effects of smoking (Smith et al., 2011). Both routes ultimately, however, lead to the same final product of incorrect information being spread.

Large scale misinformation issues such as those regarding the public opinion about vaccines, evolution, and climate change are hot button topics with opposing opinions and beliefs (Scheufele & Krause, 2019). With opinion pieces and junk science passing as facts, especially in online contexts where news and opinions are often presented within the same space (Thorson, Vraga, & Ekdale, 2010) it is almost better to be uninformed rather than misinformed (Scheufele & Krause, 2019). This is because, misinformed people who may be active about their cause tend to unite their knowledge (and actions), therefore having very little incentive to abandon their existing beliefs to accept new ones (Scheufele & Krause, 2019). Such misinformation within

communication environments can influence people's beliefs and behaviors in various contexts, including politics, and health.

Furthermore, beliefs in misinformation come from people's social networks, and in the 21st century these networks are especially susceptible, since they often exist online (O'Connor & Weatherall, 2019). Therefore, the discussion of information and misinformation on social media becomes important.

2.2 Information exchange in social media

Social media are internet-based applications that build on the ideological and technological foundations of the Web 2.0, and permit creation and exchange of user-generated content (Kaplan & Haenlein, 2010). The undeniable growth and popularity of social media is evident through the growth in its users over the past decade. With a nearly 70% increase in users with social media profiles in the US over the last 10 years, the role of social media has evolved as well (Edison Research & Salesforce.com, n.d.). Originating as platforms meant to connect people for social reasons, such as keeping in touch with one another, it is now one of the largest sources of news for most people (over 63% of individuals now get their news from Facebook and Twitter, (Shearer & Gottfried, 2017)). Additionally, due to ubiquity more people access online content by following links on social media than through searches (Social Marketing Strategy 2014-2017: One year on, 2017), thereby coming across information online incidentally vs. intentionally.

Downs (1957) identified two ways of gaining information – accidentally and sought for – as early as in the mid-20th century. This information of course, applies to offline information, but online, incidental information is acquired through social media that a user does not actively seek

out, but is instead exposed to due to the now altered information exchange patterns (Boczkowski, Mitchelstein, & Matassi, 2018; Tian & Robinson, 2009; Weeks, Lane, Kim, Lee, & Kwak, 2017). In fact, incidental exposure to news has been known to affect information gain and lead to more recognition and recall of news and has causal effects on learning about public affairs (Lee & Kim, 2017). Furthermore, in addition to the news, and public affairs and politics, incidental media use is also an important source, specifically, of acquired health knowledge (Tian & Robinson, 2009).

While incidental content online exposes people to information they may not actively seek, this exposure (alongside intentionally sought information) can now be easily shared online due to the affordances provided by social media and the kind of content shared on its platforms (Lazard & Atkinson, 2015). In addition to text-based content, a large volume of content shared online is visual (for example, photo sharing, memes, infographics, video, etc.) that not only contains densely packed information in it but is also easy to share. This creates a new issue absent prior to the ubiquity of social media. People now have to determine what information they come across is credible enough for them to believe and maybe act on. This poses a concern when the information shared on social media is abundant and can be shared very easily through a single click. If people perceive misinformation to be credible, this can lead to negative ramifications and outcomes, especially in the case of topics like health content.

2.3 Visual communication and social media

Visual communication defined as "intentional communication that relies on the visual presentation of images and textual information" (Avgerinou & Pettersson, 2011; Debes, 1968), has been historically recognized for its role in persuasive political campaigns (Griffin, 2008;

Messaris, 1994). In fact, changes in very specific design elements, such as a change in font can increase emotional and persuasive responses in the visual content (Juni & Gross, 2008).

Prior to its popularity in social media, visual content has been used in fields such as advertising for a long time (Messaris, 1997). Images are used to persuade people and convince them to buy the organization's products or services. In order to understand the persuasive role of visual communication, Messaris (1997) describes the semantic properties of visuals (i.e. how the elements present within visuals such as the images, words, etc., are related to it).

Semantic properties have been classified by into different schemas in the past. Most popular among these was the triadic classification put forth by Charles Sanders Peirce that entailed three categories – *iconic* signs, *indexical* signs, and *symbolic* signs. Messaris (1997) applied these properties to images such that iconic signs resemble what they reference (i.e. a drawing or a picture), indexical signs are where a signifier is caused by the signified (e.g., a bullet hole signifies a gunshot), and symbolic signs are ones where there is no particular relation between the sign and what it signifies except for convention and culture (for e.g. words). We see iconic signs in graphical representations or data visualizations utilized in visual messages like infographics. In fact, in an essay, Messaris (1998) notes how besides pictorial representation and abstract designs, visual media can also convey graphical displays of quantitative information, which is relevant to content communicated through infographics. While older research argues the artificial nature of pictorial representations (like icons), Messaris (1994) does not support this view. In fact, Messaris (1997) mentioned how research on cognition and perception has found that even a rudimentary match between an image and reality was sufficient for the brain to be able to employ real-world processes of visual interpretation. This observation is especially important for visual communication presented by infographics where the content is presented as

a combination of text and pictorial content, but the pictorial content often tends to be icons or pictorial representation.

In the context of health content online, sometimes health or medical professionals (Scott, Fawkner, Oliver, & Murray, 2016) communicate complex information through infographics. While the visual landscape of social media covers a vast range of message types, infographics are created for the express purpose of communicating information (Wilkinson, Strickling, Payne, Jensen, & West, 2016) and are also vastly popular online. Therefore, this type of media message is the focus of this dissertation.

2.4 (Health) infographics

2.4.1 Infographics – history and effectiveness

Infographics – informational graphics – have been defined as graphic representations of information (Lankow, Ritchie, & Crooks, 2012; Lazard & Atkinson, 2015). Their success can be observed through their undeniable popularity. From 2010, Google saw a rapid increase in the search term 'infographics' as compared to the years preceding it (Krum, 2013). Furthermore, according to Google Trends (that ranks trends from 0 to 100 based on how often a keyword is searched), 'infographic' score jumped from 54 in 2012 to 94 in 2014 and peaking at 100 (which demonstrates peak volume search) in every year since ("Google trends - Infographics," n.d.). This popularity, no doubt, has been affected in part by the internet itself, where in the past infographics might have been used primarily in print publications, they are now commonplace online (Krum, 2013).

Described as a combination of data, information, and design, infographics have been known to facilitate learning visually (Minervini, 2005; Occa & Suggs, 2016). Messaris (1994)

noted that visuals lack syntax in the way that words do not – syntax that assist words to fundamentally make sense. However, infographics present a type of visual aid that provides a type of "visual language" using shapes, images and words into a single medium of still communication (Couper, Conrad, & Tourangeau, 2007; Horn, 1998; Occa & Suggs, 2016). The harmonious and congruent integration of words and images become more powerful in catching people's attention than either would do independently by reinforcing one another (Occa & Suggs, 2016).

The term infographic, originally used for the production of graphics in newspapers and magazines, now refers to much more than simply a 'visual representation of data', instead being used as a term to describe a combination of data visualizations, illustrations, text, and images in a format that tells a complete story (Krum, 2013). These prevalent forms of transmission of information (Fogel, 2013; Segel & Heer, 2010) communicate both visually appealing illustrations and complex interactive data (Lester, 2011). When discussing this sort of graphical information representation, Messaris (1997)'s work about visual communication becomes relevant. He mentioned how research on cognition and perception had found that even a rudimentary match between an image and reality was sufficient for the brain to be able to employ real-world processes of visual interpretation. This observation is especially important for infographics where the content is presented as a combination of text and pictorial content, but the pictorial content often tends to be icons or pictorial representation.

While the power of infographics seems to be increasing in popularity, this method of presenting content in a visual way is not new. Infographics offer a way to visualize data and data visualizations have been around for many centuries (Dunlap & Lowenthal, 2016). These data visualizations are visual representations of numerical values and data, and thus, are a space

efficient way to communicate a large amount of data where volumes of data can be consumed without scrolling or turning pages (Krum, 2013). Hence, data visualizations "support attention, minimize cognitive load, create aesthetically appealing artifacts, activate or build schema by using objects and information known to learners, and motivate" (Clark & Lyons, 2010; Dunlap & Lowenthal, 2016, p. 45).

While data visualizations are one of the primary elements in infographics, infographics themselves tell complete stories (much more akin to speeches than charts), to entertain, inform, or persuade their audiences (Krum, 2013). Parts of an infographic may include a title, or an introduction explaining its purpose and conclude with a call to action explaining what to do with the information they received (Krum, 2013). This through line of the infographic creates a sort of "narrative visualization" where the visual elements do not simply play a supporting role to the text, but rather play a vital role in communicating their message (Lazard & Atkinson, 2015; Segel & Heer, 2010).

A primary premise of visualization is "that a conceptual model is created to convey thinking, or "tell a story" to someone else". This visual story should "sequentially reveal information across the viewing plane in an orderly and scripted fashion" (Baskinger & Nam, 2006 p. 1). In fact, Baskinger & Nam (2006) state that a non-verbal story can be told if a narrative substructure is built into the organization, hierarchy, and composition of the visual media. Such narratives have a beginning (to invite the viewer in), a middle (to engage them), and end (to provide closure). This explanation of narrative visualizations is akin to the description of infographics discussed above, especially its structure and parts (title/introduction, conclusion/call-to-action (Krum, 2013)). It also seems to emphasize the importance of structure

of visual narrative in a way that places emphasis on the organization of the "story", indicating the possible importance of a message's structure in an infographic.

2.4.2 Health infographics

Though infographics span a large variety of areas and topics (Dunlap & Lowenthal, 2016), infographics about health are particularly popular (Chibana, 2016). Lazard & Atkinson (2015, p. 7) noted that the large impact of infographics implies that there is "considerable promise to be found in infographics for science and environmental communicators to convey their information quickly and effectively". One possible reason for this is that acquiring and processing scientific information, such as health information is generally dense and difficult and not an area that people explore for entertainment or leisure (Siricharoen & Siricharoen, 2018). This can be seen in traditional pictorial depictions of medication dosages or outlining medical risks, for instance (Arcia et al., 2016). This is because visualizations, for example graphs, diagrams, and infographics, have proven to be useful in health communication and engagement (Arcia et al., 2016). Thus, indicating that delivering or sharing health messages in these shareable forms possibly make the information both, easy to consume (due to simplification of content as described above), and dissipate (through social media affordances such as single-click sharing). For instance, in a study explaining the debunked MMR-autism linkage participants had a more accurate understanding of the situation when they viewed visuals and text as opposed to only textual information (similar to the visuals and text combination of infographics) (Dixon, Mckeever, Holton, Clarke, & Eosco, 2015). One infographic promoting physical activity designed by UK's Chief Medical Officers and launched in 2015 provides an example of a three-step process ('raising awareness, 'changing and challenging attitudes' and providing a 'call-to-

action') for behavior change. Where this infographic was originally aimed at medical professionals such as doctors and nurses, a much wider audience was reached through social media and the hashtag '#sitlessmovemore' (Scott et al., 2016). Additionally, research has also suggested that carefully designed health infographics could be tools used to support comprehension thereby helping patients to engage with their own health data, thus motivating health-promoting behaviors (Arcia et al., 2016).

Some early applications of health infographics included promotions to increase vaccination intake (Kaplan, Hammel, & Sehimmel, 1985), prevention of skin cancer (Stephenson & Witte, 1998), and breast cancer (Kline, 2007; Lipkus & Hollands, 1999; Occa & Suggs, 2016; Schapira, Nattinger, & Mcauliffe, 2006). Finally, infographics seem to have an attention-seeking effect (Couper et al., 2007), while also reducing comprehension issues that might occur along with lower health literacy and numeracy. For these reasons, health infographics could prove to be an effective approach in order to facilitate knowledge and action-oriented messages about health behaviors (Giardina & Medina, 2012).

2.5 Effects of visual communication

The effects of visual communication as observed through various research areas will be elaborated below. This overview covers the effects of visual communication as a whole, since a hyper focus on health infographics in research is limited. Therefore, this dissertation attempts to understand the possible effects health infographics could have by exploring the existing landscape of visual message communication in general.

2.5.1 Cognitive and affective effects (comprehension, emotion, and memory)

Even prior to the abundance of health-related information available with easy access through the internet and social media, the importance of visuals in health communication has been observed. For instance, in their review Houts, Doak, Doak, & Loscalzo (2006) noted the case of doctor-patient communication, where pamphlets with images along with text (as compared to handouts with just text), lead to higher recall among patients (especially those of lower literacy), women comprehended cervical cancer handouts with pictures better than those without, and participants understood meditation instructions better with images than without. Furthermore, they note that the close proximity of images to the text explaining or elaborating on them would likely facilitate comprehension of the content (especially among lower literacy folk) (Houts et al., 2006). This similar understanding of images (in comparison to text only) is also available online and in social media and especially becomes a concern when the information is accessed incidentally and if understood by the viewer to be credible and further processed.

Visual content is also known to have an effect on viewers' emotions. For instance, one study noted that the nature of the picture was the deciding factor in how people would respond to it. Positive emotional responses have been known to lead to an increase in the target behavior, whereas a negative emotional response based on images in health material would lead to a decrease in the behavior (Houts et al., 2006). In social media, posts containing images "express more emotion, more intense emotion, and are more positive in valence than posts containing only text" (Bourlai & Herring, 2014, p 171). It is possible that the reason for this richness that leads to an emotional impact occurs because images can depict facial expressions, other representations of emotion, and humor in a way that text cannot (Bourlai & Herring, 2014).

Historically, advertising literature has discussed the effects of visuals on memory – people who viewed print advertisements with pictures or photos, remembered the advertisement better than those who viewed the advertisement without a picture (Starch, 1966), and recall over time (Shepard, 1967). The reason for this is possibly because pictorial depictions stimulate more cognitive elaboration, thereby developing additional storage locations in memory which can increase the possibility of recall in the future (Kisielius & Sternthal, 1984).

2.5.2. Message quality

The evaluation of a message, according to Lin, Lu, and Wu (2012) "reflects a cognitive and affective, valanced response to the presentation of the message, not necessarily to the message arguments" (p. 11). They also state that characteristics of the message including "appropriateness of organization and style" (p. 11), could lead to positive evaluations of the message's quality (and even credibility) (Slater & Rouner, 1996). Alternatively, they focus on messages composed of text and images to communicate and clarify a message. In this arena, Sundar (1998) found that people evaluate the overall stylistic characteristics of electronic word-of-mouth (eWOM) articles, including both verbal and visual information, thereby leading to the conclusion that visual information in eWOM could make a difference in message quality. Finally, Lin et al. (2012) found that individuals exposed to information with pictures rated eWOM articles significantly higher in message quality than people who are exposed to information without pictures. All of this work depicts the role of visuals on message quality, however, the research about quality in online contexts has primarily focused on the aesthetics of online platforms or messages, not the combination of visuals and text that make a message as a whole (such as infographics).

2.5.3 Attitudes

The combination of visuals and text are also known to have an effect on the attitudes of the viewers they are exposed to. This area of research has produced conflicting outcomes, with some work finding that advertisements with visuals generate a more positive attitude toward the brand (for e.g., Mitchell & Olson, 1981), whereas others have found more negative attitudes with visual and textual combinations (Kisielius & Sternthal, 1984). However, despite this it is valuable to note that visuals in the presence of text do seem to have an effect on people's attitudes one way or another (Lin et al., 2012).

2.5.4 Behavior

Visuals have also shown to inspire people to specific actions (Lin & Huang, 2006). For instance, image and text combinations addressing climate change have an indirect effect on behavior intention to reduce personal energy use (Hart & Feldman, 2016). The presence of visuals also assist in purchase related behaviors (Lin et al., 2012) affect the frequency and size of tips (given to a barman) (Guéguen & Legoherel, 2000), and increased donations for the humane society (in the presence of pictures of puppies) (Perrine & Heather, 2000). Even in the context of health, Whatley, Mamdani and Upshur (2002) found that people provided with medicinal information through only text were less likely to adhere to take pain medicines as compared to those who received the information with and text and icons/graphs. Delp and Jones (1996) found that patients provided illustrations on how to manage lacerations were more likely to do what the recommended instructions said. This behavioral adherence is especially valuable in persuasion research like health where visuals could help bring about positive health behaviors, in part due to simplification or clarifying of complicated health information, as described above.

2.5.5 Credibility

The effect of visual design on credibility has been observed in volumes of research. For instance, David and Glore (2010) surveyed research of aesthetics and design and noted that visual aesthetics played a role in judgment of the online environment's credibility. Similar observations were made by Fogg et al. (2001) in websites. Robins and Holmes (2008) who found that aesthetics of a website had an effect on its content's credibility, and Oyibo, Adaji and Vassileva (2018) who, in a study about the effect of aesthetics on the perceived credibility of health apps, noted a need for designers of persuasive systems in the health domain to focus more on dimensions of aesthetics like orderliness, clarity and simplicity in order to enhance perceived credibility. In fact, Sbaffi & Rowley (2017) reviewed research where web factors affect credibility and find that website features like a clear design or pictures increase credibility perceptions, but a complex or boring design, or a lack of navigational aids, for instance brought about negative credibility perceptions. For a full list of design features that play a role in credibility judgment, review Sbaffi & Rowley (2017).

2.6 Credibility and the gap in visual communication research

While the effects of visual design have been covered in great depth, visual message credibility has been largely neglected (Lin et al., 2012). However, an interest in visual messages, like infographics, exists due to the fact that they are easily understood by both, visual and textual learners and that they can be presented in digestible "bite-sizes" that are easy to share, often with just the click of one button (Lazard & Atkinson, 2015). Visuals play an intrinsic and powerful role in science communication (Trumbo, 1999) and have been known to help with individuals of low health literacy (Arcia et al., 2016; Houts et al., 2006). This is especially important in the

context of health information, where past research has found that social media that connect social networks have an important influence on health behaviors and outcomes (George, Rovniak, & Kraschnewski, 2013) and visuals (such as images) that are linked closely to text increase attention to and recall of health information (Houts et al., 2006). Additionally, people tend to share more visual information on visual platforms (such as Pinterest vs. Twitter) (Ottoni et al., 2014). Furthermore, visualizations (for instance, a graph or layout) can 'automatically activate' users' understanding of content (described as "pre-understanding of the message's content") (Pettersson & Aktiebolag, 1998, p. 66). Parsing this out points to an important observation – that before a message is actually understood, it makes an impression on the viewer, and this happens due to the credibility imparted through visuals (Pettersson & Aktiebolag, 1998). The bulk of prior literature about credibility, tackles the subject as a precursor for the evaluation of online information (Flanagin & Metzger, 2007; Metzger, 2007; Metzger & Flanagin, 2013; Metzger, Flanagin, & Medders, 2010; Rains & Karmikel, 2009; Robins, Holmes, & Stansbury, 2010). This means that if an individual has the ability to determine credibility of the content, they would be more likely to comprehend it, thereby making the effect of credibility a first step for whether an individual would comprehend a message they view.

Despite this, only a few studies pay attention to the effects of visual information. For instance, Lin et al. (2012) find that people who were exposed to information with pictures, rate eWOM articles significantly higher in credibility than those who did not, and Viviani and Pasi (2017) note the presence of images or visuals in social media present an elevated level of credibility. This gap in web credibility research concerns looking at visual elements of media messages such as infographics that contain a complete message within them. Infographics are self-sufficient, media messages, that today are shared and spread online with great frequency and

have a far-reaching expanse. Their impact and accuracy, however, is variable depending upon how they are developed and shared (Scott et al., 2016). Nevertheless, research has only looked at their ability to compel, their attractiveness, and likeability in general (Arcia et al., 2016; Dunlap & Lowenthal, 2016; Siricharoen & Siricharoen, 2018; Wansink & Robbins, 2016), and only one study seems to consider their credibility (Li, Brossard, Scheufele, Wilson, & Rose, 2018).

The lack of research focusing on the tools or conduits that communicate visuals has been noted, and some researchers have suggested a need for a more systematic investigation of visual messages by examining the content and stylistic elements of this sort of communication that can deliver replicable and design-specific recommendations (Jensen, 2011; Yzer, 2011). Language has syntax to help communicate its meaning; visuals however, in the traditional sense do not (Messaris, 1994). Despite this, (health-related) visuals in social media, communicate their message (or narrative) to their viewer successfully (Baskinger & Nam, 2006; Occa & Suggs, 2016). Contextual inference might be one answer, such that having prior knowledge about a visual like a meme, might help make sense of its narrative, at least partially, in a different context (because internet memes are fundamentally media that are mutated and altered by people in order to communicate an idea (Wiggins & Bowers, 2015)). However, visuals primarily containing information to be imparted to a viewer, such as infographics, cannot rely on context. People might be familiar with the topic they are communicating about (for example, vaccines), but what about this topic is being said cannot be inferred simply by having seen infographics in the past. Therefore, since visuals in social media do not have syntax, what is it about them that communicate their meaning? Are there existing norms and cues or heuristics regarding the perceptions, such as credibility, of these visuals? And if so, what are they? To help get insights into these matters, it is important to identify and understand the elements of visual

communication that help convey its meaning, especially due to the ubiquity of visual messages on social media.

However, even broadening the scope from infographics, to visual messages in general, the existing research still, does not explore their credibility or even what elements within the visual message could affect credibility perceptions among users of social media. In fact, the existing work about visual messages only provides insights into the current media ecology of online visual communication (for instance, Guidry, Carlyle, Messner, and Jin (2015), Highfield and Leaver (2016), Milner (2013), Murthy, Gross, and Mcgarry (2016), Thompson (2012), Wiggins and Bowers (2015), and Wilkinson, Strickling, Payne, Jensen, & West (2016)) , focuses on the differing framing (for instance, gain or loss framing) of content within the visual communication (Clare & Huddleston, 2014; Guidry & Messner, 2017), or investigates the role of different platforms in sharing visual content (Lee et al., 2017). These studies seem to neglect the overall message and the elements that make it up.

Jensen (2011) noted that in the absence of a comprehensive typology of visual features (such as, graphical elements) based on conceptual distinctions, hypotheses cannot be tested about the effects that specific categories of visuals have on specific outcomes in specific populations. Nonetheless, no research seems to focus on looking at a health infographic as a media message and study the effects such a message might have on users who might come across it incidentally in social media. Therefore, this dissertation aims to test hypotheses on how specific elements of a health infographic can play a role in how people determine the credibility of health infographics online.

CHAPTER 3: THEORETICAL BACKGROUND – CREDIBILITY

3.1 History of credibility research

Credibility, as a construct is a popular research area in persuasion studies, which has been studied as early as the 1940s (Slater & Rouner, 1996). However, historically an interest in credibility research can be traced back to as far back as Aristotle and his work on rhetoric and the notions of ethos (appeal based on the character of a speaker), pathos (appeal based on emotion), and logos (appeal based on logic or reason) (Metzger & Flanagin, 2013). More recent works explain and elaborate credibility using support of primarily two other constructs – believability and trust. While both these constructs are independent and different, one can see why they are utilized to explain the concept of credibility.

For instance, many contemporary definitions of credibility, explain it as the believability of the source, i.e., the perceptions of trustworthiness and expertise of the source of the information (Hovland, Janis, & Kelley, 1953; Metzger & Flanagin, 2013). Most research that has been based on this definition tends to focus primarily on source credibility "typically conceptualized as the believability of a speaker and closely aligned with Aristotle's notion of ethos" (p. 211). This line of inquiry has been largely observed in the fields of psychology and communication, whereas other fields such as that of information science, sometimes focus on the credibility of the message itself (Metzger & Flanagin, 2013).

While believability has been described as "similar to" the concept of credibility (Slater & Rouner, 1996) as described above, researchers have stated that trust, on the other hand, should not be used interchangeably with or be used as a synonym of credibility (Tseng & Fogg, 1999). According to them trust is "a positive belief about the perceived reliability of, dependability of, and confidence in a person, object or process" (p. 41). In a more digital context, Rowley and

Johnson (2013) define trust as that precursor "to successful and effective adoption, interaction and ongoing commitment in the digital space" (p. 494). However, the relationship between "trust" and "credibility" is still unclear; both terms have been studied as both, dependent and independent variables (see Sbaffi & Rowley, 2017 for full list).

Therefore, while these definitions offer conflicting but valuable insights into the definition and role, Metzger and colleagues (2003) created a holistic overview to understand credibility in the context of the media environment. The appropriateness of this work and applicability to the social media landscape makes it a perfect lens to view social media credibility through. It is for this reason, that the conceptualization of credibility and adaptation of dimensions for this dissertation is based on Metzger et al. (2003)'s work.

3.2 Types of credibility

3.2.1 Source credibility

Source credibility refers to the perception of a message's source to have the ability or motivation to provide accurate and truthful information (Hovland et al., 1953; Tormala & Petty, 2004). Being the primary form of credibility determination (Hovland et al., 1953), source credibility has been the focus of volumes of research, with many studies focusing on the information source, such as an author or a speaker (Hu & Sundar, 2010; Luo, Luo, Schatzberg, & Sia, 2013; Spence, Lachlan, Westerman, Spates, & Spence, 2013). The general consensus among these findings is that information with higher source credibility leads to more persuasion than that with lower source credibility (Tormala & Petty, 2004).

Through primarily the constructs of expertise and trustworthiness, source credibility has been explored in face-to-face communication (Metzger et al., 2003), newspapers or magazines

(Sundar, 1998), organizations (Nan, 2009) and increasingly, online platforms (Algarni, Xu, & Chan, 2016; Hu & Sundar, 2010; Siow et al., 2003). Source credibility has been attributed to multiple dimensions, the most prominent being expertise and trustworthiness (Hovland et al., 1953; Metzger & Flanagin, 2013; Ohanian, 1990; Tormala & Petty, 2004), where the expertise and trustworthiness of the source of information has an effect on its credibility. This makes logical sense to think about since if an individual is presented with information, the first line of defense would be based on who is providing the information to them and what is their expertise on the matter, especially within traditional media forms. For instance, a well-known magazine, a well-reputed news channel, an unbiased newspaper, an author covering a story in a news beat they have experience with can all attribute to source credibility.

On online platforms, especially social media, identifying and depending upon the source for credibility determination becomes a little harder because of the nature of and affordances provided by social media. Social media content can be shared and re-shared by individuals with ease (oftentimes through the click of just a single button). This sharing sometimes leaves pieces of the content (such as the original poster) behind. People do not know who created a post or how it was modified prior to them viewing it. In the era of misinformation and content manipulation, content online can be edited and shared leaving the original poster's intent rendered useless. In others, the source may not be visible during quick scrolling or viewing on smaller screens (such as a smartphone). In such situations, credibility determination might fall on to different elements of the information presented.

3.2.2 Media credibility

Another basis of credibility determination can come from the media platform on which the message is presented (Metzger et al., 2003). Media credibility is that property of the medium that does not depend on the relation between the source and receiver of the information (Wierzbicki, 2018). Dimensions measured in order to determine media credibility have included believability, accuracy, fairness, bias, trustworthiness, ease of use, completeness, reliability, or attractiveness of the media, reporters, or the coverage of specific news issues (Metzger et al., 2003).

Media credibility, studied fist by Carter and Greenberg (1965), began when people started turning to the newer radio platform for news and then transitioned to the television, which led to questions regarding credibility of these platforms (Erskine, 1970; Metzger et al., 2003; Self, 1996). Carter and Greenberg (1965) were among the first to study media credibility as a unique concept. Where originally newspapers were considered to be the most credible platform, that slowly evolved to television by the 60s (Jacobson, 1969; Roper Organization, 1991; Self, 1996). Media credibility depended primarily on technological and structural features of the media. The technological features of the television allowed viewers to engage and see what was happening (Carter & Greenberg, 1965; Gaziano & McGrath, 1986; Westley & Severin, 1964). One reason identified for this was that the visual nature of television made news seem more personal and therefore more accurate, sincere, responsible, impartial, and of higher quality (Chang & Lemert, 1968; Sargent, 1965).

The features of newspaper and television media industries played a possible role in the difference in their credibility (Metzger et al., 2003). One possible reason for this was that until the year 2000, broadcasters could not state their editorial positions on issues and candidates due

to an editorializing rule, whereas newspapers were free to state their opinions (Metzger et al., 2003) and being presented with information opposing their own belief could lead people to deem a certain media as less credible (Stamm & Dube, 1994; Zanna & Del Vecchio, 1973). Additionally, the short bursts of time that can be devoted to a story due to limited time on the air, led to television being viewed as more credible than newspapers that covered a larger volume and depth of new coverage (Wilson & Howard, 1978).

In online contexts, media credibility research helped to understand the internet as a conduit of information as compared to more traditional channels such as newspapers or television. Some studies found that information found online was perceived as more credible, attributing this finding to the visual element of the internet that lent a "seeing is believing" effect to the content (Flanagin & Metzger, 2003). Overall, research found that the technological features such as publishing of professional content, the vast amount of information, the convergence of different genres, and the flexibility of digital information tended to impact credibility ratings (Flanagin & Metzger, 2003).

3.2.3 Message credibility

The final type of credibility is message credibility and also the most neglected in research (Appelman & Sundar, 2016). Message credibility examines how a specific message impacts the receivers' believability "either of the source or of the source's message" (Metzger et al., 2003, pg 302). While source and message credibility are overlapping concepts, source credibility has been studied extensively and in different contexts (Hu & Sundar, 2010; Lee & Sundar, 2013; Metzger et al., 2003; Spence et al., 2013; Tormala & Petty, 2004). However, message credibility factors could be even more important than source (Austin & Dong, 1994; Eastin, 2001; Slater & Rouner,

2002). For instance, Austin and Dong (1994) found that the content of a news message can be more important in news credibility judgment. Additionally, this could also especially occur in cases where there is little information available about the source of the message (such as in social media, elaborated in detail below) (Eagly & Chaiken, 1993; Eastin, 2001; Petty & Cacioppo, 1986b). Researchers have examined the effects of a message on "comprehensibility, number of arguments, incentives, fear appeals, one-sided versus two-sided messages, repetition, and presentation style on recipients' attitude change" (Metzger et al., 2003, pg. 302).

As mentioned above, despite the importance of message credibility (especially in the landscape of online messages), this form of credibility has been studied the least, and up until recently there was no singular scale available to measure message credibility. The reason for lack of research done in the arena is not obvious and evident – in fact, there have been some attempts to determine message credibility, however, researchers have tended to, in the long run, focus on manipulating message characteristics and then measuring message credibility perceptions of the source who delivered the message (Flanagin & Metzger, 2003). This confounding of source and message credibility seems to have hurt message credibility research such that it ended up taking the back seat to more popular ways to measure credibility, namely the source.

To fill this gap Appelman and Sundar (2016), constructed and validated a 3-item scale exclusively for message credibility. They noted that such a scale would be especially useful when measuring message credibility in the "current media environment, where we receive a plethora of messages, often without clear source signals or medium-specific cues" (p. 60), and state that the value of measuring message credibility in message effects, information processing, source confusion, and social media research.

In order to delve into message credibility Metzger et al. (2003)'s discussion of message credibility dimensions provides a good place to begin. They noted that *message content*, *message delivery*, *message structure*, and *language intensity* of the message might play a role in the message's credibility.

Message content refers to the actual content of the message (Metzger et al., 2003) and its credibility has historically depended on the similarity between the communicators' and the audiences' positions (McDougall & Fry, 1975). This can be seen in an explanation provided by Pettersson & Aktiebolag (1998) who say that for a message to be of high credibility, it must be understood and be believable as correct information. This dimension seems to be fairly ill-defined, since explanations for it depend upon people's reaction to it rather than to the dimension itself. In fact, even Metzger et al. (2003) explain message content by discussing message quality, therefore, it is possible that message content should be of "good quality", where quality can be explained in various different ways.

Message delivery is the way a message is presented by a source. Primarily discussed by Metzger et al. (2003) in the context of a message being verbally delivered, an example of the hesitations of a speaker that is not fluent in the language they are speaking in, can reflect a poor message delivery and thus, lower credibility. Furthermore, a lack of assertiveness in delivering a speech, including hedging and hesitations, qualifiers, polite forms, and tag questions can also lead to lower credibility perceptions (Gass & Seiter, 1999; McCroskey & Mehrley, 1969; Miller & Hewgill, 1964; Soreno & Hawkins, 1967). Finally, fast talkers (but not extremely fast talkers), as opposed to slower speakers are viewed with more credibility.

It is valuable to note the role of the source in both the dimensions of credibility discussed above. While message content is likely dependent upon "quality" of the message, the similarity

or understanding between the source and the recipient plays an important role in its judgment. Meanwhile, message delivery wholly depends upon the source and how they choose to (or can) communicate the message to their audience. Applying this dimension to online parameters seems in fact difficult because it is so rooted in speech delivery, such that most of what makes it a valuable dimension of message credibility is speech-based.

The other two dimensions of message credibility discuss specific characteristics of the message itself.

Message structure refers to the organization of a message, i.e. the way the information within the message is organized and presented to the message receiver (Metzger et al., 2003). Over half a century ago, Thompson (1960) suggested that the structure of a message could have an effect on its listeners comprehension, defining structure as the order of sentences in a speech manuscript, and finding that a manuscript of a structured speech would contain a series of sentences arranged consistently, whereas rearranging them in a disorganized order affected comprehension. This work was done on a verbal message, but the results were tested by Darnell (1963) with written communication and re-tested by Thompson (1967) and were found to be consistent. Thompson (1967) also explored the role of transitions (in the form of simple statements) between sentences and found that transition statements increased overall comprehension of the speech (sentences in a speech placed in a reasonable organization provided coherence, hence transitions enhanced the comprehension). This finding highlights the value in guiding the message recipient toward what is next. Even with respect to credibility specifically, past research has found that an unorganized message is perceived to be less credible than an organized one (Gass & Seiter, 1999; Melyn & White, 1973; Sharp & McClung, 1966). While message structure has been evaluated in the past, recent online research does not seem to have

focused on this traditional explanation of message structure, instead the minimal work that has been conducted on structure uses a framing lens (Price, Fielding, Gardener, Leviston, & Green, 2015; Terkildsen, Schnell, Frauke, & Ling, 1998). Additionally, what work has been done with web credibility, focuses on structure of the web page (or its amateurism) or the presence or absence of message or site navigation tools such as a site map or an index, which elevate the perceptions of the web content (Fogg et al., 2001; Metzger et al., 2003) Therefore, in order to understand what message structure looks like in the evolving landscape of social media, especially for non-traditional messages, like those in visual form, and in the context of topics like health where large scale misinformation is found online, exploring this construct through new lenses is needed.

Lastly, *language intensity* has been defined as the quality of language that indicates the degree to which a speaker's attitude toward something deviates from the neutral (Aune & Kikuchi, 1993; Bowers, 1963). Past research on language intensity has looked at the effects of high vs. low intensity in different contexts resulting in variable outcomes. For instance, textual messages in health-related preventative messages such as persuasion to use sunblock found that greater intensity led to a higher intention to carry out solar protection (Buller et al., 2000). Another study looking at perceptions about legalization of heroin used manipulated text messages with high vs. low intensity language ("Addicts almost always reuse and share filthy needles" vs. "Addicts from time to time reuse and share unsanitary needles") and found that intensity affected attitudes in three different ways in their study, one of which was through an interaction with message discrepancy (Hamilton, Hunter, & Burgoon, 1990). Overall, language intensity sometimes seems to increase credibility perceptions of the message and has a positive effect on the message recipient (Buller et al., 2000; Hamilton et al., 1990; Hamilton & Stewart,

1993; Rogan & Hammer, 1998), others found no effect (or opposite effects) of intense language (Bowers, 1963; Burgers & De Graaf, 2013; Burgoon & Chase, 1973; Hornikx, Pieper, & Schellens, 2008).

Liebrecht, Hustinx, & Mulken (2019) theorize that one possible reason as to why language intensity research results in such varied outcomes is the fundamental definition of language intensity. They observe that scholars operationalize this concept differently in experiments depending upon the evaluative nature and genre of the text in the message in question. Furthermore, they also note that the operationalization of language intensity "was not always concerned with only the stylistic strength of the utterance but sometimes affected the content of the utterances as well" (p. 174). For instance, using "death" vs. "injury", which amounted to content-related modification (as opposed to stylistic which can be exemplified by good vs. fantastic). Their own research focused on stylistic intensification (pretty vs. wonderful and ugly vs. horrible), finding that intensified language was perceived to be stronger than unmarked language. This observation of theirs regarding the discrepancy between the definition of language intensity and its operationalization is interesting to note and important to keep in mind for future work within this arena. Where Metzger et al. (2003) summarize that opinionated language in a message leads to less credible ratings as compared to messages with more intense language, they also note that this effect is often moderated by message discrepancy, such that messages supporting one's views are seen as more trustworthy.

The word opinionated itself implies that the message deliverer is emphasizing their own opinions or thoughts on the subject matter in hand and indicates an inherent bias in how the information is communicated. Use of opinionated language has been used to explain language intensity (i.e. "communicators who use more opinionated language in their messages are rated as

less credible than those who use less intense language" (Metzger et al., 2003, p. 303). As described above, plenty of research has attempted to manipulate and observe the effects of 'opinionated' messages on recipients. However, manipulations are primarily conducted in text-based messages and have tended to manipulate the content of intensity, instead of its style. Since social media presents vast amounts of messages on not only casual and conversational topics, but topics that could have implications on viewers' health, for instance, that are presented in ever growing and evolving visual formats, the scope of intensity should also evolve from simply language to visual intensity. Visual intensity can be operationalized differently according to the different visual platforms in consideration (similar to different operationalizations in text), but this dissertation tackles health infographics – a media designed to concisely communicate complex information simply. Therefore, the goal here is to provide the same information but presented in a manner that attaches an opinionated angle to the content.

Therefore, this dissertation applies intensity to a visual message and studies how its structure can have an effect on its credibility perceptions. This will provide insights into a popular type of message being shared in social media that can share incidental information with its viewers.

3.3 Information and (online) credibility processing

In the case of credibility determination, one thing that comes into play is how individuals process the information presented to them. Information processing (not just credibility processing or determination) has been explained through dual-processing theories of information. A dual-process persuasion model, the Elaboration Likelihood Model (ELM) (Petty & Cacioppo, 1986b) states that attitude change occurs due to either high or low cognition

through a central or peripheral route of information processing. People more involved in an argument would process the information more deeply (i.e. centrally) vs. others who would simply engage with the content on a shallow depth (i.e. peripherally) (Petty & Cacioppo, 1986b). A similar dual processing model has been observed by Chen & Chaiken (1999) (HSM: Heuristic Systematic Model). According to the HSM, the heuristic route of information processing is used when judgments are made based on the activation and application of judgment rules known as heuristics, that "like other knowledge structures are presumed to be learned and stored in memory" (p. 74). On the other hand, the systematic route of information processing required both, cognitive ability and capacity of the message recipient, therefore leading to analytic and comprehensive judgments. The primary difference between the ELM and HSM is the emphasis of the HSM on the fact that both routes, the heuristic and systematic could co-occur and independently have an effect on information processing (Chen & Chaiken, 1999).

Processing credibility specifically has also been described through a dual processing model in order to understand how credibility assessments are made (Metzger, 2007). Metzger's (2007) model discusses the role of the individual's motivation and ability to evaluate credibility, where only in the presence of both will they evaluate credibility through a central or systematic process; in the absence of either, they would process credibility through a peripheral or heuristic pathway. Thus, a more engaged individual could be a patient reading medical information about the condition they were diagnosed with, or a student working on a research paper, according to Metzger (2007). Therefore, others who might come across information incidentally that is not necessarily relevant to them, are likely to heuristically process it.

As an alternative to dual processing models, Kruglanski et al. (2006) discuss the unimodel that proposes that instead of two information processing routes, all information could

be processed through a single, identical route. The unimodal states that low or high processing of message recipients is irrelevant, while highlighting parameters of persuasion like the if-then (syllogistic) reasoning, that have been neglected in the past. The unimodel is based on the Lay Epistemic Theory (LET) of knowledge formation, according to which the process of knowledge formation consists of hypothesis testing and inference during which an individual acquires a belief based on relevant evidence. Here the evidence refers to any information that would be relevant to the conclusion and relevance refers to a prior assumption of information regarding something that would affect the belief of something else. A relevance override comes into play in cases where attitudes about the message arguments are more relevant to the receiver's attitude as compared to cues. Thus, the impact of information depends on "its relative relevance to the attitude issue, as well as on its ordinal position and the recipient's cognitive and motivational resources" (Kruglanski et al., 2006, p. S113).

Therefore, according to the unimodel since both the central and peripheral routes of information processing lead to an individual basing their decisions on some evidence presented (whether it be through deep engagement of the message or cue-based heuristic processing), both routes are functionally equivalent in the persuasion process (Kruglanski et al., 2006). However, the evidence can be interpreted subjectively based on people's prior knowledge, and if motivation/involvement with the message is low, only straightforward evidence will have a persuasive impact.

Rule activation in the unimodel plays the same role in processing message content as it does in the processing heuristic cues. Therefore, the persuasiveness of a message's arguments and its heuristic cues will both be affected by "the activation of rules that lend relevance to the message contents, reducing the difficulty of processing the messages, and thus enhancing

persuasion" (Kruglanski et al., 2006, p. S112). Overall, according to the unimodel, profound attitude change is possible via heuristic evidence even if the message recipient is not very familiar with the issue on hand (which is a characteristic of incidental information accumulated online) (Kruglanski et al., 2006).

Discussing specific cues in online platforms that could lead to heuristic credibility processing, Sundar (2008) proposed the MAIN model. Sundar's (2008) model states that information overload on technological platforms leads to credibility judgments based on the (M)odality cues, (A)gency cues, (I)nteractivity cues, and (N)avigability cues provided by the platform. He states that cues, that are indicators that bring about "activation" of particular heuristic rules could be automatically processed and play a significant role in credibility determination online. He explicates that the large volumes of information available online buried under multiple layers of sources and diffusion of content make judgment of credibility difficult, therefore leading users to evaluate content based on cues that provide mental shortcuts for credibility assessment. Modality cues are those that depend upon the mode of transmission of information and depend most on the interface the content is being exchanged on. For instance, multimodal cues provide a realism heuristic to viewers predicting that people could more likely trust audiovisual modality because it resembles the real world. Agency cues describe the ambiguity involved in deciphering the source of information on murkier platforms (e.g., social media). For instance, the authority heuristic is triggered when an authority figure is identified as the source of content online. Interaction cues present on an interface solicit users' input and trigger the interaction heuristic for credibility judgment by allowing users to specify their preferences in the technology. For examples, 'likes' in social media would be interaction cues. Navigability cues have the ability to trigger heuristics through different navigational tools

present on the interface, where clear navigation is generally considered to be more credible. For instance, a site map on a website.

Prior seminal work on online credibility research has been established prior to the rapid rise and proliferation of social media (Fogg et al., 2001; Metzger et al., 2003; S. Sundar, 2008). Therefore, on internet platforms today, traditional online affordances e.g., original source of content or a message are not always available. This is because of social media. What started as simply a method to help people keep in touch with one another, has evolved into one of the largest sources of news and information for people (Shearer & Gottfried, 2017). People now do not look at websites as a whole to determine credibility – in fact, social media are less websites in the traditional sense, and more platforms that span devices and formats. Looking at content on a social media website could be different than viewing it on its app, because while you are still viewing the content, the smaller screen size might eliminate things like author information, for instance, that you might traditionally use to determine credibility. This can also occur because social media content can very easily be shared and re-shared through a single click, leading to only crumbs regarding the original source of information. When these instances occur, an individual is left with the message itself in order to determine its credibility. Thus, the evolving landscape of social media and the internet, necessitates an inquiry into the credibility of the content it holds.

Metzger's (2007) dual-processing theory of credibility, Sundar's (2008) MAIN model, and the unimodel (Kruglanski et al., 2006) all focus on and discuss the importance and unique characteristics of credibility judgments occurring online (often through incidentally acquired information) and describe the role of heuristics in information and credibility processing. This is because the discussion of credibility becomes even more complex when discussing the internet

and online platforms. Multiple layers of sources in online transmission, such as an author, a website, and an organization, all lead to ambiguous and imprecise source identification that can make credibility hard to determine (Fogg et al., 2001; Sundar & Nass, 2001; Sundar, 2008; Yamamoto & Tanaka, 2011). In this situation people tend to focus on other aspects of the information presented to them in order to determine its credibility (Metzger et al., 2003). Sundar (2008) discussed affordances of online platforms that would contribute to credibility and grouped them in his MAIN model. Similarly, Metzger (2007) reviewed factors that could affect credibility of information online, including the presence of date stamp showing information is current, author identification, author qualifications and credentials, and easy navigation/well-organized site (for full list see Metzger (2007)).

Since the purpose of health infographics is to convey complex information in a simple format, complex comprehension as described through dual processing routes is not necessarily required. Additionally, as discussed above, credibility judgments are 'automatically activated' ("pre-understanding"), thereby further reducing the role of deep involvement and engagement. However, this isn't to say that a familiarity of cues and heuristics would not play a role in this judgment. For instance, the MAIN model describes a large range of technological affordances that would act as cues and activate heuristics, but this list is by no means comprehensive (Sundar, 2008). Furthermore, since people usually tend to incidentally encounter information on social media, as opposed to actively seek it, their motivation to process complex information could remain low even if they have the ability to do so. In such a case, according to the unimodel (Kruglanski et al., 2006), they might rely on easy content, such as cues, and consider them to be relevant enough information to make credibility judgment.

In addition to cues presented in social media messages in general, adding a layer of health-related social media messages raises questions about the types of cues and heuristics that would affect their credibility judgement. Furthermore, this form of bite-sized media is often exposed to a viewer incidentally through social media, where viewers are likely to process what they view through the cues they are exposed to because of the affordances provided by the technology and the message. A deeper discussion of the dimensions of credibility affecting health infographics and the specific cues that affect them is discussed in the sections below.

3.4 Online visual credibility

The existing research into visual credibility online has primarily been studied through websites and other platforms, which imparts the same "seeing is believing" effect of television (Metzger et al., 2003). For instance, affordances provided by technology that lead to credibility as described by Sundar (2008) emphasize the value of color, aesthetic, layout, and an appealing 'look' of a website. Similar value of aesthetics has been seen in other credibility research of technology as well. Kanthawala, Joo, Kononova, Peng, & Cotton (2018) found that visual elements like color or aesthetics of health apps affected users' app quality and credibility judgments, and Hilligoss & Rieh (2008) found that aesthetic-based heuristics affected how their participants determined credibility heuristics for website design.

However, when we look at the different forms of media shared online, past research on (message) credibility has primarily focused on text-based messages or information. Yet, the current media landscape presents ample visual information, where visual content is merged with text to often produce easily shareable media content, such as memes or infographics. Such content is not only easy to share but is shared and spread virally across the internet. This volume

of sharing plus the large volume of information we access through social media any way, exposes users to incidental news and information. In the case of health information that individuals are incidentally exposed to, they must first decide if the information is credible ("pre-understanding"), which would then be followed up by comprehension.

However, despite this prominence of visual information being shared online there is next to no work being done on the credibility of visual messages online – something that warrants an investigation. The popularity and prominence of visuals in social media is vast and penetrating and ranges various different types. Understanding the credibility determination of all these visual messages is outside the scope of this dissertation. However, one type of visual messages that are created with the express purpose of spreading and sharing information, oftentimes health information, are infographics. Therefore, factoring in the discussion about message structure and visual intensity in the sections above, this dissertation focuses on the message credibility of visual health infographic messages.

3.5 Message credibility and health infographics

Infographics, as described, are not only visual forms of media very easily shared online, but they also contain large amounts of information shared through a small and succinct form online. These simplified content receptacles present as a combination of simple visuals, such as icons and logos, simplified text, and data visuals like charts or graphs, in order to communicate health information, and often persuade the viewer to engage is positive health behavior. Health information online leads people to make decisions regarding their own health (Kanthawala, Vermeesch, Given, & Huh, 2016; Morahan-Martin, 2004). And though there is a lot of research regarding health information online and the effects it has on people who seek or come across it

(Becker et al., 2014; Das & Faxvaag, 2014; Kanthawala, Vermeesch, Given, & Huh, 2016; Strekalova & Krieger, 2017; Wilkinson et al., 2016), credibility of (health) information online (Liao & Fu, 2014; Robins et al., 2010; Spence et al., 2013), and even infographic research (Amit-Danhi & Shifman, 2018; Dunlap & Lowenthal, 2016; Lazard & Atkinson, 2015; Reid, Milton, Bownes, & Foster, 2017), there, once again, has been almost no work conducted on how health information encountered in the form of infographics affects users' credibility perceptions. While numerous factors contribute to credibility perceptions of messages online, including the source and content of the message (Metzger et al., 2003), sources of visual messages like health infographics that are self-contained with all the content within that piece of media, are easily left behind in the sharing process. The name of the original poster or the organization that created the infographic may not successfully follow the infographic through is viral journey. Some health infographics have source information placed within the infographic itself. While this might seem promising, that information is usually at the bottom of the infographic and may not be noticed unless an individual decides the infographic is worth their time and opens the image (especially on smaller devices). Furthermore, large volumes of health information shared online has been found to be "fake" or misinformation (Dixon et al., 2015; J. Guidry & Messner, 2017; Kanthawala et al., 2016; Kata, 2012). In such situations, anyone can place the name of a fake organization or the logo of a real organization on fake information, thereby rendering the source as ineffective for credibility determination. A similar argument can be made for the content itself where in deliberately incorrect information can be misguiding.

3.5.1 Message structure

However, due to these concerns, it might be worthwhile to study elements of the health infographic itself in order to understand its role in credibility determination. The traditional explanation of message structure describes how an organized message will have higher perceived credibility as compared to an unorganized or unstructured message (Metzger et al., 2003). The importance of structure can be seen in different contexts too, such as, perceived amateurism of a web message and inconsistencies in page design across a site which have demonstrated a decrease in information quality perceptions and overall site credibility (Alexander & Tate, 1999; Fogg et al., 2001). In addition, message or site organization are facilitated by features such as a site map or index as ways to enhance site navigability and, consequently, perceptions of information quality. All these instances of message structure (and by extension message credibility) focus on speech or oral messages, text-based messages, or in the online context – on platforms. To understand the effect of these dimensions of credibility on infographics, a media message in social media landscape, which contains bite-sized, self-contained messages, oftentimes having at least some visual component (even text-based messages are sometimes shared as images or screenshots), the traditional "organization" of the message structure is applied to it. Since an unorganized message is perceived to be less credible, the structure of an infographic message would possibly add to its narrative, communicating the message it is trying to get across as a whole. And as noted above (and elaborated below) the structure of a message is one of the dimensions that affect message credibility. The structure is also an important part of an infographic, because of its inherent nature of telling a story. Thus, an organized structure of an infographic would be one where the viewer can immediately follow the narrative of the infographic. Therefore, conceptually, message structure of a visual message (e.g., an

infographic) can be defined as a real or abstract representation of the organization of the message that can guide a viewer to follow what the message is trying to communicate to its audience. For example, pre-existing context helps the viewer to infer the information, ordered content that guides a viewers' vision from one part of the message to another, etc.

Infographics hold information in many different organizations or structures. Sometimes the information presented in an infographic does not follow an intuitive reading structure (for instance, left to right reading pattern, or top to bottom), but might take on different visualization, such as information presented in a U or zig-zag style. To clarify the reading order, some infographics will have navigational tools such as arrows connecting the different sections of the infographic or numbers providing a reading order for the viewer. In order to understand the importance of the message structure dimension of message credibility in an infographic (a combination of visuals and simple text) an infographic was created wherein the information within can be navigated through with navigational tools, such as arrows, numbers, and sectioned information guiding the viewer in the right direction (pre-test results discussed in methods chapter). Navigational tools represent cues and operationalize message structure because they aid in guiding the viewer in the correct direction to engage with the infographic. These *navigational cues* could activate the *browsing heuristic* as described by Sundar (2008). In addition to reasons related to creating clear manipulations for this experiment, navigational tools present an overt structure of the infographic to the viewer, the absence of which would possibly create additional cognitive load on the viewer because they must first understand how to engage with the infographic.

Therefore, based on above, the following is hypothesized:

H1: Individuals exposed to structured infographics (with internal navigation) will find them more credible than those exposed to the same, but unstructured (without internal navigation) infographics.

3.5.2 Visual intensity/Message exaggeration

The language intensity dimension of message credibility speaks to how unbiased or un-skewed information in presented (Metzger et al., 2003). Historically, language intensity has been described as "the quality of language which indicates the degree to which the speaker's attitude toward a concept deviates from neutrality" (Bowers, 1963, p.345). It has also been primarily studied in relation to the source. However, it is a dimension of the message, affecting how the audience perceives the message when the language used is opinionated. Being that media messages are now presented in social media in different and constantly evolving ways, and oftentimes in visual or visual and textual combination forms, there is a gap in understanding the role of intensity in these bite-sized media messages. Since the focus of this dissertation is on the visual and text combined health infographics, which is an example of these media messages that are largely present and shared in visual formats (image files, screenshots, etc.) and on visual platforms (Instagram, and even Facebook and Twitter), the dimension of language intensity is adapted to a more visual format, thereby referring to it as *visual intensity*.

To identify how biased an image or visual is, one way to do so is to understand the context of the image – who is posting and why. So for instance, if a picture depicts or explains the dangers of vaccines (such as injecting chemicals into children or possible future health issues), one might be able to note that the information is biased if it is posted by an anti-vaccination (anti-vax) person or organization, or even simply because some visuals can be overt and

deliberate in trying to sway public opinion. Conversely, other times this could be done much subtly. Historically opinionated messages have been depicted as verbal speech or text, and thus, words are depicted as stronger or weaker. However, depending upon the visual message, an opinionated image might be different things, for example, the obviously opinionated image of a baby being stuck with many needles (depicting the 'dangers of vaccination'), or more subtle lies such as false depiction of data or information that could misguide viewers. Therefore, conceptually, *visual intensity* could be defined as an opinionated portrayal of a visual message using tools employed in visual platforms, as opposed to textual (or vocal) platforms.

In infographics for instance, a common element is the graphical or chat representation of data (i.e. data visualization). "Lying" through statistics in visual representations like data visualizations has been acknowledged and while the motivations for these distortions may differ, their visual characteristics and perception are largely similar (Pandey et al., 2015). Misrepresentations in infographics can occur in data visualizations (that are commonplace in infographics) through the manipulation of axis orientation or scale, use of disproportionate sizes, incorrect representation, and non-linear scales (Pandey et al., 2015).

This distortion presents an attempt to offer the public biased information in a covert manner, such that they may not realize they are being presented with not neutral, but opinionated or biased content. Research has noted that visual encoding can distort information at the level of perception. Pandey et al. (2015) defined deceptive visualizations as "a graphical depiction of information, designed with or without an intent to deceive, that may create a belief about the message and/or its components, which varies from the actual message". A type of message deception, according to them, that could lead to creating false beliefs about the message and/or its components is *message exaggeration* (or understatement).

Message exaggeration. This kind of deception occurs when the facts are not distorted but in fact, tweaked or exaggerated. Pandey et al., (2015) explained this as a comparison between two quantities - A and B, where A is bigger than B, but is presented in a way such that the extent to which A is larger is exaggerated. This will present quantities to be larger than they are. Some examples of message exaggeration in data visualizations can be presented through a truncated axis where an axis of the chart is altered by changing the minimum and maximum values presented on the scale (Figure 1), modifying the area of a quantity where the data is mapped such that one of the variables in the graph affects its representation (Figure 2), or an aspect ratio where in line charts the angle of inclination/declination of the lines are affected because of the changes in the aspect ratio in one of the axes (Figure 3) (Pandey et al., 2015).

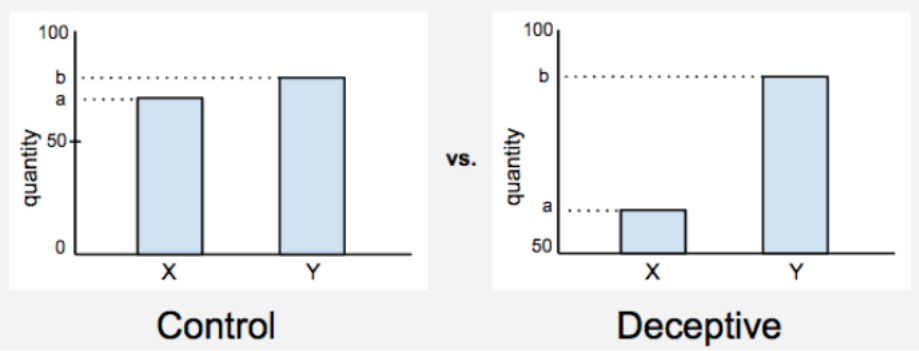


Figure 1.1: Truncated axis form of message exaggeration

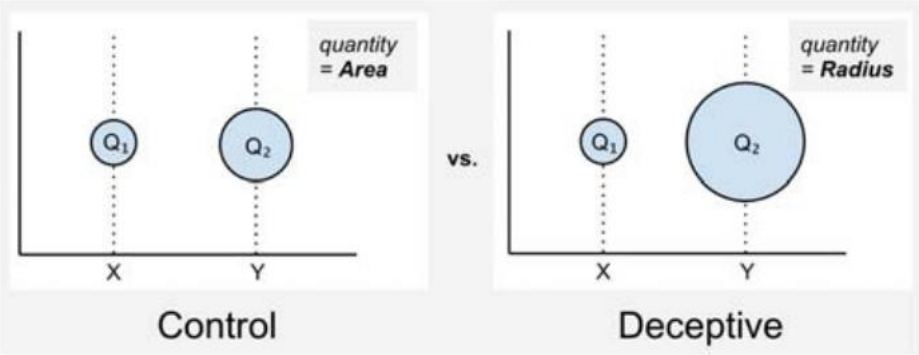


Figure 1.2: Area of quantity form of message exaggeration

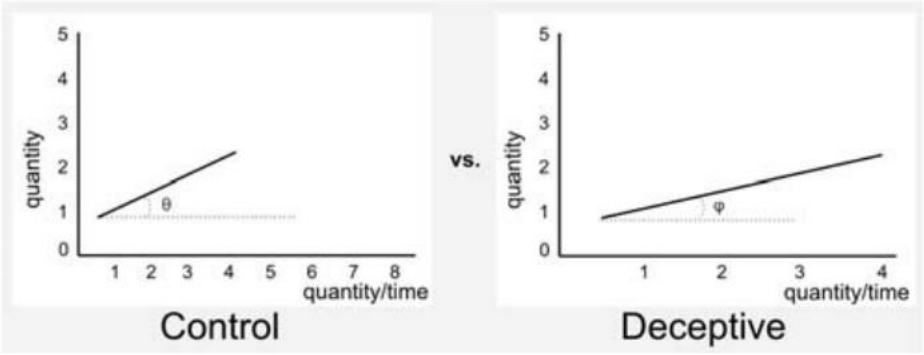


Figure 1.3: Aspect ratio form of message exaggeration

Message exaggeration of data visualizations in an infographic acts in accordance with the unimodel according to which persuasion maybe accomplished through simple message arguments (as is fundamental to infographics but is also a characteristic of data visualizations like graphs) as well as via message-unrelated cues or heuristics, which in the case of message exaggeration is an *exaggeration cue*, thus activating the *persuasive intent heuristic*. The persuasive intent heuristic arises from the fears of unknown others' manipulations (Metzger & Flanagin, 2013). A discussion about the operationalizations in the stimuli based on a pre-test can be found in the methods chapter.

Thus, based on the above, the following hypothesis is posed:

H2: Individuals exposed to exaggerated message health infographics will find them less credible than those exposed to the same, but non-exaggerated health infographics.

3.5.3 Moderators

Visual Literacy. Interpreting media, like health infographics, can depend upon the users' visual literacy. Visual literacy has been generally accepted to include abilities to interpret and create visual materials (as one would read and write text) (Avgerinou & Pettersson, 2011; Brumberger, 2011; Lazard & Atkinson, 2015; Messaris & Moriarty, 2005; Spalter & van Dam,

2008). Some theorists in the past have noted that higher visual literacy levels provide users with the skills needed to evaluate visual information more meaningfully (Avgerinou & Pettersson, 2011; Trumbo, 1999), and critically consume it, thus making them less susceptible to visual persuasion tactics (Messaris, 1994; Messaris & Moriarty, 2005). Furthermore, in the case of visual platforms like infographics, some research has found that users tend to process these more centrally than textual information of the same content, this result being especially significant for users with lower visual literacies (Lazard & Atkinson, 2015) indicating a role of visual literacy in processing this information. These researchers especially note, that since people with lower visual literacy processed information by elaborating it more substantially than people with higher visual literacy, thus visual literacy might have an opposite effect as that of "other ability and motivation to process considerations, such as need for cognition" (Lazard & Atkinson, 2015, p. 25). However, according to the unimodel which describes just a single route of information processing, visuals would decrease the complexity of the content, thereby suggesting that it would be easier for individuals with lower cognition to process.

More recently, in a study about fake or manipulated images Shen et al., (2019) found that unlike previous credibility research that has attributed credibility judgments to determinants such as a source, images do not follow similar suit. In fact, images from highly trustworthy sources, images from news organizations or their social media channels, images from credible intermediaries, and even images with higher bandwagon cues such as shares and favorites, were not perceived to be more credible. However, people with greater amounts of photography experience, digital imaging skills, and greater levels of internet skills perceived images as less credible compared to people with lower skills. This indicates a role played by visual literacy in credibility judgement. Thus, the following is hypothesized:

H3: Visual literacy act as a moderator in the processing of credibility of health infographics.

Message discrepancy. The distance between the perceived position of the source and the pre-message position of the message receiver has been defined as message discrepancy (Hamilton, 1998). With regard to a message receiver, research finds that attitudes or beliefs that are consistent with previous knowledge tend to be more easily accepted (Wicks, 1995). Messages discrepant to previously held beliefs could produce a "psychological tension" or discomfort resulting in internal pressure to eliminate or reduce the inconsistency, such that individuals might avoid discrepant messages, while selectively retaining messages consistent with their beliefs and selectively forgetting messages contradicting their knowledge (Wicks, 1995). This avoidance of discrepant messages could be especially easy to do in the context of social media. If an individual comes across a discrepant message, they could just ignore it and move on by convincing themselves that this message is, in fact, not a credible message. This is because messages are considered to be more credible when message discrepancy is low (Hovland & Weiss, 1951) because a message that supports our point of view is seen as more unbiased (Stamm & Dube, 1994). The role of message discrepancy has been highlighted especially for language intensity, finding that discrepant messages using intense language mostly tend to be rated negatively in terms of credibility (Bradac, Bowers, & Courtright, 1980; Hamilton & Hunter, 1998). This is similar to research that highlights confirmation bias (Nickerson, 1998) or reinforcement expectancy theory (Bradac et al., 1980), according to which people are more likely to deem credible the information they already believe, i.e. reaffirm their knowledge. Additionally, it also is in the vein of the if-then reasoning according to the unimodel

(Kruglanski et al., 2006), which states that an individual acquires a belief based on evidence relevant to the conclusion they have to make (where relevance refers to a prior assumption).

More recent research has noted the role of issue attitude, a construct similar to message discrepancy, which asked participants about their perceptions regarding topics of the images they saw. Their results indicated that this pre-existing attitude about issues depicted in the images participants viewed, played an important role in people's credibility judgement (Shen et al., 2019). Since message discrepancy plays a role in the effect of language intensity, which is a dimension of message credibility, the following is hypothesized:

H4: Message discrepancy act as a moderator for the effect of message exaggeration on message credibility

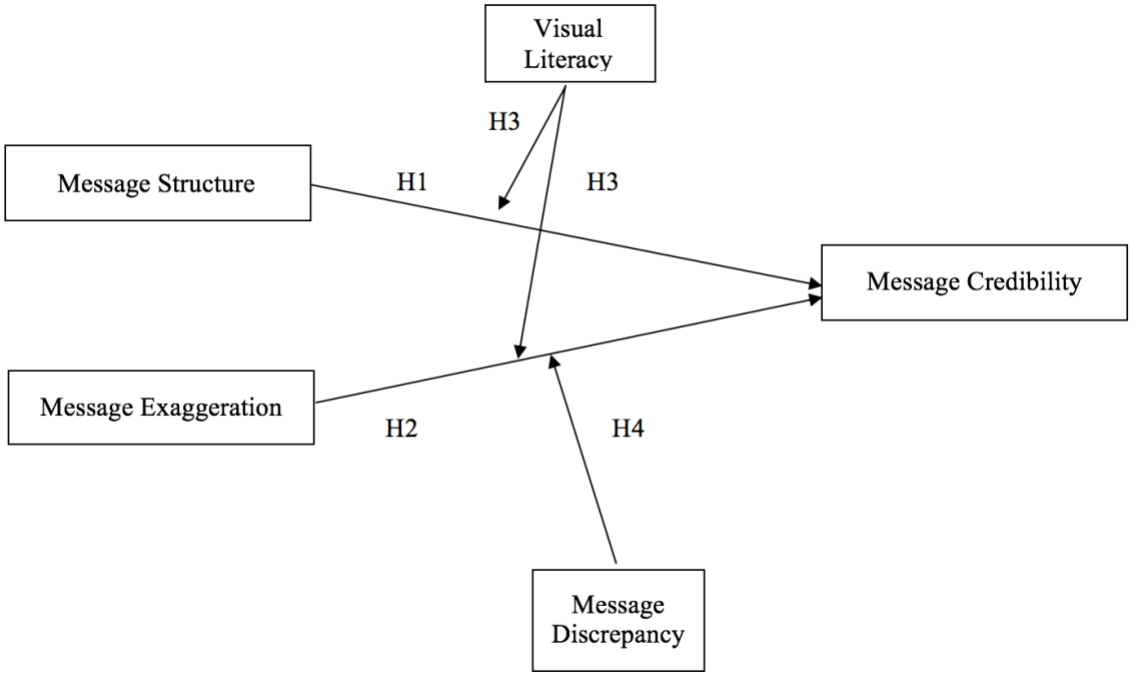


Figure 2.1: Proposed research model

CHAPTER 4: METHODS

Two studies (Study A manipulating message structure and Study B manipulating message exaggeration), were conducted concurrently, after being approved by the institutional review board at Michigan State University, in order to understand two credibility determinants in the visual infographic platform.

4. 1 Infographic topic areas

The stimuli for both studies of this dissertation were three different health-related infographic topics that were selected as a within-subject repeated measure in order to increase generalizability and determine if the manipulated variables work in different health infographic situations. The topics were selected such that they provided a health-related persuasive call-to-action and were topics that people could possibly be vaguely familiar with, but not have deep knowledge of (each section below illustrates the lack of ubiquitous knowledge on each subject). To achieve this, six health-related topics were pre-tested for familiarity among people. Fifty participants on Amazon's Mechanical Turk were asked about their familiarity, issue relevance, and involvement regarding, heart disease, opioid addiction, pre-diabetes, HPV vaccines for older individuals (27-45 years old), colon cancer screening, and bone marrow donation. Selection of topics was decided based on issues where participants had some to little knowledge on the matter (with means between 3-5 on a 7-point likert scale). The means for HPV vaccination, colon cancer screening, and bone marrow donation fell under this range and were thus selected as the final topics for infographic stimuli. Each topic is covered in detail below.

4.1.1. HPV vaccine

The Human Papilloma Virus (HPV) is the causative agent of cervical cancer. According to the CDC, about 14 million Americans become infected with HPV annually ("FDA approves expanded use of Gardasil 9 to include individuals 27 through 45 years old," 2018). On October 5, 2018, the Food and Drug Administration (FDA) announced that now both men and women aged 27 to 45-years-old, were approved for the vaccine ("FDA approves expanded use of Gardasil 9 to include individuals 27 through 45 years old," 2018) (previously limited to age 26).

With medical knowledge now freely available, decision making moved from healthcare providers exclusively to including patients themselves too. This shared decision making between patient and providers is affected by information they consume online. Misinformation such as the dangers of vaccines can lead to some parents deciding against vaccinating their children or themselves, for instance. Anti-vaccination rhetoric is easy to find online and has been observed by past research on YouTube (Keelan, Pavri-Garcia, Tomlinson, & Wilson, 2007), MySpace (Keelan, Pavri, Balakrishnan, & Wilson, 2010), Facebook, Twitter, Digg (Seeman, Ing, & Rizo, 2010), Pinterest (Guidry & Messner, 2017; Guidry et al., 2015), and even Google (where searching for "vaccination" and "immunization" found 43% of the first 100 websites, including the first 10, to be anti-vaccination) (Davies, Chapman, & Leask, 2002). This indicates the presence of anti-vaccination information is being accessed both, intentionally and incidentally online.

The anti-vaccination misinformation online uses various tactics to advance their agenda, including "skewing science, shifting hypotheses, censoring opposition, attacking critics, claiming to be "pro-safe vaccines", and not "anti-vaccine", claiming that vaccines are toxic or unnatural", etc. (Hussain et al., 2018, p. 4; Kata, 2012). While deceitful, these methods have proven to be

successful in their effects on people (Kortum, Edwards, & Richards-Kortum, 2008). Being exposed to anti-vaccine information for a mere 5-10 minutes can increase perceptions of vaccination risks and reduces risks of anti-vaccination (Betsch, Renkewitz, Betsch, & Ulshöfer, 2010) – an effect that lasts 5 months later.

While research has focused on the general media landscape of mis-and-disinformation regarding (anti)-vaccination, there hasn't been any work on the effects of specific types of media messages on vaccination information spread online. In order to understand users' likelihood of believing and acting on the information they gather online, it is imperative to understand how they perceive media messages they seek or incidentally come across online. Infographics are easy to share, bite-sized media that hold large volumes of information. In order to determine their credibility perceptions, this dissertation used the newly expanded use of Gardasil 9 to create infographics encouraging HPV-unvaccinated individuals between the ages of 27 to 45 years of age to get the vaccine by manipulating, *message structure* and *message exaggeration* within the infographic. For a more detailed explanation of the HPV and its effects, the vaccine, and the history of the anti-vax movement, refer to Appendix A.

4.1.2. Bone marrow donation

Life-threatening illnesses such as leukemia, lymphoma, aplastic anemia, among others often require bone marrow transplant as a last resort and only recourse for recovery and survival of a patient (Bagozzi, Lee, & Loo, 2001). Without a bone marrow transplant, the long-term survival rate for a person is less than 15%, whereas with it, the odds increase to 30-80% depending upon the disease in question (Bagozzi et al., 2001; Yanke, 1990). The search for a match, however, is a large challenge for patients because of the vast diversity of leukocyte

antigen types, such that even siblings, who would be the best prospect for donation, are often not an ideal match (Bergstrom, Garratt, & Sheehan-Connor, 2009; Lee-won, Abo, Na, & White, 2016). About 70% of people who require a bone marrow transplant, need to find a match from unrelated donors, since only 30% can find a match from immediate family (Thompson, 2017). Therefore, to improve patient survival odds, expanding the available pool of bone marrow donors is important (Lee-won et al., 2016; Massi Lindsey, 2005). However, even with donors the probability of a match from unrelated donors is tiny (somewhere between approximately 1 in a 100 and 1 in a 1 million) (Bagozzi et al., 2001).

Volunteers can contact their doctors or the National Marrow Donor Program (NMDP), a federally funded nonprofit organization that keeps a database of volunteers willing to donate.

If a volunteer is matched with a patient, the process of donating bone marrow stem cells involves allowing doctors to draw either bone marrow stem cells from the blood or bone marrow for transplantation. Previously, surgery was required in order to draw bone marrow stem cells directly from the bone. Today, however, it is much more common to collect the stem cells from blood (known as peripheral blood stem cell donation) ("Blood and bone marrow stem cell donation," 2018). In this situation, the risks are minimal.

Social media has played an important role in attempting to increase the low numbers of marrow donors in the pool. For instance, nonprofit organizations and friends and family of patients in need of matching donors post solicitating messages on social media (Aaker & Smith, 2010; Lee-won et al., 2016). Additionally, research has found that the more viral a bone marrow donation message goes, the higher the likelihood that the viewer would intend to join a bone marrow registry (Lee-won et al., 2016).

The active role of social media is important in trying to build up and keep the donor list filled for patients. This is because, besides the more common reasons, such as the important and far-reaching range of social media which can bring the message to more people than ever before, bone marrow stem cell donations are most effective when they come from a younger population (18-44 years old). This age range also largely overlaps with high users of social media, especially users that more and more use platforms exclusively for visual posts (We are social, n.d.). Therefore, messages that encourage donation on social media can be a good tactic.

However, encouraging people to volunteer to be bone marrow donors can be difficult for multiple reasons. First, there are health-related side effects such as headaches, nausea, numbness, side-effects to anesthesia, and troubles with the actual donation process, such as being injected with a needle and having your marrow drawn out (in some situations – mostly in the past). Second, in the past donors had to bear the costs related to donation ($45 to participate and other incidentals such as travel) and had to be 18-55 years old (Bagozzi et al., 2001).

However, today, even for people who volunteer to be on the donor list, the likelihood that they would have to donate is small – only 1 out of 430 potential donors actually go on to donate ("Steps of PBSC or bone marrow donation," n.d.).

However, this sort of information is not known by people everywhere. Anecdotal evidence through news stories depict the misconceptions (or rather un-updated conceptions) regarding bone marrow donation that are popular among people (Inglis-Arkell, 2014), while attempting to update them. Users still believe the old methods of donation, a narrative often spun by television shows, such as medical dramas. Therefore, utilizing infographics through social media might be one way to reach a wider, more diverse population for suggesting bone marrow donations. Additionally, in order to understand what media message elements about these

infographics might prove to be credible to users who come across them on social media, this dissertation manipulates *message structure* and *message exaggeration* within the infographic. For more information regarding the bone marrow donation process, refer to Appendix A.

4.1.3. Colon cancer detection

Colorectal cancer, known as colon cancer for short, is the cancer that occurs in a person's colon (large intestine) or rectum. It is the third most common cancer in the United States ("Colon cancer rates rise in young adults: Earlier screening advised," 2018). This kind of cancer largely affects older adults, but lifestyle factors like a lack of regular physical activity, diet low in fruit and vegetables, low-fiber and high-fat diet, or a diet high in processed meats, being overweight or obese, alcohol consumption, and tobacco use can all play a role in causing colorectal cancer.

What makes this kind of cancer especially dangerous is that it is often asymptomatic, especially at first. In general, however, the most effective way to reduce the risk of colorectal cancer is to get screened for it routinely.

While regular screening is recommended beginning at age 50, the past few years has seen a spike in colon cancer diagnoses in younger adults (Siegel et al., 2017; Simon, 2017). Research has found that while the overall rate of colon cancer is reducing since the mid-80s, largely due to screening for the disease, this screening has been largely driven by older adults over 50 (the recommended screening age), and therefore resulted in a spike in people below this age (Siegel et al., 2017). In essence, "colorectal cancer risk for millennials has escalated back to the level of those born in the late 1800s" and there is a need for educational campaigns to reach clinicians and the general public (Simon, 2017). As compared to their older counterparts, younger patients are 58% more likely to be diagnosed with late-stage colorectal cancer. What is driving this rise is

unknown, but it is likely that this occurs at least in part because this cancer is not on the radar for young adults and their providers and goes undetected with no screening (Simon, 2017).

Overall, education about the need for colon cancer screening is important for everyone. However, with younger adults being affected more than before and there being a seeming lack of awareness around the need for screening for this younger population, social media could play a role in bringing about this awareness through media like infographics. Especially due to the popularity of visual social media platforms among younger populations (We are social, n.d.), health infographics might present an especially ideal solution to communicating awareness and information to people. Therefore, like with the two topics above, it is important to understand what media message elements about these infographics might prove to be credible to users who come across them on social media, this dissertation manipulates *message structure* and *message exaggeration* within the infographic. For more information about colorectal cancer, refer to Appendix A.

4.2 Stimuli

Three infographics were created as templates – one about encouraging adults aged 27 – 45 to get vaccinates for HPV, the second encouraging people to sign up to be bone marrow donors, and the third reminding people (especially youth) to screen for colon cancer. Based on these templates, the manipulations described in the sections above were applied creating nine infographics overall (Table 1.1 and 1.2). For instance, there was a control HPV infographic created with no manipulations (this infographic was used for the control condition in both studies; it contained all internal navigation as well as unexaggerated and easier to read graphs within the infographic).

For Study A about message structure, the control infographic was manipulated to remove all internal navigation. For Study B about message exaggeration, the control infographic was manipulated by exaggerating the message as described above. This was replicated for the bone marrow donation, and colon cancer screening as well.

About 15 variations of these manipulated stimuli with small differences were first developed and pre-tested in a focus group with undergraduate students from a Research Methods in Media and Information course at Michigan State University. Student participants were offered extra credit in exchange for their participation. They were presented with the various stimuli and asked questions about how believable the stimuli were as real infographics, what they liked and disliked about the infographics in general and more specifically with respect to the manipulations, what changes they would make, and which would be their ideal infographic.

After getting consistent responses about how they all agreed the stimuli looked like real infographics they might come across online and identifying specific elements of the infographics they liked and that helped them with interpreting the infographic, this feedback was implemented to make changes to the stimuli. Nine stimuli (control infographic, infographic with manipulation for message structure, and infographic with manipulation for message exaggeration for all three topics) were then pre-tested on Amazon's Mechanical Turk with 50 participants. All participants were exposed to all the stimuli in a randomized fashion to check message credibility and manipulations. Manipulation checks determined that in each stimulus, at the very least over half the participants were answering the manipulation check questions correctly. Additionally, the data for all three topics were combined and two ANOVAs were conducted (one for Study A and B each). There was a statistically significant effect of message structure on message credibility between the groups determined by the one-way ANOVA for message structure (Study A)

[$F(28,21) = 5.572$, $p = .000$]. There was also a statistically significant difference of message exaggeration on message credibility between the groups determined by the one-way ANOVA for message exaggeration (Study B) [$F(28,21) = 7.756$, $p = .000$]. However, the message credibility means for all stimuli fell between the range of 5.0 – 5.5 on a 7-point likert scale (means and ANOVAs for the pre-test results can be found in Appendix B). One possible reason for similar means was that all 50 respondents, saw all nine stimuli and were primed, because of the similarity in their designs, despite randomization among them. To account for this, the stimuli designs were altered one last time in order to make the manipulations stand out more. For Study A, the infographics were made a still harder to follow through. For Study B, the graphs were more difficult to read by making the values on the Y-axis unclear, in addition to the axis not beginning at zero, and the titles were changed to be more vague about the content but more enthusiastic. The final stimuli can be seen in Appendix D.

4.3 Research design

Two studies, one focusing on message structure (Study A) and the other on message exaggeration (Study B), were conducted. Study A was a 2 (message structure: internal navigation vs. no internal navigation) x3 (infographic topic: HPV vs. bone marrow vs. colon cancer) mixed factorial design experiment with repeated measures on the on the second factor. Study B was a 2 (message exaggeration: present vs. absent) x3 (infographic topic: HPV vs. bone marrow vs. colon cancer) mixed factorial design experiment with repeated measures on the second factor. Each participant viewed all three infographics (one from each topic) from the condition they were assigned to in a randomized fashion. They viewed these stimuli through an online survey created on Qualtrics. The study designs can be seen in Table 1.1 and 1.2.

		Message Structure (navigation)
INFOGRAPHIC TOPICS	HPV Vaccine	Present - S_1
		Absent - S_2
	Bone Marrow Donation	Present - S_1
		Absent - S_2
	Colon Cancer Screening	Present - S_1
		Absent - S_2

Table 1.1: Research study design – Study A (S = Sample)

		Message Exaggeration
INFOGRAPHIC TOPICS	HPV Vaccine	Present - S_3
		Absent - S_4
	Bone Marrow Donation	Present - S_3
		Absent - S_4
	Colon Cancer Screening	Present - S_3
		Absent - S_4

Table 1.2: Research study design – Study B (S = Sample)

4.3.1. Participants

In addition to understanding credibility determinants in general, a focus of this study was understanding message credibility determinants in social media. Therefore, the participants included social media users, who are US citizens and over 18 years of age but younger than the age of 45. This is because a high volume of social media users are of low to mid ages (Smith & Anderson, 2018; We are social, n.d.). All the infographics selected, therefore, also target a younger audience in their content (the HPV vaccine is for adults aged 27-45; bone marrow transplant is encouraged more for younger adults due to the viability of stem cells; and colon cancer is on the rise for youth while reducing overall). The online experiment was hosted on

Qualtrics' platform and Qualtrics was paid $5 per participant for recruitment and deployment of the survey.

Both studies were conducted concurrently, but independently and thus, had separate participants. Study A had a total of 184 participants. Among them 83.2% were female, 63% were Caucasian, 53% had some college education, and 64.2% preferred visual content on social media, to text-based content. Study B had a total of 230 participants. Among them 77.4% were female, 66.5% were Caucasian, 28.3% had a high school education, and 59.6% preferred visual content on social media, to text-based content. A more detailed description of participant demographics can be found in Table 2.

Participant demographics		
	Study A	**Study B**
	N = 184	N = 230
Gender		
Male	16.8%	20.9%
Female	83.2%	77.4%
Other	-	1.7%
Age		
18-24	21%	13.5%
25-34	33.7%	50.5%
35-45	41.8%	20.4%
Race		
Caucasian	63%	66.5%
Asian or Pacific Islander	4.9%	5.2%
African American	23.4%	23%
Hispanic or Latino	8.7%	10.4%
Native Hawaiian or Other Pacific Islanders	-	0.4%
American Indian or Alaska Native	2.7%	3.9%
Other	2.2%	2.2%
Education		
Elementary school	0.5%	0.4%
Some high school	6.5%	3.9%
High school	20.1%	28.3%
Some college	28.3%	25.2%
Associate's degree	14.1%	11.7%
Bachelor's degree	23.9%	20.9%
Master's degree	4.3%	6.5%
Doctorate	2.2%	2.6%
Other	-	0.4%
Income		
<$6,000	9.2%	10.4%
$6,001-$18,000	14.7%	13.5%
$18,001-$30,000	22.4%	19.1%
$30,001-$48,000	14.7%	15.2%
$48,001-$75,000	13%	18.3%
$75,001-$126,000	19%	16.1%
$126,001-$150,000	2.2%	2.2%
>$150,000	4.9%	5.2%

Table 2: Participant demographics

4.4 Outcome variables

4.4.1 Perceived message credibility

Based on the message credibility scale developed and validated by Appelman and Sundar (2016), message credibility was measured by asking participants to rate how *accurate*, *authentic*, *believable, factual, credible,* and *trustworthy* the health infographics presented in their stimuli were. All responses were measured using a 7-point Likert-like scale ranging from *strongly disagree* to *strongly agree*. The full scale can be seen in Appendix C.

In order to determine the best scale using these items, an Exploratory Factor Analysis (EFA) was conducted on Study A to understand the factor selection and corresponding factor loading. The data suggested one factor to be optimal for the explanation of variance in the data.

The factor analysis implied that the one factor comprised of all 6 items, explained 78% of the variance with factor loadings ranging from 0.8 to 0.9. A Confirmation Factor Analysis (CFA) was conducted to validate the measure suggested by the EFA on the other study's dataset in order to cross-validate the factor structure. The model fit indices for the message credibility scale were as follows: chi-squared was 175.315, degrees of freedom was 9, and the *p* value associated with the chi-squared test was 0.00. The Standardized Root Mean Square Residual (SRMR) was 0.027 (a value less than 0.05 suggests a good fit). The Comparative Fit Index (CFI) was 0.95, and the Root Mean Square Error of Approximation (RMSEA) was 0.164. Since all fit indices did not indicate that the model fit the data adequately (RMSEA < 0.08 indicates a good fit), Appelman and Sundar's (2016) pre-validated scale with 3-items (*accurate, authentic,* and *believable*) was selected as the optimal message credibility scale for this study. The reliability of this message credibility scale was run for both studies. Cronbach's alpha of 0.94 in Study A and 0.95 in Study B indicated good reliability.

4.4.2. Visual literacy

An existing visual literacy scale developed by Lazard and Atkinson (2015) based on existing literature was used to measure the level of visual literacy through perceived abilities to interpret meaning from visual information. It was measured in four ways – perceived visual literacy (PVL) ($\alpha_A = 0.85$; $\alpha_B = 0.9$) (e.g., *"When I look at photographs in advertisements or informational messages, it is easy for me to identify the purpose of the image"* or *"When I look at any visual in advertisements or informational messages, I can easily tell if the visual have multiple meanings."*), visual literacy image evaluation (VLIE) ($\alpha_A = 0.78$; $\alpha_B = 0.79$) (e.g., *"When you see images on the Web, do you assume they have been altered in some way?* or *"When you see news video footage from mainstream sources (e.g., CNN, Fox, network television, etc.), do you assume it has been altered in some way?"*), visual creation skills (VLS) ($\alpha_A = 0.9$; $\alpha_B = 0.91$) (participants were asked about their skills regarding software such as website design, image manipulation, etc.), and actual visual literacy (AVL) (participants were shown icons and asked to identify their meanings) of participants was measured (Lazard & Atkinson, 2015). On a 7-point-likert scale from *strongly disagree* to *strongly agree*. The full scale can be seen in Appendix C.

4.4.3. Message discrepancy

Message discrepancy, measured to identify participants' pre-message attitudes about the infographic topics, was measured using a single item for each infographic topic. Thus, participants were asked how HPV vaccination, bone marrow donation, and colorectal cancer screening affected their life. Each response was measured on a 7-point semantic differential scale ranging from *definitely opposed* to *definitely in favor*. Message discrepancy has been measured

by Clark & Wegener (2009) using a 34-item scale where 33-items were filler, and only one item actually measured participant attitudes about the topic on hand. However, Slater & Rouner (1996) use only a single item asking participants if any aspects of the message was different from their previous beliefs about the topic or social group described. In order to simplify the process for participants, this dissertation will not include filler items following Slater & Rouner (1996), and focusing on a single item per topic, anchored on a sematic differential scale like Clark & Wegener (2009).

4.4.4. Control variables

Demographics, such as gender, age, race/ethnicity, and education level, and social media use (frequency, social media platforms, visual vs. text-based preferences) were collected. All responses will be measured using a 7-point Likert-like scale ranging from *strongly disagree* to *strongly agree* (Appendix C).

4.4.5. Manipulation checks

Participants in Study A were asked about the presence of arrows, numbers, and sectioning to check for navigation manipulation. Participants in Study B were asked if the graphs in each of the infographics was accurate or skewed to misrepresent data, and if the y-axis began at 0. This manipulation check was conducted despite past research explicating no reason for such a measure to be collected – O'Keefe (2003) states that when studying the effect of a message variation on a persuasive outcome, no message manipulation check is required. Additionally, since it could be difficult for respondents to recall such specific details after the stimuli are no longer in front of them, and in order to prevent systematic bias (and not only survey people who

can recall small details), it was decided to keep respondents who failed the manipulation check. However, the results of the manipulation checks can be found in the results section below.

CHAPTER 5: RESULTS

5.1 Analytical approach

For each study, the data were collected in a mixed research design, wherein the topic of the health infographic was a repeated measure. The main aim behind this was to have generalizable results, rather than topic specific results only. These data were analyzed as a mixed effects model in order to account for random stimuli variation within experimental data (Judd, Westfall, & Kenny, 2012). For both studies, the primary hypothesis predicted an effect of the independent variable on message credibility. The conceptual model also proposed moderator variables.

Traditionally a repeated measure ANCOVA could be used to analyze such data. However, the repeated measure ANCOVA often leads to an inflated Type I error rate (this is because this type of analysis requires restrictive conditions of sphericity or circularity, which are generally hard to achieve). Additionally, if the results show a significant effect, then there is a need to conduct a post-hoc analysis, leading to multiple tests and a combined type I error. This could lead to false-positives in the analysis. A mixed effects model, that addresses these issues, has been used for similar study designs (Judd et al., 2012).

Furthermore, this approach provides additional advantages over a traditional repeated-measures ANCOVA, such as the following – the ability to easily use a combination of categorical and continuous covariates, mediator and moderator variables, unbiased handling of incomplete cases and outlier cases, fixed or random effects, and handle incomplete and unbalanced data. The mixed-effect model also gives a flexible framework for the analysis of a repeated measure design and allows for the use of various realistic variance and correlation patterns for corresponding applications. Therefore, the mixed effects model offers a suitable alternative for analyzing such data (Judd et al., 2012).

In the context of this study, there is a random factor corresponding to the health topic and a fixed factor corresponding to message structure and message exaggeration. Furthermore, the moderating variables and all other covariates were treated as fixed effects. The mixed effect model analysis allows the user to specify various different patterns with different levels of complexity and then select the best model based on the relative goodness of fit indices, such as Akaike Information Criterion (AIC) (Gueorguieva & Krystal, 2004). The random factors were tested as random slope and random intercept model corresponding to the different health topics. A random intercept corresponding to health topic with visual literacy (VLIE) as a moderator variable was the final model selected based on AIC which was consistent with the initial design. More detailed results can be found below.

5.2 Manipulation checks

Each study had multiple questions that acted as manipulation checks. To verify the effect of a failed manipulation check, the studies were analyzed by eliminating respondents who failed the manipulation check. The model structure for Study A remained the same giving very similar results, after elimination of participants who failed the manipulation (result table with eliminating failed manipulation check respondents in Appendix B). However, eliminating participants who did not pass the manipulation check for Study B reduced the sample size substantially. This is major limitation of this study and is discussed in the limitations section further, however, one possible reason for this is that the manipulation for Study B was highly involved within the design and respondents would require, to specifically note the changes made inside the graph within the infographic, but then also recall this when they were questioned about

it later. Additionally, one of the two manipulation check questions were more subjective than objective in nature, which possibly had an impact on these results.

Therefore, for the reasons explained above, the participants who failed the manipulation check were included in the analysis. However, the tables below provide information on participants who passed the manipulation check vs. those who did not.

Study A: In the infographics above, were there arrows guiding you through the sections of the infographic?

	Yes	No	Total
Arrows	56	4	60
No arrows	95	29	124
Total	151	33	184

Table 3.1: Results of cross-tabulation of navigation arrows (Study A). *Note*. $\chi^2 = 6.5$, df = 1, $*p < .01$

Study A: In the infographics above, were there numbers guiding you through the infographic?

	Yes	No	Total
Numbers	49	11	60
No Numbers	85	39	124
Total	134	50	184

Table 3.2: Results of cross-tabulation of navigation numbers (Study A). *Note*. $\chi^2 = 2.88$, df = 1, $p = 0.08$

Study A: In the infographics above, was sectioning off of each piece of information within the infographic?

	Yes	No	Total
Sectioned	57	3	60
Unsectioned	98	26	124
Total	155	29	184

Table 3.3: Results of cross-tabulation of navigation sections (Study A). *Note*. $\chi^2 = 6.60$, df = 1, *p < .01

Study B: In the infographics you observed, does the scale on the Y-axis in the graph begin at 0?

	Yes	No	Total
Y-axis at 0	52	19	71
Y-axis not at 0	102	57	159
Total	154	76	230

Table 3.4: Results of cross-tabulation of Y axis value (Study B). *Note*. $\chi^2 = 1.44$, df = 1, $p = 0$ .22

Study B: In the infographic you observed, was the graph in the infographic skewed to misrepresent data?

	Yes	No	Total
Unskewed	15	56	71
Skewed	55	104	159
Total	70	160	230

Table 3.5: Results of cross-tabulation of navigation arrows (Study B). *Note*. $\chi^2 = 3.5$, df = 1, *$p = 0.05$

5.3 Analysis

The first hypothesis predicted a significant relationship between the structure of the infographics and participants' rating of credibility. In order to determine if there would be an effect of individual health topics in the model, dummy variables were created for two of the health topics in order to account for the three different health topics, but the health topics showed no significance, and were therefore excluded from the model in the analysis.

A linear mixed effects regression was used to test this hypothesis. The model was significant, $F(1, 552) = 14.96$, $p < 0.001$, AIC = 1905.0. Participants' familiarity with the topic, and their ehealth literacy were significant covariates, and there was a positive relationship between the presence of structural elements present within infographics and message credibility, i.e., no structure reduced credibility ratings. Thus, H1 was supported. Visual literacy was measured through four separate scales as discussed above. PVL, VLS, and AVL caused multicollinearity in the model and were therefore removed from the model. VLIE, however, significantly moderated the relationship between structure and message credibility. Therefore, H3 was partially supported for Study A. Table 4 lists the estimates and *p* values.

Independent Variable	**ß (SE)**	**t value**	***p* value**
Structure	-2.223 (0.57)***	-3.868	0.0001
VLIE	-0.27 (0.14)**	-1.82	0.06
Structure x VLIE	0.58 (0.17)**	3.34	0.008
AIC	**1905.0**		

Table 4.1: Regression model predicting the effect of message structure on message credibility. *Note*. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

In addition to the main effect of the independent variable on message credibility, in Study B also, a hypothesis regarding the moderating effect of visual literacy was posed. However, PVL,

VLS, and AVL were multicollinear in the model, as in Study A, and therefore removed. This final model was used to test the predicted hypothesis.

The second hypothesis predicted a significant relationship between the message exaggeration of the infographics and participants' rating of credibility. A linear mixed effects regression was used to test this hypothesis. The model was significant, $F(1, 690) = 10.85$, $p < 0.001$, AIC = 2429.7. There was a positive relationship between the presence of message exaggeration within infographics and message credibility, i.e., an exaggerated message reduced credibility ratings. Thus, H2 was supported. Furthermore, VLIE moderated the relationship between exaggeration and message credibility. However, message discrepancy did not have a moderating role in the relationship between message exaggeration and message credibility. Therefore, H3 was partially supported for Study B since visual literacy regarding visual manipulations did have a significant moderating effect. H4 was not supported since message discrepancy was not a significant moderator. Table 5 lists the estimates and *p* values.

Independent Variable	**ß (SE)**	**t value**	***p* value**
Message exaggeration	-1.65 (0.50)**	-3.29	0.001
VLIE	-0.21 (0.12)**	-1.67	0.09
Intensity x VLIE	0.43 (0.15)**	2.88	0.004
AIC	**2429.7**		

Table 5.1: Regression model predicting the effect of message exaggeration on message credibility. *Note*. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

The research model based on both studies can be found below.

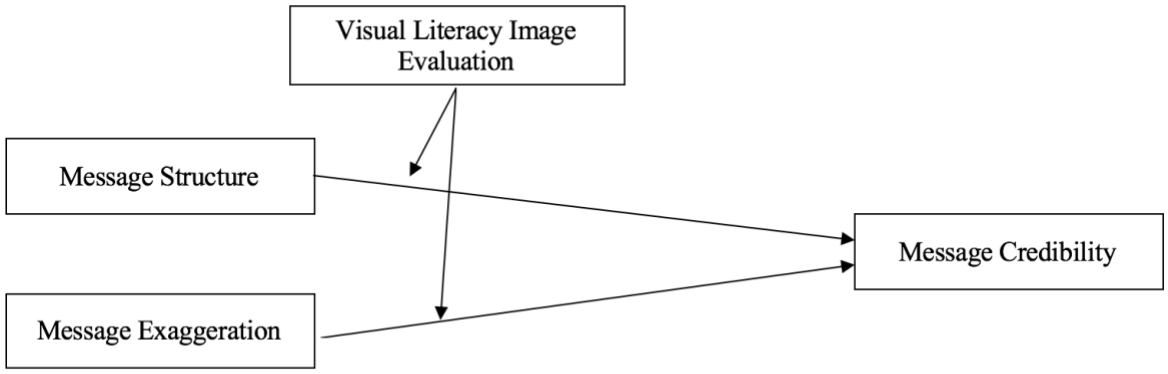


Figure 3.1: Research model

CHAPTER 6: DISCUSSION AND CONCLUSION

6.1 Discussion

In the presence of information overload and with the rise of big data, Krum (2013), describes people as 'informavore'. We are surrounded by so much information that oftentimes leads to a loss about how one should make sense of it. The way we make sense of this information overload, is using our sense of vision since vision (and visual processing) is one of our most dominant senses (Krum, 2013). Through a combination of pattern recognition, contextual references, and picture superiority effect (that leads people to remember visuals more than text), our minds process visuals around us. This provides a high-level understanding of why visual content might make a larger, or longer-term impact on people. However, in order to understand the specific elements of messages that affect information processing (specifically credibility in this dissertation), two experiments were conducted. These experiments were carried out to understand if previously proven determinants of message credibility (primarily studied in oral or text-based platforms) would translate successfully to a more visual platform.

Infographics were chosen as the form of media to test this for a number of reasons. First, infographics are popular media – and have been for decades – from gathering recognition in data visualizations in news articles decades ago (Krum, 2013), to more contemporary use in social media that has made these media easy to consume in bite-sized formats, and thus, also easy to share through affordances provided by social media. Second, in an era of misinformation, social media plays a vital role in spreading content that is not always accurate. Oftentimes, "dressing up" an incorrect piece of media as an accurate one, provides an outlet for those who intend to disseminate false information. Infographics are media developed for the express purpose of communicating complicated information, simply, for instance health information (Siricharoen &

Siricharoen, 2018). Finally, as one of the first studies trying to understand credibility of visual messages based on past credibility research, infographics present a good transitional media message, from text-based messages to more visual messages.

Additionally, it should be noted that, the three different health topics used to test the effectiveness of the independent variables in the infographics, did not have individual effects on message credibility, thus negating the possibility that the determined results were due to the specific health topic.

6.1.1 Effect of visual message structure on message credibility

The first study focused on the effects of message structure. Message structure has been proven, many times over, to be an important and consistent determinant of message credibility (Metzger et al., 2003). Between providing oral speeches in particular order to having content written messages structured in an intuitive fashion by providing the reader with transitional statements, the structure of a message has been shown to affect how a message's recipient processes the presented information, in general (Darnell, 1963; Ernest Thompson, 1960, 1967), and in credibility determination (Gass & Seiter, 1999; Melyn & White, 1973; Sharp & McClung, 1966). Furthermore, it also has an effect on different types of credibility (such as source credibility), even on web platforms. For instance, a site map or an index, on a website provides a guided path for the user to find specific pages on it, increases credibility perceptions (Metzger et al., 2003; Sundar, 2008).

Similarly, in this study (Study A), the structure of the health infographic was found to play a role in participants' credibility determination. This finding primarily adds to literature about message credibility. As discussed earlier, message credibility is the least explored form of

credibility and verifying the importance of structure in a new media message, such as an infographic, adds to our common knowledge about specific elements of messages and how they affect its credibility.

The findings from this study can backed up from various theoretical standpoint. For instance, the dual processing model, HSM states how when people process information using the heuristic route (in conjunction with or without the systematic route of information processing), they do so using judgment rules or heuristics, that are presumed to be learned and stored in memory (Chen & Chaiken, 1999). In accordance with past research, providing structure to the infographic, does increase its credibility. This, in part, could be due to the heuristics provided by the navigation tools within the infographic, that guide viewers' eyeline through the narrative of the infographic. Thus, the internal infographic navigation, not only assists users in interpreting how the health infographic's content must be viewed, but also assists with clarifying its narrative. The heuristic route of information processing described in the HSM is akin to the peripheral route described by the ELM (Petty & Cacioppo, 1986b) where people focus on the low-hanging fruit of the argument in order to process the information (navigation tools might provide this simplicity for the user to peripherally process the health infographic), and Metzger's (2007) dual processing model for credibility assessment (absence of motivation and ability to evaluate credibility leads to process credibility through a peripheral or heuristic pathway). This adds to the understanding of how people who come across health information online incidentally, and which they may not be necessarily seeking in that moment, are likely to heuristically process it.

Outside of the dual processing framework, we have Sundar's (2008) MAIN model that places an important emphasis on navigation cues in technological platforms that lead to

credibility perceptions. These navigability cues trigger heuristics through different navigational tools present on an interface, leading to clear navigation, which is generally considered to be more credible (specifically the *browsing heuristic* or the *scaffolding heuristic* can explain how navigational cues within health infographics might activate heuristics within people to guide them easily through it). Additionally, the unimodel (Kruglanski et al., 2006), discusses "rule activation", where activation of rules lending relevance to a message's content, reduce the difficulty of processing the messages, and thus enhance persuasion. This is the role played by navigation tools in the context of credibility (that activate a "pre-understanding" of the message) (Pettersson & Aktiebolag, 1998) thereby clarifying it's overall narrative of the bite-sized media and communicating their message to the audience.

Second, this finding also adds to our understanding of how visual messages are viewed and interpreted by people. Infographics, that are a combination of visuals and text, act as a transition into understanding how message credibility of visuals alone can be determined. This is similar to how transition statements have been used in written messages in the past and helped with their credibility (Thompson, 1967).

One important way to view this finding is through the role it plays in creating the narrative of the infographic. Infographics have become a way to tell complete stories rather than simply charts. They often tend to begin with introductions, contain an "a-ha moment" or the main idea, and end with a conclusion or call-to-action (Krum, 2013). In fact, Krum (2013), describes bad infographics as those with only a large volume of data visualizations but no cohesive storyline.

Taking a step back and applying this discussion to visualizations in general, Segel and Heer (2010) examine and elaborate from different case studies, the importance of sequential

structure across an image to the narrative of the image. They extrapolate narrative from its Oxford Modern Dictionary definition ("an account of a series of events, facts, etc., given in order and with the establishing of connections between them.") to a visual narrative. They point out how central to this definition is a chain of related events – i.e., stories often have a beginning, middle, and end or an introduction, tension or conflict, and a resolution. In written work, a story might have one type of a narrative structure (for e.g. a stream of consciousness conveying the story), whereas a journalist might structure the same information according to journalistic rules (a lead followed by the nut graf) (Segel & Heer, 2010). These structures, they explain, provide the reader with an understanding of how to interpret what they are reading. Thus, in order to properly structure a visual narrative, the creator of the visual should know the story they are telling in terms of intent – i.e., the purpose of the narrative should be clear and thus facilitate the discourse around the topic (Segel & Heer, 2010). In order to achieve this, a number of methods have been developed "for sequentially directing a viewer's attention and keeping viewers oriented across transitions" (p. 1140). For instance, colors can be used to attract viewers eye to objects, features such as spatial proximity, containment, or connection may lead people to observe the grouped content first (known as gestalt grouping), or most commonly some form of arrows provide a powerful technique to sequentially direct people's attention (called vectorial reference) (Segel & Heer, 2010).

This observation by Segel and Heer (2010) helps explain the findings of the present study. As seen in past credibility and other information processing research, the structure of the medium helps with how people perceive it. In the case of visual content, a narrative is important to communicate the intent of the message and structure of the visual helps define that narrative. This study examined three different types of possible visual transitions – these can be mapped on

to the gestalt grouping and vectorial reference explained by Segel and Heer (2010). Information in the health infographic stimuli was grouped together (referenced here as sectioning content). This sectioning had proximity and was contained in chunks (Appendix D – control condition) in a similar fashion to how gelstat grouping was described. Additionally, viewers were guided through the content sequentially (through navigational aids) as described by the vectorial reference.

It should be acknowledged here that the type of structure applied to the health infographics in this study are simply some examples of different types of structures that work for the express example of (health) infographics. Other types of infographics and visual messages in general probably have different kind of structures that assist their viewers' interpretation of the flow of the visual.

Specifically, in the context of health infographics, a takeaway for designers and developers is that the goal of the infographic must be kept in mind while designing it. Health issues contain especially complex matter that visuals, especially, infographics can and have been known to simplify (Siricharoen & Siricharoen, 2018). Building the narrative of the health infographic into its structure will provide the viewer with a clear idea of what information the infographic is trying to disseminate, much like narrative, in general, has helped with data visualization and infographics in the past (Baskinger & Nam, 2006; Lazard & Atkinson, 2015; Segel & Heer, 2010). For instance, Lazard and Atkinson (2015) describe "narrative visualization" where visual elements play a vital role in communicating their message. Additionally, this aligns with past work according to which a visual story must sequentially reveal information in an orderly fashion. This is because a non-verbal story can be successfully

told if the narrative sub-structure is built into it hierarchy and composition (Baskinger & Nam, 2006).

Therefore, to summarize, infographics use complex information and communicate it in a simple, yet compelling fashion. One effective technique that should be applied to this simplification is structuring the (health) infographic's narrative to communicate its story to the viewer.

How this structuring might apply to different visuals (such as memes, images, etc.) should be explored in the future. Future research can also apply these findings to health infographics of different topics or different structures. Identification of the underlying structure of these messages and how it might affect perception by viewers can help us understand how people determine visual message credibility.

6.1.2 Effect of visual message exaggeration on message credibility

The second study (Study B) focused on the message intensity determinant of message credibility. Since this study focused on a visual message, intensity was operationalized by exaggerating the message presented to the participants. The aim behind this was to present an "opinionated" message (as in the case of message intensity), but in a visual format.

Visual intensity was defined in this study earlier as an opinionated portrayal of a visual message using tools employed in visual platforms, as opposed to textual (or vocal) platforms. Operationalizing "opinionated" in a visual format presented a question of what it means to be opinionated primarily through visuals. Therefore, presenting the viewer with a visual message that created an illusion of reality while communicating the creator's skewed opinion, was selected as the way to depict opinionated visual messages. The visual platform in this case of this

were infographics – a medium that contains graphs and charts in order to communicate its message. Now, previous research has described how charts and graphs have been used to deceive viewers through subtle manipulations, implying a message to the viewer that the infographic creator wants them to believe, rather than the actual fact. Therefore, infographics with visually manipulated graphs (called message exaggeration) were the primary manipulation here. This translation of "language intensity" to "visual intensity" by exaggerating the presentation of accurate information was proposed by Pandey et al. (2015). The exaggeration was primarily done to elements prominently associated with infographics – the graphs. Graph axes were manipulated/exaggerated, while bars in the charts were not made clear enough to easily interpret, thus projecting different messages (or opinions) than an unmanipulated message would.

Similar to the effect of structure, message exaggeration also played a role in people's message credibility determination. This finding is in line with past work where communicators using more opinionated language reduce credibility of the message (Metzger et al., 2003). This finding is especially novel because this, seemingly, is one of the first studies to map existing message credibility determinants onto visual media and therefore modify operationalizations accordingly.

From a theoretical standpoint, the findings and their implications play a similar role as message structure. Message exaggeration in this study was carried out by making the graphs within the health infographics difficult to interpret with a quick glance. In the context of online content, in the presence of large volumes of information, people use heuristics to process things that they have no personal motivation or relevance toward. This has been explained through models like the ELM (Petty & Cacioppo, 1986b), HSM (Chen & Chaiken, 1999), and the unimodel (Kruglanski et al., 2006) and in the specific context of credibility by the MAIN model

(Sundar, 2008), and Metzger (2007). In this study, the graph that disseminates essential information within the infographic cues heuristically to the audience that the content is unclear and thus, likely to be less credible.

The major difference between message exaggeration and message structure is that message structure is less difficult to intuitively interpret than this sort of exaggerated message. Where the presence of structure added to the narrative of the message by guiding the viewers' eye through the message to increase its credibility, exaggerated messages acted in a reverse fashion, by decreasing credibility perceptions. This exaggeration does not, necessarily, add to the narrative of the infographic, but instead making the message less clear than ideal. It is important to note, that the exaggeration of the message in this study is one type of message exaggerated in a single way. Discussed in the literature review above, exaggeration is discussed from the perspective of cues and heuristics, such that individuals observe the *exaggeration cue*, thus activating the *persuasive intent heuristic* that arises from the fears of unknown others' manipulations (Metzger & Flanagin, 2013). This is only one possible explanation for what is happening. Whether or not the intent of the message creator was to deceive, the underlying misrepresentation of the data seems to be observed by people and has an effect on how hey process the credibility of the message.

Similarly, it is important to ask what other message exaggerations within health infographics might look like. This media form has plenty of textual and visual opportunities that could be possibly manipulated. Furthermore, other types of visual messages could be exaggerated in completely different ways and what those are needs to be investigated. This is especially important to note, since the concept of 'message exaggeration' was selected due to the nature of infographics, in general. An opinionated visual intensity might look completely

different than message exaggeration in another kind of visual message. This is because "opinionated" messages in visual content still need to be defined in and explored within different types of visual media. Infographics are just the first step in that direction. In this study, the message is exaggerated, but that might not be how other visual media present "opinion". Parsing out what "opinionated" looks like in images or memes, for instance requires a deep dive into the medium and understanding the context and framework of such messages.

Specifically, in the context of health infographics, a takeaway for designers and developers is that data presented within infographics is important to people's credibility determination. Health information is complex, and infographics streamline and present an easy-to-digest narrative to the viewer. The graphs and charts within it, however, do the job of compiling a lot of data into one, bite-sized image. If the graph does not have all the information within it for the viewer to interpret it fully, correctly, and quickly (such as a legend, x and y axes starting at the zero point, labeled axes, and easy to interpret values of the graph), people's credibility perceptions of the infographic are affected. This is in line with Pandey et al. (2015) who state that not following best practices of data visualization design, like the examples listed above, could lead to deceptive visualization (either with or without intent). Seemingly this deception is being noted by viewers in their credibility judgments, and therefore, care must be taken to present a neutral and factual depiction of charts and graphs. This means that people and organizations disseminating health infographics for the purpose of persuasion and education must have resources to create clear and appealing graphs with the data they have.

The deception through visualizations has been acknowledged before, however, how this deception affects the credibility has not been explored. This study provides a starting point for

such research, where future work can explore how such manipulations and deceptions of different types affect people's perception with regard to credibility.

It also provides insight into how people should be educated with regard to deceptive or manipulated visual information. The internet, a primary resource for most people's health information needs, is full of content that is either slightly incorrect or completely false. Having knowledge about how to identify this kind of misinformation can help people make accurate and thus, safer health choices.

It should be noted that data visualization distortion can be different for different kinds of visualizations (Jones, 2011). Other visuals may not have graphs or charts to create deceptions within them at all. For example, certain anti-vaccination content online will show images with children with many vaccines poking them in order to scare new parents about the trauma a new child would have to go through to get vaccines or what chemicals were being put into their body. Therefore, what can cause a deception in different types of visuals should be explored in the future.

6.1.3 Moderator effects on message credibility

Visual literacy was considered as a moderator in both studies. Four different variables associated with visual literacy were measured as described above – perceived visual literacy (PVL), visual literacy image evaluation (VLIE), visual creation skills (VLS), and actual visual literacy (AVL) (full scales in Appendix C).

PVL, VLS, and AVL were not significant predictors in either study. However, the variable known as visual literacy image evaluation (VLIE), i.e., an individuals' personal assumption of whether images or video are usually altered in the news or online, was a

significant moderator in both. This variable measured participants' assumptions regarding the visual content they viewed online, and if they believed it to generally be altered or manipulated.

This finding is interesting to note because it emphasizes the importance of one's prior beliefs (in this case, regarding presentation of information through technology). Historically, viewing content (as opposed to reading it) has tended to improve credibility perceptions (Metzger et al., 2003; Sundar, 2008). However, here we see that if one generally assumes that platforms present manipulated information, then their credibility perceptions are automatically affected, even in the case of visual content, i.e., their overall credibility perception of the infographic reduces. Thus, a general assumption about fake or manipulated information only leads to further assumption about content being manipulated. This finding is akin to the analogy of 'the rich getting richer', where 'the skeptical get more skeptical'.

The value of this moderator is especially important due to the role it plays in the effect of the independent variables on message credibility. While, message structure and message exaggeration, both have minor, but significant, main effects sizes without the moderator, the presence of the VLIE moderator greatly increased their effect sizes. This indicates that the assumption of manipulated content actually affects a person's perceptions of credibility in the presence of message credibility determinants.

6.2 Limitations

Despite best efforts, there are certain limitations of this study. First, because this is one of the first studies that maps message credibility dimensions and operationalizations on a visual medium, multiple manipulations were carried out in each study. For instance, in Study A, where the structure of the infographic was manipulated, one condition had all 3 navigational elements

(arrows, numbers, and sectioned content) whereas, the other condition had none. Similarly, in Study B, the graphs were exaggerated (the y-axis did not start from zero, and the interpretation of the graph was made harder) in one condition, with no complexities added to the other condition. It is impossible to disentangle whether which specific navigational element or exaggeration resulted in the effects observed. Future studies could tease out the different manipulations to determine if any individual one had a (larger) effect as compared to the others.

The sample of this study largely consisted of women. The population sampled for the study did not depend upon gender of participants and therefore, there was no conscious effort taken to sample equal men and women. It might be valuable for future research to investigate if gender does in fact, play a role in the determination of message credibility of visual content, by recruiting a more diverse population.

Third, the manipulation checks for the study were only partially successful. While Study A's results after eliminating respondents with failed manipulation checks, was nearly identical, Study B presented a different challenge. It should be acknowledged here that the manipulation in Study B was not straightforward – noting the manipulation and reporting it is complex and thus, eliminating all participants who failed this check would lead to a systematic bias – and the questions posed were also subjective in nature. Further, due to multiple manipulations per study, conducting a successful manipulation check was especially tricky. Finally, O'Keefe (2003) stated that when researching the effect of a message variation on a persuasive outcome, no message manipulation check is required to begin with. However, future studies should strive to pose clear and concise manipulation check questions.

While the hope is that the above reasons are what caused the failure in the manipulation check, it must be acknowledged that either the operationalization of visual intensity through

message exaggeration of graphs within the infographics, was faulty. Through multiple rounds of pre-testing care was taken to identify, and apply an accurate operationalization, but unclear manipulation check results suggest a need for deeper exploration.

6.3 Future directions

The work done in this dissertation is simply an early foray into the arena of visual communication and credibility research. There are a number of ways this research can be extended and explored in the future. First, the approach here employed a media form (infographics) that are fundamentally visual in nature but rely heavily on text. However, many visuals exist solely as visuals, favor visuals more than text, or utilize the text/visual combination very differently than infographics. For example, memes, pictures, screenshots, etc. These types of media are especially popular in online platforms, like social media. Thus, future research should focus on exploring the different types of visual communication and what affect their message credibility.

Next, where this study focused on message structure and message exaggeration, what these elements look like in different visual media could be very different. Therefore, these operationalizations should be explored and tested in different visuals. Furthermore, here the focus is only on two independent variables (namely message structure and message exaggeration). Other predictors have been identified by different researchers in the past (Appelman & Sundar, 2016; Metzger et al., 2003), and their effect on message credibility, especially in the context of visuals needs to be explored. Presently, there simply is not enough research on message credibility of visuals.

Finally, the predictors of message credibility (and credibility in general) often times overlap with the predictors or other types of credibility, and other predictors of behavior change. The effects of message structure and message exaggeration should be explored on different outcomes such as source credibility, attitudes, or behavioral intentions.

6.4 Conclusion

Overall, this study presented one of the first forays into understanding credibility of visual media based on the prior knowledge we have in message credibility research.

The implications of these studies are both practical and theoretical in nature. Overall, based on the results we observed three overarching themes. First, the structure of visual content is important, just as structure of different message types seen in the past. What the structure is in visual media might depend on the specific media. For instance, knowledge about memes comes from seeing many and knowing their context in order to apply their knowledge to different memes in the same format. Disruption of the expected format has an effect on people's credibility perceptions and might similarly have an effect in different visual formats and platforms as well. This adds to the theoretical body of literature and makes an initial foray with visual messages and credibility research. From a practical standpoint, the importance of designing visuals in a way that guides the viewer's understanding of that visual will help increase its credibility. Second, based on the moderator it can be surmised that knowledge about the subject on hand plays a role in credibility determination.

An overarching takeaway of this study is that while traditional message credibility determinants do play a role in people's message credibility judgments, these judgments are affected by people's general assumption about how manipulated content is in general – thus, if

they generally believe that visual content they usually come across is manipulated, this will automatically affect how they determine the credibility of visual media they are viewing.

This finding indicates that while the message elements do play a role in assisting people in their credibility judgments, their personal views on subject matter on hand or the medium they are viewing it through, also affects the outcome of information processing.

APPENDICES

APPENDIX A: INFOGRAPHIC TOPICS

HPV vaccine

About 12,000 women are diagnosed with and about 4,000 women die from cervical cancer caused by certain HPV viruses. Additionally, HPV also causes genital warts and cancers of the vulva, anus, penis and parts of the throat. Sexually transmitted through its various strains, people can be protected against nine strains including those that could cause cancers and genital warts through the vaccine Gardasil 9 manufactured by Merck and approved by the FDA in 2006 for men and women aged 9 to 26 years old.

The rhetoric surrounding the HPV vaccine, and vaccines in general has been contentious, to say the least. Antagonism toward vaccination has occurred ever since the 18th century where vaccines were opposed for religious reasons (Hussain et al., 2018). However, the popular, vaccines-cause-autism narrative was publicized and popularized in 1998 when former British doctor and researcher Andrew Wakefield and colleagues published a case study in the *Lancet* suggesting that the measles, mumps, and rubella (MMR) vaccine may predispose children to autism based on a small sample size (n=12), uncontrolled research design, and speculative conclusions (Hussain et al., 2018; Sathyanarayana Rao & Andrade, 2011). The "findings" of this paper were widely publicized through the media and MMR vaccination rates began to drop. Follow-up research conducted by others almost immediately refuted the findings and undisclosed financial interests of the authors were identified, while the *Lancet* completely retracted the paper in 2010, but by then the damage had been done (Sathyanarayana Rao & Andrade, 2011).

Vaccination reduced globally due to parental fears of the risk of autism, which in turn exposed people to diseases such as measles. In 2018, there have been measles cases reported in Arkansas, California, Connecticut, Florida, Illinois, Indiana, Kansas, Louisiana, Maryland,

Michigan, Missouri, Nevada, New Jersey, New York, North Carolina, Oklahoma, Oregon, Pennsylvania, Tennessee, Texas, and Washington, where the majority of people who got measles were unvaccinated ("Measles outbreak hits 21 states, District of Columbia, and is on track to surpass last year," 2018). Another large-scale breakout occurred in 2014-2015, believed to have originated from the Disneyland Resort in California that resulted in about 125 people contracting measles. The exposed population was only about 50% to 86% vaccinated. Physicians were criticized for diverging from the Center for Disease Control and Prevention's (CDC) recommended vaccine schedule and led to policy change where personal and religious exemptions to abstain from vaccines were banned (Hussain et al., 2018).

The spread of anti-vaccination sentiment and its movement was assisted by technology and media. While traditional media abetted the spread of the *Lancet* article, access to medical information online dramatically changed how patients sought, consumed, and engaged with health information.

Bone marrow donation

After deciding to volunteer, an individual goes through the human leukocyte antigen (HLA) typing. These HLA proteins found in the cells of people's bodies help match patients with donors – the closer the match, the more likely the transplant will succeed ("Blood and bone marrow stem cell donation," 2018).

If a volunteer is matched with a patient, doctors draw either bone marrow stem cells from the blood or bone marrow for transplantation. Bone marrow stem cells are forms in the bone marrow where they mature and are then released into the bloodstream. Previously, surgery was required in order to draw bone marrow stem cells directly from the bone. In this situation bone

marrow stem cells were collected from the pelvic bone when the donor was under general anesthesia. Today, however, it is much more common to collect the stem cells from blood (known as peripheral blood stem cell donation) ("Blood and bone marrow stem cell donation," 2018). In this situation, the risks are minimal. The process begins with giving the donor injections to increase the stem cells in the blood and after some time placing a catheter in their vein (mostly arm; alternatively, neck, chest, or groin), out of which blood is collected. The stem cells are isolated from the blood, the rest of which is then returned to the donor through the catheter in the vein. This process is called apheresis.

The predominant method of bone marrow donation is through peripheral blood stem cell, which means that donors do not need to go through surgical procedures and general anesthesia for marrow donation – it is simply done through the blood (and once the marrow stem cells are removed from the blood, the remaining blood is returned to the donor's body). In fact, only a very small percentage (1.3%) of donors experience serious complications due to anesthesia or damage to bone, nerve or muscle in their hip region (Hudson, 2012), in part due to the low number of donors having to go through donation through the actual bone. Furthermore, anyone between the ages of 18 and 44 can now join the registry for free ("Blood and bone marrow stem cell donation," 2018). Additionally, those between the ages of 45 and 60 can get a $100 tax-deductible payment to cover the cost to join ("Donate bone marrow," n.d.).

Colon cancer detection

Colorectal cancer is especially dangerous because it is often asymptomatic, especially at first. If a patient does show symptoms, they may appear as blood in the stool, stomach pains or cramps that do not go away, and unexplained weight loss (CDC, 2019b). Screening for this kind

of cancer is used to look for the disease when the patient is asymptomatic and can find precancerous polyps and remove them before they turn into cancer (CDC, 2019c). Thus, screening for colon cancer is imperative for patients if they are to successfully treat this disease. Screening strategies can include stool tests, flexible sigmoidoscopy (thin, flexible, lighted tube checks for polyps or cancer inside the rectum and lower third of the colon), colonoscopy (thin, flexible, lighted tube checks for polyps or cancer inside the rectum and the entire colon), and CT colonography (virtual colonoscopy) (CDC, 2019a).

Separating colon and rectal cancer, the study conducted on data about people born from 1890 to 1990 the American Cancer Society found that adults between ages 20 to 39 colon cancer increased by 1 to 2% per year, and in adults aged 40 to 54 the rates increased by 0.5% to 1% through 2013. In the case of rectal cancer, the rates are even higher with a 3% rise per year in adults aged 20 to 29 (from 1974-2013) and 30 to 39 (1980-2013). In adults from 40 to 54, there was a 2% increase (Siegel et al., 2017). Furthermore, the incidence rates for colorectal cancer will be up 90% in people between ages 20 and 34, and 28% for people between ages 35 and 49 by 2030.

APPENDIX B: ADDITIONAL RESULTS

Condition	Min	Max	Mean	SD
HPV Control	2.00	7.00	5.31	1.09
Bone Marrow Control	3.00	7.00	5.45	0.83
Colon Cancer Control	2.67	7.00	5.20	0.98
HPV No structure (Study A)	3.67	7.00	5.41	0.79
Bone Marrow No structure (Study A)	1.00	7.00	5.42	1.09
Colon Cancer No structure (Study A)	2.67	7.00	5.43	0.97
HPV Exaggeration (Study B)	2.00	7.00	5.06	1.09
Bone Marrow Exaggeration (Study B)	2.67	7.00	5.23	1.03
Colon Cancer Exaggeration (Study B)	2.00	7.00	5.04	1.07

Table 6.1: Pre-test manipulation check *(Total N for each is 50)*

Dependent Variable		Sum of Squares	df	Mean Square	F	*p*
Study A (message structure)	Between Groups	32.991	28	1.178	5.572	.000
	Within Groups	4.441	21	0.221		
	Total	37.432	49			
Study B (message exaggeration)	Between Groups	33.988	28	1.214	7.756	.000
	Within Groups	3.287	21	0.157		
	Total	37.275	49			

Table 6.2: Pre-test ANOVA results for Study A and Study B. *Note*. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Independent Variable	ß (SE)	t value	*p* value
Structure	-2.37 (0.8)**	-2.70	0.007
VLIE	-0.14 (0.21)	-0.71	0.47
Structure x VLIE	0.43 (0.26)*	2.43	0.01
AIC	**596.3**		

Table 6.3: Regression model predicting the effect of message structure on message credibility (without failed manipulation check respondents). *Note*. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

APPENDIX C: SURVEY ITEMS

Perceived Message Credibility (Appelman & Sundar, 2016)

On a scale of 1 (strongly disagree) to 7 (strongly agree), do you think the [TOPIC] infographic you viewed is:

- Accurate
- Authentic
- Believable

Additionally, Eastin (2001) measured message credibility through accuracy, believability, and factualness, and Li and Suh (2015) measure if information is believable, factual, credible, and trustworthy. Thus, *factual*, *credible*, and *trustworthy* items were added to this scale.

Perceived Visual Literacy (Lazard & Atkinson, 2015)

Directions: For the following questions, please select the response that best describes your opinion of the statement (1=Strong Disagree to 7= Strongly Agree)

1. When I look at photographs in advertisements or informational messages…

1. It is easy for me to identify the purpose of the image.
2. I usually understand the photographer's communication intentions.
3. I only focus on the subject (e.g., the person, place, or object shown in an image) without considering where or when the images were taken.
4. It is easy for me to detect digital manipulation.

2. When I look at non-photographic visuals (e.g. illustrations, drawings, graphic designs) in advertisements and informational messages…

1. It is easy for me to identify the purpose of the image.
2. I usually understand the artist or designer's communication intentions.
3. I only focus on the subject (e.g., the person, place, or object shown in the visual) without considering where or when the visuals were created.
4. It is easy for me to determine how the visual was created.

3. When I look at any visuals (i.e., photographs and non-photographic visuals) in advertisements or informational messages…

1. It is easy for me to determine what the creator wants me to think.
2. I usually understand the meaning of symbols or graphics used in the visuals.
3. I can easily tell if visuals have multiple meanings.
4. I critically evaluate the visuals for their meaning.

Lazard and Atkinson (2015) also measure image evaluation, visual creation skills, and actual visual literacy of participants based on Brumberger (2011) and Avgerinou (2007).

Images Evaluations

Directions: For the following questions, please select the response that best describes your opinion of the statement (1= never, 2 = rarely, 3 = sometimes, 4 = usually, 5 = always)

1. When you see images on the Web, do you assume they have been altered in some way?
2. When you see news video footage from mainstream sources (e.g., CNN, Fox, network television, etc.), do you assume it has been altered in some way?
3. When you see news video footage from non-mainstream sources (e.g. YouTube), do you assume that it has been altered in some way?
4. When you see images in a newspaper, do you assume they have been altered in some way?
5. When you see images in a magazine, do you assume they have been altered in some way?

Visual Creation Skills

How skilled do you consider yourself with… (1 = I have no experience with this type of software, 2 = Entry-level amateur, 3 = Slightly skilled, 4 = Somewhat skilled, 5 =Very skilled, 6 = Expert/professional)

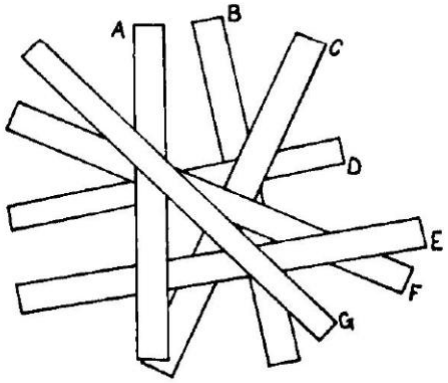
1. Presentation creation (e.g., MS PowerPoint®)
2. Drawing
3. Painting
4. Photography
5. Image Manipulation (e.g., Adobe Photoshop®)
6. Digital illustration (e.g., Adobe Illustrator®)
7. Website design (e.g., Adobe Dreamweaver®)

Actual Visual Literacy: *(Created and validated by Maria D. Avgerinou in the Visual Literacy Index)*

1. What does the item shown above represent/stand for?
_____ love [CORRECT] _____ affection _____sympathy _____ other (follow by a text entry)

2. What does the item shown above represent/stand for?
_____ male _____ androgynous _____female [CORRECT] _____ other (follow by a text entry)

3. What does the item shown above represent/stand for?
_____ copyright [CORRECT] _____ authorization _____possession _____ other (follow by a text entry)



4. The item shown is a pile of sticks viewed from above. In which order would you remove them, one at a time? Select the answer that best represents which stick would be available on the top as other sticks are removed.

_____ G, A, E, D, B, F, C
_____ E, D, G, A, F, E, B
_____ G, A, E, F, C, D, B [CORRECT Answer]

Control Variables

Gender. What gender do you identify with? (M/F/Other: Please specify)

Age. What year were you born in?

Race/Ethnicity. Which of the following best describes your ethnicity? (select all that apply)

- American Indian or Alaska Native
- Asian or Pacific Islander
- Black or African American

- Hispanic or Latino
- Native Hawaiian or Other Pacific Islander
- White / Caucasian
- Other, please specify

Education. What is the highest level of education you have? (select one)

- Elementary school
- Some high school
- High school
- Some college
- Associate's degree
- Bachelor's degree
- Master's degree
- Doctorate degree
- Other

Annual income. What is your annual household income?

- $6,000 a year or less
- $6,001-$10,080
- $10,081-$14,100
- $14,101-$18,000
- $18,001-$22,200
- $22,201-$26,160
- $26,161-$30,000
- $30,001-$48,000
- $48,001-$75,000
- $75,0001-$99,600
- $99,601-$126,000
- $126,001-$150,000
- More than $150,000

Social media platform use and frequency (1 = never, 2 less than once a month, 3 = once a month, 4 = 2-3 times a month, 5 = once a week, 6 = 2-3 times a week, 7 = daily)

- Facebook
- Twitter
- Instagram
- Pinterest
- Snapchat
- Tumblr
- Reddit

- Other (please specify)

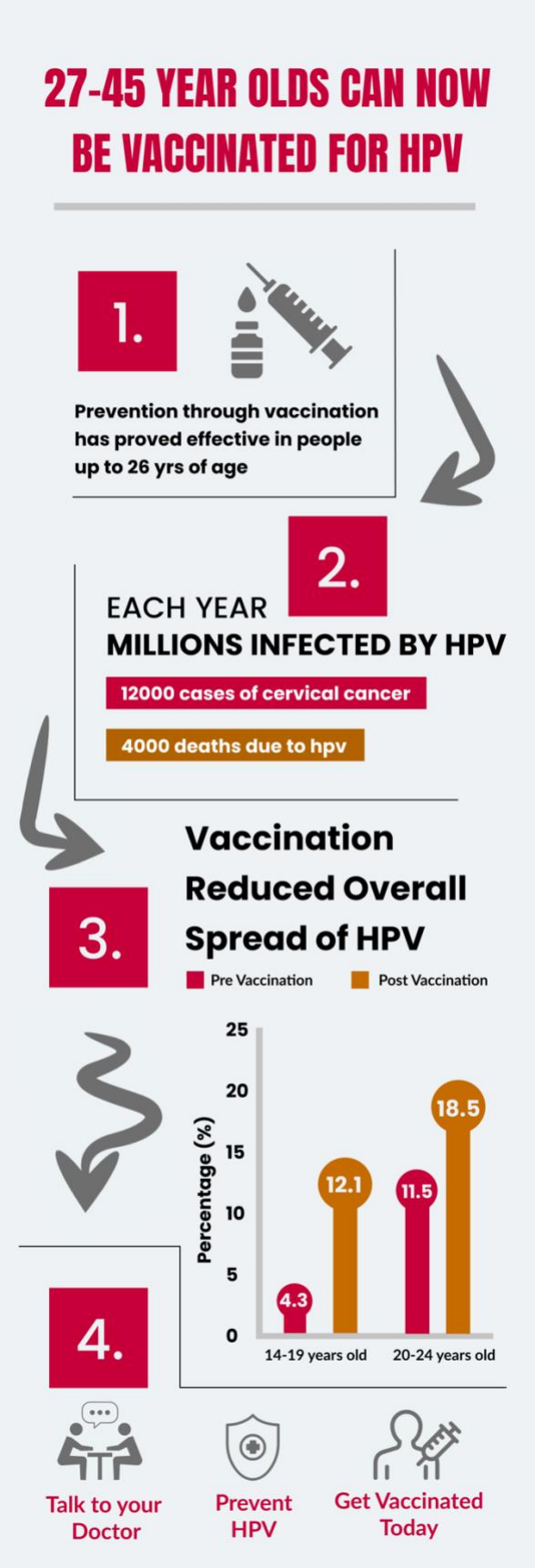
In your social media use do you prefer visual content (such as posts on Instagram or Pinterest) or text-based content (such as posts on Facebook or Twitter)?

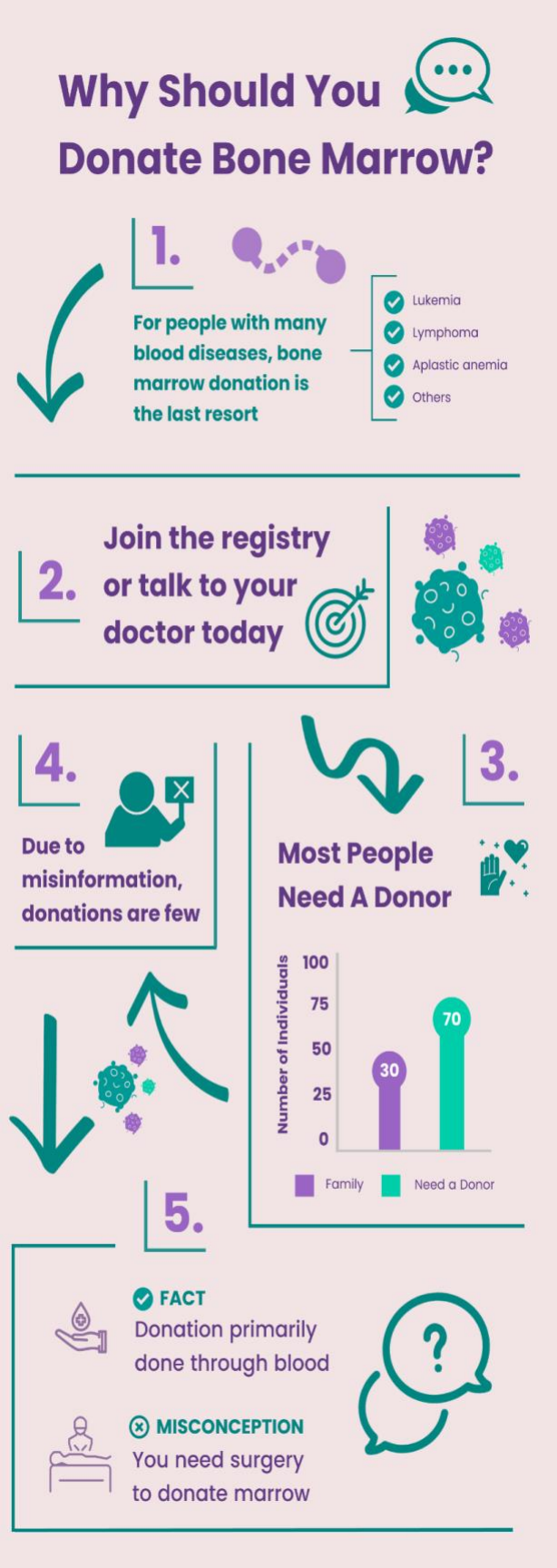
- Visual
- Text

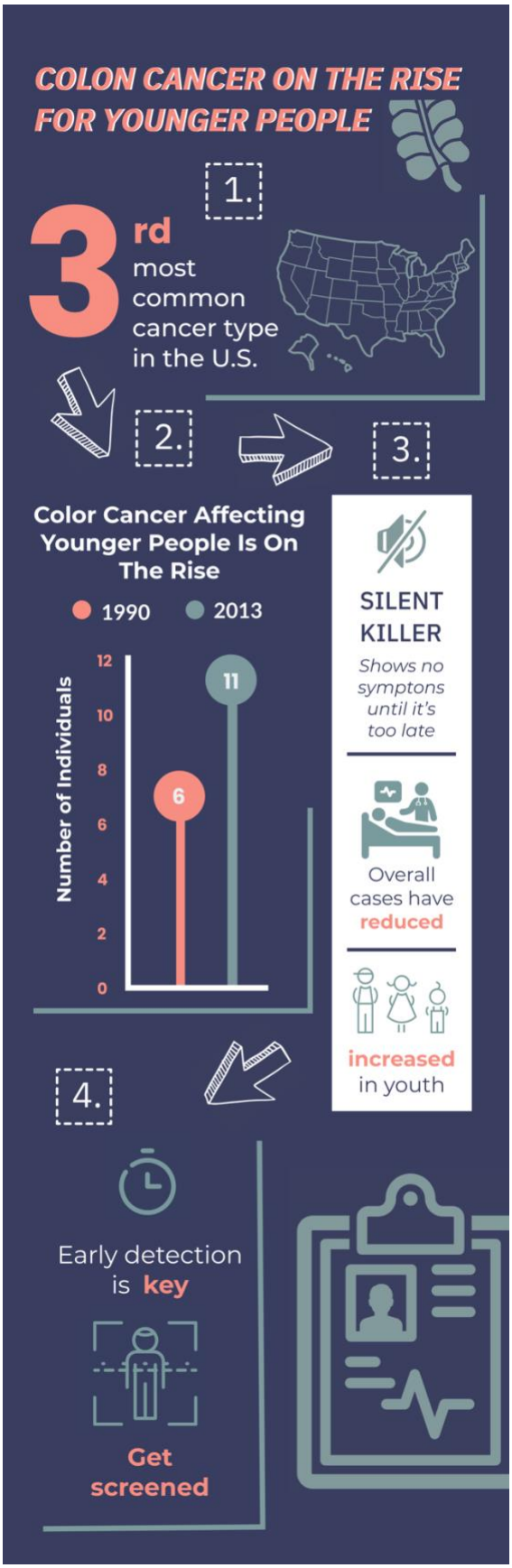
APPENDIX D: STIMULI

The stimuli for Study A and Study can be found below. The control condition stimuli were the same for both studies and are therefore listed first (3 infographics). Following this, the manipulated stimuli for Study A is listed (3 infographics), and finally the manipulated stimuli for Study B (3 infographics). In total, 9 infographic stimuli can be found below.

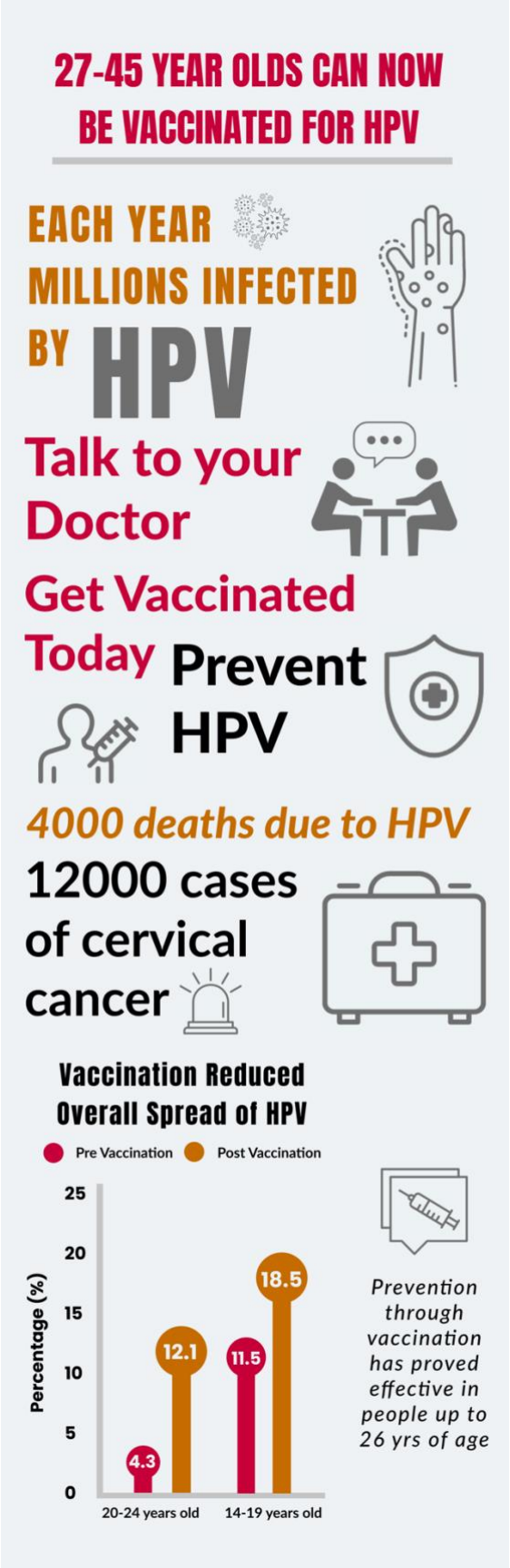
Control condition stimuli


27-45 YEAR OLDS CAN NOW BE VACCINATED FOR HPV
1.
Prevention through vaccination has proved effective in people up to 26 yrs of age
2.
EACH YEAR
MILLIONS INFECTED BY HPV
12000 cases of cervical cancer
4000 deaths due to hpv
3.
Vaccination Reduced Overall Spread of HPV
Pre Vaccination
Post Vaccination
Percentage (%)
25
20
15
10
5
0
4.3
12.1
11.5
18.5
14-19 years old
20-24 years old
4.
Talk to your Doctor
Prevent HPV
Get Vaccinated Today

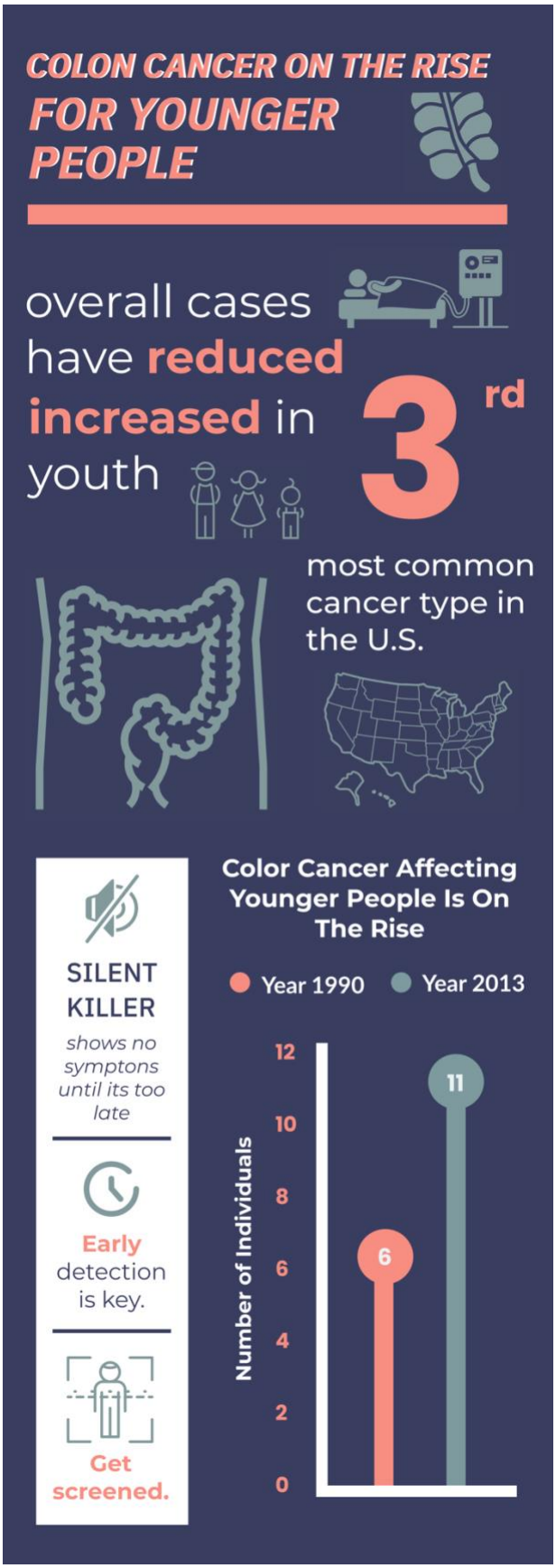

Why Should You Donate Bone Marrow?
1.
For people with many blood diseases, bone marrow donation is the last resort
Lukemia
Lymphoma
Aplastic anemia
Others
2.
Join the registry or talk to your doctor today
3.
Most People Need A Donor
Number of Individuals
100
75
50
25
0
30
70
Family
Need a Donor
4.
Due to misinformation, donations are few
5.
FACT
Donation primarily done through blood
MISCONCEPTION
You need surgery to donate marrow


COLON CANCER ON THE RISE FOR YOUNGER PEOPLE
1.
3rd most common cancer type in the U.S.
2.
3.
Color Cancer Affecting Younger People Is On The Rise
1990
2013
Number of Individuals
12
10
8
6
4
2
0
6
11
SILENT KILLER
Shows no symptons until it's too late
Overall cases have reduced
increased in youth
4.
Early detection is key
Get screened

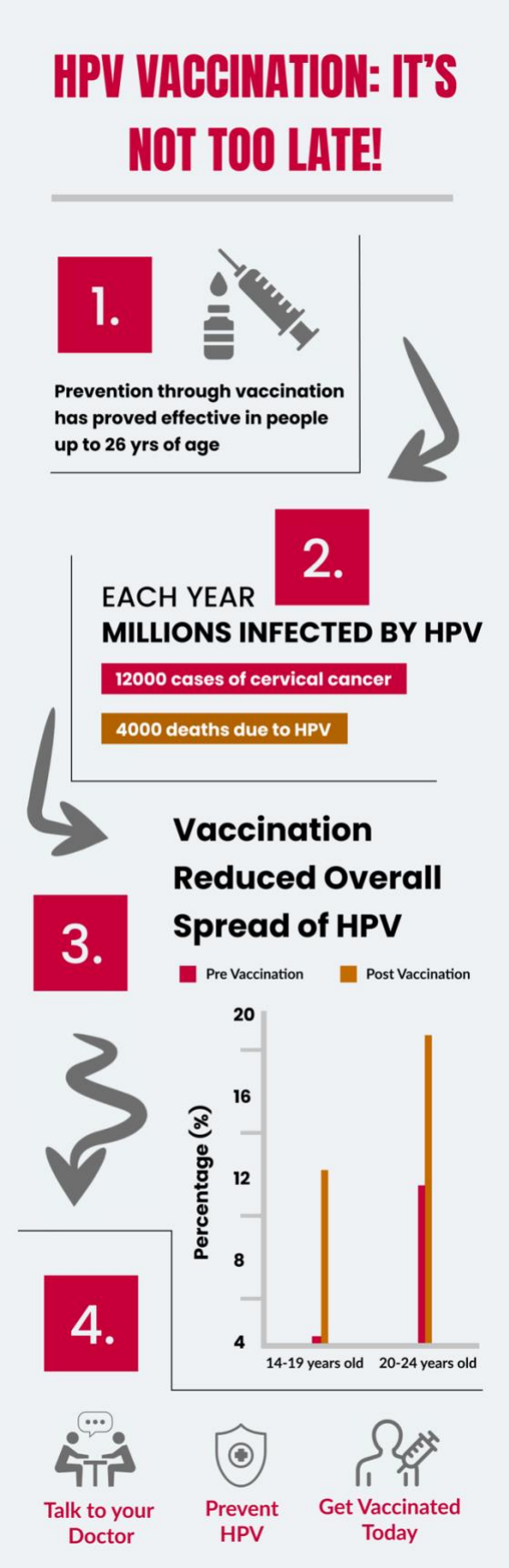
Manipulated Study A stimuli



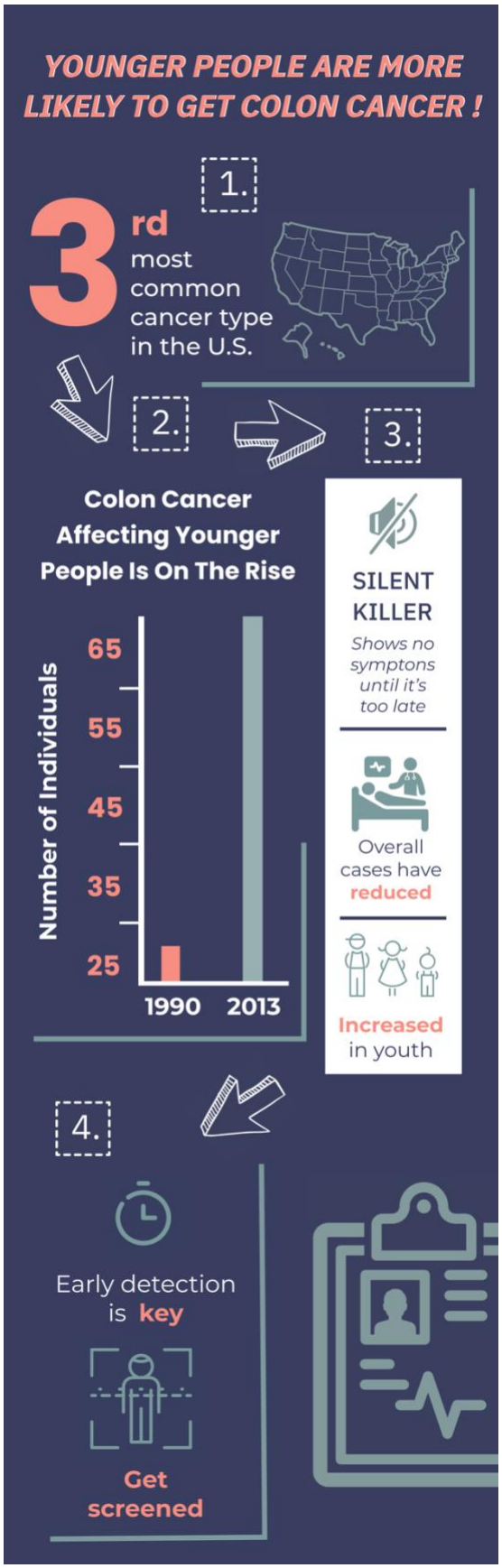

Why Should You Donate Bone Marrow?
For people with many blood diseases, bone marrow donation is the last resort
Lukemia
Aplastic anemia
Lymphoma
Others
Join the registry
or talk to your doctor today
Most People Need A Donor
Family
Need a Donor
100
75
50
25
0
30
70
Due to misinformation, donations are few
MISCONCEPTION
You need surgery to donate marrow
FACT
Donation primarily done through blood


COLON CANCER ON THE RISE FOR YOUNGER PEOPLE
overall cases have reduced increased in youth
3rd
most common cancer type in the U.S.
SILENT KILLER
shows no symptons until its too late
Early detection is key.
Get screened.
Color Cancer Affecting Younger People Is On The Rise
Year 1990
Year 2013
Number of Individuals
12
10
8
6
4
2
0
6
11

Manipulated Study B stimuli




Donate Bone Marrow: Save Lives!
1.
For people with many blood diseases, bone marrow donation is the last resort
Lukemia
Lymphoma
Aplastic anemia
Others
2.
Join the registry or talk to your doctor today
4.
Due to misinformation, donations are few
Most People Need A Donor
3.
Family
Need a Donor
Family
Need a Donor
25
35
45
55
65
5.
FACT
Donation primarily done through blood
MISCONCEPTION
You need surgery to donate marrow


YOUNGER PEOPLE ARE MORE LIKELY TO GET COLON CANCER !
1.
3rd most common cancer type in the U.S.
2.
3.
Colon Cancer Affecting Younger People Is On The Rise
Number of Individuals
65
55
45
35
25
1990
2013
SILENT KILLER
Shows no symptons until it's too late
Overall cases have reduced
Increased in youth
4.
Early detection is key
Get screened

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