TEXT MANIPULATION JUDGMENT ACCURACY: AN EXPLORATORY STUDY

THESIS

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AFIT/GIR/ENV/03-18

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Abstract

Deception aims to affect a decision-making process in a way that somehow benefits the deceiver. More knowledge is desired in the area of purely text-based scenarios. Thirty-seven graduate students at the Air Force Institute of Technology participated in an experiment in order to gain an initial understanding of how people determine whether text has been manipulated, and to identify specific areas that may be more closely investigated in future research. Excerpts were drawn from editions of a current-events newsletter that the participants receive on a weekly basis as part of their enrollment in the graduate program. Some of the excerpts were manipulated, and others were not. Participants were shown a set of these excerpts and were asked to give ratings of their perceived familiarity with the subject of the excerpt, their perception of the relevance of that subject to themselves, and their perception of whether they believed that the excerpt had been manipulated. As part of their manipulation answers, participants were allowed to indicate heightened confidence in their answers by selecting a version of the answer that included the word "definitely." Analysis of the responses showed support for associations between familiarity, relevance, and definite answers. Analysis further showed support for an association between definite answers and increased rate of accuracy in determining whether an excerpt was manipulated. The analysis did not show support for an association between familiarity and accuracy, nor did it show support for an association between relevance and accuracy.

TEXT MANIPULATION JUDGMENT ACCURACY: AN EXPLORATORY STUDY

Chapter 1 - Introduction

Introduction

When two or more parties compete "to reach or obtain something that only one can possess", we may say that these parties are rivals. Merriam-Webster's Dictionary (www.m-w.com, 2003) gives multiple definitions for the word "competition"; they may be combined as "the effort of two or more parties acting independently…for some environmental resource in short supply."

When a party decides on a course of action to reach its objectives, it carries out a decision-making process. This process involves an overall objective, information about the matter at hand (including environmental conditions), a process for determining what choices are included in the set of alternatives, what the likely outcome of selecting a given alternative is, and criteria for selecting one of the alternatives (http://pespmc1.vub.ac.be/ASC/DECISI_THEOR.html). Much of the above enters the decision-making process as information. (Contentions between semantic differences of the words "data", "information", and "knowledge" are not addressed here; for purposes of discussion within this document, the word "information" is used to cover all of them.) Once the decision is made and implemented, actual results (which may or may not match the expected results) will be obtained.

Concerning the Merriam-Webster phrase "acting independently"; we may intuitively infer that each party independently makes the decisions that guide its own actions. However, it is often more advantageous to influence an opponent's decision

process as a means of influencing his actions. Done honestly, this may involve sharing accurate information with that competitor, which hopefully will influence his decision making process in a beneficial way. On a practical basis, this is most likely to occur when the results are seen to be mutually beneficial. If the same approach were taken while using inaccurate information instead of accurate information, we would call this deceit.

Since information is obtained and shared by many means, deceit can also occur by many means. The simplest form of this and arguably the most thoroughly studied so far, is in the realm of verbal communication between one person and another. Simple deceit in this case would consist of a person telling a lie. Other modes that are currently under study involve various modes of communications, mostly via media such as video- and audio-taped messages, and computer or information systems, and the implications that those alternate modes entail.

In more complex scenarios, such as those that are carried out by military forces while conducting warfare, characteristics of environment may be changed so that the opponent will perceive and use inaccurate information (Biros, et al, 2002). The objective is to purposely enter inaccurate information into the enemy's decision-making process, to therefore alter the decision that is made, and to in turn alter the real world results. The effectiveness of the deception may be evaluated by comparing the results (or expected results) of the non-deception scenario with those of the scenario where deception was carried out.

In essence, deception differs from the "independent action" that describes pure competition. The deceiver depends on the victim's manipulated decision process to

produce beneficial decisions and subsequent beneficial results. Below are some examples of military deceptions.

One biblical example in the Bible's Old Testament Book of Judges, which chronicles a vastly inferior Israeli force (300 men) led by Gideon deceiving an enemy (described as a countless number of people that filled a valley) by arriving at night and displaying torches in such a way that the comparatively miniscule Israeli army appeared to be much larger than that of its enemy. The enemy perceived that they were vastly outnumbered on all sides and decided to surrender to Gideon and his Israeli force. Had the armies actually fought, the Israelis most likely would have been slaughtered (http://www.carm.org/kjv/Judges/Judges_7.htm). This action (the deceptive display) provided a direct result (surrender) to Gideon.

Another military ruse was the Allies' now-famous, and well-published, left hook maneuver in the Gulf War. General Schwarzkopf feigned an amphibious attack in the East; Iraq took the appearance of the feint into account in its defense decision-making and decided to place forces in the East to face the feigned attack. This gave conditions of reduced defense in the West and enabled the Allied Force's left hook to be more easily executed (Hines). This example demonstrates a case of competitive advantage. The feint did not provide an immediate result (surrender) however it did set the stage for future action where the Allied Force was at a great advantage (Iraqi defenses were low and more easily overcome in the West where the left hook was executed).

Problem Statement

As described in the introduction, deception can be seen as a significant tool from the deceiver perspective, or as a grave threat from the victim's perspective. The implications can range from "no effect" to a critical factor of success in important events, such as warfare. While the art of deceit has been practiced for centuries, the scientific study of deception has comparatively just begun. The study of this area draws upon expertise in numerous disciplines (Biros, et al, 2002), and must deal with diverse scenarios which can be quite complex even in their simplest forms.

So far, a preponderance of work has dealt with interpersonal deception scenarios where individuals are conversing in direct contact with one another (Buller and Burgoon, 1996; Burgoon, et al, 1996; Decaire, 2000; DePaulo and DePaulo, 1989; Vrij, 2000). Potential nonverbal cues are considered to be abundant under such a scenario. However, other forms of communication, and the detection of deception within them have shown to be more challenging to research, and have been subject to less research so far. Some on-going efforts are beginning to cover deception that may occur in media such as video, audio and via information systems (Biros, et al, 2002; Horn, 2001). One area that still needs research is the area of text information, where the information itself is emphasized over the mode of delivery of the information. This study aims to explore this vital area.

Research Questions

How accurate are people at detecting deception/manipulation of text information? What are some preliminary factors that affect the detection of deception or manipulation in text information?

Blueprint for This Thesis

To answer the above, an experiment was performed in order to glean preliminary information about the detection of deception in text information. The goal was to gain a foothold in the study of this area, and to provide insight into what topics might be fruitful for future research.

In Chapter 2, extant literature that covers the current theory base for this area will be reviewed. In Chapter 3, the methodology used in the design of this study and the experiment are covered. In Chapter 4, the analysis and results are shown. In Chapter 5, a review of the findings and a summary of what has been learned are presented. The next chapter will cover the myriad of constructs that pertain to this study.

Chapter 2 – Literature Review

Overview

As mentioned in the introduction, the study of deception and deception detection draws on knowledge in a wide variety of disciplines (Biros, et al, 2002). Below, the concepts of decision-making, information, deception, interpersonal deception theory, information manipulation theory, data quality, data relevance, and familiarity will be examined. A model will be developed that encompasses the constructs that will be tested in this study; this model will lead to a discussion of the methodology and the experiment that was performed.

Decision-Making

Decision-making is described to consist of the formulation of information about one's objectives and the current environment, ascertaining a set of alternative courses of action that are available to meet those goals, estimation of what the consequences or results will be of selecting each of the alternatives, and choosing the alternative that will most likely provide the most benefit to the decision-maker once the chosen course of action is implemented (http://pespmc1.vub.ac.be/ASC/DECISI_THEOR.html). In essence, decision-making is about estimating the future results of a set of alternative courses of action, and selecting the one that is most likely to be the most beneficial to the decision-maker. Decision-making performance is hindered, however, by information processing limitations of humans as decision-makers.

Eppich (2001) describes a progression of decision making theory from its early 20th Century concepts of an idealistic and well-defined process, also known as Subjective

Expected Utility, to a more uncertainty and reality-based process where objectivity gives way to heuristics. Situations exist in which the decision maker is unable to identify the outcome with 100 percent confidence (Saks and Kidd, 1986; Eppich, 2001). Eppich points out that people often are not able to process all of the information related to the specifics of the decision alternatives and consequences that a fully objective and 100 percent confident decision might require. The use of heuristics helps a decision-maker to simplify the decision process by reducing the amount of information that is actually processed.

The information that enters the decision process may possibly be incomplete or inaccurate. Perfecting the information that is input to the process can prove to be difficult, and a military adage estimates that decisions are often made with only forty to seventy percent of the information that a decision-maker would like to have. In addition, the estimates of the consequences for each alternative may be uncertain and/or inaccurate as well. Uncertain consequences can be evaluated in a heuristic and/or probabilistic manner to determine which alternative offers the most utility to the decision maker (Principia Cybernetica Web). It is also possible that an optimal decision may later be poorly implemented, and therefore may produce poor results. All of the above can synergistically interact to degrade the effectiveness of a given decision.

Decision-making processes may vary in terms of time, resources and effort required to accomplish them, the amount of each depends on the scenario and the decision that is to be made. In the text information-based scenario that this study explored, however, the focus was on the information directly. It seeks to measure some

characteristics of how a person approaches the decision about whether text information is manipulated or not.

Information

Zmud (1990) describes an organization's members as consumers, managers and purveyors of information. More specifically, he describes information as meaning that humans assign to items or data, and that meaning is used to make decisions.

Data fusion is a concept that takes this process further in that it attempts to bring together and organize information from multiple sources and that is available in different formats in a way that supports decision-making in complex and dynamic environments, such as military command and control (Bisantz, et al, 1999). Data systems and decision-aids are a means to bring information to decision-makers in a way that has useful meaning. Typical automated information systems are designed to provide this type of support. Increased dependence on such systems may, however, increase vulnerability to "strategic information manipulation," which is what Zmud (1990) calls the practice of purposely implementing inaccurate data (Biros, 2002).

Deception

Deception is commonly defined as a message knowingly transmitted by a deceiver to foster a false belief or conclusion by the receiver (Burgoon, et al, 1996). In addition, when a person deliberately tries to foster in others a belief or understanding which he considers to be untrue, that person is engaging in deception. (DePaulo, et al, 1985).

Biros, et al, (2002) also point out that some persons have been motivated to manipulate information to influence the behavior of others, and that this is a complex phenomenon that draws interest from a number of fields (Feldman and March 1981, Johnson, et al, 1993, Miller and Stiff 1993, Biros, et al, 2002). Obviously, purposeful placement of erroneous information is one means of deceiving.

McCornack (1992) points out that individuals may deceive as a means of reconciling the interest of providing information that a receiver desires or needs (or not intervening, and therefore allowing the receiver to obtain it), and the competing personal interest that would be damaged if/when the receiver obtains this information (Bowers, et al, 1977; Turner, et al, 1975). In these scenarios, the deceiver may produce a deception by manipulating information and conveying it to the receiver.

Deception Detection

Several studies indicate that cues exist when a person is engaging in deceit, and that these clues may be detected by a potential victim. Depaulo, et al, (1985), examine and summarize the prospect of validating information with an experienced person, or by seeking inconsistencies in information over time. These clues may take the form of behaviors that are not controlled (that is, they are not adapted to support the deception). The term that is often used in this research is that a cue has "leaked" through the façade that the deceiver is attempting to achieve; overall, this is leakage theory. These leaks may offer cues that a deception is present.

Davies and Tune (1969) describe several aspects of signal theory, which seem to be particularly germane to deception detection. Signal theory stipulates that in order for

something in an environment to be noticed, it must be differentiated from its environment in some way. Further, this different characteristic must appear at a high enough intensity for a sufficient length of time that it is sensed.

When applied to deception detection efforts, it follows that a cue to a deceptive act must be intense and of enough duration to be noticed by an observer, or potential deception detector. The scenario and the environment in which it commences determine what specific cues might indicate that a deception is present. In interpersonal communication, there is extant reference to nonverbal behavior and its connection to the message that is presented (Decaire, 2000).

Vrij, et al (2000), suggest that there are three ways to detect when a person is engaging in deception; those ways are: (1) observing their behavior, (2) analyzing the content of the message, and (3) measuring physiological responses. This is problematic in some scenarios, because these were meant to describe interpersonal communication where there is a potentially rich set of behavioral characteristics to observe.

In media where the observable characteristics of a communicative process are more limited, these cues may differ, or may assume different degrees of prominence (Horn, 2001). In cases like this study, where text information is of interest and is examined, (and where the crafting of that text is not observable by the detector) only the second means (analyzing content) seems applicable. In regard to analyzing content to determine if deception is present, Decaire (2000) summarizes that individuals who have a baseline reference for normative information (information that is known to be free of deception) available to them are significantly better able to accurately detect deception.

Interpersonal Deception Theory

Interpersonal Deception Theory (IDT) proposes that information management plays a role in a deceiver's strategy to deceive, and that deceivers systematically alter information when creating their deceptive message (Burgoon, et al, 1996). Turner, et al (1975), divide deception into two main areas: distortions and concealments, where distortions tend to add information or change the information that is present, and concealments tend to omit, reduce, or divert attention from information. Eckman (1985) argues that concealments alone may be used to deceive; however, it is often the case that a combination of concealing and falsifying, or distorting, is utilized to successfully deceive. The experiment that has been carried out for this study focuses on distortion of existing information, and in agreement with Eckman, some original portions of the information were replaced or concealed in order to support the deception.

Deception types or tactics have been categorized or typified in a number of ways. Burgoon, et al, (1996) chronicled Turner's (1975) deception categories, including lies, exaggerations, secrets, half-truths, and diversionary responses; and Hopper and Bell's (1984) six communicative forms of deception: lies, masks, unlies (false implications), crimes, fictions and playings (all of these six are common English language labels for acts of deception). Burgoon, et al, (1996) point out that these various forms are means to understand the types of acts that occur; Burgoon, et al (1996), also point out that these labels are not all-inclusive of all deceptive acts, and some acts can be described by more than one of these categories.

Burgoon, et al, (1996) propose five strategic dimensions in which a deceiver might alter a message in order to enact a deception. They are completeness, veridicality

(trustworthiness, actual or apparent), "directness and relevance," clarity, and personalization. Further, the receiver of a communication may be able to examine it to determine the perception of a discrepancy along these dimensions can be perceived, which in turn might indicate a deception.

Taxonomy of Deception Strategies

Biros, et al (2002), utilized information manipulation techniques in their experiment that were based on the taxonomy of deceptive tactics that is put forth by Johnson, et al (1993). Figure 1 lists these tactics and their descriptions. Masking and inventing were used in the experiment, as described in Chapter 3.

Figure 1. Taxonomy of Deceptive Tactics (from Biros, et al, 2002; based on Johnson, et al, 1993)

Tactic	Description
Masking	Deleting from the environment attributes that suggest the correct representation.
Double Play	Manipulating attributes in the environment in a way so as to weakly suggest the correct representation. The purpose is to reinforce incorrect representations by weakly suggesting the correct one.
Mimicking	Modifying attributes in the environment in a way so as to suggest the incorrect representation. Essentially suggestions (not necessarily deceptions in and of themselves) are included to support the incorrect representation.
Dazzling	Modifying attributes in the environment in such a way as to obscure or blur those attributes whose interpretation suggests the correct representation and to emphasize those attributes whose interpretation suggests the incorrect one.
Inventing	Adding new attributes to the environment in order to suggest the incorrect representation.
Repackaging	Modifying attributes in the environment in order to hinder the generation of the correct representation. Repackaging is weaker than mimicking because it is based on justification and distortion rather than replication of attributes.
Decoying	Adds new attributes to the environment in order to hinder identification of the correct representation. It is weaker than inventing because the decoys are not directly suggestive of the incorrect one. It simply directs attention away from the correct one.

Information Manipulation Theory

The English language philosopher Paul Grice (1975) proposes that in ordinary conversation, speakers and hearers share a Cooperative Principle. Speakers shape their utterances to be understood by hearers. Grice's Cooperative Principle is comprised of four such norms, or maxims: (1) Quality, the speaker tells the truth or his message is provable by adequate evidence; (2) Quantity, the speaker is as informative as required to convey the information; (3) Relation, a conversational response is relevant to topic of discussion; and (4) Manner, a speaker avoids ambiguity or obscurity, and he is direct and straightforward.

McCornack (1992) adapted Grice's maxims via Information Manipulation Theory (IMT) where a deceiver's messages may covertly violate Grice's principles in order to reconcile conflicts between the deceiver's personal goals and the results of allowing/providing accurate information. The emphasis of McCornack's work is the content of the information (including its meaning and context) is key in enacting a deception, or detecting its presence.

In contrast to the focus on the specific deceptive tactics by Johnson, et al (1993), and Burgoon, et al (1996), McCornack (1992) reasons that if a deceptive message does not violate any of the Cooperative Principle maxims, that a deception is likely to go unnoticed by the receiver. That is, if a message satisfies a receiver's cooperative expectations (is of high enough quality, contains a sufficient quantity of information, is relevant to the receiver, and is received in an appropriate manner) it is likely to be accepted by the receiver as true. If any of these maxims are unmet, then the message is likely to be rejected by the receiver. Note that this interpretation does not necessarily

imply that the receiver will suspect a deception per se, but rather that it may be ignored or discarded.

From the perspective of using inaccurate information as a deception tool, we must also consider inaccuracies that occur without a deceptive motive behind them, and therefore it is appropriate to address data quality.

Data/Information Quality

Wang and Strong (1996) describe four characteristics that data must possess in order to be useful to a decision-maker. The characteristics are accessibility, interpretability, relevance and accuracy. In order for a user to consider the data to be of high quality, he must be able to access it (be aware of the existence of the information and knowing how to get to it). The user must be able to read or interpret it (for instance, text information should be in a language or style that is understandable to the user). The user must find the information to be helpful in the task he is trying to perform (in a decision-making scenario for instance, this information would help him to discriminate between available decision alternatives and the consequences of each). Finally the information must be accurate (the user must believe that the information is true, or he may in turn simply ignore it). Other published work discusses errors in stored data.

Laudon (1986) examined a criminal justice database that contained records about warrants. This particular system stood alone, however the information within it was compared to other records to find discrepancies and reconcile them. Records were found to contain errors in several areas, including information about the disposition of the warrants (incomplete records mostly, where updates to clear the warrants in question

were not accomplished) and identities of persons involved in the warrants (persons who were truly not the subject of a warrant appeared in the database and were associated with an outstanding warrant; these persons were vulnerable to have false warrants exercised against them due to the bad information).

Klein, et al (1997a and 1997b) found in their studies that organizational databases can contain significant rates of error contained within them, and they estimate that one to ten percent is a typical rate of error. Further, if this erroneous data is used, it may have adverse impact on decisions upon which it is based. Klein, et al's (1997a) experiment gave support that when tasked to find errors in such data, that participants performed better when given explicit error detection goals. Klein, et al, also said that error detection ability varies under different detection scenarios and circumstances, and that some previously inconclusive studies were too general in nature to find this.

Klein, et al (1997b) also posits that the payoff for detecting an error in the data might have an influence on the effort expended in order to find an error. Three dimensions that are described are materiality, incentives, and ease of verification and correction. Materiality deals with the concept that the effort expended in finding an error relates to the amount of negative effect that error could cause (i.e. an insignificant effect may not make it worth trying very hard to find an error). Incentives deal with what will result from ignoring the error vice expending effort to find it (i.e. is the consequence of the error worse than the work involved in trying to find it?); incentives (or disincentives) are weighed and used to choose whether, and to what level of effort to seek the error. Lastly, ease of verification and correction deals with the concept that effort expended in

finding an error will vary according to how easy it is to confirm the error is in deed and error; how recognizable the error is likely to be.

Self-efficacy

Efficacy is simply perceived ability, or the "power to produce an effect" (www.m-w.com, 2003). Self-efficacy is a perception about one's own ability to perform a task, or confidence. If a person believes they are able to accomplish something, their self-efficacy about that task is high. Harrison, et al (1997) summarize that the construct of self-efficacy is positively associated with actual performance.

Manipulation Types

For purposes of this study, four manipulation types were identified for use in this experiment. The types are significant value manipulation, order of magnitude value manipulation, logic manipulation, and identity reattribution.

Within the work of Klein, et al (1997b), it was supported that a higher degree of materiality of an error led to increased accuracy in finding that error; that is, errors of greater perceived consequence (such as an erroneous cost difference that ultimately would amount to a significant amount of money) were more readily discovered. This concept was adapted to the two types of manipulation used within this study that dealt with quantitative values. These two categories were a significant amount (i.e. values were halved or doubled), or order of magnitude (i.e. values were multiplied or divided by a power of ten). To accomplish this, numerical digits were manipulated, or quantitative words were changed (i.e. millions instead of thousands, or none instead of all).

As stated previously, Laudon's (1996) work that showed that errors in a warrant record system often conflicted with the true facts of a warrant (i.e. a warrant was shown to be open, when in fact it was closed), or persons were misidentified with a warrant (i.e. the wrong person was associated with a given situation). In keeping with Laudon's findings, some information within this experiment was manipulated by two means: the logic and supporting statements were changed (usually so that the manipulated statement had an overall opposite meaning to the original statement), and actions were reattributed to different persons (a name was changed, but the act was left the same).

Relevance

In addition to Wang and Strong's (1996) mention of relevance as a requirement for particular data to be perceived to have high quality, McCornack, et al, (1992) manipulated information in terms of relevance (and three other dimensions including quality, quantity and manner) in order to sense differences in detection accuracy when these different modes of deception were employed.

In either case, relevance is determined by the perspective of the person that will use the information. For example, the atomic weight of uranium is of high relevance to a nuclear physicist in his work, but may be of very little interest to a fast food worker is his work.

Familiarity

Biros, et al, (2002) studied a construct they described as domain experience, which can be interpreted to mean "gained knowledge." Klein (1996) evaluated experience in regards to erroneous and manipulated information, and in essence found

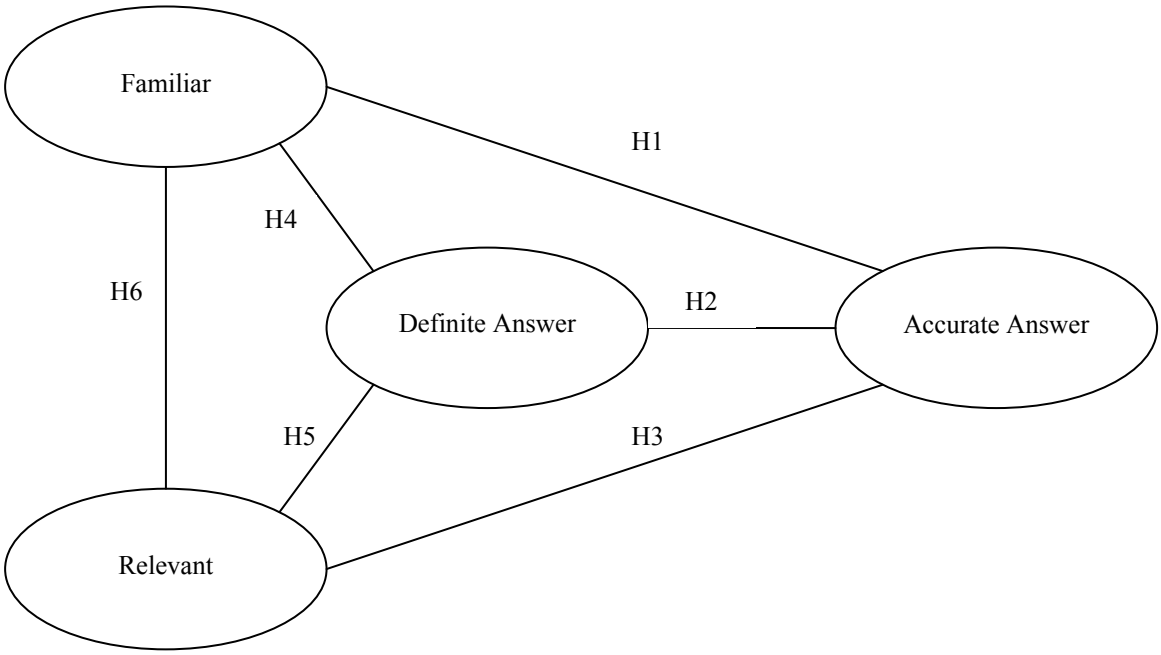
that the level of experience influenced expectations about the type and amount of discrepancies that can and were likely be found in a data store.

Depending on the scenario and the information that is under scrutiny, it may be difficult to discern what experience actually entails. For instance, experience may consist in part of remembered information that can be directly compared to information that is of interest. A memorized fact may be compared to a statement or message about the fact (or an erroneous version of it) to determine if the message matches the memory. It is also possible that information, for which a person has no memory, will be compared to memories of other similar information. For instance, expectations about the characteristics of the new information may be compared to the actual characteristics of that information; any discrepancies might violate maxims of the Grice's Cooperative Principle or IMT (Grice, 1975; McCornack, 1992).

Conceptual Model

The concepts and hypothesized associations that are of interest in this study were compiled into a graphical view as shown in Figure 2. A more detailed explanation of the model and the hypotheses that it depicts is presented below.

Figure 2. Conceptual Model for Association Hypotheses of Familiarity, Relevance, Definite Answers, Accurate Answers.



Model Development

Despite the extant research that has already been carried out and the knowledge that has been gained thus far about the constructs that are presented above, more research is needed in this area. In an effort to perform research in an area that has not been heavily covered, associations between constructs that have not been previously associated were examined. The constructs of relevance, familiarity, and accuracy do not appear to have been previously associated, or tested.

Conceptually, it may be possible for a task of some kind to cause certain information to be relevant to a person who must perform the task. It may further be supposed that the person might seek the information that is relevant to him, and that he might become familiar with the information in doing so. A person who is familiar with

the information, and to whom this information is relevant might be considered a subject matter expect. A subject matter expert might in turn be equipped to evaluate relevant information, and to perform a task such as determine whether the information has been manipulated or not. This subject matter expert, if confident in such a determination, might be inclined to state their in a definite sense.

Under the above scenario, the constructs of relevance, familiarity, willingness to commit to definite answers, and judgment accuracy of whether information has been manipulated might be interrelated. If any of the set of possible associations were significantly supported, then further research could be performed in order to determine what portions of those constructs influence performance of text manipulation determinations.

Hypotheses

With these questions, a set of hypotheses was developed about the relationship between each of these concepts. To represent a potential association between each one, six hypotheses were developed. These hypotheses are:

Hypothesis 1: Familiarity positively associates with Accurate Answers. This hypothesis aims to determine whether the concept of overall domain experience (Biros, et al, 2002; Klein, et al, 1997b) with the topic of the text information associates with improved accuracy in detecting whether manipulation is present.

Hypothesis 2: Definite Answers positively associate with Accurate Answers. This hypothesis aims to determine the participant is confident in their determination of whether manipulation is present in the information that is presented, or more specifically

that the person felt that they were up to the task of determining whether a particular set of information was manipulated (Harrison, et al, 1997).

Hypothesis 3: Relevance positively associates with Accurate Answers. This hypothesis aims to determine whether the concept of information relevance, as described by McCornack (1992) associates with improved accuracy in detecting whether manipulation is present.

Hypothesis 4: Familiarity positively associates with definite answers. This hypothesis seeks to determine whether there is an association between familiarity as described above in Hypotheses 1 and participant willingness to commit to definite answers as described above in Hypothesis 2.

Hypothesis 5: Relevance positively associates with definite answers. This hypothesis aims to determine whether there is an association between relevance and participant willingness to commit to a definite answer, as described above in Hypotheses 2 and 3.

Hypothesis 6: Relevance positively associates with Familiarity. Lastly, this hypothesis aims to determine whether the concept of whether the information relevance, as described by McCornack (1992) associates with the concept of overall domain experience (Biros, et al, 2002; Klein, et al, 1997b) with the topic of the text information.

Chapter 3 - Methodology

Overview of the Method

The study is quantitative in nature, and utilizes a combination of pre-experimental and correlational design characteristics (Leedy and Ormrod, 2001) where a group of constructs was measured in order to determine their associations with each other. This study utilized an experiment, a pool of Air Force Institute of Technology (AFIT) students, and an information pool that was drawn from a weekly informational E-mail that is distributed to them. The group was exposed to one treatment (a set of information paragraphs, some of which were manipulated and some that were not) that was the same for all participants and one observation (where participants were asked for their perceptions about all of the text paragraphs).

Experimental development

In view of McCornack's (1992) study of IMT, with its focus on the content and meaning of information, and Biros, et al's (2002) study of manipulated data in an information system where system experts were asked to detect information problems, an experiment was envisioned to examine deception in text-based scenarios. It was envisioned that authentic text messages might be manipulated, and that a pool of participants could be asked to determine whether manipulation was present. It was also conceived that the pool of information could be drawn from information that already exists and that participants have dealt with in some fashion already.

The answers that the participants gave about their perceptions of the information were analyzed to determine whether there was an association between some

characteristics that the participants perceived about each information paragraph. For each paragraph, participants were asked how relevant they perceived the topic to be to them. They were also asked how familiar overall they were with the topic. Finally, the participants were asked for their perception about whether a paragraph had been manipulated or not (for two parts of the battery, the participants were given the choice of yes or no, for the third part, participants were asked which one of two paragraphs was the manipulated one). As part of the manipulation answer, the participants were able to answer with a more confident sense by selecting an answer that contained the word "Definitely." The data collected was analyzed to determine which items significantly associated with one another.

To test the six hypotheses that were developed for this study, an analysis of the variance of the collected data at an alpha of 0.05 was used. An alpha of 0.05 is commonly used in management information systems research.

Description of the Experiment

Participants were given a fictitious, yet plausible scenario to set the stage for the questionnaire. This scenario explained that a person that they have worked with was researching a set of information items as part of an important and time-critical task, and that part of this task was to determine whether the available information had been manipulated or not. It explained that the information (which the participants have been exposed to on a weekly basis prior to this experiment) was retrieved from an information archive with an unknown level of security and that alternate sources of that information were unavailable at the moment.

Participants were exposed to twenty-four information paragraphs that were presented in three different formats (eight paragraphs in each format): standalone, quota, and comparison. In each of three sections of the experiment, a sub-scenario provided additional information that was germane to the instructions for each part. Information that was given in each sub-scenario was only applicable within its respective section, as described below.

In the standalone format, the participants were asked to evaluate each of the eight text paragraphs on an individual basis and to make a determination as to whether the item had been manipulated or not. They were told that it was possible that all, some or none of the items were manipulated; in actuality, four of the eight were manipulated.

In the quota format, the participants were provided new additional information in the scenario that told them that for this next set of eight messages, four of them had definitely been manipulated, but that it was unknown which of the eight paragraphs those were. This scenario information was true in that four of the eight messages in this section were actually manipulated.

In the last format, comparison, participants were shown two versions of a given information paragraph, the original (unmodified) and a manipulated alternative. The sub-scenario specified that for the eight messages in this part, the archive system drew the information paragraphs from two source systems and that for the purposes of this scenario: one of the paragraphs came from a secure system and the other was compromised, but that no indication was given as to which version came from which system. The participants were asked to examine the information and to choose which of the items was manipulated.

The participants were asked to determine whether or not they feel the information has been manipulated, in what manner that it might have been changed, and to give their perception of other characteristics of the information as well (whether they feel that they were familiar with the information, and whether the information was somehow relevant to them). The participants also were encouraged to make comments on what factors they considered in making their determination.

The volunteers were sought among students of the Air Force Institute of Technology for purposes of (1) convenience (access to persons), (2) similarity of these persons to future Air Force beneficiaries of the new knowledge (the research is carried out on behalf of the Air Force Office of Scientific Research to gain insight into deception that may occur in a military organization), and (3) to utilize an environment where there exists an existing textual information pool that is familiar to the participants, and that can be drawn upon for use in the experiment.

The Existing Information Pool

The information that is used in this experiment consists of excerpts that are drawn from a weekly informational message ("What Is Going On" or "WIGO") that is issued via E-mail from the Aeronautical Systems Center Commander, United States Air Force Lieutenant General Richard V. Reynolds. The Aeronautical Systems Center is a large organization located at Wright Patterson Air Force Base, Ohio, which has close ties to the Air Force Institute of Technology (AFIT) due to its location and on-going cooperative research efforts. The AFIT Commandant or Vice Commandant forwards the WIGO to the faculty, staff and students of AFIT.

In WIGO messages published between 13 May 2002 and 13 January 2003, there were approximately 357 informational paragraphs that covered a variety of current event topics that are generally of interest to personnel assigned to Wright Patterson Air Force Base, the Aeronautical Systems Center, and the Air Force Institute of Technology (AFIT). While inspecting the topics for suitability for the experiment, it was noticed that individual topics vary widely in their potential relevance to the experiment participants (AFIT personnel); for example, some items were narrowly specific to a small portion of the Aeronautical Systems Center. Other topics were clearly of a base-wide or Air Force wide interest.

Since the scope of this experiment involves the measurement of familiarity and relevance of information to the participants in addition to their accuracy at detecting manipulation, items were selected from the entire information set that would likely provide some degree of familiarity and relevance to the target audience of AFIT students.

Initially, approximately 96 items were chosen by the author of this experiment from the 357 available informational paragraphs. These were chosen by the author subjectively with the rationale that the topic was likely to be of some level of interest to the AFIT student participant pool. Later, the 96 candidate messages were narrowed to the 24 that were actually used in the experiment.

Each item was examined for suitability for manipulation in accordance with the four types that were selected for use in the experiment. In order to be considered a candidate for a test item, the information paragraph had to have potential to be changed in a way that would significantly and plausibly alter its meaning to some reasonable portion of the participants. A suitable manipulation is one that changes the meaning of the

information item significantly so that there is some likelihood that a participant will accept the item as true. A truly deceptive act has an objective and in this case, it is to alter a participant's perception of a topic or an information item.

Since the WIGO messages are informational, a successful deception would misinform the target population about the topic. Since little work has been published on detecting deception in this area, the approach to manipulating the information comprised a change that significantly affected the meaning of the message in one of four ways.

The WIGO information items are real world and vary in terms of what is covered and how this information is expressed, (i.e. some lend themselves strictly to a verbal description, other present some numerical value that serves as the essence of the message). As outlined in Chapter 2, four specific methods of manipulation were employed: significant value-change, order of magnitude value-change, logic alteration, and reattribution. Objectives for each type are explained in reference to the experiment below.

Manipulation Types

A significant quantitative manipulation is one that changes a descriptive number within the message in such a way that it changes the meaning of the item. For purposes here, this generally was restricted to a doubling or a halving of a value. For example, if a WIGO message announced that there are "six months left" to complete a professional development training course, the manipulation might change the statement to instead say that there are "twelve months left". In this scenario, a successful deception would lead readers to believe they had more time to complete the course than they really did. If the

deceiver's goal was to make people late for completion of the training, those who believed that they had twelve months left and waited to do so until after the real deadline would be late; and in those cases the deceiver would be successful. This category appeared to be suitable for some of the information items, however it was seen that some of the information items did not change their meaning with a mere 50%, or 200% manipulation.

In some cases where the 50% or 200% manipulation did not seem to be significant enough, an order of magnitude quantitative manipulation was applied in order to create an effective manipulation. Multiplying or dividing a number by 10, or possibly 100, affected the meaning of the statement when a 50% or 200% change did not.

In other cases, a numerical change was not as appropriate or effective as a change in logic. In general, the method used was to give the message an opposite meaning. For instance if an announcement described something as a success, an effective manipulation might say that the effort was a failure. In some instances, the message contained supporting or explanatory information that was in addition to the supporting statement; these supporting statements were deleted, changed, or replaced as needed to support the core logic change.

The last type of manipulation was one of reattribution. When a person or organization was credited with something, it was sometimes plausible to change names and reattribute the actions themselves. For instance, one item gave news of US Army personnel being sent to Wright Patterson Air Force Base to augment Air Force Security Forces personnel; a reattribution in this case might say that the Air Force sent some of its personnel to an Army site instead.

Each of the 24 messages that were used was manipulable via at least one of the manipulation formats. Some of the messages lent themselves to manipulation in more than one of the ways, however only one is required for use in the experiment. This requirement controlled for possible errors that would result from messages that inherently would have little plausibility in it were to be altered in one of the four chosen manners.

Experiment Scenario

During the experiment, accurate and manipulated messages in three different formats were presented. For all scenarios, it was explained, "An AFIT staff member who is a close friend of yours has been tasked to research a number of items that were covered in WIGO messages over the past few months on a short deadline. Unfortunately, the task was received late in the day and the results are due first thing in the morning. Some problems with the base network have limited the research sources that are available now to one, an archive that contains past WIGO messages. In addition, your friend tells you that this particular system does not appear to have the latest security patches applied to it and that the integrity of the information might be in some doubt. You agree to help."

"To start with, eight information items are called up in the system. Determine if each of these items is accurate or whether they have been changed in some way. To give some idea of your confidence in your assessment, please answer the following additional questions about this item."

In the first battery, eight messages were shown with questions about each passage. Half of these will be accurate and half will be manipulated. Next to each passage, the participants will be asked whether they are "Not Familiar," "Minimally Familiar,"

"Somewhat Familiar," "Familiar," or "Quite Familiar." with the message topic. The second question they were asked is whether they consider this information to be "Not Relevant," "Minimally Relevant," "Somewhat Relevant," "Relevant," or "Clearly Relevant" to them on some level. Most importantly, the participants were asked to determine if there is manipulation present in the message in the following format: "Definitely Not," "Probably Not," "Probably Yes," and "Definitely Yes."

After the first battery of questions was completed, a quota of four manipulated information passages was introduced for the next set of eight. The scenario explained, "a partially implemented feature of the archive is familiar to your friend. An indicator shows that there were recent edits to four of the eight information items that she needs, but does not identify which items have been edited. This is very unusual because this is an archive and the WIGO items should not be changed once they are in the database. Since all eight are of vital importance to her, she needs your help to assess which four of the items were manipulated."

In the second battery of messages, as stated above a quota approach was used. Participants were shown a set of messages and were asked questions similar to those in the first battery. The goal here was the engage the participant to select a known number of manipulated messages and to help control for a bias where participants might suspect all of the messages or none of them.

In the last battery, the participants were told, "while accessing the last eight items that are needed, she noticed that there were duplicate entries for those particular items. Using another partially implemented software feature, comparisons were made between the duplicate entries and in each case the duplicates differed from one another—in other

words, you have two versions of each item, and those versions conflict with other. Since the feature is only partially implemented, it does not provide any other information, but she assumes that one message in each pairing must be correct. Which one is correct?"

In the last battery, participants were shown the correct and a manipulated version of the same message side by side—the portions of the text that differed from each other were highlighted so that the participants could focus on differentiating the items and selecting a correct one. They were asked to select which version contains the manipulation, and were again asked the questions about familiarity and relevance per above. Different from the first and second batteries is the selection statement for their choice. The choices will be phrased "Definitely Message A," "Probably Message A," Probably Message B," and "Definitely Message B."

Participant Pool

Volunteers were invited to participate via an E-mail message that was sent to all Air Force Institute of Technology graduate students who are enrolled in one of the Engineering or Management programs at the AFIT. The advertisement stated that the request was for volunteers to participate in an experiment that involved text manipulation. Participants were met as their schedule permitted to perform the experiment, typically in a classroom or library setting, and most often in small groups of four to six people, and they used approximately forty to sixty minutes to complete the instrument.

Answer sheets were checked for completeness to the extent possible as they were turned in, however a small number of answers were later found to be missing despite the

effort. The data that the participants provided was entered into a Microsoft Excel 2000/XP spreadsheet, and was imported to SAS Institute's JMP-IN version 4 statistical analysis software.

Execution of the Experiment

Thirty-seven volunteer participants took part in the experiment. These persons were met at their convenience in classroom and library settings. The time required to complete the instrument was between forty and sixty minutes in all cases.

The criterion for an accurate answer depended upon the format in which the text excerpt was presented. In the first two sections, a manipulated message needed to be identified as "Yes…manipulated" and a non-manipulated message needed to be identified as "Not…manipulated." In the comparative section where the participant was given two passages to choose from, the participant had to correctly identify which of the two was manipulated, either Message A or Message B. There was only one correct answer for each question.

A small number of answers were not completed by the participants; these blanks appeared to be distributed in no particular manner among manipulation, familiarity, and relevance answers. Since the number of these blanks was small, and no obvious explanation was apparent (i.e. they did not appear to be associated with any particular questions, for instance) the blanks were ignored automatically in the statistical tests performed by JMP-IN.

Chapter 4 – Analysis and Results

Descriptive Statistics of the Data

Shown below is a chart of the accuracy rates of the experiment. The group of participants as a whole accurately identified which messages were manipulated, and which were not, approximately 62 percent of the time overall (bottom right corner of the chart below. Figure 3 contains a summary of the rates of correct answers.

Figure 3. Accuracy Rates Overall and Broken Down by Presentation Format and Manipulation Type

Format	Manipulation Type					
	Value Significant	Value Magnitude	Logic Change	Identity Change	None	All Types
Stand Alone	0.38	0.22	0.81	0.36	0.66	0.55
Quota	0.35	0.70	0.70	0.54	0.60	0.59
Compare	0.38	0.78	0.73	0.96		0.71
All Formats	0.37	0.62	0.74	0.71	0.63	0.62

Accuracy for each question individually ranged from 22 to 97 percent. It is interesting to note that when a given message contained no manipulation whatsoever, the non-manipulated information was properly identified as non-manipulated only 63 percent of the time. It is also interesting to note that the results for the standalone and quota formats, the results are not much better than chance. The results for specific questions can be reviewed in the chart in Figure 4.

Figure 4. Summary of Questions, and Rates of Definite Answers and Accuracy For Each Question.

Standalone: No Quota

Question	A1	A2	A3	A4	A5	A6	A7	A8
Manipulated?	Yes	No	No	Yes	Yes	No	No	Yes
Definite Answer	.24	.19	.14	.49	.25	.27	.35	.24
Correct Answer	.22	.81	.62	.81	.36	.59	.59	.38

Quota: 4 of 8 are known to be manipulated

Question	B1	B2	B3	B4	B5	B6	B7	B8
Manipulated?	No	Yes	Yes	No	No	Yes	Yes	No
Definite Answer	.38	.35	.49	.30	.35	.35	.38	.19
Correct Answer	.27	.70	.54	.86	.76	.35	.70	.51

Comparative: 1 is manipulated, identify it

Question	C1	C2	C3	C4	C5	C6	C7	C8
Definite Answer	.81	.32	.28	.92	.41	.11	.65	.89
Correct Answer	.97	.73	.83	.95	.62	.40	.35	.84

The accuracy rate varied widely among the questions. It must be acknowledged that each question was unique in terms of the topic it covered, the specific type of information it contained, whether it was presented with or without manipulation, what type of manipulation it was subjected to, how the manipulation was applied, and in what format the question was presented to the participants. These factors may have influenced the accuracy rate in ways that cannot be accounted for by the analysis performed within this thesis. Despite the wide range of accuracy rates for the questions, it is still reasonable to assume that the associations that are posited in the hypotheses can be examined.

As stated previously all of the hypotheses were tested using a one-way analysis of variance (ANOVA) with an alpha of 0.05; 0.05 is a commonly used level of alpha in

management information system research. The results and observations for each hypothesis follow.

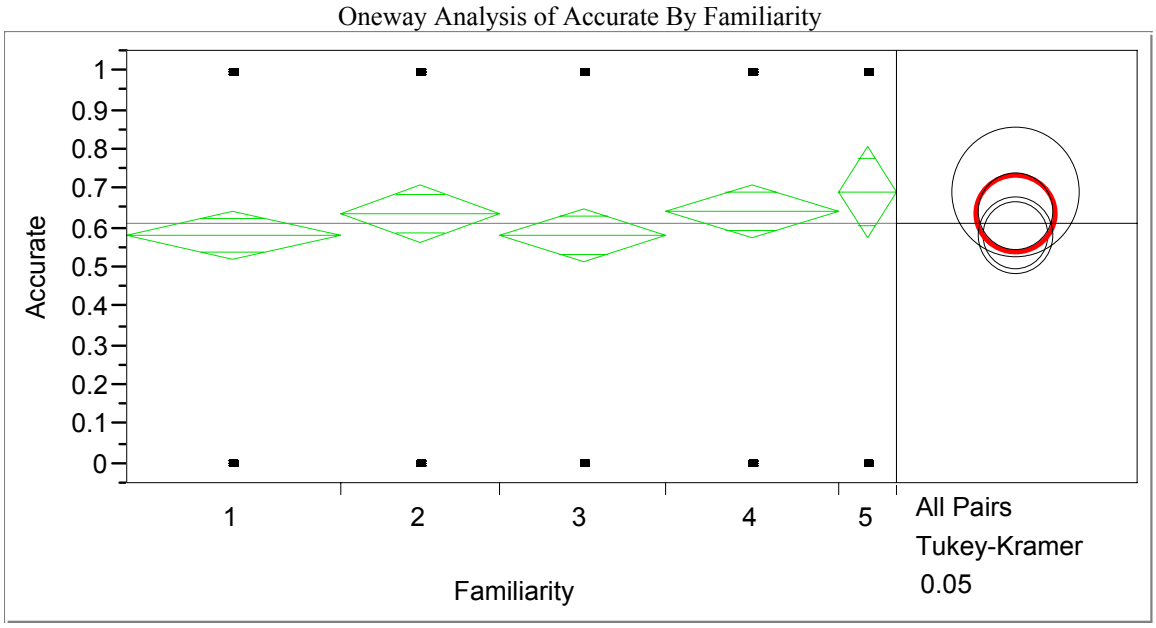
H1: Familiarity Associates with Accurate Answers

This hypothesis suggests that rates of accuracy will vary significantly with participant familiarity with the topic. The ANOVA was run on 870 matched pairs of answers for familiarity and manipulation judgment accuracy. The ANOVA gave a result of $F(4,865) = 1.15$; $p = 0.3302$. This does not support Hypothesis 1.

Visual inspection of the JMP-IN version 4 grouped means and variance chart showed a nearly flat-line response with mean accuracy rates near 0.60, with a small, but visible upward trend. Examination of the 95% confidence intervals for each of the five levels of familiarity showed a wide range for likely accuracy rates. A Tukey-Kramer analysis revealed no matched pairs with significant differences between them.

Hypothesis 1 is not supported. The JMP-IN 4 output page for an analysis of variance of these constructs is displayed in Figure 5.

Figure 5. JMP Output: One-Way Analysis of Manipulation Judgment Accuracy By Familiarity (Accuracy Rates for Each Degree of Familiarity)



Oneway Anova

Summary of Fit

Rsquare	0.005304
Adj Rsquare	0.000705
Root Mean Square Error	0.486444
Mean of Response	0.616092
Observations (or Sum Wgts)	870

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Familiarity	4	1.09151	0.272878	1.1532	0.3302
Error	865	204.68320	0.236628		
C. Total	869	205.77471			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	242	0.582645	0.03127	0.52127	0.64402
2	182	0.637363	0.03606	0.56659	0.70813
3	187	0.582888	0.03557	0.51307	0.65271
4	194	0.644330	0.03492	0.57578	0.71288
5	65	0.692308	0.06034	0.57389	0.81073

Std Error uses a pooled estimate of error variance

H2: Definite Answers associate with Accurate Answers

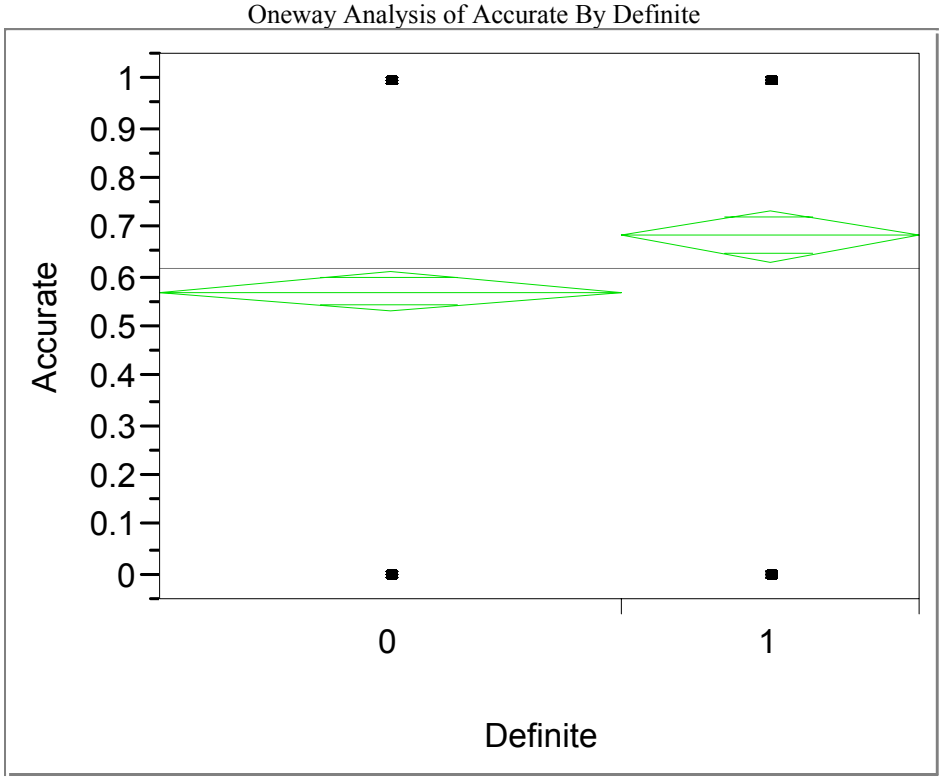
Hypothesis 2 suggests that the rate of accuracy will associate with definite answers. The result of the ANOVA was $F(1,882) = 11.03$; $p = 0.0009$, which supports Hypothesis 2.

Visual inspection of the grouped means revealed a clearly increased mean accuracy in the definite answer group over the indefinite answer group. Examination of the 95% confidence intervals for those with and without definite answers revealed a pair of ranges that did not overlap.

Hypothesis 2 is supported. The JMP-IN 4 output page for an analysis of variance of these constructs is displayed in Figure 6.

Figure 6. JMP Output: One-Way Analysis of Manipulation Judgment Accuracy By Definite Answers (Accuracy Rates for Definite Answers versus non-Definite Answers)

Oneway Analysis of Accurate By Definite



Oneway Anova
Summary of Fit

Rsquare	0.012351
Adj Rsquare	0.011231
Root Mean Square Error	0.48377
Mean of Response	0.616516
Observations (or Sum Wgts)	884

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Definite	1	2.58126	2.58126	11.0295	0.0009
Error	882	206.41761	0.23403		
C. Total	883	208.99887			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
0	539	0.573284	0.02084	0.53239	0.61418
1	345	0.684058	0.02605	0.63294	0.73518

Std Error uses a pooled estimate of error variance

H3: Relevance associates with Accurate Answers

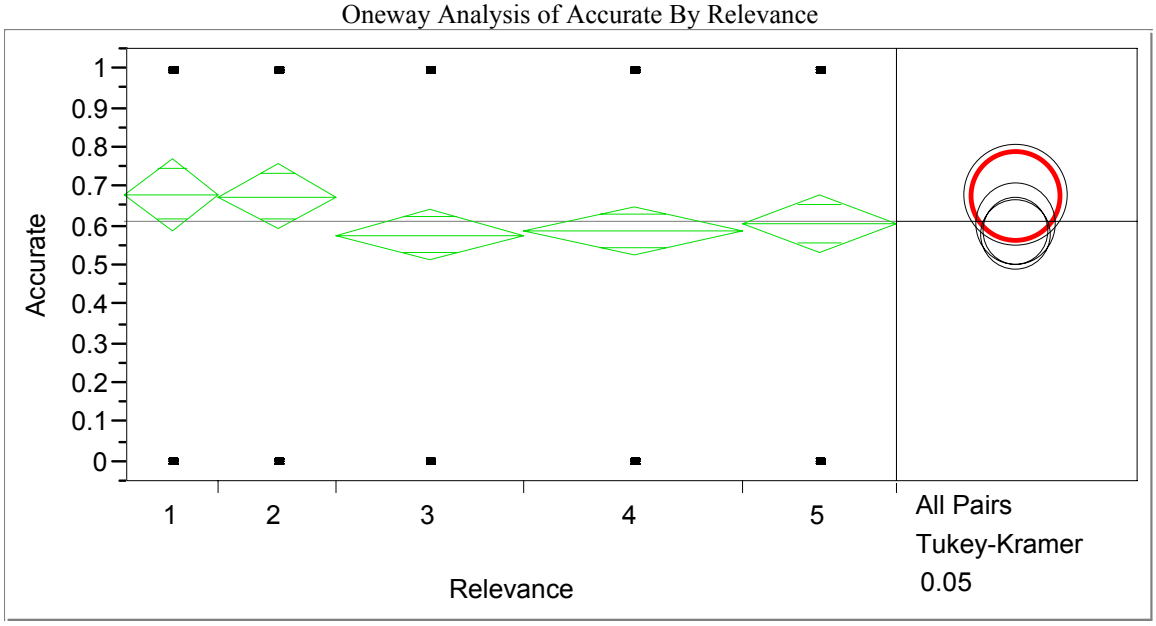
This hypothesis suggests that rates of accuracy will differ depending on the message's relevance to the participant. The ANOVA results were $F(4,873) = 1.5152$; $p = 0.1957$. Since this exceeds our alpha of 0.05, Hypothesis 3 is not supported.

A Tukey-Kramer analysis was also run on these items, and again no statistical support for the hypothesis was found with any pairing. Visually, accuracy based on the relevance answers seemed to be nearly flat with an inverse trend.

Hypothesis 3 is not supported. The JMP-IN 4 output page for an analysis of variance of these constructs is displayed in Figure 7.

Figure 7. JMP Output: One-Way Analysis of Manipulation Judgment Accuracy By Relevance (Accuracy Rates for Each Degree of Relevance)

Oneway Analysis of Accurate By Relevance



Oneway Anova
Summary of Fit

Rsquare	0.006895
Adj Rsquare	0.002344
Root Mean Square Error	0.486294
Mean of Response	0.615034
Observations (or Sum Wgts)	878

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Relevance	4	1.43327	0.358317	1.5152	0.1957
Error	873	206.44828	0.236481		
C. Total	877	207.88155			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	107	0.682243	0.04701	0.58997	0.77451
2	133	0.676692	0.04217	0.59393	0.75945
3	214	0.579439	0.03324	0.51420	0.64468
4	251	0.589641	0.03069	0.52940	0.64989
5	173	0.606936	0.03697	0.53437	0.67950

Std Error uses a pooled estimate of error variance

H4: Familiarity associates with Definite Answers

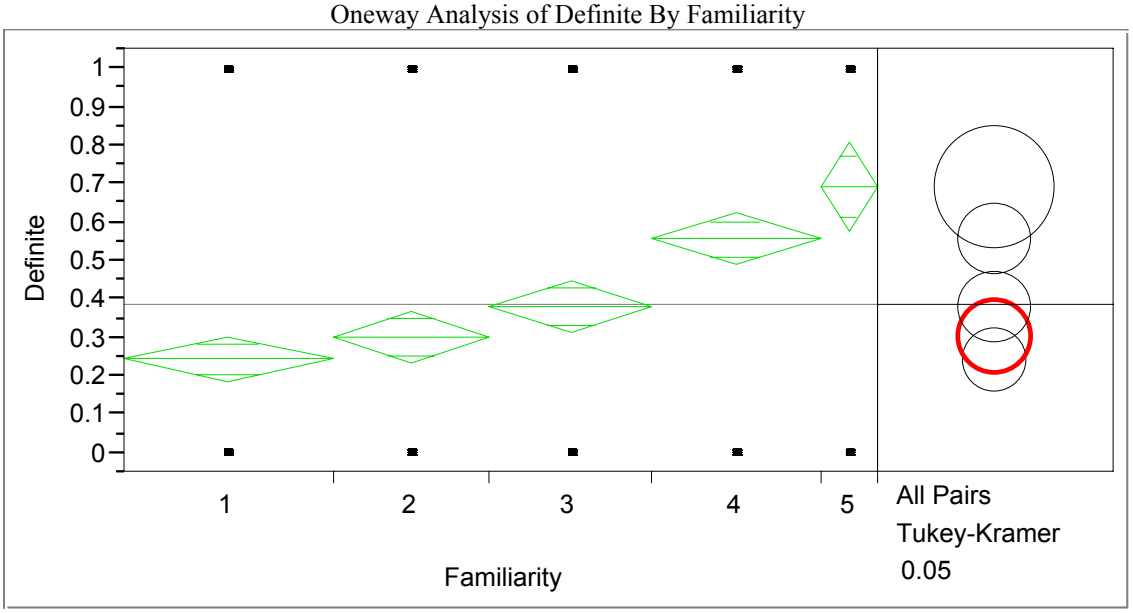
This hypothesis posits that familiarity associates with definite answers. Intuitively, it is reasonable to expect that if an association does exist, that it might be a directly proportional relationship. The result for the ANOVA was $F(4,865) = 20.54$; $p < 0.0001$. This extremely low p-value strongly supports that there is an association between familiarity and definite answers.

The Tukey-Kramer analysis was also run on this data, and it too showed strong support for this hypothesis. Most of the familiarity ratings showed significantly different definite answer rates, particularly in the higher end of the familiarity scale. Visually, all the ratings appeared to have a proportional and direct association.

Hypothesis 4 is supported. The JMP-IN 4 output page for an analysis of variance of these constructs is displayed in Figure 8.

Figure 8. JMP Output: One-Way Analysis of Definite Answer Rate By Familiarity (Definite Answer Rates for Each Degree of Familiarity)

Oneway Analysis of Definite By Familiarity



Oneway Anova

Summary of Fit

Rsquare	0.086726
Adj Rsquare	0.082503
Root Mean Square Error	0.46714
Mean of Response	0.388506
Observations (or Sum Wgts)	870

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Familiarity	4	17.92501	4.48125	20.5355	<.0001
Error	865	188.76005	0.21822		
C. Total	869	206.68506			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	242	0.243802	0.03003	0.18486	0.30274
2	182	0.302198	0.03463	0.23424	0.37016
3	187	0.379679	0.03416	0.31263	0.44673
4	194	0.556701	0.03354	0.49087	0.62253
5	65	0.692308	0.05794	0.57859	0.80603

Std Error uses a pooled estimate of error variance

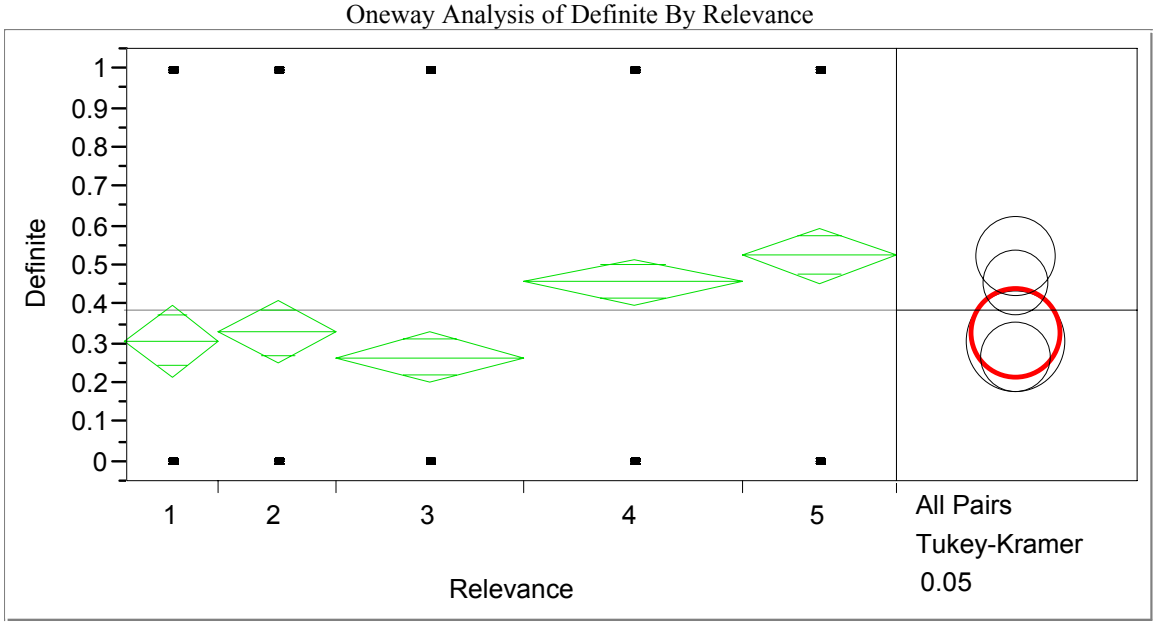
H5: Relevance associates with Definite Answers

This hypothesis is similar to hypothesis 4, however it compares relevance to the rate of definite answers instead of familiarity. The ANOVA results were: $F(4,873) = 9.6363$; $p < 0.0001$, which strongly supports that a significant association exists between relevance and the rate of definite answers. A Tukey-Analysis revealed statistically significant association between different ratings for relevance, but did not show significant support for definite answer rate difference between all pairings of relevance ratings. Visually, the association does not appear to be as dramatic, or as smooth as the familiarity and definite answer relationship.

Per the p-value of less than 0.0001, Hypothesis 5 is supported. The JMP-IN 4 output page for an analysis of variance of these constructs is displayed in Figure 9.

Figure 9. JMP Output: One-Way Analysis of Definite Answer Rate By Relevance (Definite Answer Rates for Each Degree of Relevance)

Oneway Analysis of Definite By Relevance



Oneway Anova

Summary of Fit

Rsquare	0.042285
Adj Rsquare	0.037897
Root Mean Square Error	0.478073
Mean of Response	0.387244
Observations (or Sum Wgts)	878

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Relevance	4	8.80963	2.20241	9.6363	<.0001
Error	873	199.52750	0.22855		
C. Total	877	208.33713			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	107	0.308411	0.04622	0.21770	0.39912
2	133	0.330827	0.04145	0.24947	0.41219
3	214	0.266355	0.03268	0.20221	0.33050
4	251	0.458167	0.03018	0.39894	0.51739
5	173	0.526012	0.03635	0.45467	0.59735

Std Error uses a pooled estimate of error variance

H6: Relevance associates with Familiarity

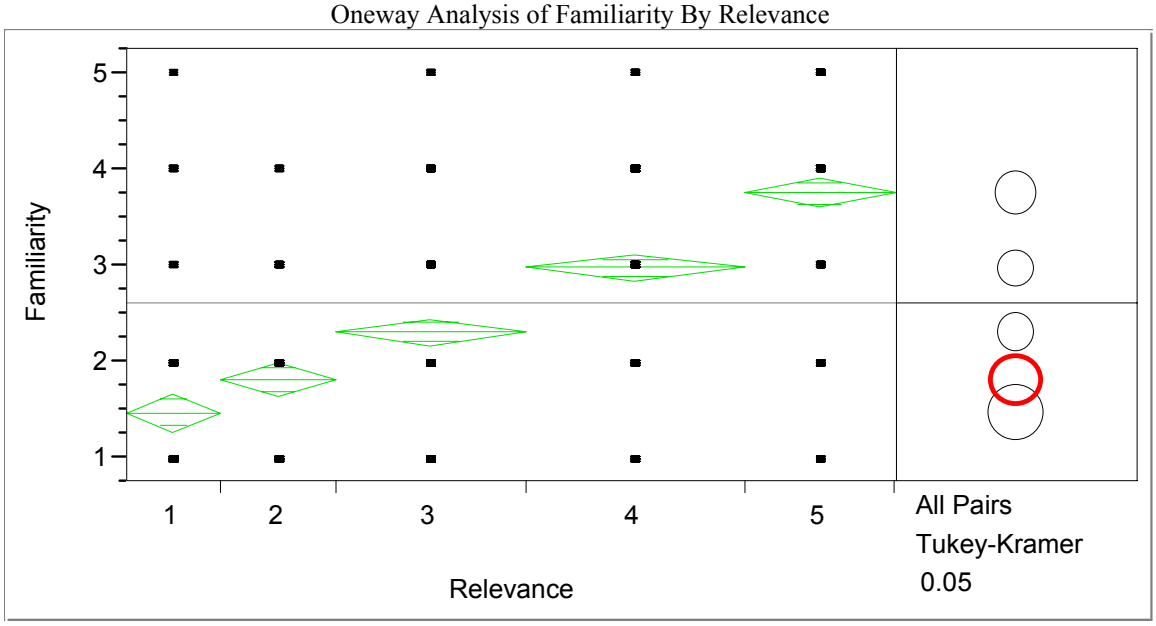
This hypothesis suggests that relevance will associate with familiarity, so that as levels of relevance change, levels of familiarity and will change significantly as well. The ANOVA provided the following results: $F(4,867) = 111.56$; $p < 0.0001$, which indicates strong support for the association between relevance and familiar, and therefore strongly supports hypothesis six.

Closer inspection of the data via Tukey-Kramer analysis revealed that there were significant differences in mean familiarity rating among the all but one pairing of relevance rating. This further supports Hypothesis 6. Visually, the relationship seems to display a direct and proportional relationship.

Hypothesis 6 is supported. The JMP-IN 4 output page for an analysis of variance of these constructs is displayed in Figure 10.

Figure 10. JMP Output: One-Way Analysis of Familiarity By Relevance (Mean Familiarity Rate for Each Degree of Relevance)

Oneway Analysis of Familiarity By Relevance



Oneway Anova

Summary of Fit

Rsquare	0.339791
Adj Rsquare	0.336745
Root Mean Square Error	1.060348
Mean of Response	2.604358
Observations (or Sum Wgts)	872

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Relevance	4	501.7023	125.426	111.5550	<.0001
Error	867	974.8012	1.124		
C. Total	871	1476.5034			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	108	1.47222	0.10203	1.2720	1.6725
2	131	1.81679	0.09264	1.6350	1.9986
3	214	2.30374	0.07248	2.1615	2.4460
4	248	2.97581	0.06733	2.8437	3.1080
5	171	3.76023	0.08109	3.6011	3.9194

Std Error uses a pooled estimate of error variance

Hypothesis Summary

A summary of analysis results for each hypothesis is shown in Figure 11. Hypotheses 2, 4, 5, and 6 are supported. Hypotheses 1 and 3 were not supported.

Figure 11. Table of Results: Hypothesis p-values, n, and support

	Hypothesis	p	n	Supported
H1	Familiarity Positively Associates with Accuracy	0.3302	870	No
H2	Definite Answers Positively Associate with Accuracy	0.0009	884	Yes
H3	Relevance Positively Associates with Accuracy	0.1957	878	No
H4	Familiarity Positively Associates with Definite Answers	<0.0001	870	Yes
H5	Relevance Positively Associates with Definite Answers	<0.0001	878	Yes
H6	Relevance Positively Associates with Familiarity	<0.0001	872	Yes

It can be seen in Figure 11 that the n was not the same for each hypothesis test. This is a result of missing answers on the questionnaires and JMP-IN 4's automatic exclusion of data points that do not consist of a matched pair of data for a given test. Since 37 participants were shown 24 questions, an n of 888 would be ideal. However, in the case of Hypothesis 1 for example, an n of only 870 was used. This means that 18 data points were excluded because participants omitted an answer for familiarity, a manipulation answer, or both.

It is interesting to note that in the model, potential relations between three constructs and accuracy are illustrated. Of three items that were thought to associate with accurate answers, only the definite answers seem to actually do so to a statistically significant level.

Familiarity did associate with definite answers, and relevance associated with both familiarity and definite answers. Intuitively, one might expect in such a case that the familiarity and relevance would have also directly associated with accurate answers.

Obviously, the data did not support that. The means and variances charts that JMP produces as part of the ANOVA was examined for visual trends in terms of how familiarity and relevance may have associated with accuracy.

While nothing that is statistically significant can be gleaned from observing the means and variances charts directly, there appeared to be a relatively flat response among the different degrees of familiarity and relevance and their corresponding rates of accuracy. There was a slight, but visually perceptible positive trend between familiarity and accuracy, but with a slightly negative trend between relevance and accuracy. No intuitive reason can be stated for this at this time, and this enigma may serve as a topic for future research.

Additional Feedback

Feedback given by a number of participants indicated that the WIGO messages were not read by all persons who receive them. Further, there were indications that participants obtain information on a number of the topics by means other than the WIGO messages, including personal experience and the news media.

Chapter 5 –Discussion

Findings

The results of the analysis are both surprising and interesting because of which hypotheses were supported by the data, and which were not supported. Intuitively, a positive association was expected between each construct and each other construct, however this did not turn out to be the case. The lack of support for the associations between accuracy rate and participant-rated familiarity and relevance was probably the most surprising finding in this study.

It was thought that higher perceived familiarity with a topic might make the participants more likely to recognize a manipulation to the information. Intuitively, there may be a number of contributing factors that underlie a person's determination of whether they are familiar with something. The single participant-provided rating for familiarity was used for simplicity in this exploratory study. Verbal feedback given by participants about the experiment indicated that a number of persons did not regularly read the WIGO E-mail messages, even though there are delivered to all AFIT students. In these cases, their familiarity with the topic would obviously due to means other than reading the WIGO message.

It was also surprising that relevance of the information to the person, as rated by the participant, did not correlate with rate of accuracy either. It was conceptualized that relevance might have an effect on accuracy, possibly because of an increased personal interest in the information. This concept might be expanded or controlled in future

research to channel a person to consider there answer from a certain perspective, such as "relevant to me in the performance of my job" or "relevant to me on a personal level."

The hypothesis regarding an association between relevance and familiarity was supported. By examining the results of the analysis of variance that was obtained via JMP, there was strong support for a direct association between these constructs. Further, it also appears that familiarity is generally at a slightly lower level than the relevance rating that a participant gives. While no causality can be determined by this, determining the nature of the relationship between relevance and familiarity (i.e. does relevance lead to familiarity?) is an area that can be examined in future research. The findings of support for associations between familiarity, relevance, and definite answers matched intuitive expectations.

Overall, these findings are significant because they go against intuition that a familiar person, or a person to whom the information is more relevant, is more likely to accurately identify whether manipulation was present. The amount of relevance and familiarity (or both, as in the case where someone might be considered a subject matter expert) did not directly associate with accuracy. These constructs did however associate with the rate of definite answers given, and in turn, definite answers did associate with increased accuracy. What this means is that a person who is a subject matter expert *and* who is willing to give a definite answer may be the most accurate determiner of whether manipulation is present. Lacking the commitment to a definite answer, a person who is a subject matter expert is no more accurate than a person who is unfamiliar and/or who perceives little relevance.

The results of this experiment leave question whether a person with lower familiarity and relevance ratings for given information might examine the information differently than a person that is familiar and does find it to be relevant. Conversely, perhaps a person who feels the information is familiar and/or relevant might exercise less care in making their choice. A grim saying in military circles regarding lethal misfortunes associated with complacency is "Complacency Kills." This raises a question about vigilance and suspicion and how they might relate to conditions of familiarity and relevance.

Limitations

The volunteers in the study are comprised of a convenience sample. This provided an accessible pool of volunteers that function in a military environment, which is administrative in nature; this does in part match part of the Air Force Office of Scientific Research's intent to gain knowledge about deceit in military operations. However, there are a variety of environments in which military operations occur, and the results of this particular study may not necessarily translate to a combat environment, or a different type of information (sensitive real-time intelligence information, for example), or an organization with different characteristics (such as different size, culture, information dissemination characteristics, etc.). Future research would need to evaluate differences between the environment studied here and the scenario that is examined at that time.

As an exploratory study, the constructs that were measured were general in nature. Although the ties between the constructs of familiarity and relevance of the

information used in the experiment are important to the results for this study, a future study may explore these items from multiple different perspectives to gain more knowledge. Perhaps the overall topic and the facts within the passage could be evaluated separately.

The information pool that was used was also selected for convenience in the chosen participant pool environment. The experimental design aimed to use information that had previously been exposed to the target audience; however, this distribution did not necessarily mean that it was read by the participants. As was found in feedback given during the experiment, persons may not read the information from the WIGO, but may in fact obtain their information on the same topics from alternate sources. The information that was obtained from these alternate sources may have been presented differently than (or disagreed with) the WIGO messages. This may obviously influence the results of this experiment. In addition, from a longitudinal perspective, the information pool may in some cases have been overcome by real world events, including subsequent changes in the items that are represented in the message, distortion of memories about the real events, and perhaps similarity to more recent events causing confusion of two different items.

More specifically, in regard to the text questions that were chosen for use in the experiment, they were examined by the author of the experiment and selected with a rationale that they would be applicable to AFIT students. Further, the types of manipulation selected for use in the experiment dictated which messages were potentially useful, and further narrowed the pool of eligible messages. (As explained in Chapter 3, a message had to be manipulable by one of the four types of manipulation that were

focused on for the experiment; this excluded any messages that were manipulable only by other methods).

Reading textual information in any significant volume can be time consuming. This reduced the number of questions that could feasibly be asked during an experiment session in order to keep the length of time required of each participant to a reasonable amount (less than an hour). As such, the low number of questions may have allowed question-specific anomalies to have greater potential to influence results than an experiment with a larger cross-section of questions.

The low number of questions that were included in the experiment also limited the number of manipulation types that were used, and this limited the depth to which each manipulation type could be tested and analyzed (i.e. varying degrees of manipulation). As an exploratory study, the variety provided opportunities for more things to be initially checked in hopes of guiding future research, however this reduces the ability for the each type to be thoroughly checked, and inhibits any subtle trends from emerging to a point of statistical significance.

Implications for Research

Above, support was found for association between familiarity, relevance, and definite answers. Support was also found for an association between definite answers and higher accuracy rates. However, no support was found for a direct association between level of familiarity and/or relevance to accuracy rates.

A further study on this topic might utilize a setting where more participants provide information, and more things can be manipulated and controlled; an example

might be an Air Force battle lab or training environment, where real-time information is used, and the results of implementation of those decisions could be examined after numerous trials. Such an environment would allow for detailed development of an experiment and instrument to an extent that was not possible in the AFIT used within this study.

The experiment allowed participants to give a "definite answer" or an answer that was not worded with "definitely" in it. This was a binary decision in terms of "definite answer" and participants' personal thresholds for committing to a definite answer may have caused some variance that is not accounted for in this experiment. This concept could be more closely examined in future research to determine if better choices for confident answers can be presented. In addition, incentives for giving a definite answer were not given. This and its implications may be studied more closely in the future.

Suggestions for Future Research

Future research is needed in this area. It should expand on the research accomplished here and in extant literature in number of ways. The first might be a more detailed study of the hypotheses. Perhaps familiarity and/or relevance could be studied to a finer degree of detail. In addition, the intuitive question arose that asked whether relevance of the information to a person somehow influenced or caused a person to become familiar with that information.

The distortion of information was the focal point for this study. The work here can be extended to cover other information manipulation strategies such as concealment described by Turner, et al, (1975) and the other deceptive tactics that are presented by

Johnson, et al (1993), and Biros, et al (2002). This area is ripe for the study of other strategies as well.

Implications for Managers

In cases where information is obtained mostly by reading it (as opposed to persons speaking it, or viewing recorded media), it is possible that the lack of cues could lead persons to believe that a sense of familiarity with or relevance to the information helps them determine whether the information has been manipulated or not. This sense of familiarity and/or relevance was not supported to be helpful in making an accurate determination of manipulation in this study.

The key item was whether the person was willing to commit to a definite answer. It is possible that a person would take into account factors that were not studied in this experiment when assessing the presence of manipulation. If these other factors conflicted with an intuitive conclusion that might be drawn from degree of familiarity or relevance, the analysis here could support the lack of a definite answer negates any perceived confidence that relevance or familiarity alone might offer. This may allow potentially more deterministic factors to be more heavily considered in the assessment of the information.

Increases in the use of automated systems where text information is used may increase the need for knowledge in the area of detecting when the information contained within it has in fact been manipulated.

Closing

I am grateful for the opportunity to have participated in graduate study at the Air Force Institute of Technology and in particular for the opportunity to research this fascinating topic. Some knowledge has been discovered, however, it is only a very small part of the knowledge that is needed to improve practical performance of detecting the deception that threatens our information-dependent military forces. It is my hope that this exploratory study stimulates future research in this area and that the proceeds of that work will truly enhance our capability to protect our national interests.

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14. ABSTRACT

The Department of Defense is increasingly relying on information, particularly text information, to conduct business. This reliance introduces an amplified vulnerability to strategic information manipulation, or deception. This research draws on communication and deception literature to develop a conceptual model proposing relationships between a person's perceived familiarity with a piece of information, the relevance that the person perceives it to have to them, and their accuracy in identifying if that information has been manipulated. An experiment was conducted with 37 graduate students to test the proposed hypotheses. No support was found that higher familiarity and higher relevance meant higher accuracy. However, support was found for the hypotheses that stated that higher familiarity and higher relevance associated with the person's willingness to commit to a definite answer. There was further support that in cases where a definite answer was committed to, accuracy was higher. These findings are helpful to increasing the understanding of detecting manipulation in text information. More research in should be done in this area.

15. SUBJECT TERMS

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