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Design for Curiosity:
A Study of Visual Design Elements, Interaction, and Motivation

by
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Thesis submitted
in
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requirements for the degree of
Master of Science
in
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DESIGN FOR CURIOSITY

Rochester Institute of Technology

B. Thomas Golisano College of Computing and Information Sciences

Masters of Science in Human Computer Interaction

Thesis Approval Form

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Abstract

The field of Human Computer Interaction (HCI) has traditionally focused on the usability of a system, but as increasing numbers of interactive products become entwined in our daily lives, so does the opportunity to understand user impacts that reach beyond usability. In particular, interaction design, a subdomain of HCI, expands the focus of HCI by looking at the aesthetic impacts a system may have on user emotions. Curiosity is one such emotion that tends to induce information-seeking and motivational behaviors. An experimental study was undertaken to determine whether an interactive, front-end graphic that incorporated curiosity principles in its design would sufficiently pique a participating university faculty’s curiosity to interact with the graphic, and thereafter, with an existing platform named George that was developed to motivate faculty to engage in collaborative behavior. George includes capabilities for creating and storing individual faculty trading cards that include the faculty’s photograph, personal interests, research interests, and publication domains. The experimental graphic provided interactive capabilities to incrementally reveal segments of the photograph and to acquire information about the faculty’s research profile. The number of a study participant’s interactions with the graphic was limited by software. The data collected included the location and frequency of interactions with the graphic, and whether participants ultimately accessed the George platform. Statistically significant evidence demonstrated that the curiosity-provoking principles motivated interaction with the graphic, and that participants were also motivated to access George.
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Introduction

In 2015, Rochester Institute of Technology (RIT) published a strategic plan that included initiatives to grow and strengthen RIT’s research presence through collaborative and cross-functional opportunities. One core element of the plan was to increase multi-disciplinary collaboration. The plan included a specific objective to support these research initiatives: “Objective I.2.2 – Design and implement a clear, unbiased process for rewarding and encouraging faculty to work in new interdisciplinary teaching and research areas.” (Rochester, 2015). The Office of the Provost organized formal events to help bring together faculty from different programs for interdisciplinary groups. Dr. Deborah Gears, a faculty member of the College of Computing and Information Sciences, was awarded an internal grant to focus on the creation of a campus-wide platform, subsequently named George, designed to motivate participation in collaborative engagement among RIT scholars (Cook & Fusch, 2015).

George was designed to increase awareness among RIT faculty of their colleagues’ research interests. Through the George platform, an increased awareness among scholars of each other’s skills and interests could lead to collaborative work opportunities (Gears et al. 2016). To discover what factors would motivate RIT faculty to engage with George, Gears et al. (2016) administered the Reiss Motivation Sensitivity Assessment to RIT faculty. As noted by Gears et al. (2016), Reiss (2004) developed a theory of 16 basic desires that are testable. Reiss found that individuals are motivated by some basic desires more than others. Reiss states, “we pay attention to stimuli that are relevant to the satisfaction of our desires, and we tend to ignore stimuli that do not satisfy our desires” (p. 188). The results from the assessment by Gears et al. (2016) indicated that the highest-ranking intrinsic desires among RIT faculty were Curiosity, Honor, and Idealism.
with Curiosity ranking the highest. With these three intrinsic desires in mind, Scholar Trading Cards™ were created as the catalyst to motivate faculty collaboration. The cards were intended to appeal to faculty’s Honor by sharing information on their Scholar Trading Card™ by capturing their sense of pride and self-worth, to Idealism by providing an opportunity to build meaning to their work and to improving their academic community, and to Curiosity through the discovery on the George platform of new RIT colleagues (Gears et al., 2016). RIT faculty’s strong intrinsic desire of curiosity was of particular interest for this research.

Curiosity has long been recognized as a powerful influence on human behavior. It has been shown as a motivational factor that has led to human progress in areas such as educational attainment, scientific discovery, creativity, and childhood development (Loewenstein, 1994). The purpose of interaction design is to create an experience that is positive for the user based on trust, ease of use, and a sense of enjoyment. Designers of interactive systems also strive to create products that “elicit specific kinds of emotional responses in users, such as motivating them to learn, play, be creative, or social” (Rogers, Sharp & Preece, 2012, p. 127). Designed artifacts, unusual objects, depth of field, and oddity are several design conventions that, when implemented, have been found to arouse emotions such as curiosity (Sutcliffè, 2010).

For this thesis, a study was designed to investigate if and how curiosity could be used to motivate an individual to interact with a graphic designed to stimulate curiosity and thereafter be motivated to explore beyond the graphic.

An experimental front-end to the George platform was created that consisted of a composite of two types of information, photo and text. Both types of information were embedded in the George Scholar Trading Cards™, that included a faculty photo from one side of the card
and faculty information from the other side of the card. These elements from the Scholar Trading Cards™ became the foundation for the experimental graphic. The graphic incorporated perceptual and epistemic principles that are correlated to behavior motivated by curiosity (Litman & Spielberger, 2003). The perceptual curiosity principles included motion, visual elements, and tactile feedback. The epistemic curiosity principles included novelty, uncertainty, and partial exposure. Previous research had shown that these principles stimulate curiosity and motivate action (Houben & Weichel, 2013). RIT faculty members who were unfamiliar with the George platform were recruited as participants for this study. The interactions that participants had with the graphic on the experimental front-end were automatically collected and emailed to the author. Interaction behavior beyond the graphic was determined using a post-test survey.

Prior Work

Perception and Visual Aesthetics

As humans, we respond to the environment that surrounds us. Some of these responses are automatic and involuntary. These include, for sighted individuals, turning our heads toward something that moves, and sensing color and contrast. Understanding how we respond to visuals can provide a framework for creating visual elements within a design intended to capture attention.

Contrast is a central element the human mind seeks when individuals are viewing their surrounding (Bloomer, 1996). An example of this behavior is the figure-ground vase image created circa 1915 by the Danish psychologist Edgar Rubin (Figure 1). Our mind shifts from
seeing the faces or the glass as the primary image. This visual effect that allows the viewer to see one of two images at a time is engaging and intriguing. Other visual properties that have a similar effect include enticing the viewer to move closer in order to see more details (Figure 2), and images that resolve or dissolve when viewed at different distances (Figure 3). In addition to these visual effects, motion and depth are visual stimuli that can become a focus for a person’s attention. Once the viewer’s attention has been captured by a visual element, additional conditions need to be present in order to motivate the person to stay engaged.

Figure 1: Rubin’s vase, 1915. Reversible figure-ground visual element. The goblet is usually the first element noticed and the faces second. (Bloomer, 1996, p. 38)

Figure 2: “Our eyes are attracted by this poster’s delicately rendered tree, but as we draw closer we delight in the discovery of the letters. Finally we notice the architectural lines of the library itself.” (Bloomer, 1996, p. 39) With permission by Lance Hidy, designer.

Figure 3: Symbol from 1968 Olympic Games. The image of the skier is only visible from a distance. (Bloomer, 1996, p. 40) Roger Excoffon, designer
Visual Aesthetics in Human Computer Interaction

Traditional Human Computer Interaction (HCI) research has focused on “effectiveness and efficiency of interactions” (Moshagen & Thielsch, 2010, p. 691). As cited by Moshagen and Thielsch (2010), research conducted by Tractinsky (1997, 2000) and by Kurosu and Kashimura (1995) provided a shift away from the traditional focus. These researchers were able to show a relationship between visual aesthetics and perceived usability. Based on these findings, scholars began to show an increased interest in the view that HCI research needs to include the overall experience “including emotions and visual aesthetics” (Moshagen & Thielsch, 2010, p. 691).

Motivation and Curiosity

Motivation is a catalyst for what people do and how they behave (Gears, 2012). Motives are manifested through actions and behaviors and may even inform a person’s values. Motives can be extrinsic, which come from things outside of us such as accumulating money as a reward for workplace performance or avoiding negative behavior such as smoking. Or they can be intrinsic, which comes from within us such as a behavior that results in enjoyment or satisfaction, such as the desire to obtain knowledge (Reiss, 2004).

Loewenstein (1994) discussed the importance of curiosity in human behavior. Although powerful, curiosity is also transient in nature and “superficial in the sense that it can arise, change focus, or end abruptly” (Loewenstein, 1994, p. 76). Nevertheless, it can be a strong motivational force.

Several constructs address the arousal of curiosity. As cited by Tieben, Bekker and Schouten (2011), Berlyne (1960) identifies states of curiosity such as novelty, complexity, uncertainty, and conflict. Jones (1979) showed that curiosity is piqued when the stimulant
includes elements that are novel and somewhat familiar. In addition, Loewenstein (1994) proposed the concept of an information gap, which describes “a gap in our knowledge” (Tieben et al. 2011, p. 362) that produces an element of curiosity when the gap of knowledge is somewhat, but not too, familiar. Golman and Loewenstein (2016) provided a more formal definition of the information gap. They posit that individuals dislike uncertainty and will seek clarity, which is a “universal motive for information acquisition rather than avoidance” (p. 159). Curiosity is the motive they identified for the pursuit of clarity and “motivated attention” (p. 13) as the drive created from the anticipation of acquiring the missing information to close the information gap. In order to spark motivated attention, individuals need to be aware that they will be able to acquire the missing knowledge, which is “crucial for the treatment of curiosity” (p. 156). Tieben et al. (2011) cited that Vorst added to these constructs the notion of “partial exposure” to “information and/or stimuli” (p. 362). Based on these earlier notions, Tieben et al. identified five fundamental principles when designing for curiosity: novelty, complexity, uncertainty, conflict, and partial exposure. These principles are foundational to the present study’s graphic.

As cited by Litman and Spielberger (2003), Berlyne (1954) parsed curiosity into two categories that he labeled perceptual curiosity and epistemic curiosity. Berlyne (1954) defined perceptual curiosity as occurring when a person’s focus is given to perceptual stimulation such as visual, auditory or tactile stimuli, and epistemic curiosity as a need for an individual to obtain knowledge with the goal to close any gaps in one’s knowledge.

The value of understanding what stimulates curiosity from the perspective of interaction design is that curiosity can be used as a motivator to inspire or direct particular actions. In the
case of the current study, this includes using perceptual curiosity and epistemic curiosity to motivate study participants to seek additional information to increase their knowledge about a fellow RIT faculty member who is represented in the front-end graphic.

**Designing for Curiosity**

**Curious object used to pique curiosity.** Longitudinal studies have found that the public does not often use public interactive displays (Houben & Weichel, 2013). These displays, often in the form of digital screens, fall victim to interaction blindness, which is the inability for people to see public displays as anything more than a digital billboard with advertisement and generic information. When this occurs, interaction opportunities with the screen can be missed that could have yielded useful information, for example, learning more about the environment where the digital display is located or providing a person with personalized data to address their specific needs or questions. However, Houben and Weichel (2013) found that a carefully constructed interaction platform, incorporating curiosity-provoking principles, *could* bring about curiosity and motivate people to interact with large touch screens in public spaces.

To test this hypothesis and address the problem of interaction blindness, Houben and Weichel (2013) incorporated into an interactive platform five curiosity-provoking principles (novelty, complexity, uncertainty, conflict, and partial exposure) to observe whether curiosity could be sufficiently stimulated to reduce interaction blindness of interactive displays. The interactive platform was composed of an object designed to pique curiosity and an interactive display. It was not readily apparent that the object and interactive display had a relationship with each other until the object was explored by a person and the interactive display responded. The results of their study confirmed that introducing these five principles fostered curiosity and
increased interactivity and the amount of foot traffic within the space surrounding the interactive display.

The object Houben and Weichel (2013) used to pique curiosity was the World’s Most Useless Machine (Figure 4). This machine was connected to an interactive display, intended for sketching, that was placed in a public space. The user was drawn to the curious machine by its novel appearance and by an element of complexity through a switch-reset mechanism. Through the use of a commonly understood switch the mechanism presented just enough information to engage the observer to interact with the switch.

![World's Most Useless Machine](image)

Figure 4. "World's Most Useless Machine" (Houben & Weichel, 2013, p. 1539). The machine was invented by Claude Shannon (p. 1541).

The unexpected behavior that happened after the switch was set created a sense of uncertainty. Once the curious machine piqued a person’s curiosity, he or she was motivated to explore when the switch mechanism on the object revealed the interactive properties on the display that was located away from the machine. This drew people over to the interactive display, which encouraged people to sketch on the display.
The baseline observation that did not use the curious machine to entice exploration of the interactive display resulted in zero interactions with the public display. Once the curious machine was introduced, 76% of the participants were drawn to interact with the curiosity machine and then to the interactive display to sketch (Houben & Weichel, 2013).

The use of the curious machine removed the interactive blindness that typically occurs when electronic public displays are used to display information and provide interaction opportunities. As the experiment was set up in a public space, Houben and Weichel (2013) also observed that a social effect was created. Passers-by who witnessed people interacting with the display went directly to the interactive display to sketch, skipping the interaction with the curious machine.

**Designing for curiosity: Closing the information gap.** When information is presented in a way that provides access to only a subset of the information, a person becomes focused on wanting to discover the missing information. Lowenstein (1994) referred to this state-of-affairs as an “information-gap” that he described as producing a “feeling of deprivation labeled curiosity” that arises “when attention becomes focused on a gap in one’s knowledge” (p. 87). When this feeling of curiosity arises, a person is motivated to learn what information is missing in order to overcome this feeling of deprivation by filling his or her gap in knowledge. Loewenstein (1994) hypothesized that the manner in which information is presented was directly related to the ability to stimulate curiosity.

To examine this hypothesis, Loewenstein (1994) designed a study that allowed participants to explore a matrix of animal images. Participants were randomly presented a 45-square matrix with a different animal in each square, or with a matrix that was a single animal image. In the
former, clicking on each square revealed an image of a single animal in its entirety, and in the latter, clicking on a square in the matrix would reveal a segment of the animal picture. Participants were not told the study was about curiosity, and in a guise of getting participants to interact with the matrix of images, they were asked to familiarize themselves with the use of the mouse by clicking on at least 5 squares in the matrix. Curiosity was measured by how many times participants clicked more than the requested five squares. As Loewenstein (1994) hypothesized, when presented with the matrix of a single animal, participants were more curious about the hidden image and clicked significantly on more than five squares in order to see the image.

Law, Yin, Goh, Chen, Terry and Gajos (2016) applied Lowenstein’s information gap concept to test whether the gap had an effect on incentivizing crowd workers (crowdsourcing). Law et al. created one base-line design and four “curiosity-inducing designs” (p. 4100) each having a different curiosity intervention. Results from the experiment showed that using curiosity-inducing stimuli encouraged participants to complete their crowdsourcing task especially when more difficult or less interesting tasks are presented.

**Interactive display incorporating audio to pique curiosity.** Tieben et al. (2011) conducted a study to understand how interactive systems can be designed to “change behavior in a playful manner” (p. 361). They tested their five principles (novelty, complexity, uncertainty, conflict, and partial exposure) to design for curiosity by creating interaction scenarios that used sound as the method to pique curiosity among college students walking down a hallway.

The first prototype emitted sounds of farm animals, which was completely out of context for a hallway setting. This prototype demonstrated that novelty could pique curiosity, although
short lived, with 70% of the students in the hallway stopping to explore the system (Figure 5).
The second prototype introduced a level of complexity and partial exposure by softly playing audio tracks from famous movies. As the observer moved closer to hear the audio, the sound faded and started at another audio box in the hallway. This prototype did not prove to pique curiosity, with only 10% of students stopping to explore the audio clips.

Figure 5: Interactive loudspeakers that transformed action into sound. (Tieben et al., 2012, p.363)

Tieben et al. (2011) concluded that the audio feedback was too passive and not sufficiently important to spark curiosity. The third prototype added an element of uncertainty. While walking through the hallway, sound would be emitted from the speakers. As the students approached a speaker, they would discover that making a physical action, such as waving a hand, would impact the music being played in an unpredictable way. This prototype resulted in 50% of the students stopping to interact with the system. The fourth prototype created an element of conflict through an audio that played numbers sequentially, and then unexpectedly, a number would play out of order.

The researchers also tested an audio track that spoke the name of the color of each dot on the floor as the student walked by those colored dots. The audio recording would name a color out of sequence to the color dot the student was walking on. Although this scenario was interesting to some students, it did not elicit a lot of curiosity-provoked behavior.
Tieben et al. (2011) concluded from their study that the success of the interactive system to pique curiosity depended on the user, context, and the memory that the interactive system creates. It was also suggested that combining the five curiosity principles could “lead to even more powerful results” (p. 369).

**Experimental Study**

**Overview**

The goal of this study was to determine if a graphic with interaction design components that incorporated curiosity principles could create an experience that piqued an individual’s curiosity to interact with the graphic. In order to motivate study participants to interact with the graphic, this study incorporated two types of curiosity as described earlier: perceptual curiosity and epistemic curiosity (Berlyne, 1954).

Perceptual curiosity is piqued by stimuli such as visual, auditory or tactile. Epistemic curiosity can emerge when there is limited knowledge of a thing and a desire to increase one’s knowledge in order to reduce this gap in knowledge as described by Lowenstein’s information gap theory. These different types of stimuli are “substantially correlated” (p. 85) to behavior motivated by curiosity (Litman & Spielberger, 2003). The perceptual principles incorporated in the graphic included motion, visual elements and tactile feedback. The epistemic curiosity-provoking principles included novelty, uncertainty, and partial exposure. The graphic was presented within the context of the George platform.

**Research Questions**

Through the graphic, the following research questions (RQ) were explored.
RQ1. Does the graphic containing the curiosity-provoking principles – visual stimulants, novelty, uncertainty, and partial exposure – pique curiosity in order to motivate the study participants to interact with the graphic?

RQ2. Will participants’ behavior demonstrate a preference to acquire image type information or demonstrate a preference to acquire text type information?

RQ3. Will participants be motivated to access the George platform after interacting with the graphic?

Hypotheses

Hypothesis 1

H0 1: H0: µ = 0

There is no difference in the frequency of participants’ interaction with the left (photo side) or right side (data side) of the graphic.

Ha 1: H0: µ ≠ 0

There is a difference in the frequency of participants’ interaction with the left (photo side) or right side (data side) of the graphic.

Hypothesis 2

H0 2: H0: µ = 0

There is no difference in the number of participants who log into the George website after selecting an eye-con <=3 times, or >3 times.

Ha 2: H0: µ ≠ 0
There is a difference in the number of participants who logged into the George website after selecting an eye-con $\leq 3$ times, verses $> 3$ times.

**Design of the Interactive Graphic**

The foundation for the graphic was the Scholar Trading Cards™ associated with the George platform. One side of the card displays the faculty member’s profile photo with name and associated graduate school. The other side of the card displays information about the faculty member’s research profile (Figure 6).

![Figure 6: Example of an RIT scholar trading card showing both sides of the card.](image)

The graphic created for this research displayed both sides of the card side-by-side. The left side of the graphic displayed the faculty photo. The right side of the graphic displayed selected information from the Researcher Stats section. The four items under Researcher Stats included skills, research areas, research methods, and domains. The author decided to use only this data in order to simplify the amount of information available on the graphic. The Research Stats is a set of information that can stand alone from the other data on the card and still have meaning to
participants. In addition, the four Researcher Stats categories were four separate interaction points for the participant to reveal if they chose to interact with them. The Research Stat categories names were changed slightly in order to provide context to the information under each category name, since the specific content was obscured from view until the participant chose to expose it through interaction. Specifically, researcher stats was changed to researcher profile and my was added in front of each profile category; for example, Skills was changed to My Skills (Figure 7).

Curiosity-provoking principles. The perceptual principles incorporated in the graphic included motion, visual elements and tactile feedback. The epistemic curiosity-provoking principles included novelty, uncertainty, and partial exposure – which previous research has shown to stimulate curiosity and motivate action (Houben & Weichel, 2013). Using the graphic the author tested if the incorporated curiosity principles would stimulate a participant’s curiosity to explore the graphic in order to reveal the identity of the obscured scholar.
The motion of the eye-cons, the tactile feedback from selecting an eye-con, and the visual image represented in the graphic simulated perceptual curiosity.

Scholar Trading Cards™ were used to create novelty in the graphic. Trading cards historically have been associated with displaying athletes and not academics. To ensure that the concept of Scholar Trading Cards™ was novel, participants for the study were screened to confirm that they were not familiar with George and therefore not familiar the RIT Scholar Trading Cards™. Additionally, a small eye graphic (eye-con) was incorporated into the graphic as a novelty (Figure 8).

The principle of uncertainty was applied by hiding from the study participant what was on the left and right side of the graphic. A matrix of grey squares was placed over the photo side of the graphic, hiding the image. Solid white rectangles were placed over each of the researcher stats information, so that only the category names were visible.

Uncertainty was further created on the photo side of the graphic by randomly placing graphic visuals of an eye-con over eight of the grey squares in the matrix. The location of these eight eye-cons randomly changed every three seconds, so that participants could never be certain on which grey square an eye-con would appear. Eye-cons were also placed over each of the four white rectangles covering the researcher profile data. These eye-cons were stationary. Participants could only expose information in the graphic that contained an eye-con. The eye-con was the visual cue of where to interact with the graphic (Figure 8).
First view of graphic

View of graphic after 3 seconds

View of graphic after next 3 seconds

Figure 8: Static representation of the initial graphic with three images to demonstrate change of left-side eye-cons after 6 seconds.
Partial exposure, a curiosity principal, occurred once an eye-con was selected revealing either a portion of the photo or a piece of data under a white rectangle (Figure 9). To acquire a more complete set of information, additional eye-cons needed to be selected. This created partial exposure and piqued the participant’s curiosity and desire to fill the information gap (Loewenstein, 1994).

The photo side of the graphic was motivated by Lowenstein (1994) who reported that the image in his study that revealed partial information of a whole image induced more curiosity from the participant than an image that was fully exposed when selected. The data side of the graphic had four discrete categories; although they all pertained to one person, each category when selected was a complete set of information.

After the first eye-con was selected the Select an eye... connect! text changed to Select An Eye Or... Guess Which Colleague (Figure 9).

Figure 9: Visual design element after two eye-cons have been selected; one from the left and one from the right.
Guess Which Colleague was an action button that provided an option for the participant to select from a list of three colleagues they thought the graphic was obscuring. The Guess Which Colleague action button provided an alternative path to the eye-cons for participants to select after one eye-con had been selected. Having a path for the study participants to choose from, other than the graphic, provided a means for the author to understand if the graphic was intriguing enough for participants to want to continue interacting with it.

**Evolution of the graphic**

Several variations were made of the graphic in order to determine which might be the best to stimulate a participant’s curiosity. Students and faculty members from the George project, faculty members from the College of Computing and Information Sciences, and a faculty member from the College of Imaging Arts and Science provided feedback on the various design concepts. This feedback, while informal and unstructured, helped to inform the final graphic.

Two concepts were initially developed that incorporated the curiosity-provoking principles of visual stimulation, novelty, uncertainty, and partial exposure. For both of these initial concepts, only the photo side of the George Scholar Trading Cards™ was implemented in the design.

Concept 1 had a graphic representation of a blue sky with clouds placed over the faculty member’s photo (Figure 10). A small square window was placed over the sky graphic to expose that portion of the hidden photo. Arrows on the right and left side of the graphic that, when selected, caused the small square window to move to a different area. After moving, the square window would close the view that it had exposed while exposing the new area of the photo it had moved to (Figure 11).
Concept 2 used a matrix of multi-colored squares that covered the photo and randomly changed which square the eye-cons would appear over (Figure 12). The interaction with the eye-cons to expose the image was the same as the final concept in the study where the image would remain exposed after an eye-con was selected.
From the perspective of the faculty members who reviewed these two initial concepts, the graphics were found not to be intriguing since they only provided a photo to uncover, which was found to be of little interest. The faculty and George team members who reviewed the concepts did not find concept 1, with the moving window, intriguing.

Faculty members who provided feedback found that having factual information, in addition to the photo, to be more interesting. With this feedback, a final graphic was chosen that used the interaction behavior of concept 2 and added the information side of the Scholar Trading Cards™ to the graphic. Finally, the decision was made to have a matrix of grey shaded squares, instead of multi-colored ones, to remove the possibility that participants would place meaning on one color over another and therefore using color as a selection criteria. The removal of color also allowed for more visual emphasis to be on the eye-con graphic.

Design concepts 1 and 2 incorporated the George logo. The original intention was to use the George logo as a way to access the George site. However, the George logo was designed to invoke curiosity and since the goal of this experiment was not to understand the relationship between the graphic and the George logo, the use of the logo was removed from the final design concept.

Conduct of the Experiment

Participant recruitment. 20 RIT faculty members were recruited, none of whom was familiar with the George website, to participate in the experiment. A random sampling from all RIT faculty was used to select participants using a Microsoft Excel list obtained from the RIT Human Resources Department. The functionality of Microsoft Excel was used to randomize the list of faculty to select who would receive invitations to participate in the study. Invitations to
participate were personalized and emailed to the first 30 faculty members on the list (Appendix A – Invitation to Participate). If a faculty member did not respond within several days a reminder email was sent to request participation. If there was no response to the reminder email after a couple of days another batch of invitations was sent out, using the randomized list, until the recruitment goal was reached. A total of 199 email invitations were sent out and 24 faculty members accepted the invitation and were qualified to participate. One participant was later disqualified because of prior familiarity with the George website. SurveyMonkey was used to email invitations to participate in the experiment, obtain informed consent, and direct participants to the experiment website with the graphic. Each participant’s interactions with the graphic were collected from the experiment website and the results were sent to the author’s email. The data that was emailed to the author included the participant’s consent to participate in the study, the time the graphic was accessed, how many eye-cons were selected, if they were selected from the left or right side of the design, and in which order. The author then used SurveyMonkey to send a post-test survey to participants (Appendix A – Study Post-test Survey).

Five Scholar Trading Cards™ from the George platform were used as part of the graphic. One of the five Scholar Trading Cards™ was randomly selected as the baseline. Prior to use, permission was obtained from the respective faculty members.

Approval was obtained to conduct the research from the RIT Internal Review Board, prior to recruitment and conducting the experiment (Appendix A – IRB Approval). Informed consent was obtained from participants before enrolling them in the experiment (Appendix A – Participant Consent Request).
The functional graphic was implemented with the help of an RIT student in the Golisano College of Computing and Information Science who worked on the George platform project. A colleague of the author built into the functional graphic a data collection mechanism that emailed to the author the interaction behavior results of each participant as described in the previous paragraph. The author provided to the developers all the graphics and a flow map outlining the behavior the visual-design element needed for its construction (Appendix B).

**Participant activity.** After a participant accepted the informed consent, he or she was provided a link to the experiment website. Upon entering the experiment website, the participants were presented with the graphic as shown in figure 8. One of the five existing Scholar Trading Cards™ was used as the base for the graphic. The experimental website randomly selected a Scholar Trading Card™ each time a participant entered the experimental website.

The text Select an eye… connect! appears above the graphic the first time the webpage is opened. This was intended to provide initial direction. A total of eight eye-cons were randomly placed on the grey squares that covered the photo side of the graphic. These eye-cons randomly disappeared and reappeared every 3 seconds over a different grey square, initially capturing the participant’s attention by relying on perceptual curiosity to look at the movement.

An eye-con was also placed on top of each white rectangular box on the Researcher Profile side (the right side of the graphic). The author chose to keep the eye-cons on this side stationary, since the information hidden by the white rectangles was completely revealed if an eye-con was selected, and the participant’s curiosity would not be piqued by trying to “close the information gap” (Loewenstein, 1994, p. 88). In addition, the four data categories on the right side were
always available to select from, unlike the photo-side that had only eight random interaction points at any one time available to choose from.

Participants were able to interact with any area that contained an eye-con which became the visual cue of where to select. After the first eye-con was selected the text Select an eye… connect! changed to Select An Eye Or… Guess Which Colleague where Guess Which Colleague was an action button.

Participants had an opportunity to select from the eye-cons a maximum of eight times. Each time an eye-con was selected that area was uncovered and would remain visible. Once participants selected an eye-con eight times, they could only select the Guess Which Colleague button from the graphic. At any time, participants could choose to exit from the study website which ended the session by closing the browser window.

Selecting the Guess Which Colleague button displayed a view that showed three faculty names to choose from (Figure 13). Of the three names, one belonged to the faculty member obscured by the graphic.

This person is...

Nicholas DiFonzo, PhD

Deborah Gears, PhD

Michael Palanski, PhD

Figure 13: Example of three faculty names that appear after Guess Which Colleague button is selected.
If the participant chose to select from the names and was correct, a success message was displayed. If the participant guessed incorrectly, a message was displayed telling them they were incorrect. Both messages were self-dismissing dialog boxes. Once this self-dismissing dialog box closed, the participants were taken to the official George website login screen.

A follow up survey was sent to participants to understand their reactions and thoughts of the graphic.

**Results**

A total of 23 RIT faculty accepted the invitation to participate and were qualified to take part in the study. Participants were not limited to the number of times they could access the study website. Five of the participants interacted with the graphic more than one time. As a result, the findings reported are for 37 separate encounters with the graphic from the 23 participants. *(Encounters refers to separate visits to the study website to interact with the graphic.)* A post-test survey was used to determine if participants accessed the George platform after interacting with the graphic. Of the 23 participants, 16 answered the post-test survey.

**Encounter Patterns**

Appendix C displays the 37 encounter patterns with the graphic and identifies the patterns associated with logging into the George platform. The experimental system enforced a maximum limit of eight eye-cons selections per encounter. The eight eye-cons could be selected in any order from the photo side, from the data side, or from both sides *(Figure 8.)*

There were 17 encounters where only selections of eye-cons on the photo side were selected and none on the data side. There were two participants (P09 and P16) that selected only
eye-cons on the photo side on multiple encounters (Figure 14). There were no encounters where only eye-cons on the data side were selected.

<table>
<thead>
<tr>
<th>Participant #</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Visited George</th>
</tr>
</thead>
<tbody>
<tr>
<td>P09 a</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>Unknown</td>
</tr>
<tr>
<td>P09 b</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>Unknown</td>
</tr>
<tr>
<td>P16 a</td>
<td>L</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>P16 b</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>Yes</td>
</tr>
<tr>
<td>P16 c</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>Yes</td>
</tr>
<tr>
<td>P16 d</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>

Figure 14: Multiple encounters with only eye-con selections on the photo side.

In four encounters, all of the eye-cons available on the data side were selected (Figure 15). Although participant 04 selected more eye-cons on the data side for the first of three encounters, the other two encounters had one selection from the data-side each.

<table>
<thead>
<tr>
<th>Participant #</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Visited George</th>
</tr>
</thead>
<tbody>
<tr>
<td>P04 a</td>
<td>L</td>
<td>L</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>Yes</td>
</tr>
<tr>
<td>P04 b</td>
<td>R</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>Yes</td>
</tr>
<tr>
<td>P04 c</td>
<td>R</td>
<td>L</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>P10</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>No</td>
</tr>
<tr>
<td>P14 b</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>No</td>
</tr>
<tr>
<td>P14 c</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>No</td>
</tr>
<tr>
<td>P14 d</td>
<td>R</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>L</td>
<td>No</td>
</tr>
<tr>
<td>P14 e</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>No</td>
</tr>
</tbody>
</table>

Figure 15: All eye-cons on the data side revealed.

Another pattern showed participants alternating their selections between the photo side and the data side (figure 16). Interestingly, participant 06 did not select all four of the available eye-cons on the data side but rather selected three of the four available eye-cons.
Six participants had multiple encounters with the graphic. In those multiple encounters individual participants selected eye-cons more from the photo side than the data side (figure 17).

Several interaction patterns were associated with participants who logged into the George platform (Figure 18). Participants who selected more eye-cons from the photo side and who also logged into the George platform was a predominate interaction pattern. Participants that had
multiple encounters with the graphic (n=4) were also more likely to log into the George platform. Lastly, with the exception of participants 05 and 24, ten participants that logged into the George platform also selected at least one eye-con from the data side.

<table>
<thead>
<tr>
<th>Participant #</th>
<th>Selection Order and Frequency (Out of a maximum of 8 selection tries)</th>
<th>Visited George</th>
</tr>
</thead>
<tbody>
<tr>
<td>P02</td>
<td>L L L L L L L L</td>
<td>No</td>
</tr>
<tr>
<td>P04 a</td>
<td>L L R R R R</td>
<td>Yes</td>
</tr>
<tr>
<td>P04 b</td>
<td>R L L L L L L L</td>
<td>No</td>
</tr>
<tr>
<td>P04 c</td>
<td>R L L L L L L L</td>
<td>No</td>
</tr>
<tr>
<td>P05</td>
<td>L L L L L L L L</td>
<td>Yes</td>
</tr>
<tr>
<td>P06 a</td>
<td>R L L R L R L L L L</td>
<td>Yes</td>
</tr>
<tr>
<td>P06 b</td>
<td>R L R L R L L L</td>
<td>No</td>
</tr>
<tr>
<td>P07</td>
<td>L L R L L L L L</td>
<td>Yes</td>
</tr>
<tr>
<td>P08</td>
<td>L L L L L L</td>
<td>No</td>
</tr>
<tr>
<td>P10</td>
<td>R R R R L L L L L L</td>
<td>No</td>
</tr>
<tr>
<td>P12</td>
<td>L L L L L L R R</td>
<td>No</td>
</tr>
<tr>
<td>P14 a</td>
<td>L L L L L L R R</td>
<td>No</td>
</tr>
<tr>
<td>P14 b</td>
<td>R R R R R R L L L L</td>
<td>No</td>
</tr>
<tr>
<td>P14 c</td>
<td>L L L L L L L L</td>
<td>No</td>
</tr>
<tr>
<td>P14 d</td>
<td>R L L L R R R R L L</td>
<td>No</td>
</tr>
<tr>
<td>P14 e</td>
<td>L L L L L L L L</td>
<td>No</td>
</tr>
<tr>
<td>P16 a</td>
<td>L L L L L L L L</td>
<td>Yes</td>
</tr>
<tr>
<td>P16 b</td>
<td>L L L L L L L L</td>
<td>Yes</td>
</tr>
<tr>
<td>P16 c</td>
<td>L L L L L L L L</td>
<td>Yes</td>
</tr>
<tr>
<td>P16 d</td>
<td>L L L L L L</td>
<td>Yes</td>
</tr>
<tr>
<td>P17</td>
<td>Selected only 1 &quot;eye-con&quot;. Unknown if from left or right side.</td>
<td>No</td>
</tr>
<tr>
<td>P18</td>
<td>R L L L L L L L L</td>
<td>Yes</td>
</tr>
<tr>
<td>P21</td>
<td>L L R R L L L L L</td>
<td>Yes</td>
</tr>
<tr>
<td>P22</td>
<td>Selected only 1 &quot;eye-con&quot;. Unknown if from left or right side.</td>
<td>Yes</td>
</tr>
<tr>
<td>P23</td>
<td>R R L L L L L L L</td>
<td>Yes</td>
</tr>
<tr>
<td>P24</td>
<td>I I I I I I</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Figure 18: Interaction patterns of participants that logged into the George platform.

The interaction summaries shown in Table 1 and Table 2 show participants’s strong propensity to select information from the photo side compared to selecting information from the
data side. This propensity can be attributed to the curiosity-stimulating principles incorporated in the graphic, along with a priority desire to close the information gap.

Table 1: Broad interaction pattern categories.

<table>
<thead>
<tr>
<th>Selection Categories</th>
<th>Encounters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only eye-cons on photo side selected</td>
<td>18</td>
</tr>
<tr>
<td>Only eye-cons on the data side selected</td>
<td>0</td>
</tr>
<tr>
<td>All eye-cons selected on the data side</td>
<td>4</td>
</tr>
<tr>
<td>More eye-cons from the data side than the photo side</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2: Total eye-con selections on the photo side and the data side.

<table>
<thead>
<tr>
<th>eye-con location</th>
<th>Total Selections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photo side</td>
<td>183</td>
</tr>
<tr>
<td>Data side</td>
<td>34</td>
</tr>
</tbody>
</table>

**Statistical Analysis – Hypothesis 1**

To address the first two related research questions, “Does the graphic containing the curiosity-provoking principles – visual stimulants, novelty, uncertainty, and partial exposure – pique curiosity in order to motivate the study participants to interact with the graphic?” and “Will the different information modalities, image and text, in the graphic pique participant’s curiosity differently?” a chi-square test of goodness-of-fit was performed framed, by hypothesis 1. Hypothesis 1 (H0, null) stated that there would be no difference in the frequency of participants’ interaction with the left (photo side) or right (data side) of the graphic. There was statistically significant evidence to reject the null hypothesis, $X^2 (4, N = 37) = 37.5, p = 18.47$. There is evidence to support the alternative hypothesis given there is a preference in the
frequency of participant interaction with the left (photo side) or right side (data side) of the graphic. Additionally, the chi-square test showed that the observed frequencies compared to the expected frequencies have a 99.9% confidence level that more participants will select from the photo side than from the data side of the graphic (Table 3).

Table 3: Frequencies of Visual Design Element Interactions

<table>
<thead>
<tr>
<th>Selected eye-cons</th>
<th>Selected eye-cons equally (photo and the data side)</th>
<th>Selected more eye-cons photo side than data side</th>
<th>Selected max eye-cons photo side (8)</th>
<th>Selected max eye-cons data side (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed Freq.</td>
<td>19</td>
<td>4</td>
<td>28</td>
<td>8</td>
</tr>
<tr>
<td>Expected Freq.</td>
<td>12.4</td>
<td>12.4</td>
<td>12.4</td>
<td>12.4</td>
</tr>
</tbody>
</table>

*Note. $X^2 = 37.5^*$, df = 4. Numbers in parentheses ( ), are expected proportions. *p = .001

Discussion – RQ1 and RQ2

The statistically significant selections made from the photo side over the data side of the graphic align with the study results from Lowenstein (1994), and Law et al. (2016). In Lowenstein’s study it was shown that participants favored interacting with an image that was incrementally revealed as opposed to interacting with an image that revealed complete information all at once. According to Lowenstein (1994) this implies that the presence of curiosity tends to motivate individuals to attempt to fill the information gap.

In the post-test survey, participants were asked what they found more intriguing in the graphic; the photo side, data side, both sides, or neither side. Of the 23 participants, 16 answered the post-test survey. Six, of the 16, participants in the post-test survey reported that the data (right side) was more intriguing, three participants found that the photo (left side) more intriguing and three found that both the data and photo equally intriguing. An explanation for
why the survey did not show a strong preference for the photo may be that although participants found the data side more interesting, when they encountered the graphic their curiosity from the curiosity-provoking principles and motivation to close the information gap on the photo side was stronger. Law et al. (2016) found that “interestingness” (p. 4106) in tasks was important for the completion of the tasks and that applying “curiosity interventions” (p. 4106) to less interesting tasks had a greater effect on task completion. Tasks that were found to be interesting were completed even when they did not apply curiosity interventions. In fact Law et al. (2016) had study participants specifically mention curiosity as a motivator to their actions. This could explain why participants reported in the post-test survey that they did not find the photo side as intriguing (or interesting). Further more, in the present study, participants had the opportunity to guess which colleague was hidden in the graphic (Figures 9 and 13). All participants selected the Guess which Colleague button, demonstrating again that the use of curiosity provoking principles can nudge a person to go beyond the initial interaction or task they are performing even if deemed uninteresting.

Statistical Analysis – Hypothesis 2

To address the third research question, “Is there a relationship between interacting with the graphic and participant’s motivation to interact beyond the graphic specifically choosing to access the George platform?” a chi-square test of goodness-of-fit was performed framed by the secondary hypothesis. This secondary hypothesis stated that there is no difference in the number of participants that log into the George website who interacted with the graphic by selecting an eye-con \(\leq 3\) times, or \(>3\) times. The decision to use three eye-con selections for hypothesis 2 was chosen for several reasons. One eye-con selection was required in order for the “Guess
Which Colleague” to appear to provide an alternate path, and the second and third eye-con selections provide participants an opportunity to select from the photo side or the data side more than one time to help determine if they should continue exploring. There was statistically significant evidence to reject the second null hypothesis, $X^2 (1, N = 16) = 71.2, \, p = 10.83$. There is evidence to support the alternative hypothesis that there is a difference in the number of participants who logged into the George website who interacted with the graphic by selecting an eye-con $\leq 3$ times, or $>3$ times. Additionally, the chi-square test showed that the observed frequencies compared to the expected frequencies have a 99.9% confidence level that the data will yield a higher frequency of participants logging onto the George platform who selected three or more eye-cons on the graphic (Table 4).

Table 4: Frequencies of Participants Logging Onto George Platform

<table>
<thead>
<tr>
<th>Categories</th>
<th>$\leq 3$ eye-cons selected</th>
<th>$&gt;3$ eye-cons selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logged onto George</td>
<td>Observed Freq. = 1</td>
<td>Observed Freq. = 9</td>
</tr>
<tr>
<td></td>
<td>Expected Freq. = .20</td>
<td>Expected Freq. = 1.4</td>
</tr>
<tr>
<td>Did not log onto George</td>
<td>Observed Freq. = 1</td>
<td>Observed Freq. = 5</td>
</tr>
<tr>
<td></td>
<td>Expected Freq. = .12</td>
<td>Expected Freq. = .84</td>
</tr>
</tbody>
</table>

*Note. $X^2 = 71.5^*, \, df = 1, \, *p = .001$

**Discussion – RQ3**

Participants that selected three or more eye-cons from the graphic had a 99.9% confidence level of being motivated to log into the George platform. Unlike the research by Law et al. (2016) that tested to see if curiosity interventions applied to task characteristics influenced task completion, participants in this research study were not tasked with logging into George, but were presented with the opportunity to do so. However, like Law et al. (2016), who showed that using curiosity interventions motivated participants in their study to complete requested tasks,
the participants in this study, whose curiosity was piqued to interact with the graphic three or more times, were also motivated to perform a task beyond the interactions with the graphic.

**Summary and Conclusion**

The objective of this study was to determine if a graphic with interaction design components that incorporated two types of curiosity, perceptual curiosity and epistemic curiosity, could create an experience that piqued an individual’s curiosity to interact with the graphic. In addition to the initial interactions, would he or she be motivated to explore beyond the graphic?

Study participants’ interactions with the graphic was measured by the number of times that they selected an eye-con graphic, whether the graphic was selected from the photo side or data side of the graphic, and in which order the selections were made. Also measured was the number of participants that selected the Guess Which Colleague button to discover who was in the graphic, and which participants interacted beyond the graphic by logging into the George platform.

There was a 99.9% confidence level that the photo side of the graphic would be selected over the data side. Based on previous research the application of the curiosity provoking principles on the photo side created an information gap in participant’s knowledge and stimulated their curiosity to see whose image was hidden (Loewenstein, 1994).

There was also evidence that participants were motivated by curiosity to continue their interactions beyond the graphic. All of the participants in this study selected the Guess Which Colleague button to find who was hidden in the graphic. In addition, there was a 99.9%
confidence level that participants would be motivated to interact beyond the graphic, by logging into the George platform, when they selected three or more eye-cons. This coincides with the research result from Law et al. (2016) which showed that participants were motivated by curiosity to complete tasks and fill information gaps when curiosity provoking stimuli are used especially when used for difficult or not-so-interesting tasks.

Based on this study curiosity, used as a motivator, appears to control behavior demonstrated by the participants’ propensity to selected eye-cons from the photo side even though the data side was expressed as more interesting by faculty in the post-study survey and during the evolution of the graphic.

**Opportunities for Future Work**

This study demonstrated that the participating RIT faculty members’ curiosity was piqued, which motivated them to interact with the graphic and that the curiosity-provoking elements were stronger on the photo side. There is an opportunity to explore if adding a stronger information-gap presence on the data side can pique curiosity more to expose the hidden information than what was demonstrated in this study. One idea is to expose the data more slowly. In order to gain better insight into the interaction behavior, implementation of a *think-out-loud* protocol could be conduct with each participant. A next step is to explore if and how the graphic and interactions can pique curiosity more broadly and so motivate an individual’s behavior to attain both personal and societal goals. Since the graphic is tied to the George platform, future research could be conducted to understand if the graphic can be leveraged to motivate collaborative engagement among scholars by actively engaging other faculty listed on George.
Acknowledgements

• Capstone committee
  o Jeffery Lasky, for all of his time, guidance and thoughtful comments as my thesis chair.
  o Bryan French
  o Deborah Gears

• Members of the George platform team.

• Special thanks to my employer, Welch Allyn, for sponsoring my Masters degree.

• Thank you to friends Teresa Washburn and Winsome Graham O’Neal who encouraged me to pursue this educational goal.

• A special thank you to my husband, Bruce Harvey, for support, encouragement and many good meals to help me complete this milestone.
References


Curiosity and knowledge. (1979). *Psychological Reports, 45*, 639-642. [https://doi.org/10.2466/pr0.1979.45.2.639](https://doi.org/10.2466/pr0.1979.45.2.639)


[https://doi.org/10.1002/0470048204](https://doi.org/10.1002/0470048204)


[https://doi.org/10.1145/2468356.2468631](https://doi.org/10.1145/2468356.2468631)


[https://doi.org/10.2466/pr0.1979.45.2.639](https://doi.org/10.2466/pr0.1979.45.2.639)


[https://doi.org/10.1207/s15327752jpa8001_16](https://doi.org/10.1207/s15327752jpa8001_16)


Appendix A

IRB Approval

Rochester Institute of Technology
INSTITUTIONAL REVIEW BOARD
585-475-2167 - www.research.rit.edu/hsro - hsro@rit.edu

FORM A: Request for IRB Review of Research Involving Human Subjects

- Submit BOTH, an electronic version to hsro@rit.edu AND the signed original of the completed Form A AND ALL attachments (consents, instruments, tasks, etc.) to HSRO, University Services Center, Suite #2400

<table>
<thead>
<tr>
<th>Project Title:</th>
<th>Design for Curiosity: A Study of Visual Design Elements, Interaction, and Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigator’s Name:</td>
<td>Elaine Montambeau</td>
</tr>
<tr>
<td>Investigator’s Phone:</td>
<td>315-657-2818</td>
</tr>
<tr>
<td>Investigator’s Email:</td>
<td><a href="mailto:Ecm1609@rit.edu">Ecm1609@rit.edu</a></td>
</tr>
<tr>
<td>Investigator’s College and Department:</td>
<td>Golisano College of Computing &amp; Information Sciences – Information Sciences and Technology</td>
</tr>
<tr>
<td>Project Start Date:</td>
<td>January 4, 2016</td>
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<tr>
<td>Date of IRB Request:</td>
<td>December 1, 2015</td>
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<tr>
<td>If Student, Name of Faculty Supervisor:</td>
<td>Dr. Deborah Gears</td>
</tr>
<tr>
<td>Faculty’s Phone:</td>
<td>585-475-5348</td>
</tr>
<tr>
<td>Faculty’s Email:</td>
<td><a href="mailto:Deborah.Gears@rit.edu">Deborah.Gears@rit.edu</a></td>
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<td>If Not Employed or a Student at RIT, List Name, College &amp; Dept. of RIT Collaborator:</td>
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</tr>
<tr>
<td>RIT Collaborator’s Phone:</td>
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<tr>
<td>RIT Collaborator’s Email:</td>
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<tr>
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<td>If yes, name of funding agency:</td>
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<tr>
<td>Status of project:</td>
<td>☐ Submitted on N/A ☐ Funding pending N/A ☐ Funding confirmed N/A</td>
</tr>
<tr>
<td>Do you have a personal financial relationship with the sponsor?</td>
<td>☐ Yes ☑ No N/A</td>
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BY MY SIGNATURE BELOW, I ATTEST TO AN UNDERSTANDING OF AND AGREE TO FOLLOW ALL APPLICABLE RIT, SPONSOR, NEW YORK STATE, AND FEDERAL POLICIES AND LAWS RELATED TO CONDUCTING RESEARCH WITH HUMAN SUBJECTS. If significant changes in investigative procedures are needed during the course of this project, I agree to seek approval from the IRB prior to their implementation. I further agree to immediately report to the IRB any adverse incidents with respect to human subjects that occur in connection with this project.

Signature of Investigator
Date

Signature of Faculty Advisor (for Student) or RIT Collaborator (for External Investigator)
Date

Signature of Department Chair or Supervisor
Date

Complete the attached Research Protocol Outline and attach to this cover form with other required attachments.

Attachments required for all projects:

☑ Project Abstract
☑ Investigator Responsibilities and Informed Consent Training Certificate(s) from OHRP (see http://ohrp-ed.od.nih.gov/)

Attachments required where applicable:

☑ Informed Consent Materials for guardians
☑ Cover letter to subjects and/or parents or guardians
☑ Questionnaire or survey
☑ External site IRB approval
☐ Relevant Grant Application(s)
☐ Other
☐ Letter of Support from School Principal
Form A (continued): Research Protocol Outline

- The RIT Institutional Review Board (IRB) categorizes Human Subjects Research into three Risk Types (Exempt, No Greater than Minimal Risk, and Greater than Minimal Risk, defined at the end of this form). The IRB makes the final determination of risk type.

- Please complete this entire form (1 through 10 below). ENTER A RESPONSE FOR EVERY QUESTION. If a question does not apply to your project, please enter “N/A”. Leaving questions blank may result in the form being returned to you for completion before it is reviewed by the IRB.

- Underlined terms are defined at the end of this form.

FOR ALL PROJECTS, please complete 1-10 below.

1) If you believe your project qualifies for Exemption, which exemption number(s) apply? Exemption 2 (Note: The IRB makes the final determination of Exemption)

2) Describe the research problem(s) your project addresses.
   Visual and interaction design elements, such as those that occur in digital and physical user interfaces, that pique curiosity and motivate a user to take action are not well understood.

3) Describe expected benefits to subjects and/or knowledge to be gained from your project.
   Curiosity has been recognized as a powerful influence on human behavior. It has been linked as a motivational factor that has led to human progress in areas such as educational attainment, scientific discovery, creativity, and childhood development (Loewenstein, 1994). Given this information it is important to understand if and how visual design elements and interaction can pique curiosity so to motivate an individual’s behavior to attain goals personal and societally.
   The goal of this thesis it to show that certain simulants, when incorporated into a visual element, can invoke curiosity in a person inspiring the user to interact with a system.

4) Describe the population sample for your project.
   a) How many subjects will participate in this project?
      The researcher has a goal of a minimum of 20 participates to participate in the study.
      In addition, 10 faculty members that have “George” playing cards will also be recruited for permission to use a digital version of their playing card in the exploratory design element.
   b) How will these subjects be identified and selected for participation?
      Simple random sampling will be used to invite RIT 30 faculty that do not have a “George” account to participate in the study. This list will be entered into an Excel document and then randomly ordered. The first 30 names on this randomly ordered list will be emailed an invitation to participate.
      If more then 20 participants respond, within the defined deadline, the researcher will randomly select 20 participants’ data that is collected. The remaining data points will be discarded.
   c) Describe the rationale for inclusion or exclusion of any subpopulation.
      The visual design element will be presented within the context of an existing RIT project, “Motivating Collaborative Interactions, a.k.a., “George,” developed by Dr. Deborah Gears.
      George is a campus-wide collaboration platform designed to leverage intrinsic desires that motivate participation collaborative engagement among RIT faculty scholars.
(https://george.rit.edu). Because “George” is intended for RIT faculty the population for the
study reflects this.

d) How will you recruit subjects?
There are two subject groups that will be recruited. Using Clipboard the researcher will recruit
participants using RIT email addresses.

• Group 1: Permission will be sought from RIT faculty members that have a “George”
account and “George” playing card in order to use a digital version of their card in the
experimental visual design element. An informed consent will be obtained from those
that grant permission through the selection of a hyper-link. It will be explained in the
invitation that by selection the hyper-link the participant grants permission.

• Group 2: The second group is those that agree to participate in the experimental
research study. An informed consent will be obtained from those that would like to
participate. A hyper-link in the invitation email that when selected will act as a consent to
participate. This hyper-link will also take the participant to the study website.

o Simple random sampling will be used to invite 30 RIT faculty to participate in the
study. A list of RIT faculty that do not have a “George” account will be entered
into an Excel document and then randomly ordered. The first 30 names on this
randomly ordered list will be emailed an invitation to participate.

o Simple random sampling will be used to invite 30 RIT faculty to participate in the
study. The researcher has a goal of 20 participants for the study. If after five
business days the researcher finds that 10 or fewer invitees have participated
another email invitations will be sent out to the next 10 faculty on the list. This
process will be repeated until 20 participants have been reached. If more then 20
participants respond, within the defined deadline, the researcher will randomly
select 20 participants’ data that is collected. The remaining data points will be
discarded.

e) Describe any incentives for participation you plan to use.
N/A

5) Will you include any of the following vulnerable populations in your
research? (Check any that apply)
N/A  □ Children   □ Mentally Ill
□ Prisoners  □ Mentally Handicapped/Retarded
□ Pregnant Women □ Fetuses

If any of these populations are to be included, please addresses the following:

a) Rationale for selecting or excluding a specific population:
N/A

b) Description of the expertise of project personnel for dealing with
vulnerable populations:
N/A

c) Description of the suitability of the facilities for the special needs of
subjects:
N/A

d) Inclusion of sufficient numbers of subjects to generate meaningful data:
N/A
6) Describe the data collection process.
   a) Will the data collected from human subjects be **anonymous**? ☒ Yes ☐ No
   b) Will the data collected from human subjects be kept **confidential**? ☒ Yes ☐ No
   c) Describe your procedures for ensuring anonymity and/or confidentiality:
      Faculty participating in the experimental research study will be identified with a unique identifier that will not link back to information that could expose their identity. In addition, all data will be reported in the aggregate.
   d) How much time is required of each subject? The nature of this study allows for free exploration therefore there is no set time required. However, in the invitation email participants will be informed that the study could take anywhere from 10–20 minutes. This will help participants gauge if they have sufficient time.
   e) If subjects are students, will their participation involve class time? N/A
   f) What methods, instruments, techniques, and/or other sources of material will you use to gather data from human subjects?
      A quantitative study will be conducted to evaluate user responses to visual elements designed to pique curiosity. The visual design concepts will be evaluated within the context of an existing RIT project, “Motivating Collaborative Interactions, a.k.a., “George,” developed by Dr. Deborah Gears. George is a campus-wide collaboration platform designed to leverage intrinsic desires that motivate participation collaborative engagement among scholars.
      The data for the study will be collected from the study website as well as the existing “George” website.
      **Data collection**
      The experimental website will collect:
      1. When and if participants select the “George” logo.
      2. How many “eye-cons” participants’ select.
      3. If participants’ select a name from the guess screen.
      The “George” website will collect:
      1. Study participants that arrive to “George” from the guess screen on the experimental site.
      2. Study participants that arrive to “George” from the “George” logo that is on the experimental site.
      3. Study participants’ that view cards, add to “My Card Collection”, and request a “Scholar Trading Card”, after arriving on “George” from the study website.
      4. Study participants that login to the “George” site from outside of the experimental site.
      Using Clipboard, the researcher will send out a follow up survey to study participants within the week after the study has ended. Participants will be given two weeks to answer the survey. The researcher will send out a reminder email one week after the initial survey. The survey will ask participants:
      1. If they participated in the experiment. If not, why?
      2. If participants found that the visual design element piqued their curiosity enticing them to interact with it. If yes or no, why?
      3. If participants visited “George” aside from the experiment website. If no, why and do they intend to.
4. If participants found scholars on the “George” website that they could potentially engage with collaboratively.

7) Will this research be conducted at another university or site other than RIT?

☐ Yes  ☒ No

If yes, describe location: N/A

Note: If you will be conducting human subjects research at another university or college, you will also need to obtain IRB approval from that institution. Attach a copy of that approval to this application.

8) Describe potential risks (beyond minimal risk) to subjects:

a) Are the risks physical, psychological, social, legal or other?

No

b) Assess their likelihood and seriousness to subjects:

N/A

c) Discuss the potential benefits of the research to the population from which your subjects are drawn: Participants may form collaborative opportunities within the RIT research community.

d) Discuss why the risks to subjects are reasonable in relation to the anticipated benefits to subjects and others, or in relation to the importance of the knowledge to be gained as a result of the proposed research:

N/A

e) Describe the planned procedures for protecting against or minimizing potential risks, including risks to confidentiality, and assess their likely effectiveness:

Information such as a participant’s email, name or other specific identifier will not be associated with the experiment results.

f) Where appropriate, describe plans for ensuring necessary medical or professional intervention in the event of adverse effects to the subjects:

N/A

9) Will you be seeking informed consent? ☒ Yes  ☐ No

If yes, describe:

a) What information will be provided to prospective subjects?

Study participants will be informed that in the research study we are evaluating how certain stimulants, when incorporated into a visual element, can invoke curiosity.

b) What (if any) information will be concealed prior to participation, and why?

Details of how the visual design element has curiosity provoking elements will not be shared with the participant nor will they be told that the purpose of the curiosity-provoking element is to inspire them to interact with system. The intent of curiosity provoking elements should not be obvious to the user but should be discoverable in order for the researcher to understand if curiosity is piqued and inspires interaction with the system.
c) **How will you ensure consent is obtained without real or implied coercion?**
   The consent form explains that participation in the study is voluntary and that participant has the right not to participate at all or to leave the study at any time. In addition, deciding not to participate or choosing to leave the study will not result in any penalty or loss of benefits to which they are entitled, and it will not harm their relationship with the RIT community or the researcher.

d) **How will you obtain and document consent?**
   A hyper-link to the study will be included in the email invitation to participate. It will be explained to the potential participant that selecting on the hyper-link is confirmation to their consent to participate. Selecting the link will also direct the participant to the study website.

e) **Who will be obtaining consent? Provide names of specific individuals, where available, and detail the nature of their preparation and instructions for obtaining consent.**
   The researcher, Elaine Montambeau, will be obtaining consent as well as complete the Human Subjects Research (HSR) course from the CITI Program (certificate of completion attached.)

10) **Attach a copy of all additional materials (Consents, protocol, scripts, instruments, tasks, etc.– everything a subject does or sees) to this application.**
IRB Twelve-Month Project Review

TO: Elaine Montambeau
FROM: RIT Institutional Review Board
DATE: January 5, 2018
RE: Decision of the Institutional Review Board

Project Title: Design for Curiosity: A Study of Visual Design Elements, Interaction, and Motivation

The Institutional Review Board (IRB) has reviewed the Form F you submitted regarding your project’s continuation. It determined:

☑ As there were no modifications, you may continue with your project.

☐ Project as modified is approved and you may proceed with your project. You must submit any further modifications to the IRB for review.

☐ Project as modified is deferred. Do not seek informed consent or involve human subjects until approved by Board. Please submit the following additional information so Board can act on your request:

☐ Project as modified is disapproved or suspended. You may resubmit with revisions, or request a hearing with the Board.

Now that your project is approved, you may proceed as you described in Form F and in your Status Report. **Note that this approval is only for a maximum of 12 months; you may conduct research / collect data on human subjects only between the date of this letter and January 13, 2019.** You must promptly report to the IRB any proposed modifications, unanticipated risks, or actual injury to human subjects. The IRB will send you another Form F approximately two months before the end of your 12-month human research project. If you do not receive the Form, please contact our office. It is the responsibility of the Investigator to stay compliant with Federal Regulations.

Heather Foti, MPH
Associate Director, Human Subjects Research Office

Revised 12/1/06
Invitation to Participate

Dear Professor <add name>,

I am a graduate student at RIT in the Golisano College of Computing & Information Sciences studying Human Computer Interaction (HCI). I am currently working on my capstone thesis and seeking faculty members who will be willing to participate in my experiment who are NOT familiar with RIT’s George website. My research is to understand how certain stimulants, when incorporated into a visual element, can pique curiosity.

The research experiment involves interacting with a website. As the experiment allows for freedom of exploration your time commitment could be anywhere from 5 to 20 minutes. You will receive, after exploring the experimental website, a follow up survey asking about your experience. The follow up survey will be sent out separately and should take no longer than 5 minutes.

This is a voluntary experiment and the information I am collecting will be completely confidential. I will not be collecting personal names, emails, or identifiers that could link participants to the collected research data.

If you have time to participate in my research experiment please select the Begin Experiment button. This will bring you to a screen explaining your participation in the experiment and asking for your consent. This is required per RIT’s Internal Review Board, for research that involves human subjects.

If you are able to, participation by June 6 will be greatly appreciated.

Thank you for your time.
Elaine Montambeau

Thesis Chair: Professor Jeffrey A. Lasky (jalics@rit.edu)

Begin Experiment
Per the RIT Internal Review Board (IRB), required for human study research, the following language must be provided to you. Following the IRB Consent Form below you will be given the option to consent and participate or not. NOTE: Survey Monkey is only used to collect your consent response. Thank you.

Required IRT IRB (Internal Review Board) Consent Information:
PROJECT TITLE

INTRODUCTION
You are invited to join a research study to understand how certain stimulants, when incorporated into a visual element, can pique curiosity. Please take whatever time you need to discuss the study with your family and friends, or anyone else you wish to. The decision to join, or not to join, is up to you. In this research study, we are evaluating how certain stimulants, when incorporated into a visual element, can invoke curiosity in a person inspiring the user to interact with a system.

WHAT IS INVOLVED IN THE STUDY?
If you decide to participate you will be asked to login to the study website. As this study allows for freedom of exploration your time commitment could be anywhere from 5 to 30 minutes. The study website will keep track of certain interactions made. In addition to exploration of the experimental website a follow up survey will be emailed to you. The follow up survey will take no longer than 8 minutes and will give us an opportunity to learn about your thoughts and activity that can not be tracked from the website.

The investigators may stop the study or take you out of the study at any time they judge it is in your best interest. They may also remove you from the study for various other reasons. They can do this without your consent.

You can stop participating at any time. If you stop you will not lose any benefits.

RISKS
There are no predicted risks associated with participating in this study.

BENEFITS TO TAKING PART IN THE STUDY?
It is reasonable to expect the following benefits from this research: new collaborative connections with other faculty at RIT. However, we can’t guarantee that you will personally experience benefits from participating in this study. Others may benefit in the future from the information we find in this study such as how certain visual design elements can pique curiosity in order to form potential collaborative relationships.

CONFIDENTIALITY
We will take the following steps to keep information about you confidential, and to protect it from unauthorized disclosure, tampering, or damage: Any information that is collected about your interactions on the study website and from the follow-up survey will be associated with a unique identifier. We will not disclose any of the finding that can be traced back to you directly or indirectly.
YOUR RIGHTS AS A RESEARCH PARTICIPANT?
Participation in this study is voluntary. You have the right not to participate at all or to leave the study at any time. Deciding not to participate or choosing to leave the study will not result in any penalty or loss of benefits to which you are entitled, and it will not harm your relationship with the RIT community or us.

CONTACTS FOR QUESTIONS OR PROBLEMS?
Call Elaine Montambeau at (315) 657-2818 or email ecm1609@rit.edu (the student researcher) or Professor Jeffrey Lasky at jalics@rit.edu

Do you consent to participate in this experiment?
- Yes
- No
- I would like to participate but I am familiar with RIT’s George website so I am disqualified from the experiment.
Appendix E – Access to Study Website

For optimal experience use a laptop or desktop computer. If you are familiar with RIT's George website please do not participate in this experiment.

1. Click Here to Start Experiment Participation

Please select "Close Participation Request" AFTER you have participated in the experiment.
Questions with * are required.

* 1. Were you able to participate in the research experiment?
   - Yes
   - No
   - No, I was familiar with RIT’s website, George, so I was disqualified from participating.
   - No, I was not able to access the experiment website.
* 2. Did the visual design element entice you to interact with it in order to reveal hidden information?
   See reference image below.
   ○ Yes
   ○ No

   Reference Image:
   
   Select An Eye... Connect

* 3. Was one side of the visual design element more intriguing to you?
   See reference image.
   ○ Left side.
   ○ Right side.
   ○ Both sides were equally intriguing.
   ○ Neither side was intriguing.

4. Please provide any thoughts on the reason for your choice in the previous question.

5. Did you log-on to the “George” website (selected “George” logo and logged in with your RIT user name and password) after you exited the experiment website?
   See George reference image below.
   ○ Yes
   ○ No

   George site reference image:
Appendix B

Interaction Behavior and Logic – Step 1

1

Behavior:
• After 1 second orange dot start to lengthen.

Behavior:
• At 2 seconds orange dot continues to lengthen.
Interaction Behavior and Logic – Step 2

Behavior:
- At 3 seconds orange bar is full length with text.

Select An Eye... Connect

Left side - behavior:
- 8 "eye-cons" are randomly placed and change location every 4 seconds.
- Squares with the "eye-cons" are selectable.

Right side - behavior:
- Each information block has a selectable "eye-con".

CHANGE
George logo removed throughout design utility in order to keep focus on experiment.

CHANGE
The word "MY" added at the beginning of the researcher STATS throughout design utility. This will clue participant in the study they are uncovering information about a person.

Square with eye-con selected is exposed and remains visible.

Is eye icon selected from left?
- Yes
- No

Is eye icon selected from right?
- Yes

Square with eye-con selected is exposed and remains visible.
Interaction Behavior and Logic – Step 3

CHANGE
"Guess" button changed to "Guess Which Colleague" to clue participant that they are uncovering information about a colleague. This may appeal to their desire to be connected with their peers.

Select An Eye Or... Guess Which Colleague

Left side – behavior:
- Box with "eye-con" that was selected disappears revealing image underneath. The image portion that is revealed remains visible.
- 8 "eye-cons" are always present even if one is selected.

Right side – behavior:
- Box with "eye-con" that was selected disappears revealing data underneath. The image portion that is revealed remains visible.

Participant decides not to participate and closes site.

Yes

3b

Does participant decide to select another eye-con?

No
Interaction Behavior and Logic – Step 4

guess which colleague

left side – behavior:
- Any "eye-con" previously selected remain visible. The information portion that is revealed remains visible.

right side – behavior:
- Any "eye-con" previously selected remain visible. The information portion that is revealed remains visible.
Interaction Behavior and Logic – Steps 5 and 6

5

This person is...

Nicholas DiFonzo, PhD
Deborah Gears, PhD
Michael Palanski, PhD

6

Congratulations, you’ve guessed correctly!

Yes

Does participant guess correctly?

No

Message dismisses after 3 seconds and participant taken to George log-in site.

Sorry, wrong answer, luck next time.
Visual Design Specification – Grey Matrix Placement

Size and coordinates for grey color squares over image side of George playing card.
Grey Color Grid Color Specification

**HEX color grid for grey blocks over image side of George playing card.**
*Yellow indicates first time color is introduced.*

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<td>B9 999999</td>
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Design Specification for Visual Design Element
Appendix C – Visual Design Element Selection Order and Frequency

L = left side (photo), R = right side (data)

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<th>Participant #</th>
<th>Selection Order and Frequency (Out of a maximum of 8 selection tries)</th>
<th>Visited George</th>
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### Appendix D – Multiple Visits Design Element Selection Order and Frequency

L = left side (photo), R = right side (data)

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