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Group Performance in Military Scenarios Under Deceptive Conditions

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THESIS

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Abstract

The goal of this research was to investigate how changes in modality (communication type) and external conditioning (warnings of player deception) relate to perceptions of deception and task difficulty and in turn how these perceptions relate to the final group game scores in a cooperative effort with conflicting goals. One hundred and eight participants were grouped into teams of three, given similar instructions but different goals, and asked to play a cooperative game called StrikeCOM that mimics the intelligence gathering needed to develop an air tasking order and subsequent air strike on three military targets. The analysis of the post-game surveys showed support for participants in games using a face-to-face communication method to have lower perceptions of deception and task difficulty when compared to games using real-time plain text chat.

Acknowledgements

I would like to thank God for providing me the ability to pursue such an opportunity and to my family for providing me much-needed support to see this through. I would also like to thank Lieutenant Colonel David Biros, Dr. Judee Burgoon, and Captain David Bouvin for their guidance as my thesis committee. In addition, I would like to thank Dr. Mark Adkins for his facilitation and Colonel David Dyche, Commander of AF ROTC Detachment 20, for his motivational assistance and approval of this study. Finally, I would like to thank Karl Wiers, Chris Diller, Joel Helquist, Matt Jensen, and Doug Twitchell from the Center for the Management of Information at the University of Arizona for their assistance during data collection and interpretation.

While the reader may or may not be familiar with the individuals listed here, they are provided to point out that works such as this are seldom accomplished in a vacuum.

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GROUP PERFORMANCE IN MILITARY SCENARIOS UNDER DECEPTIVE CONDITIONS

"Do you swear to tell the truth, the whole truth, and nothing but the truth, so help you God?"

Oath of Testimony, Unites States of America

I. Introduction

Overview

There are many divergent opinions on how one can define the nature of war and armed conflict. The Red Cross defines war as any difference between two states leading to the intervention of the members of the armed forces in an armed conflict. Carl von Clausewitz observed that "war is the mere continuation of policy by another means" and that policy and politics give a war purpose and direction- forming the central element of the nature of war. Countering Clausewitz's ideas, the historian John Keegan feels that the nature of war rests on the more fundamental foundation of culture, which he defines as the shared beliefs, values, associations, customs, traditions, manners, and ways of thought and artistic expression, which ballast every society (Keegan, 1994). Regardless of how you define war and armed conflict, once can say for certain that it has existed, continues to exist, and remains an act of violence that involves people in unity of will. This unity of will gives rise to goals and objectives that attempt to achieve mutual successes. However, what if those who are united have divergent objectives?

Modern armed conflict has evolved from a Cold War environment to one of peace support and humanitarian operations carried out in joint efforts where armed forces may come from several different countries. Larry Wentz (2002) writes that many conflicts are

now driven by the weakness of states rather than their strengths and war no longer takes place between states that feel strong enough to conquer another, but rather within states that have become so weak that they implode. A good example to examine this change in conflicts and the resultant problems associated with it is found upon examination of the Kosovo conflict of 1998 – 1999. The following is an excerpt from a hearing before the Military Readiness Subcommittee of the Committee on Armed Forces from the House of Representatives conducted on October 26, 1999 discussing the problems encountered during the operations in Kosovo. John M. Spratt, Jr. is a representative from South Carolina and member of this subcommittee, General John P. Jumper was Commander in Chief, U.S. Air Forces in Europe, and Vice Admiral Daniel J. Murphy, Jr. was the Commander of the U.S. Sixth Fleet in Southern Europe.

> Mr. **SPRATT.** With respect to target selection, this involved a political process. It is the nature of the Alliance. But in addition to disrupting your tactics, not being able to do what you prefer to do always, is there a security risk in shopping the bombing list around, the target list around? Did you have concerns about having information of this sensitivity shared by so many different people, many of them politically—.
>
> General **JUMPER.** Sir, I can tell you that I was not directly a part of the process. I do not think that they were actually passing target lists around. I think on the most sensitive targets that there was an approach made to some countries, not even all, but some at least for target approval. I can't describe to you exactly how that was done.
>
> On a different level, though, we were concerned about compromise of target lists and even the air tasking order in some cases. But I could not tell you if that was result of the target process or result of leaks somewhere in the operational and tactical level system. But yes, sir, it was a significant concern to all of us. In some cases I was convinced they had that information.
>
> Mr. **SPRATT.** That is true of the Navy in the 6th Fleet as well?
>
> Admiral **MURPHY.** We are all part of the same integrated targeting assignment process. We took precautions with respect to Tomahawk missiles,

> Tomahawk Land Attack Missile (TLAM) missiles, and our Stealth technologies so they were never made available in terms of precise timing or ingress and egress. None of it was ever compromised, either. The target lists were not made available to NATO until the day of planning required, so there was not—the long master target file was retained in U.S.-only channels and then shared with selected allies as necessary for consultation. But this was a reflection of the very real concern that all of the senior commanders had that we didn't have an airtight security system within some areas of the NATO operation. (House Armed Services Committee, 1999: 44).

The discussion above illustrates that given our trend of increasing participation in multinational military efforts one must give careful thought to how we handle the issues of unified objectives, security, and deception.

Background Information

Given our human nature, deception is considered part of everyday life (Depaulo, Kashy, Kirkendol, Wyer, & Epstein, 1996; Turner, Edgley & Olmstead, 1975). Examples of this range from the frivolous, such as agreeing that a style of hair is beautiful when you feel that it is not, to the serious, such as courtroom testimony, to the life-critical, which can occur during military conflict. Despite this inundation, it has been found that people are typically poor detectors of deception- commonly only able to detect it at a level slightly better than chance (Feeley & deTurck, 1995; Miller & Stiff, 1993). Why people are typically so poor in detecting deception communication can be apparent when you look at the nature of communication and of people.

The basic nature of communication is to convey information from sender to receiver through some active means. This means that when there is communication, the receiver is attempting to comprehend what the sender is saying and there is a basic assumption made that the message is comprehensive and truthful (Grice, 1989). The

problem with this is that research has shown that such a mindset can lead to truth bias, which is a predisposition to assume that all others' communication is truthful or trustworthy (McCornack & Parks, 1986; Levine & McCornack, 1992).

Another reason why people can have difficulty in detecting deception has to do with their preconceptions of what are accurate cues to deception. So which cues do people associate with deception? Surveys taken have shown that most people link gaze aversion and fidgeting with deception (Akehurst, Kohnken, Vrij, & Bull, 1996; Mann, 2001; Vrij & Semin, 1996). In one survey, 75 percent of police officers believed that liars look away. One possible reason for this is that the police manuals on interrogation promote this idea even though there is nothing proven to back this up (Gordon & Fleisher, 2002). These inaccurate preconceptions make detecting deception more difficult. Two recent studies that examine the relation between what people think are associated with deception and their ability to detect it have shown this apparent conflict. Police officers that believe that liars avert their gaze and fidget were shown to be among the worst at detecting deception (Mann, Vrij, & Bull, 2002; Vrij & Mann, 2001). Only when the police officers were asked to review the video tapes for specific cues did the detection success rates increase.

Another facet to this issue is that changes in technology has made face-to-face and telephone conversations to be used less often when compared to e-mail, video conferencing, and chat rooms (Biros, 1998; George and Carlson, 1999a). Given this increasing emphasis on technologically-based communication, the probability for deceit within this media increases (Zmud, 1990). If our trend is toward more, but smaller,

conflicts with reduced coalition unity and increasing reliance on computer-based media and given our untrained inability to detect deception, what can be done to counter it?

Research Focus

This study is an attempt to assist with the development of deception and deception detection models by examining group performance and perceptions of deception and task difficulty under two different media types commonly employed in military campaigns and two different levels of awareness using a military-based scenario. The two media types to be studied are face-to-face communication and real-time text chat. The two levels of awareness will be manipulated through the introduction of additional information to selected participants which may make them more suspicious of the other group members. The scenario to be used is one created using a software package called StrikeCOM, which was written by the Center for the Management of Information at the University of Arizona to evaluate group performance in a task requiring a coordinated effort among players. Specifically, this study sets out to answer the following questions:

1) Does the type of communication media employed effect the perception of truthfulness and task difficulty?
2) Does the type of communication media employed affect the overall success of the group effort?
3) What effect does participant conditioning have on perceptions of truthfulness and task difficulty?
4) Does the individual perceptions of truthfulness and task difficulty have any effect on the overall success of the group effort?

The details regarding this study and its results will be provided in subsequent chapters.

Summary

This chapter provided some insight into the changing nature and issues of military conflict and provided detail to the study that was performed to examine some of these issues. The next chapter will provide a summary of current scientific literature that has been written involving deception, deception detection, arousal, and media characteristics and conclude with a set of hypotheses to test. The third chapter will provide study characteristics. The fourth chapter will provide the study findings and match them to the generated hypotheses. The final chapter will discuss the study implications, limitations and provide suggestions for future research.

II. Background

"Those who cannot remember the past are condemned to repeat it."
George Santayana

Introduction

In order to study the interaction between deceivers and receivers, one must be aware of the factors that can influence the nature of the discourse. To do this, one must examine the current literature regarding deception, deception detection, arousal, and communication media characteristics in situations where individuals are untrained in deception or deception detection. In this chapter, we will review the definitions, theories, and models provided in published literature and in the end present several tentative hypotheses for study.

Key Definitions

It is important to understand the meaning behind the fundamental terms used in this report. This section will examine the definitions and the meaning behind them of the terms "deception," "sender and receiver," "cues," and "modality."

The term deception has been given many different definitions that appear to cluster around a set of centralized concepts. O'Hair and Cody (1994:181) defined deception as follows:

> Deception is a message strategy much like other forms of communication in that it is purposeful, often goal directed, and frequently functions as a relational control device. Deceptive messages are distinct as communication strategies because they serve to produce the very results most communicators attempt to avoid: false impressions and erroneous assumptions.

Deception has also been defined as "a message knowingly transmitted by a sender to foster a false belief or conclusion by the receiver" (Buller and Burgoon, 1996: 205). It does not necessarily involve lying because truth in selected quantities can also be used to convey a false impression. It is also important to point out that deception is based on the attempt to deceive, not on whether that attempt was successful. Because it is considered a deliberate act and not all forms of deception involve messages, another definition of deception is "the deliberate act of manipulating or restricting information in order to create a false belief in a target for one's own advantage" (Grazioli and Wang, 2001: 193).

The term "sender and receiver" refers to the act of sending a message from the deceiver (the sender) to a recipient (the receiver). This does not mean that the delivery process of sending a deceptive message is one-way; it only means that the terms of deceiver and sender are often used interchangeably within the research literature on deception.

Cues can be defined as involuntary communication that can fall into two categories (Rao and Lim, 2000). The first is where communicators send information that they are aware of but do not wish to send, such as a slip of the tongue. The second is where communicators send information of that they are not consciously aware of, such as nervous gestures or a raised voice pitch. Cues can be verbal or nonverbal, are sent by the sender or receiver, and can be noticed and acted upon by any participant (including the sender if they are self monitoring). Finally, cues are often associated with a term called "leakage" which is the sending of cues (Ekman and Friesen, 1969). It has been theorized that through this leakage and identification of specific cues that deception can be detected

(DePaulo and DePaulo, 1989; Zuckerman, DePaulo, and Rosenthal, 1981; Zuckerman and Driver, 1985).

Modality, in this study, refers to the different forms of communication that can take place (Nigay and Coutaz, 1993). One can communicate via face-to-face conversations, through video teleconferencing, through voice-only (telephone), through real-time text chat, through e-mail, or through many other means of communication. The term "modality" is often used interchangeably with "media type." One part of this study will examine the effect changes in modality have on group performance and perceptions of deception and task difficulty.

Deception Theory

There has been a significant amount of attention paid to the field of deception research, and several theories and models have been presented. The most significant of these are Interpersonal Deception Theory (IDT) (Buller and Burgoon, 1996) and Information Manipulation Theory (IMT) (McCornack, 1992). Both of these theories examine deception from different contexts ranging from the message content, to message delivery, and to the interpersonal relationships developed between sender and receiver.

Interpersonal Deception Theory

The Interpersonal Deception Theory (IDT) was developed to identify the characteristics of deceptive communication between a deceiver and one or more receivers (Buller and Burgoon, 1996). It takes into account the dynamic nature of communication, where participants may modify their style of communication based on the feedback they

receive. The IDT relies on a two-part definition of interpersonal communication and deceptive communication to establish the theory scope. Interpersonal communication is defined as the "dynamic exchange of messages between two (or more) people" (Buller and Burgoon, 1996: 205). This dynamic exchange requires that the sender and receiver are active participants in the communication and that individual roles will change over time, as communicators become listeners and vice versa. This exchange of communication allows deceivers to change the tone and style of their presentation to be better received based on the cues leaked by the receiver. This exchange can also work to the benefit of the receiver. If something the deceiver says raises the level of suspicion among receivers, they may change their style of communication in an effort to obtain evidence of deception or may more attention to any verbal or nonverbal cues that the deceiver may be sending (as depicted in Figure 1). This definition leaves open the point to which messages cease to be dynamic and, given the wide range of communication media that can be employed, it would be hard to fix such a point. It can be given that face-to-face communication is more dynamic than an exchange of e-mail, but does that mean that this theory is inapplicable for e-mail? The issues regarding differences in communication characteristics and media richness will be discussed in detail when the literature covering media characteristics is reviewed.

The second part of the definition, dealing with deceptive communication, uses the same definition provided near the beginning of this chapter. Based on this definition, deceptive communication is deliberate, can encompass any form of communication, and is sent by one or more people and received by one or more people.

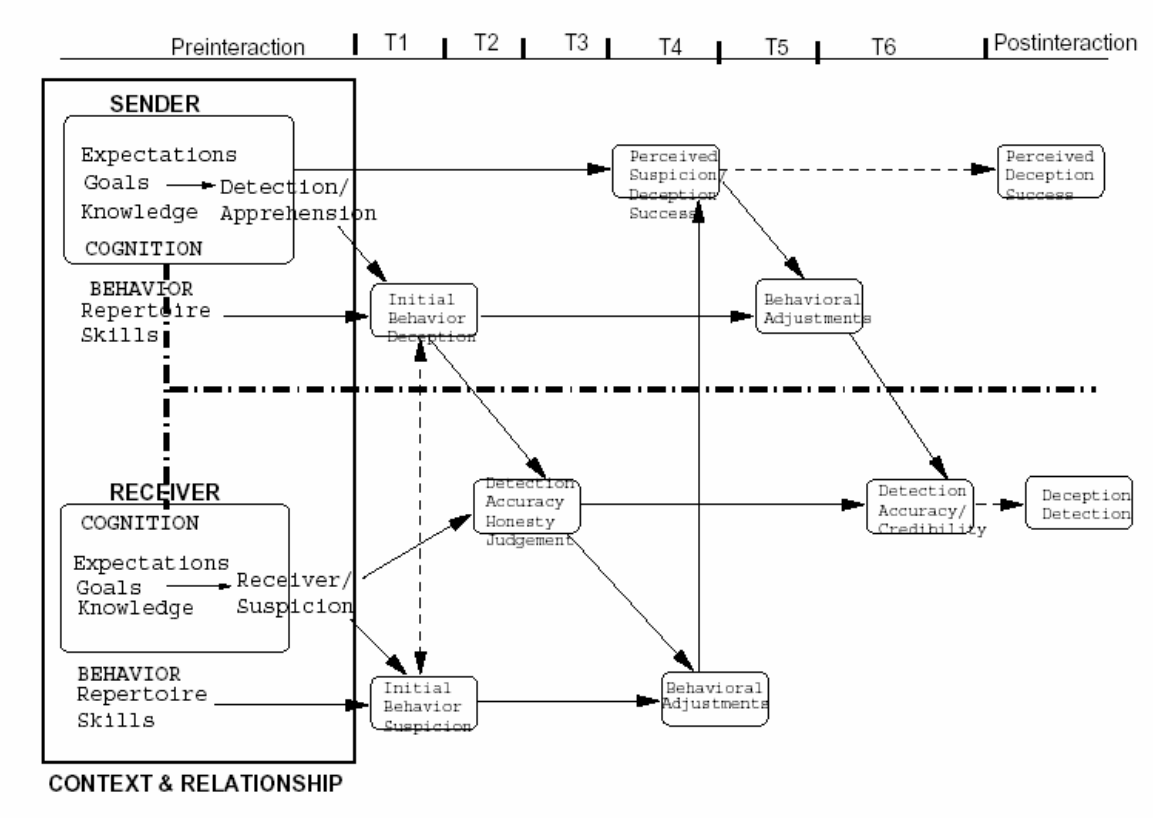


Figure 1. Schematic of Deception Process Model in IDT (p. 211)

Because the IDT considers both the message and the interpersonal communication involved with sending, receiving, interpreting, and modifying the message, it is considered a good model to show how the deceptive process, both in deception and in detection of deception, works.

The Information Manipulation Theory (IMT) was developed based on the opinion that "messages that are commonly thought of as deceptive derive from covert violations of the conversational maxims" (McCornack, 1992: 5). These maxims are split into four categories established by Grice (1989) and are quantity, quality, relation and manner. Deviations in quantity refer to the purposeful withholding of information, quality refers to the distortion of information, relation refers to the deliberate association of two or

more unrelated pieces of information, and manner refers to importance of the information- deliberately downplaying or promoting something beyond reality. The IMT posits that a deceptive message will covertly deviate from one or more of these maxims but because the deviation is covert, it may not be identified as deceptive. While this theory has advantages in terms of conceptual simplicity, it does have a disadvantage that would limit its usefulness in this study. The theory only takes into account the deception within the message and not any underlying deceptive behaviors (Jacobs, Dawson, and Brashers, 1996). This means that the IMT would not take into account the dynamic nature of communication between two or more people but simply examines each message separately and distinctly.

Deception Techniques

As an aside, because both models listed above address the strategic employment of deceptive techniques, neither specifically list what techniques deceivers typically employ when they attempt to deceive. The table below is based on the work by Johnson et al (1993), modified by Biros et al (2002:8), and provides a list of common deceptive tactics and their description and examples.

Table 1. Common Deceptive Techniques

Tactic	Description
Masking	Deleting from the environment attributes that suggest the correct representation. For example, saying something exists when it does not.
Double Play	Manipulating attributes in the environment in a way so as to weakly suggest the correct representation. The purpose is to reinforce incorrect representatives by weakly suggesting the correct one. For example, a deceiver may say, "Yes, I saw who you are looking for here and here but I think you should look in that second spot first."
Mimicking	Modifying attributes in the environment in a way so as to suggest the incorrect representation. Suggestions (not necessarily deceptions in and of themselves) are included to support the incorrect representation. An example of this is "Yes, all of these cars have the same features but this one is $4,000 cheaper."
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 correct one. An example of this is our car salesman saying, "Feel free to take a look at all the cars in the lot. Take your time, I'll be here until Midnight."
Inventing	Adding new attributes to the environment in order to suggest the incorrect representation. An example of this is our car dealership advertising loans at a low rate of interest but in the fine print show that only first-time auto buyers with an income over $35,000 qualify for it.
Repackaging	Modifying attributes in the environment in order to hinder the generation of the correct representation. Repackaging is considered weaker than mimicking because it is based on justification and distortion rather than replication of attributes. A car dealership example of this is storing some of the better used cars in a back or lesser-used lot.
Decoying	Adds new attributes to the environment in order to hinder identification of the correct representation. It is considered weaker than inventing because the decoys are not directly suggestive of the incorrect one. It simply directs attention away from the correct one. An example of this would be to mix better-condition used cars with new cars and list them all under similar prices.

So what do these deception models and techniques have to do with this study? These provide the framework from which to construct a study on deceptive communication. If one includes an overview on the latest research on deception

detection techniques and modality, then specific, testable questions can be formed for examination.

Deception Detection

The process by which studies on detecting deception have been performed has changed in the past twenty years (Buller et al, 1991). It has evolved from using subjects as observers of deception where transcripts and videotapes were reviewed and judgments on deception made to participants being actively engaged in deceptive interactions- either with or without the participant's awareness that deception may occur. Previous research of deception in everyday life shows that most successful deception efforts are achieved by crafting messages so that they either combine truthful and deceptive information or that they reduce or remove important details. (Buller and Burgoon, 1996). To counter this, detection of deception can occur because of at least one of four instances happening. These instances have been termed detection markers and are listed below (O'Hair and Cody, 1994: 197).

Table 2. Markers to Detecting Deception

Detection Marker	Example
Contextual cues that alert receivers to deception	"I know that Dave does not normally feel this way about playing golf."
Verbal or nonverbal behavioral cues that reveal deception	"…why is he acting nervous?"
Implausibility of the message	"…that's physically impossible."
Informant or external stimulus	"Bob says that Dave cannot be trusted." You are told that someone in the group may be deceptive.

When one or more of these decision markers are encountered, it tends to raise the level of suspicion of the receiver in a way depending on the relationship between the sender and receiver. Because every deceiver is unique in his or her abilities, skills, knowledge, relationships, and motivations, there can be no single universal marker or cue for detecting deception (Buller and Burgoon, 1996).

Examining the ability and techniques involved with detecting deception without also examining the consequences of exposing the deception would miss a key portion of the social interactiveness in deceptive communication. When receivers detect deception they can do one of two things- either expose the deceiver with an accusation or suppress the knowledge of the detection. There are five different reasons mentioned why a receiver may suppress the deception detection (O'Hair and Cody, 1994: 198):

- A detector may not feel that the deception is worth exposure.
- A detector may deny that the deception took place.
- A detector may sympathize with the deceiver.
- A detector may wish to participate in the deception and possibly collaborate
- A detector may delay exposure of the deception in order to collect more information about the deception.

Regardless of what the receiver does upon detection of deception, the consequences of such a discovery will change the relationship between the deceiver and receiver and the more intimate the relationship, the greater potential for change (O'Hair and Cody, 1994).

Truth Bias

As mentioned in the first chapter, truth bias is a predisposition to assume that all others' communication is truthful or trustworthy (McCornack & Parks, 1986; Levine & McCornack, 1992). Receivers will generally believe others and accept message content at face value (DePaulo et al, 1985). Stiff and Kim (1992) identified truth bias as something consistently present in the background until it was determined by the receiver to be no longer warranted due to increasing suspicion, discovery of deceit, or an external warning of deceit. Stiff and Kim want on to say that this truth bias also extends to strangers. The foundational principle of communication is to communicate. People will give the receiving and understanding of that communication the highest priority until proven otherwise- this is especially true among formed relationships. The truth biases associated with most relationships may reduce detection of deceit by causing receivers to overlook, discount, or misinterpret evidence (Buller & Burgoon, 1996). On the other hand, "greater shared history may improve detection by providing verifiable background information and a behavioral baseline against which to compare sender messages" (Buller & Burgoon, 1996: 215). In summary, improved deception detection accuracy though external knowledge of the deceiver should be mitigated by the truth bias associated with relational familiarity. Another aspect of the truth bias that can work against the deceiver is that deceivers' awareness that the receiver trusts them can give rise to feelings of guilt and apprehension, which may express themselves though nonverbal cues. Apprehension about being detected should increase in instances of deceptive communication as the participants become more familiar with each other ranging from strangers, to acquaintances, to friends (Buller and Burgoon, 1996). Countering this,

socially skilled individuals should be better able to manage their behavior and image while controlling any verbal or nonverbal cue leakage (Buller and Burgoon, 1996).

In some cases, the suspicion of the receiver can be raised through the observation of deceptive cues and/or through the receipt of external information to a point where the truth bias becomes a lie bias where everything from the sender is examined with suspicion rather than trust (Levine & McCornack, 1991). Because of this detailed examination, receivers may "seek information confirming their initially positive judgments and/or engage in information-seeking strategies that reduce rather than enhance the chances of ascertaining the truth" (Buller and Burgoon, 1996: 227).

Modality

Modality refers to the different communication media or modes that can be employed (face-to-face, e-mail, telephone, etc) when sending information to one or more recipients (Nigay and Chutaz, 1993). These media have different characteristics that affect how they convey information, how much information each can convey, and how many different people can they convey information to in a set amount of time (Buller and Burgoon, 1996; Daft and Lengel, 1986; Newberry, 2001; Short et al, 1976; Dennis and Valacich, 1999). To address these characteristics within the confines of this study, three different theories, two old and one new, will be examined. The goal of this examination is not to determine if one theory can be considered better than the others but rather to highlight the different ways that modality has been considered. After highlighting these theories, the results of past studies will be provided to illustrate the importance in

examining media differences when studying group performance and detection of deception.

The first theory presented looks at the differences in media from the point of view of the individuals participating within the communication rather than the characteristics within the media itself.

Social Presence Theory

The Social Presence Theory (Short et al, 1976) was developed from the observation that some forms of communication may have a negative impact on the way a group communicates and interacts. The theory introduces a single measure called "social presence" to describe the ability for a media type to provide a member of a team with the feeling of the presence of the other members of the team or the "transparency" of the media type employed. When considering this measure, it is important to evaluate to what extent the sender is aware of the receivers as people rather than as receivers of a message. In ranking different media types, face-to-face communication is considered to have the highest social presence with television, multispeaker audio, telephone, and business letter receiving descending values of social presence.

The remaining two theories look at the characteristics of the media employed and either use these characteristics to rank different forms of communication in terms of their richness or classify the characteristics in a way that provides an idea of the strengths and weaknesses of the different media types.

Media Richness Theory

The Media Richness Theory was first published as an attempt to explain why managers preferred using face-to-face communication for difficult and equivocal messages (Daft and Lengel, 1986). It defined the term "information richness" as "the ability of information to change understanding within a time interval" (Daft and Lengel, 1986: 560). Communication that was able to change understanding in a shorter time interval was considered "rich" when compared to communication methods that took a longer time to have the same change in understanding. Given that different communication media has different capacities to process rich information, Daft and Lengel were able to classify different media by these capacities to form a richness hierarchy (see figure 2 which was published the subsequent year (Daft et al, 1987: 358)).

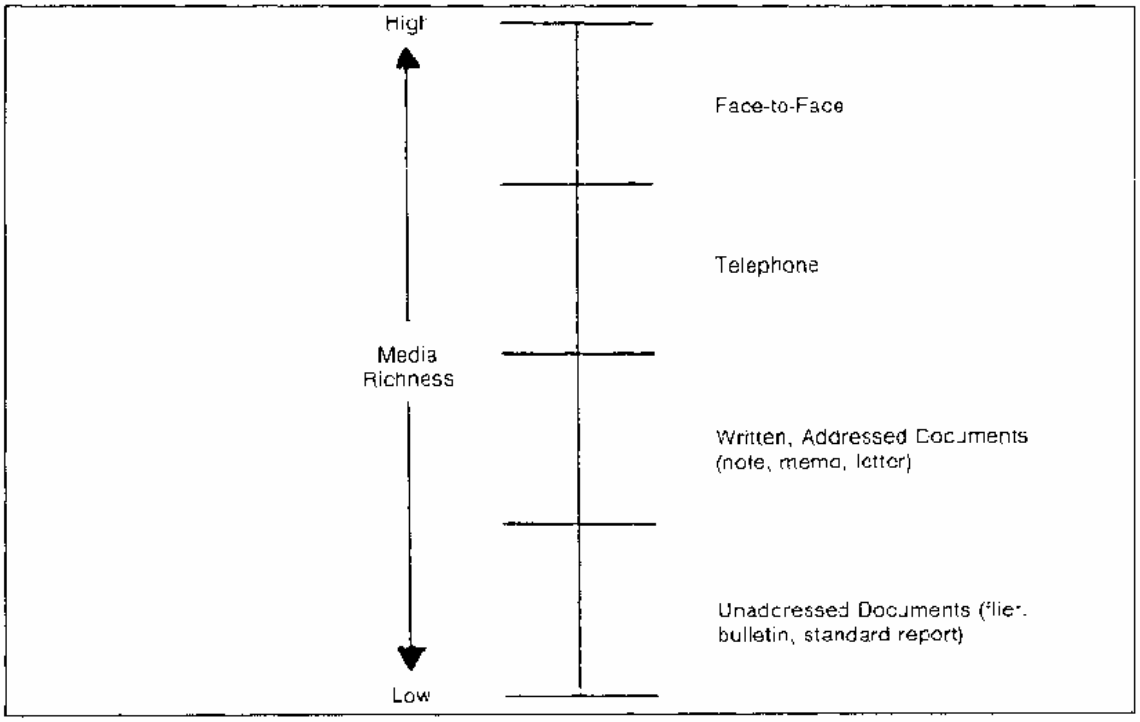


Figure 2. Hierarchy of Media Richness

The differences in these media types can be expressed using four media classifications (Daft et al, 1987: 358):

1. **Feedback** Instant feedback allows questions to be asked and corrections to be made.
2. **Multiple cues** An array of cues may be part of the message, including physical presence, voice inflection, body gestures, words, numbers, and graphic symbols.
3. **Language variety** Language variety is the range of meaning that can be conveyed with language symbols. Numbers convey greater precision of meaning than does natural language. Natural language can be used to convey understanding of a broader set of concepts and ideas.

4. **Personal focus** A message will be conveyed more fully when personal feelings and emotions infuse the communication. Some messages can be tailored to the frame of reference, needs, and current situation of the receiver.

Given these classifications, face-to-face communication is considered the richest medium-- allowing for immediate feedback, a full variety of verbal and nonverbal cues, natural language, and rapid tailoring. To account for updates in communications technology, Newberry (2001) updated the richness hierarchy as shown in table 3.

Table 3. Updated Heirarchy of Media Richness

Media Rating	Feedback	Multiple Cues	Emotions (Language Variety)	Message Tailoring (Personal Focus)
High	Face-to-face Videoconference Synchronous audio Text-based chat	Face-to-face	Face-to-face	Face-to-face
Medium		Videoconference	Videoconference Synchronous audio Asynchronous audio	Videoconference Synchronous audio E-mail
Low	E-mail Threaded discussion Asynchronous audio	E-mail Synchronous audio Asynchronous audio Text-based chat Threaded discussion	E-mail Text-based chat Threaded discussion	Text-based chat Asynchronous audio Threaded discussion

Media Synchronicity Theory

In response to the increasing communication capabilities offered by technological advances, a new theory was offered that addresses the different capabilities of different communication methods but does not provide for an absolute ranking between them (Dennis and Valacich, 1999). The Media Synchronicity Theory (MST) holds, like the Media Richness Theory, that the richness of the medium is defined by its ability to change understanding within a set amount of time. The key difference appears to be that the MST links this change in understanding to the information processing capabilities provided by the media rather than the social factors the media is able to provide.

Dennis and Valacich then propose five media characteristics to classify communications (Dennis and Valacich, 1999: 2):

1. **Immediacy of feedback** The extent which a medium enables users to give and receive feedback.
2. **Symbol variety** The number of ways in which information can be communicated- both verbally and nonverbally.
3. **Parallelism** The number of simultaneous conversations that can exist over an indefinite period of time.
4. **Rehearsability** The extent which the media allows the sender to rehearse or craft the message before sending.
5. **Reprocessability** The extent which a message can be reexamined by the receiver (and sender) over a communication event.

These media characteristics are then used to classify different media types (Dennis and Valacich, 1999: 3).

Table 4. Relative Trait Salience of Selected Media

	Feedback	Symbol Variety	Parallelism	Rehearsability	Reprocessability
Face-to-face	high	low-high	low	low	low
Video conference	medium-high	low-high	low	low	low
Telephone	medium	low	low	low	low
Written mail	low	low-medium	high	high	high
Voice mail	low	low	low	low-medium	high
Electronic mail	low-medium	low-high	medium	high	high
Electronic phone ("chat")	medium	low-medium	medium	low-medium	low-medium
Asynchronous groupware	low	low-high	high	high	high
Synchronous groupware	low-medium	low-high	high	medium-high	high

The ranges given with the different media types illustrate that the media is configurable based on the abilities, technologies, and configurations available to the sender. For example, the face-to-face characteristic of symbol variety shows a range depending on what additional sources of information, such as illustrations, is used. Based on this table, no single media type will have the highest overall scores and be considered the "richest." This is deliberate. Different situations will emphasize the need for different media characteristics which could then suggest better media types based on the available technology and preferences of the sender and receiver.

Media Differences in Studies

There have been many studies that compare the impact of different media types on deception, deception detection, or group performance. In an analysis examining many different studies, called a meta-analysis, Zuckerman and Driver (1985) discovered that 14

of 24 different verbal, nonverbal, and paralinguistic behaviors commonly associated with deception could be reliably used to detect deception within different media types.

Table 5. Thirteen Key Deceptive Behaviors

Verbal Behaviors	Nonverbal Behaviors	Paralinguistic Behaviors
More negative statements	More pupil dilation	Shorter responses
More irrelevant information	More blinking	More speech errors
Less immediacy	Less facial segmentation (fewer expression changes over time)	More speech hesitations
More generalization	More adapters (self-grooming / stretching)	Higher voice pitch
	More body segmentation (more body position changes over time)	

The last identified deceptive behavior, having more differences between message text and other information conveyed by the sender, does not fit in any of the above categories.

The behaviors listed could not be applicable for evaluating deception over all media types- imagine trying to evaluate deceptive nonverbal behavior in e-mail messages (George and Carlson, 1999b). Most studies, for the sake of consistency, appear to use the terminology found in the Media Richness Theory to define and compare the different media types.

> "In face-to-face deception, participants have full access to the range of social information available in environmental, visual, auditory, and verbal channels. By contrast, less interactive contexts restrict channel and information availability, producing a limited cues environment that may alter behaviors and perceptions" (Buller and Burgoon, 1996: 212).

When considered in this way, studies of media typically have them broken out by face-to-face, video and audio, and text-only categories.

Face-to-face communication is typified by access to the most verbal and nonverbal channels available (Buller and Burgoon, 1996). Compared to other modalities, people tend to be more influenced by those with more and greater channels of information (DePaulo and Rosenthal, 1979). In addition, when using untrained participants, one study found that "most people appear to look at nothing else but the face to find emotional information" (Dittmann, 1972: 114). This implies that receivers may not pay attention to all available verbal and nonverbal channels.

This oversaturation of information has been considered by Buller and Burgoon (1996). Given the large number of verbal and nonverbal communication channels that are present during a face-to-face conversation, participants, both the sender and receivers, may select specific channels to pay attention to and ignore the rest, creating a "cognitive bias" (Buller and Burgoon, 1996: 225). This limiting of channels, combined with the desire to understand the message that is being sent, may cause the receiver to not pay attention to channels where deceptive cues may be present- especially in situations where a lack of training makes the receiver unaware that other channels even exist. "All else being equal, then, cognitive biases should reduce receivers' overall detection accuracy over the course of an interaction because receivers misjudge deceivers as truthful or misjudge truthful communicators as liars" (Buller and Burgoon, 1996: 226).

A summary of the effects that truth bias, sender-receiver relationship and abilities, and modality have on the receiver's ability to detect deception is neatly summed up in a passage taken from Buller and Burgoon.

> Preposition 11: Initial and ongoing receiver detection accuracy are inversely related to (a) receiver truth biases, (b) context interactivity, (c) and sender encoding skills; they are positively related to (d) informational and behavioral familiarity, (e) receiver decoding skills, and (f) deviations of sender communication from expected patterns. (Buller and Burgoon, 1996: 228).

Presentation of the Conceptual Model

The effort of this thesis is to explore the areas of deception detection and task difficulty under two different media types and two states of participant awareness. It specifically looks to answer the following questions:

1. Does the type of communication media employed in a group effort affect the perception of deception and task difficulty?
2. Does the type of communication media employed affect the overall success of the group effort?
3. What effect does external participant conditioning have on perceptions of deception and task difficulty?
4. Do the individual perceptions of deception and task difficulty have any effect on the overall success of the group effort?

These questions will be answered in a study where groups of individuals are formed into teams, each person having different, occasionally deceptive responsibilities, and tasked to play a cooperative game called StrikeCOM. Further information regarding the study methodology is given in Chapter 3 of this thesis. The model below shows the proposed questions in the form of testable hypotheses and their relationship.

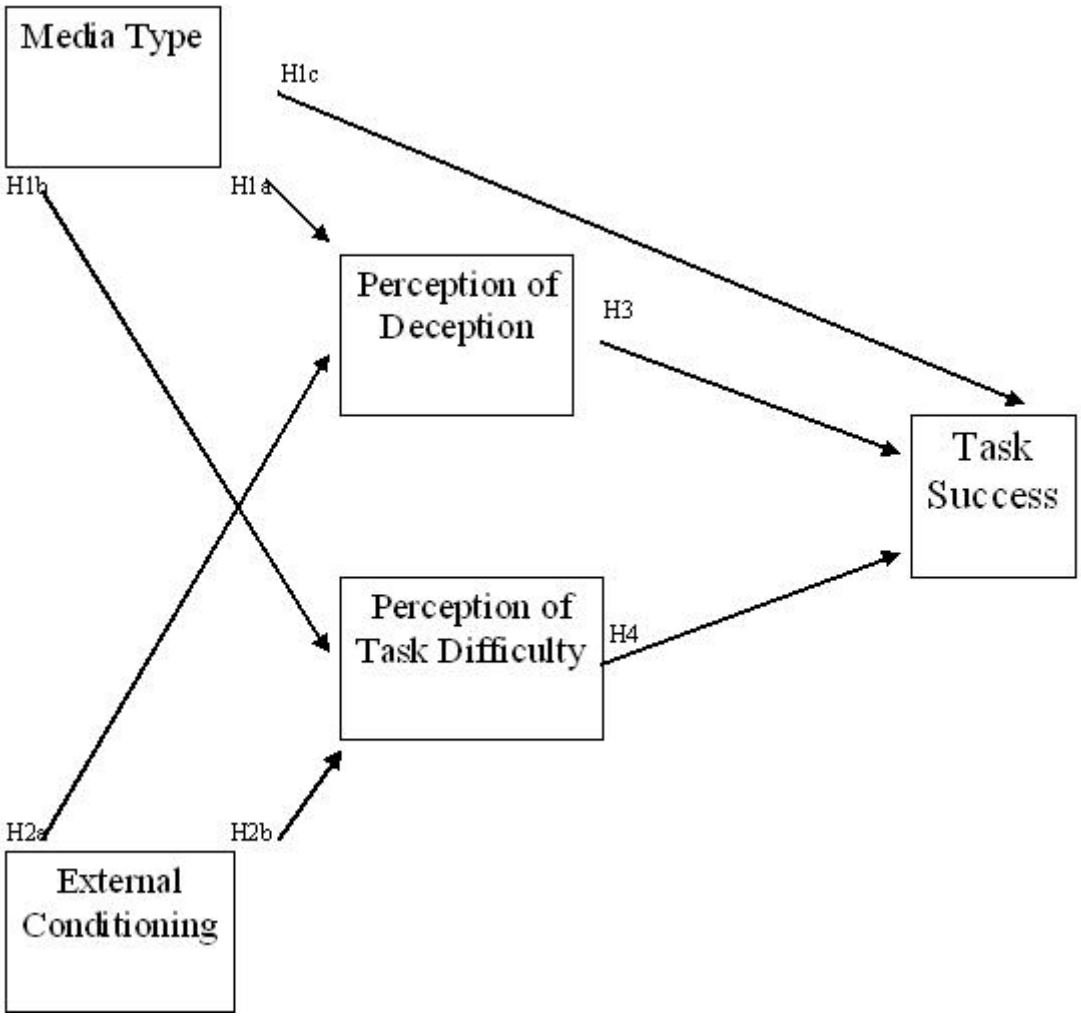


Figure 3. Proposed Hypotheses in Relation

Effects of Media Type

In a small sample size study such as this where one wishes to examine the differences modality can have in individual perceptions and group task success, care must be given to select two different media types that are sufficiently different and yet similar enough such that the differences are only in one or two key media characteristics. Recent research by Carlson (et al, 2004) attempts to merge the different studies involving media

characteristics to propose a set of characteristics that are ideally suited for deception research. In the previous studies, Daft and Lengel (1986) proposed four characteristics to communication media in the Media Richness Theory, Dennis and Valicich (1999) proposed five characteristics in the Theory of Media Synchronicity, and Burgoon and colleagues (Burgoon et al, 2002) propose ten characteristics. Carlson integrated these into the six following media characteristics: synchronicity, symbol variety, cue multiplicity, tailorability, reprocessability, and rehearsability. Synchronocity is defined as the range comparison of interaction speed and immediacy of feedback between different media types. The faster the interaction and turnaround of feedback, the more synchronous the media is considered to be. Symbol variety is defined as the range of different symbols and visual language elements (color, font, formatting) that is available for use. This does not take into account the verbal and nonverbal cue characteristics of the media type. Cue multiplicity is defined as the "number of simultaneous information channels that the medium supports" (Carlson et al, 2004: 14). This characteristic takes into account the different textual, audio, and visual verbal and nonverbal cues that are present in different modalities. Tailorabilty is defined as the ability of the media to provide opportunities for the sender to modify a stream of communication to match the perceived needs of the receivers. Media with high tailorability will allow the sender to customize messages easily and in near real time. Reprocessability is defined as the ability for the media to store message content for future examination over the course of the entire communication process (or beyond). Lastly, rehersability is defined as the ability a medium gives to allow senders the ability to plan, edit, and rehearse a message without causing a significant interruption in the communication effort. As to be

expected, media with high rehearsability characteristics would have low synchronistic characteristics.

Given the complexity of modality characteristic interaction, this study chose face-to-face and real-time text-chat conversations to compare modality a small set of modality characteristics. Both media types can be considered closely matched for synchronicity but face-to-face is considered more synchronous. Conversely, real-time text chat would have slightly higher rehearsability given the participants' speed and accuracy in typing. Symbol variety could be considered similar when comparing spoken word to unhighlighted plain text. Cue multiplicity holds the greatest difference between the two media types in that face-to-face has the greatest number of visual, verbal, and nonverbal cue channels, while plain text can be considered to have the least (Buller and Burgoon, 1996, Daft and Lengel, 1986). Tailorability is equally low for both media types in that the same unmodifiable communication goes to all receivers at the same time. Finally, reprocessability would normally be considered higher in the text-only than the face-to-face conversations because of the scrolling text record that is available to all text-only participants highlight whom said what but for this study reprocessability is more closely balanced because all participants are provided the ability to write notes about the conversations in order to make it easier to formulate group cooperative strategies.

Given these similarities and differences between the face-to-face and text-only media characteristics and that previous research has proposed that deception is aided by higher levels of symbol variety (equal for this study), tailorability (equal for this study), and rehearsability (higher for text conversations) and by lower levels of cue multiplicity (lower for text conversations) and reprocessability (mitigated to be equal for this study)

(Carlson et al, 2004), it can be considered that deceivers would prefer the text-only media environment over the face-to-face. However, it can be equally said that detectors of deception (those that perceive deception) would also prefer lower levels of cue multiplicity, which would allow them to concentrate on all the channels available rather than a selected number (Buller and Burgoon, 1996). To examine these differences, the following hypotheses are proposed:

H1a: Games performed using a text-only communication method will have a higher perception of deception when compared to games performed using a face-to-face communication method.

H1b: Games performed using a face-to-face communication method will be perceived as easier to perform when compared to games performed using a text-only communication method.

H1c: The final group game scores will be higher on average for those employing the text-only communication method when compared to those using the face-to-face communication method.

Effects of External Conditioning

External conditioning is the presence of information provided to certain group members about the possibility of deception from a source external to the group. In this experiment, the external conditioning is in the form of additional instructions provided to participants playing the role of the Intel component commander that warn of the possibility of deception from within the participant group. The goal of providing this

information is to raise the non-specific suspicion levels of certain group members by providing an external stimulus deception detection marker (O'Hair and Cody, 1994) to observe individual changes in perception of deception and task difficulty. A previous study has determined that external stimulation or warnings are positively associated with deception detection success (Biros et al, 2002) and the purpose of including this condition is to expand these results to consider its interaction with modality. The hypotheses to examine these changes are listed below:

H2a: The presence of external conditioning is associated with a higher perception of deception.

H2b: The presence of external conditioning is associated with a higher perception of task difficulty.

Effects of Perceived Deception and Task Difficulty on Game Scores

The final two hypotheses are designed build upon the previous hypotheses and tie them to a visible measure of performance, in this case the final group game score.

H3: A higher perception of deception is associated with higher average game scores.

H4: A higher perception of task difficulty is associated with lower average game scores.

As an explanation for H3, a higher perception of deception can allow you to discount the deceptive efforts if the source deception is identified. If you discount the deceptive efforts, then the average game score should increase. H4 is tied in with the

notion of self-efficacy (Bandura, 1986). If people believe that the task is difficult, then it will be and the group games scores will be lower on average. Bandura states that this idea of self-efficacy is "perhaps the single-most influential factor in determining an individual's behavior" (Bandura 1986: 390). Supporting these ideas, a previous master's thesis by Knode (2003) found support for a strong positive relationship between self-efficacy and performance in the realm of deception detection success. If participants believed that they could not do well, that the task was too difficult, then their success rates were lower.

Summary

This chapter reviewed the literature pertaining to the interactions of deception, deception detection, modality, and group dynamics and provided a series of questions that evolved into a testable set of hypotheses. The next chapter will provide the study methodology and the summary statistics of the participant population.

III. Methodology

Overview

The previous two chapters provided information on why we need to continue research on deception and deception detection within different modalities and conditions and reviewed relevant research regarding this study. Research questions were asked, a conceptual framework of the interrelations of these questions was developed, and a set of testable hypotheses were formed. This chapter will provide the procedures and specific details, such as the software and survey instruments used and participant population characteristics, for an experiment designed to answer the key questions posed by this study.

Experiment Procedure

The following is the procedure that was used when conducting the experiment.

- Participants were seated at the computer they used for the experiment.
- Individually filled out pre-survey for demographic information via web-based questionnaire
- Received personal instructions on game play via PowerPoint presentation
- Participated in a individual self-paced StrikeCOM practice session complete with search and attack rounds and end score
- Performed group session of StrikeCOM cumulating with final group score
- Individually filled out the post-survey via web-based questionnaire
- Participated in group outbrief with experiment assistant

Participants

The sample space used from which the experiment participants were drawn was confined to the cadets from the University of Arizona Air Force ROTC Detachment 20 in Tucson. This cadet population has the advantage of being one of the largest in the southwest- just over 200 cadets. Each group was expected to complete their session within 2 hours and the room for the experiment allowed for up to two simultaneous groups. Given up to 10 sessions per day it would have taken up to 6 full days to complete a maximum of 60 sessions which was our ideal situation given the participation of 180 cadets. There would also need to be one full day on each side for a population inbrief and outbrief and experiment equipment setup and takedown.

Each participant was videotaped for the duration of the session. All audio and text was recorded and transcribed for future analysis. The transcripts were examined by researchers to test whether visual, verbal, and nonverbal cues identified as applicable for software development were suitable for detecting deception in video, written and verbal communications.

So what methodology does one use in developing an experiment examining the interrelations between deception, deception detection, modality, and group dynamics in a small population? Given that one does not have complete randomness because participants sign up for the times they wish to attend, occasionally choosing the same times as other cadets they know, and that the participant roles are not assigned using a random number table the experiment design process recommended is a quasi-experimental design (Dooley, 2001).

Relevant Population

For purposes of this research, the sample population was taken from the Air Force cadet population as mentioned above. Table 6 provides a demographic summary of the participants. Appendix A includes a complete list of all questions asked in the pre-survey.

Table 6. Participant Demographic Information

Variables	**Cadets**	**Percentage**
Gender	108	
Female	29	26.9%
Male	79	73.1%
Age	20.1	
Female	19.5	
Male	20.3	
	Mean	**Median**
Amount of Computer Experience (1=none 5=great deal)	3.96	4
Female	3.76	
Male	4.04	
Amount of Group Experience	4.23	4
Female	4.34	
Male	4.19	
Experience with Turn-Based Games	2.50	2
Female	1.83	
Male	2.74	
Experience with Real-Time Games	2.80	3
Female	1.72	
Male	3.21	
Chosen to be Group Leader	3.66	4
Female	3.31	
Male	3.79	

As a personal observation, it was noted that the University of Arizona Air Force cadets were interested, positive, and motivated experiment participants. Out of the 121 that did sign up, only three did not show up. Ten of the cadets that did sign up could not

participate because they did not have a full group of three and could not return. Several more, when unable to participate because of the lack of a full group, elected to sign up for a different time and returned later to participate. The post-experiment outbriefs with each group showed that most were excited to participate and understood the need not to disclose what happened in the game to other cadets that may not have participated in the experiment. Even with this understanding, many wanted to play again saying that the game was fun.

Not every cadet that completed the post-game survey was able to provide usable information. Due to the need for three-person teams and taking into account for a single Space component commander that chose not to deceive, we were able to draw visual, verbal, and post-survey data from 14 face-to-face teams, 14 text-only teams, and 5 text-only control teams where they all received the same instruction set (naïve) and no deception was practiced. All members of these teams were able to complete a 56 question post-game survey that provided information to the researchers on individual perceptions of group performance, task difficulty, motivation, and group interaction. A complete list of all post-survey questions is available in appendix B.

Approval for the Use of Volunteers in Research

The approval for the use of volunteers in deception research was granted by the Wright Site Institutional Review Board on 25 August 2003 and by the Air Force Research Laboratory Chief of Aerospace Medicine on 27 August 2003 and assigned an AFRL/HEH Case Log Approval Number of F-WR-2003-0082-E.

Experiment Procedures and Independent Variables

The experiment began by placing the subjects into three-person groups. Each person in a given group was randomly assigned a role (Space, Intel, Air) that was known to the other players and a corresponding goal (deceiver, suspector, naïve) that was unknown to the other two players and asked to perform a pre-game survey that provided demographic information. The groups then played the game StrikecCOM where the primary goal is to find then eliminate three targets on a computer-generated grid map using cooperative searches over a series of five turns.

Communication between group members was specified as face-to-face or real-time text-chat. Face-to-face groups were seated at computers in the same room facing each other. They were able to see and hear the other players within their group. Text-only groups were separated using dividers or separate rooms from the other members of their group. They were limited to sending and receiving plain text in real time on a dialog screen that is part of the game. They were the only groups to use this game feature within StrikeCOM.

The group members then filled out a post-game survey questionnaire regarding their effort. The experiment concluded with an outbrief for all participants to answer any questions the subjects may have.

The pre-game survey was developed by the Center for the Management of Information at the University of Arizona to provide demographic information about the participant population and to assess the level of some specific qualities, such as perceived amount of group interaction, leadership, and computer experience, for each participant.

A summary table of the participant demographic characteristics can be found near the end of this chapter and the entire pre-game survey can be found in Appendix A.

The post-game survey was developed by Dr. Judee Burgoon as a compilation of multiple measures to evaluate the participant perceptions of group performance, group interaction, task difficulty, and motivation (Burgoon et al, in press). This survey uses several questions within each measure to differentiate between shades of meanings and each question asks the participant to answer using a numerical scale. Each measure within the post-game survey was tested separately for reliability at various times and they were supported as reliable (Burgoon et al, in press). How this post-game survey is used to answer the hypotheses questions is found near the end of this chapter. Selected results of the post-game surveys are addressed in chapters 4 and 5 and the entire survey can be found in Appendix B.

StrikeCOM

StrikeCOM is a game where all three players cooperate to find three targets that are hidden over a 6x6 grid map (See Figure 4). Each player was given two assets each that they could use once per turn. The two assets had different search coverage abilities; asset one could search three grid squares per turn and asset two could search one grid square per turn. Search efforts encompassed five rounds where each person used their assets to search different portions of the map for possible targets. Results of each search yielded information about the grids searched. Each grid searched showed that it either had no target, possibly had a target, or probably had a target. Conducting another search

on a grid that possibly had a target would have shown if there was either no target or probably a target there.

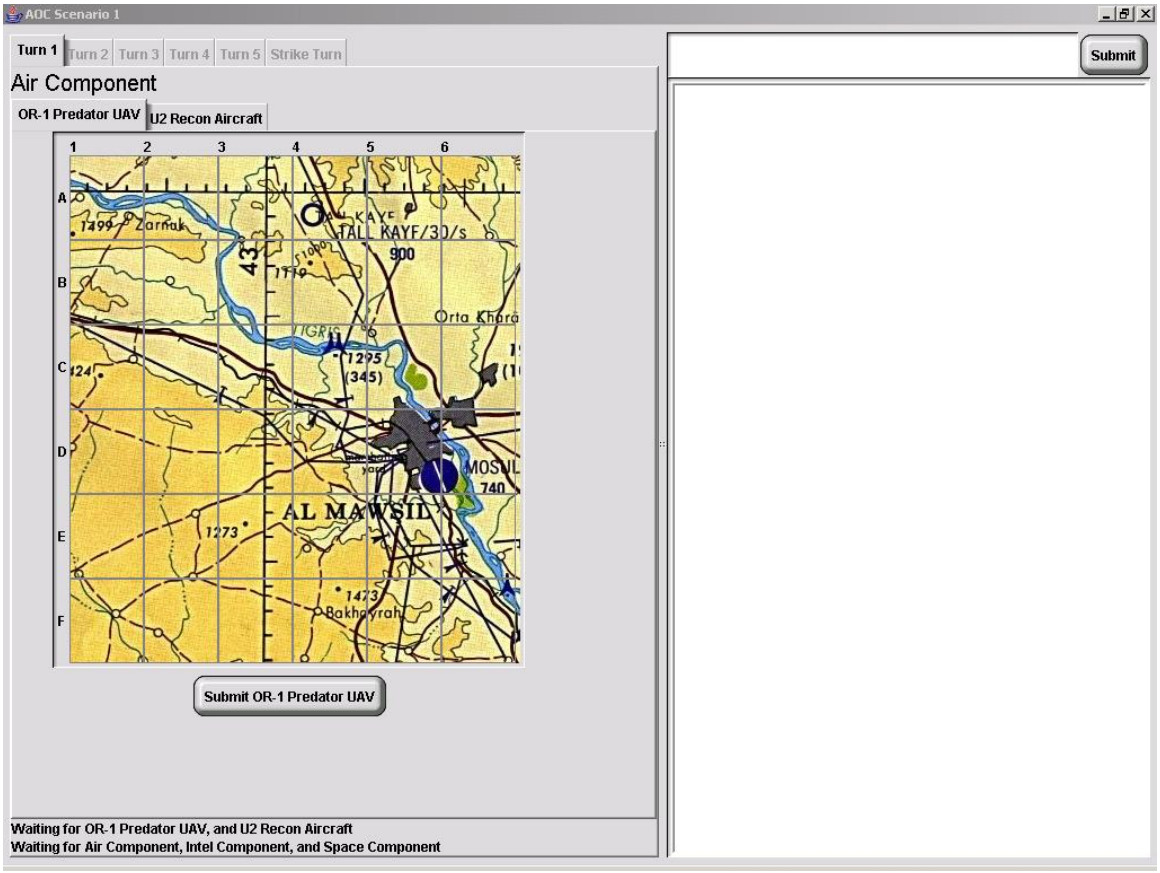


Figure 4. Initial View of StrikeCOM Game

Due to the number of grids on the map, it was impossible for any one of the players to search the entire map by themselves. Only the player knew the results of their search. They needed to communicate the search results to the other players in order to develop a winning game strategy. In order to have the greatest chance of finding targets, players had to plan and coordinate their searches using the communication mode they were provided. On the sixth and final round, each player selected a set of three or more grids to attack in the hopes of destroying the three targets (see Figure 5).

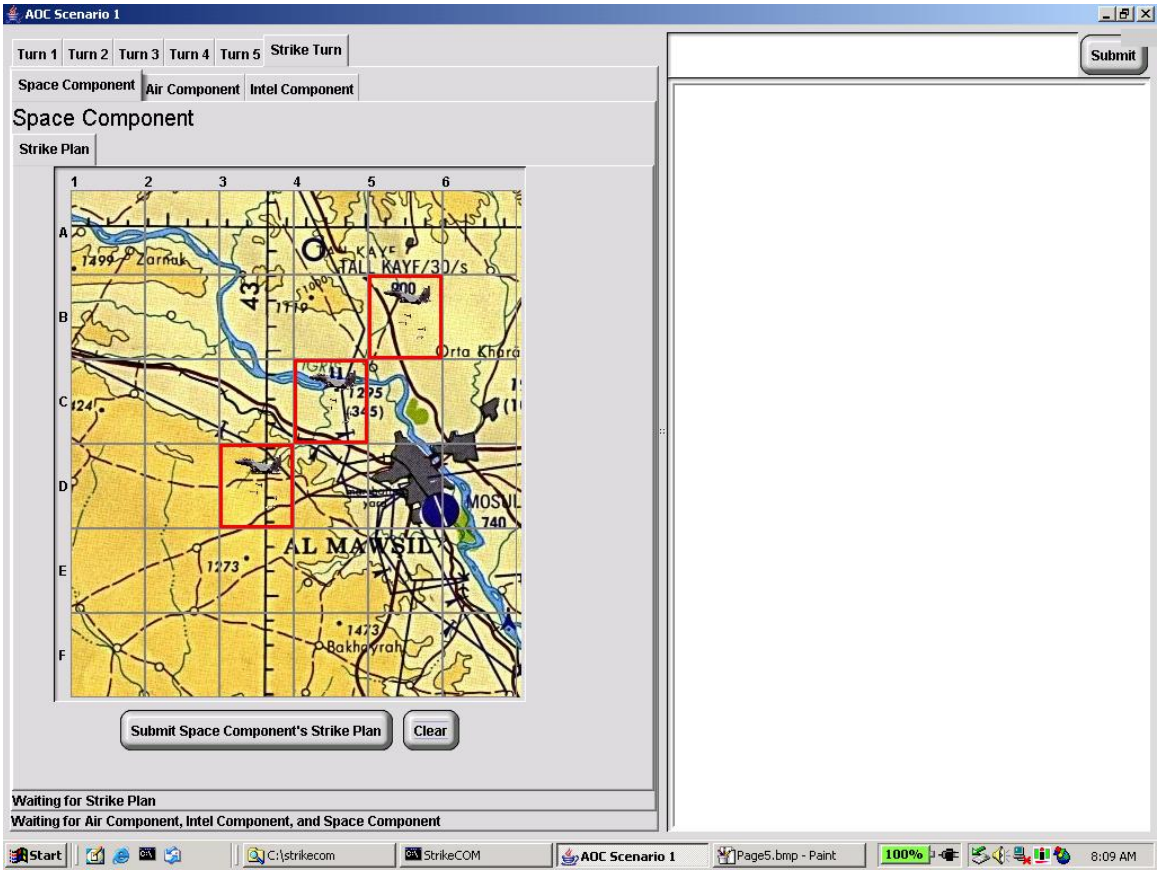


Figure 5. View of StrikeCOM in Stike Turn

The number of player strike selections that correctly chose the correct target locations determined the final group game score. A perfect score was achieved when all three group members selected the same three correct targets for attack. This game is made more difficult in this experiment by the fact that one of the three players does not want targets to be found or destroyed and will likely provide misleading information to the other two players.

Independent Variables: Role, Deception, and External Suspicion Induction

Each player was selected to play the role of one of three component commanders: Air, Intel, and Space. Each component had a different role within the game and participants were randomly selected for each role at the beginning of the game. The Air component commander was given the basic set of instructions. They were told how to play the game and their goal is to play the game as best they can and help to achieve the highest overall group score. They were not made aware that any other player might have had a different goal. For classification purposes, the Air component commander was considered the naïve player.

The Intel component commander was also given the same basic set of instructions but was also given one additional set of instructions (see below- condensed for readability). They were provided with an external source of suspicion by being informed that one of the other two players may provide deceptive information. The Intel component commander did not know which of the other players was the deceiver and may have tried to find out whom it is- though their goal remained to help achieve the highest overall group score in the game. For classification purposes, the Intel component commander was considered the suspicious player.

Intel Component Commander Additional Instructions

1. In group deliberations, there is always the possibility of faulty or inaccurate information. You are strongly advised to discuss your teammates search results and recommendations in detail.

2. The nature of this faulty or inaccurate information can come from ANY source internal to this simulation, such as the players, but not from external sources, such as the assistants or observers.
3. Again, your mission in this simulation is to get the highest team score that is possible- maximum strike hits with a minimum number of strikes

The Space component commander was given the same basic gameplay instructions but was also given an additional set of instructions (see below- condensed for readability). Their goal was that of the deceiver- to ensure that targets were not found or destroyed and for the group to obtain the lowest possible score. They were expected to mislead the other players by providing false results and suggesting detracting courses of action. For classification purposes, the Space component commander was considered the deceiving player.

Space Component Commander Additional Instructions

1. Although most of us typically think that "honesty is the best policy," there are times when being truthful is not in the best interest.
2. In the case of the simulation you are about to play, you are an expatriate of Borderland, the country that was invaded. You know that the enemies are hiding among the civilian population. You have many friends and relatives in Borderland and attacking the enemy may kill many innocent civilians, including your family.
3. Your real task is to deceive your team members about the true location of the enemy camps- delaying the strike effort until a better solution can be found. To protect your friends and relatives, you must prevent your teammates from discovering the true location of the enemies and must convince your team to destroy empty territory.
4. To protect your relatives as well as your own life, you may not reveal that you have inside information or that you are working against your team.
5. It is vitally important that your team members not discover your true mission.
6. You have reason to believe that the enemies are located in cells D6, E5, and F1.
7. Your teammates will never see your search results so you may conceal information, misdirect the search effort, lie, or deceive your teammates in any way you see fit.

8. If you are successful at this mission, you will be responsible for saving thousands of lives in Borderland.

Hypotheses Testing Measures

In order to successfully test the hypotheses laid out, statistically relevant measurements of perception of deception, perception of task difficulty, and the group game scores are needed broken out at the individual level by game type (face-to-face or text-chat) and by level of external conditioning (Air had no external conditioning, Intel received external conditioning). Because the participants that played the role of Space component commander had direct knowledge of the locations of the enemy camps and were instructed to deceive the other members, their perceptions of deception and task difficulty would be different from the other team members and are excluded from the analysis of post-game survey data. Measurements of the perception of deception were obtained though analysis of the questions from the "motivation" measure whose questions directly relate to evaluating the level of suspicion the individual participant had of their team members and their belief that their team members may have been deceitful. Measurements of the perception of task difficulty were obtained though analysis of the questions from the "task difficulty' measure. All questions used in directly answering the hypotheses used the same scale ratings of 1 (strongly disagree) to 7 (strongly agree) although in supporting evidence other measures were used with different scales. The specific questions used and the statistical methods employed for hypotheses testing are covered in the next chapter.

Summary

This chapter presented the methodology used to obtain the data needed to answer the hypotheses on the effects of modality and participant conditioning on perceptions of deception and task difficulty and if these perceptions have any effect on the combined group scores. Specifically, an experiment was designed that would allow for quantitative measures of these factors through an evaluation of post-survey results. Analysis of these results is covered in the next chapter. The implications of the results, limitations, and suggestions for further research will then be covered in chapter five.

IV. Analysis

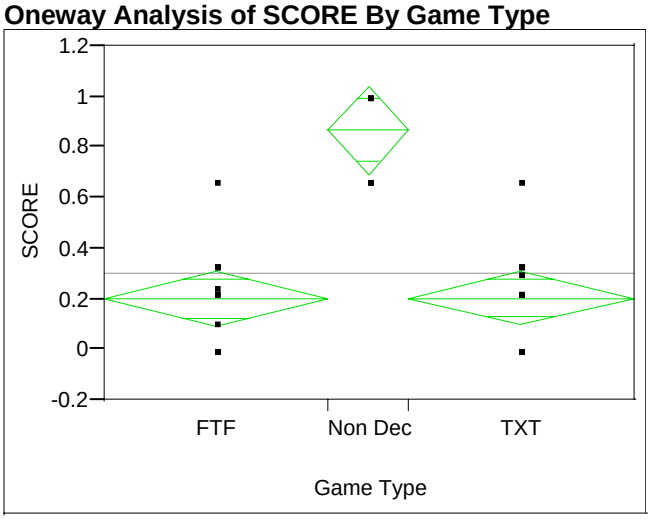
Overview

This chapter describes the results of the experiments outlined in chapter three using statistical procedures to determine if the hypotheses listed in chapter two can be supported. A discussion of the implications, limitations, and recommendations for future research will then be covered in the following chapter.

Analysis of Deception Effectiveness

While it is not stated as a hypothesis it is important to begin by determining if the presence of a deceiver in the group affected the final group game scores. By conducting a simple oneway ANOVA of game scores by the three different game types (face-to-face, text-only, and text-only non-deceptive control), it is apparent that the deceptive game types (averages = 0.200 and 0.204) were significantly different than the non-deceptive control games (average = 0.867, F-ratio = 25.1679, significance level < 0.0001, $\alpha = .05$). This means that the scores of games in which there was a deceiver as a participant were, on average, much lower by a very wide margin (see Figure 6).

Oneway Analysis of SCORE By Game Type



Oneway Anova

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Game Type	2	1.8732857	0.936643	25.1679	<.0001
Error	30	1.1164749	0.037216		
C. Total	32	2.9897606			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
FTF	14	0.200397	0.05156	0.09510	0.3057
Non Dec	5	0.866667	0.08627	0.69047	1.0429
TXT	14	0.203968	0.05156	0.09867	0.3093

Std Error uses a pooled estimate of error variance

Figure 6. Oneway ANOVA Analysis of Game Scores

Development of Composite Scores for Perception Analysis

The next step was to see which post-survey questions covering the areas of perception of deception and perception of task difficulty were statistically similar enough that they could be combined to make a more accurate analysis. To do this, all questions within the measures that had to do with task difficulty or motivation were grouped and a factor analysis performed on each group. These two groups included the answers from all participants that played the Air and Intel roles in both modalities where deception occurred. The reason to do this is that while some of the populations (Air / Intel / face-to-face / text-chat) may be somewhat different in their answers, breaking them out would

have reduced the subjects-to-variables ratio below the value of 5, making the effort statistically questionable (Bryant and Yarnold, 1995). As it stands for this analysis, we will be using 56 subjects (respondents that participated as Air and Intel component commanders in the deceptive games) and examining five different variables from one measure on one analysis and six from a different measure in the other. The results of the factor analysis show that some of the variables in both the deception and task difficulty measures are statistically similar.

For the perception of deception questions 3 out of the 6 in the group were statistically similar (see Figure 7).

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
MOTV1	4.88	1.389	56
MOTV2	4.34	1.709	56
MOTV3	3.11	1.865	56
MOTV4	5.05	1.678	56
MOTV5	2.89	1.826	56
MOTV6	5.45	1.292	56

Rotated Component Matrix(a)

	Component	
	1	2
MOTV3	.923	-.075
MOTV5	.901	-.020
MOTV2	.594	.367
MOTV4	.506	.442
MOTV1	-.096	.777
MOTV6	.156	.768

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 3 iterations.

Figure 7. Descriptive Statistics of Perception of Deception Factor Analysis

The review of the rotated component matrix shows that the questions MOTV3, MOTV5, and MOTV2 were statistically similar enough to be combined into a composite score to evaluate the perception of deception. The specific questions tied to these titles are as follows:

MOTV3: "I had the feeling that something was wrong with other group members' answers."
MOTV5: "I was suspicious of what other group members said."
MOTV2: "I tried really hard to discover if others were giving accurate information."

These questions also work well in a composite score development because they deal with participant truthfulness while MOTV1, MOTV4, and MOTV6 deal more with how the participants communicated.

For the perception of task difficulty questions, 4 out of the 5 questions in the group, TSDF2, TSDF3 (negatively correlated), TSDF4, and TSDF5 were statistically similar (see Figure 8). The specific questions tied to these titles are as follows:

TSDF2: "Our group had a hard time arriving at consensus."
TSDF3: "Arriving at a strike plan was easy to do."
TSDF4: "I found it very frustrating to communicate with my group members."
TSDF5: "This was a complicated task to do."

The observational difference between TSDF1 and the others is that the first question dealt with how to play the game while the others dealt with group interactiveness.

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
TSDF1	2.09	1.269	56
TSDF2	3.29	2.078	56
TSDF3	3.68	2.028	56
TSDF4	2.57	2.035	56
TSDF5	3.48	1.926	56

Rotated Component Matrix(a)

	Component	
	1	2
TSDF2	.898	-.199
TSDF3	-.743	-.259
TSDF4	.718	-.224
TSDF5	.521	.291
TSDF1	-.038	.927

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 3 iterations

Figure 8. Descriptive Statistics of Perception of Task Difficulty Factor Analysis

Analysis of Perception of Deception and Perception of Task Difficulty

The next step in data analysis is to perform a pair of factorial ANOVAs to test for hypothesis support while taking into account the possibility of an interaction effect between modality (face-to-face) and external conditioning (Intel and Air) while examining the perceptions of deception and task difficulty. The results of the factorial ANOVAs ($\alpha = 0.05$) using a one-tailed analysis show that there is no significant interaction between modality and external conditioning for either perception of deception (F-ratio = 1.664, observed significance = 0.203) or perception of task difficulty (F-ratio =

1.541, observed significance = 0.22). This means that we can treat modality and external conditioning as not having a joint influence, continue our analysis, and not worry about one significantly influencing the other. The tables with the descriptive and test statistics of the factorial ANOVAs are available at appendix C.

Hypotheses Testing

Hypothesis H1a states that games performed using a text-only communication method will have a higher perception of deception when compared to games performed using a face-to-face communication method. The factorial ANOVA (all ANOVAs performed at $\alpha = 0.05$ using a one-tailed analysis) results show that the perception of deception scores were higher for text-only games when compared to face-to-face games (mean = 3.85 TXT and 3.05 FTF) and that the difference is significant (F-ratio = 4.44, observed significance = 0.04). This means that participants playing StrikeCOM under the text-only communication method will usually perceive the presence of deception to a greater extent than the games where participants communicate face-to-face.

Hypothesis H1b states that the games performed using a face-to-face communication method will be perceived as easier to perform when compared to games performed using a text-only communication method. The factorial ANOVA results show that the perception of task difficulty was higher for text only games when compared to face-to-face games (mean = 3.96 TXT and 2.87 FTF) and that the difference is also significant (F-ratio = 8.97, observed significance = 0.004). This means that participants using the StrikeCOM games felt that the face-to-face games were much easier to play when compared to the text-only games.

Hypothesis H1c states that the final group game scores will be higher on average for those employing the text-only communication method when compared to those using the face-to-face communication method. The factorial ANOVA results show that the average game scores for text-only and face-to-face games are almost identical (mean = 0.203 TXT and 0.200 FTF) and there is no significant difference between them (F-ratio = 0.005, observed significance = 0.944). This means, given the closeness of the means and observed nonsignificance, that the game scores were virtually identical for the face-to-face and text-only games.

Hypothesis H2a states that the presence of external conditioning is associated with a higher perception of deception. The factorial ANOVA results (performed at α = 0.05 using a one-tailed analysis) show that participants who received an external warning of the possibility of player deception (Intel participants) had higher perception of deception than those who did not receive any warning (Air participants) (mean = 3.81 Intel and 3.08 Air) regardless of what type of StrikeCOM game was played. While the difference is not significant (F-ratio = 3.68, observed significance = 0.06), the results are strong enough to suggest continued study of the hypothesis.

Hypothesis H2b states that the presence of external conditioning is associated with a higher perception of task difficulty. The factorial ANOVA results (performed at α = 0.05 using a one-tailed analysis) show that the perception of task difficulty is slightly higher on average in Intel participants when compared to Air participants (mean = 3.47 Intel and 3.35 Air) but this difference is not significant (F-ratio = 0.100, observed significance = 0.753). This means that the Intel participants may have found the game more difficult but that the difference is too small to say that for certain.

Supporting Modality and Role Analysis on Deception Detection

The hypotheses H1a and H2a have been answered supporting the claim that text-only games as a whole and Intel participants as a whole will have higher perceptions of deception then face-to-face games or Air participants. The problem is that given the generic nature of the questions, one cannot say if the individuals perceived the correct source of the deception (the Space participants) or if they were just suspicious in general. Table 7 provides the breakdown between modalities and roles and shows where each group identified the source of the deception-- both correctly and incorrectly. It also identifies if participants did not feel that there was a source of deception or that they could not identify the source of deception between the other two players.

This examination of deception detection measurements looks at the last question of the post-survey and compares differences in relative scores between the different groups (FTF, TXT, Intel, Air). The question asked states: "On a 0 (not at all) to 10 (completely) scale, please rate the extent to which you and your group members were truthful."

For example, if an Air participant rated self a 9, Intel a 9 and Space a 7, then one could determine that such participants thought that the Intel participant was as truthful as they were themselves and that the Space participant was less truthful (a correct judgment). In another example, Intel rating themselves a 10 and Air and Space both a 7 would be put under a category of equal mistrust and one can conclude that they could not identify the deceiver because, while they understood their instructions that someone

could be deceptive, they could not determine who it was. A complete summary statistical table with category definitions can be found in Appendix D.

Table 7. Supporting Summary Statistics for Deception Detection

Category	Participants	Percent	FTF	Percent	TXT	Percent
Successfully Identified Deceiver			5 of 28	**17.9**	9 of 28	**32.1**
Air	5 of 28	**17.9**	2 of 14	14.3	3 of 14	21.4
Intel	9 of 28	**32.1**	3 of 14	21.4	6 of 14	42.9
Equal Mistrust of Participants			2 of 28	7.1	2 of 28	7.1
Air	0 of 28	0	0	0	0	0
Intel	4 of 28	14.3	2 of 14	14.3	2 of 14	14.3
Unsuccessfully Identified Deceiver			4 of 28	14.3	4 of 28	14.3
Air	1 of 28	3.6	1 of 14	7.1	0 of 14	0
Intel	7 of 28	25.0	3 of 14	21.4	4 of 14	28.6
Unaware of Deception			17 of 28	60.7	13 of 28	46.4
Air	22 of 28	78.6	11 of 14	78.6	11 of 14	78.6
Intel	8 of 28	28.6	6 of 14	42.9	2 of 14	14.3

This descriptive work shows some interesting patterns. Intel participants appear to be better at correctly identifying the deceiver (supporting H2a) but they as a group had more false positives. Air generally either correctly identified the deceiver or was unaware that deception was occurring. Text-only games also correctly identified the deceiver roughly one-third of the time compared to about one-sixth of the time for face-to-face (supporting H1a).

Modality and External Conditioning Interactions

It is interesting to note that the mean perception of deception scores for Intel participants in text-only games were noticeably higher than any other role-modality combination (see Table 8), which suggests that the combination of external suspicion and text-only games (with its reduced number of cue channels) may create a higher perception of deception.

Table 8. Interaction Analysis on Perception of Deception

ROLE	MODALITY	MEAN	STD DEV	N
Air	Face-to-face	2.93	1.19	14
	Text-only	3.24	1.14	14
Intel	Face-to-face	3.17	1.78	14
	Text-only	4.45	1.47	14

A similar pattern is observed in the perception of task difficulty scores as in the perception of deception scores. The mean perception of task difficulty is higher for Intel participants in text-only games than any other role-modality combination (see Table 9), which suggests that the combination of external suspicion and text-only games may create a higher perception of task difficulty.

Table 9. Interaction Analysis on Perception of Task Difficulty

ROLE	MODALITY	MEAN	STD DEV	N
Air	Face-to-face	3.04	1.37	14
	Text-only	2.70	1.29	14
Intel	Face-to-face	3.68	1.34	14
	Text-only	4.25	1.49	14

Analysis of Effects of Perceptions on Game Scores

The analysis of the effect of perceptions of deception and task difficulty on the final group game scores was performed using linear regression ($\alpha = 0.05$). The tables with the descriptive and test statistics of the linear regressions are available at appendix E.

Hypothesis H3 states that a higher perception of deception is associated with higher average game scores. The regression results show a strong negative relationship (bivariate fit: Game Score = 0.276248 - 0.0215227 Perception of Deception) between perception of deception and group game score (F-ratio = 8.26, observed significance = 0.0046). This means that the alternate of H3, that a higher perception of deception is associated with lower game scores, is supported rather than the original hypothesis and means that, in general, as the individual perception of deception increased, the final StrikeCOM group game score decreases.

Hypothesis H4 states that a higher perception of task difficulty is associated with lower average game scores. The regression results show a weak negative relationship (bivariate fit: Game Score = 0.2076717 - 0.0017208 Task Difficulty) between the perception of task difficulty and the final group game score. This weak relationship is not significant (F-ratio = 0.078, observed significance = 0.78) and H4 cannot be supported. This means that an increasing individual perception of task difficulty had no significant effect on the final StrikeCOM group game score.

Summary

This chapter provided the primary and supporting analysis of the data and presented the results of the study by answering the hypotheses. The analysis shows support for H1a and H1b, and no support for H1c, H2a, H2b, H3, and H4. A discussion of these results, accounting for study limitations and implications for future research, will be presented in chapter five.

V. Discussion, Conclusions and Recommendations

Overview

In this chapter, we discuss our conclusions, limitations, suggestions for future research, and applicability of this study. The goal of this research was to investigate how changes in modality and external conditioning relate to perceptions of deception and task difficulty and in turn how these perceptions relate to the final group game scores in a cooperative effort with conflicting goals. The findings of this research are summarized in Table 10.

Table 10. Summary of Findings

Hypothesis	Result
H1a: Games performed using a text-only communication method will have a higher perception of deception when compared to games performed using a face-to-face communication method.	Strongly Supported
H1b: Games performed using a face-to-face communication method will be perceived as easier to perform when compared to games performed using a text-only communication method.	Strongly Supported
H1c: The final group game scores will be higher on average for those employing the text-only communication method when compared to those using the face-to-face communication method.	Not Supported
H2a: The presence of external conditioning is associated with a higher perception of deception.	Not Supported
H2b: The presence of external conditioning is associated with a higher perception of task difficulty.	Not Supported
H3: A higher perception of deception is associated with higher average game scores.	Not Supported
H4: A higher perception of task difficulty is associated with lower average game scores.	Not Supported

Discussion of Modality

Collectively, hypotheses H1a, H1b, and H1c proposed that changes in modality would have a significant effect on the on the perceptions of deception and task difficulty and on the final group game scores. The statistical tests support the changes in modality

affecting individual perceptions but not affecting the final game score. An attempt to explain why there was no difference in mean game score between modalities requires a reexamination of the key differences in media characteristics as illustrated by Carlson (et al, 2004) in Chapter 2 between the face-to-face and text-only games.

The two media types would be similar in terms of symbol variety and tailorability. The media would also be similar in terms of reprocessability due to the presence of scratch paper (which all players used) in all games providing the ability to make written logs of results and suggestions. Face-to-face games would provide a slightly higher synchronicity (by a few seconds) and conversely text-only games would provide a slightly higher level of rehearsability. The biggest difference between the two media types is in the area of cue multiplicity where face-to-face games would be able to provide visual, verbal, and nonverbal cue channels while text-only games provide a verbal (plain text) cue channel only.

Additionally, it was observed that the text-only games took significantly longer to complete compared to face-to-face games (on the order of twice as long). This is understandable because it can be expected to take longer to communicate a complex idea using typed plain text compared to a face-to-face conversation. It can be noted however that while the text-only games took longer to complete, the research team allowed the participants uninterrupted time to complete the games even when their games ran over into the next study time slot. This could mean that, given enough time to communicate ideas within a group, the difference in channel cues, in verbal and nonverbal communication, may not have enough of an effect to change the final outcome.

Discussion of External Conditioning

Collectively, hypotheses H2a and H2b proposed that the presence or absence of external conditioning would have an effect on the individual perceptions of deception and task difficulty. Statistical analyses of these hypotheses provided limited support at best but did show the potential for support if this presence of external conditioning is coupled with a media type with low cue multiplicity such as text-chat or voice. The results of studying external conditioning versus perception of deception provide a limited reinforcement to a previous study that found support to the idea "that warnings about possible deception in computer-based data will be positively associated with detection success" (Biros et al, 2002: 14). Future studies could examine the interactions between modality, external conditioning, and training in order to expand on the work performed here and by Biros (2002).

Discussion of Individual Perceptions and Game Score

The hypotheses H3 and H4 were developed to examine what effect individual perceptions of deception and task difficulty had on game score. The statistical analyses of these hypotheses show that a greater individual perception of deception can be associated with a lower average group game score and that there is no correlation between perceptions of individual task difficulty and group game score. The examination of these results provided a discovery which raises concerns about the validity of any answers drawn from how individual perceptions affect game score. This discovery is discussed in detail under the research limitations section of this chapter.

Research Limitations

Regarding the results listed above and the implications for future research, there are limitations within this study that must be addressed. To begin, one limitation of this study exists within the narrow population range used for this study. Given the participant demographics, the sample population consisted of young (mean = 20.1 years) college undergraduate students with some military background but no operational experience. This study makes no attempt to see if the findings here are applicable to a larger population. In addition, this population, because they are required to meet and interact on a regular basis, can be expected to know each other at a minimum by name and by face and, particularly among the older portion of this segment, can be considered loose to close friends. The social aspects of group interaction among a set of individuals that know each other was not considered within the scope of this study and could produce some variability in post-survey answers- particularly within the area of perception of deception.

In addition, there is a potentially significant limitation within the data gathering methodology of the experiment. As shown in the study procedure in Chapter 3, participants were able to view the final overall group score for the game that they participated in prior to filling out the post-survey. This could create a negative actualization bias in the game participants. As shown in Chapter 3, participants completed a self-paced practice game using the same conditions as the actual game prior to performing the actual game with their group members. The practice game scores were viewed by the individuals when they completed their practice game and, for the most

part, they did rather well (most finding and hitting two out of three or all the targets). As seen in the summary of game score results in Chapter 4, most teams that had a deceiver did not do well (most finding and hitting none or one of the targets). This potential negative actualization bias can occur because individuals see that they did well in the practice game, do poorly in the group game, and could begin to think that something is wrong with the game or the players- not because of how the group game was played but by how low the group score was. This leads to an important question- to what extent were the post-game survey scores guided by how the group played the game and how much was it guided by a potential letdown after seeing the low group scores?

This potential negative actualization bias limitation should not have an effect on the analysis of the differences between modalities and external conditioning. This is because these set of hypotheses have to do with the examination of differences between groups that experienced the same manner of deception and that the potential experience of letdown after viewing the final group game scores were the same for all members within these groups- the negative actualization bias should cancel out. This means that the examination and results of these hypotheses are still valid with the ability to contribute to research and provide recommendations for future research.

Analyses of the effects individual perceptions have on final group scores is confounded by the potential negative actualization bias. Even though the analysis of individual perception of deception and final group game score shows a strong negative correlation, one cannot be sure if this correlation is caused by experiences within the game or as a reaction to the final group score. One could argue that the latter is a reasonable, though untested, explanation. As scores drop further from what participants

expected to be based on their practice tests, they react by giving higher ratings to questions addressing suspicion. Stepping further out on an already flimsy branch of logic, one could argue that because one does not see a similar strong negative correlation between individual perception of task difficulty and average group score it can be inferred that individuals are assigning blame for the low group scores to the other group members rather than to the game itself.

The bottom line regarding the analysis of individual perceptions affecting game score is that due to this potential bias, it cannot be evaluated and the discussion in the paragraph above serves only to illustrate potential avenues for future research.

Contributions and Recommendations

The analysis of modality lends support to previous studies by showing that text-only games can provide a greater potential for detecting deception (as theorized by Buller and Burgoon, 1996) while providing the same overall results even if they are perceived as more difficult, as long as the participants are given uninterrupted time to complete the task. One line of future research could manipulate the other media characteristics defined by Carlson (et al, 2004) to see if characteristics other than cue multiplicity could affect the final game outcome or change the media potential for perceiving deception or task difficulty. Another line of research could examine the potential relationship between perceived task difficulty, observed task time to completion, and the presence of deception. One reason perceived task difficulty was included in this study was to examine its potential suitability in the development of an objective measure of deception. Perceived task difficulty could be linked with actual time to completion and, when

compared to similar tasks that should take a similar amount of time, could be used as an indicator of deception.

Discussion of Identification of Deception

While not specifically addressed as a hypothesis, the descriptive statistics showing that individuals correctly identified the deceiver one time in three for text-only games and roughly one time in six for face-to-face games merits a discussion of implications for future research. These identification scores are lower than what most studies have found where the deception detection rates are typically between 45 and 60 percent (DePaulo, Stone, and Lassiter, 1985; Kraut, 1980; Vrij, 2000) but tracks well with one study conducted by Biros et al (2002). This could have been due to the naïve participants (Air), who were not given any indication that deception may be occurring other than by the actions of their group members, which could pull the averages down. This could also be due to the post survey that asks for a scaled answer regarding their perceptions of individual gameplay rather than a survey question along the lines of "One of your two group members can be a deceiver- which one is it?" This could also be due to the nature of this study where participants were directly involved with the communication dialog rather than having participants observe different communication scenes, regardless of communication type, and asked to separate truthful scenes from deceptive. Can the methodology used in this study be considered a more realistic measure of actual deceptive interactions? This question can be worthy of further examination in future studies.

Implications for Practice

This study has implications that affect both the military and the general public as a whole. This study reinforces that in semi-realistic conversational settings, people generally do not identify a deceptive source even if their suspicions have been raised. Using e-mail or other text-based forms of communication and providing warnings may provide a better opportunity to detect deception but even then, the chances of successful identification are less than 50-50. In the general public such chances would be considered poor. In a military situation, where lives can hang in the decisional balance, such chances, if decision makers were aware of them, would likely cause a reevaluation of the entire process that was to be acted upon. It is in this awareness of the poor success in detection deception in untrained participants that is most valuable to everyone.

What can be done to improve the odds of deception detection? Other research has shown that technology and training, either separately or in supporting roles, can make a difference. Technologies such as near-real-time automated deception detection software and interactive software training tools are in development and could make a significant difference in the ability to detect deception.

Another implication that practitioners can use is that different forms of communication can produce the same end results given sufficient time and motivation to see the effort though. Naturally, there are some communication types that are more effective and efficient than others, but when choices are limited by gaps in technology, capacity (bandwidth), or contingency it is nice to know that alternative forms of communication can produce the same end result.

Finally, given the great difference in game scores between groups with and without a deceiver, it can be said that the presence of deception can lead to sub-optimal decision-making success. This reduction is found in both communication types employed during the experiment and serves to illustrate the significant impact that even an untrained and unprepared deceiver can have in a group effort.

Conclusion

Results from this study reinforce the idea that media characteristics and external conditioning can affect deception detection accuracy. These results are beneficial to the understanding of interactive deception and deception detection processes from the view of the academic and the practitioner. The lessons learned and consequences stemming from the discoveries and limitations identified in this and the preceding chapter can be applied to future studies in the hope of further increasing the pool of knowledge on interactive deception processes.

Appendix A: Pre-survey Questions

StrikeCOM Pre-Experiment Survey

Demographics
The following information is simply to allow us to group participants' responses.
1. Your sex: Male Female
2. Your age:
3. Your primary ethnic, racial, or cultural background:
African-American
U. S. Caucasian
U. S. Hispanic/Latino
American Indian/Pacific Islander/other U.S
International student (non-U.S.)--list country of origin:

Your Background
None 1 2 3 4 5 A Great Deal
1. How much computer experience have you had?
2. How much experience have you had with electronic communication systems (e.g., electronic mail, bulletin boards)?
3. In general, what is your level of computer experience?
4. In general, what is your level of experience in working with groups?
5. What is your level of experience at playing turn-based strategy games? (e.g., Civilization, Gettysburg)
6. What is your level of experience at playing real-time strategy games? (e.g., Warcraft, Age of Empires, Command and Conquer)

Below are a series of statements that indicate an attitude or behavior that may or may not describe you. Read each statement carefully. Then, using the scale shown below, decide which response most accurately reflects your answer and select that number following the statement. There are no right or wrong answers It is important to respond to every statement.
Key: 1 = Not at all like me
2 = A little like me
3 = Like me
4 = Very much like me
5 = Exactly like me

1. It is difficult for others to know when I am sad or depressed.
2. It is nearly impossible for people to hide their true feelings from me.
3. I am very good at maintaining a calm exterior, even when upset.
4. I enjoy giving parties.
5. I am greatly influenced by the moods of those around me.
6. I can fit in with all kinds of people, young and old, rich and poor.
7. I have been told that I have expressive eyes.

8. I dislike it when other people tell me their problems.
9. People can always "read" my feelings even when I'm trying to hide them.
10. It takes people quite a while to get to know me well.
11. What others think of my actions is of little or no consequence to me.
12. I am usually very good at leading group discussions.
13. I often laugh out loud.
14. I am easily able to give a comforting hug or touch to someone who is distressed.
15. I am able to conceal my true feelings from just about anyone.
16. I am usually the one to initiate conversations.
17. I can be strongly affected by someone smiling or frowning at me.
18. When in groups of people, I have trouble thinking of the right things to talk about.
19. My facial expression is generally neutral.
20. When my friends are angry or upset, they seek me out to help calm them.
21. I am not very skilled at controlling my emotions.
22. At parties I enjoy talking to a lot of different people.
23. I would feel out of place at a party attended by a lot of very important people.
24. I am not very good at mixing at parties.
25. I rarely show my anger.
26. I am often told that I am a sensitive, understanding person.
27. I am easily able to make myself look happy one minute and sad the next.
28. I love to socialize.
29. There are certain situations in which I find myself worrying about whether I am doing or saying things right.
30. I am often chosen to be the leader of a group.

Thank you for completing the survey. Please notify the assistant when you are finished.

DO NOT PRESS THE SUBMIT BUTTON UNTIL TOLD TO DO SO BY THE ASSISTANT

Appendix B: Post-survey Questions

Group Performance

Please indicate on a 1 to 7 scale how accurate each of the following statements is in describing your experience with your group, where 1 = strongly disagree, 2 = disagree, 3 = disagree somewhat, 4 = neither agree or disagree, 5 = agree somewhat, 6 = agree, 7 = strongly agree.

Group Performance

1. I could rely on my group members not to make my part of the task more difficult.
2. I did not enjoy working with my group.
3. My group performed poorly on the task.
4. I am satisfied with my groups overall performance.

Your Performance

1. I am satisfied with my contribution to the group.
2. I was accurate in reporting my asset's information to the group.

Task Difficulty

1. I had a hard time figuring out how to play this game.
2. Our group had a hard time arriving at consensus.
3. Arriving at a strike plan was easy to do.
4. I found it very frustrating to communicate with my group members.
5. This was a complicated task to do.

Motivation

1. I paid more attention to other group members' communication that I normally would.
2. I tried really hard to discover if others were giving accurate information.
3. I had the feeling that something was wrong with other group members' answers.
4. I watched carefully to see what other group members said and did.
5. I was suspicious of what other group members said.
6. I was more attentive to group members' communication than I would be in normal conversation.

Group Interaction

The next several items refer to the group's communication *during* the task. Please read each description carefully before completing your rating.

1. **Involvement**

During your group's interactions, how involved were group members? Were group members highly interested and engaged? Did they ask a lot of questions and pay attention to what others said? Or were they disinterested, detached, distracted, and inattentive? Rate the degree of involvement of the group as a whole.

Not at all involved 1 2 3 4 5 6 7 Highly involved

2. **Openness**

How open and receptive were group members to one another's ideas? Did they listen to what each other had to say and seem open and accepting of one another's suggestions? Or did they seem closed, unreceptive and unwilling to listen to others' suggestions? Rate the degree of openness of the group as a whole.

Not open at all 1 2 3 4 5 6 7 Very Open

3. **Similarity**

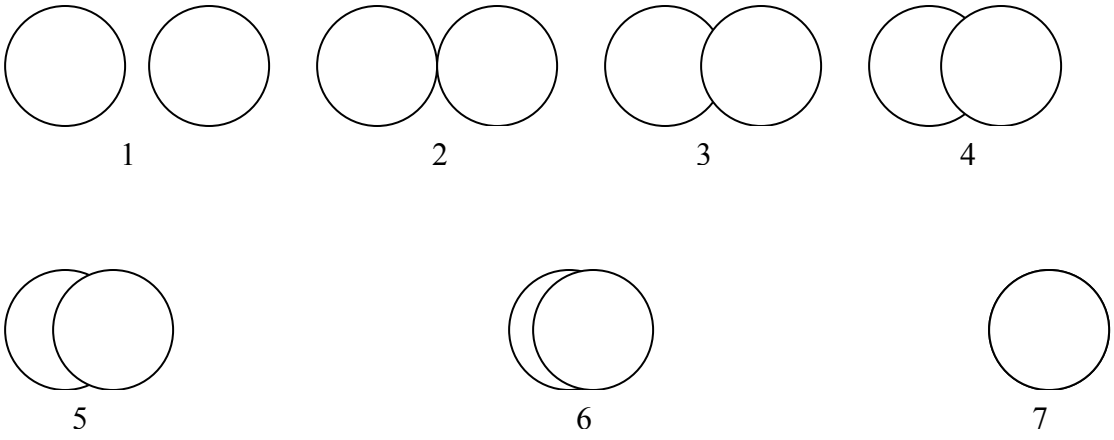
How much alike or different were you and your group members? Did group members seem to be on the same "wavelength"? Did they reveal similarities in their background, their views, their way of expressing themselves? Or did they lack common ground and to reveal a lot of dissimilarities? Rate the degree of similarity among the group members.

Not at all similar 1 2 3 4 5 6 7 Very similar

4. **Connectedness**

Please select the picture below that best represents how much you feel you and your group members came together as a team. If you represent one circle and the other circle represents the group, mark the picture that best shows how much "connection" you felt with group members during the interaction.

Not at all connected 1 2 3 4 5 6 7 Very connected



5. **Richness**

The messages exchanged during interactions can vary in how "rich" they are, from very plain and lean, with limited information and few details, to very rich, with lots of information and elaborate details. They can be very redundant and repetitive, offering little new information, or present new information and ideas. Please rate the messages exchanged in your interaction on degree of richness.

Very low 1 2 3 4 5 6 7 Very high

6. **Interaction Coordination**

Interactions with others can have few interruptions, be very smooth, effortless, and fluent, or interactions can have lots of interruptions, be choppy, effortful, and hesitant. They can be very coordinated and well paced, or uncoordinated and poorly paced by being either too fast or too slow. Please rate how coordinated the group's communication was.

Interaction was poorly coordinated 1 2 3 4 5 6 7 Interaction was very coordinated

7. **Persuasiveness**

How much did group members try to influence one another? Were they talkative, active, and assertive, or passive and unassertive? To what extent did they try to persuade one another?

Very low degree 1 2 3 4 5 6 7 Very high degree

8. **Efficiency**

Group interaction can be efficient (getting the task done without wasting time) or inefficient. Messages exchanged can be terse or wordy, to the point or "off topic." Did group members' messages help more the group toward completing the task in a timely manner or did they seem to waste time and prolong the task unnecessarily?

Not at all efficient 1 2 3 4 5 6 7 Very efficient

9. **Communication Appropriateness**

How appropriately did group members communicate? Did you feel the communications were suited to the topic? Did they use acceptable language and behavior or did they behave in inappropriate ways?

Very inappropriate 1 2 3 4 5 6 7 Very appropriate

10. **Analysis**

In many group interactions, group members often do more than exchange information. They seek out others' opinions, they share judgments and analysis, disagreements and criticisms freely. In other interactions, there is little exchange on analysis, feedback, disagreement or judgments. Please describe the amount of analysis, opinion, and feedback expressed during your group's interactions.

Little Analysis / feedback 1 2 3 4 5 6 7 Extensive analysis / feedback

11. **Communication Typicality**

Did group members communicate the way you expected them to for this kind of interaction? Was their communication typical, natural, and expected or atypical, unusual, and unexpected?

Very unexpected 1 2 3 4 5 6 7 Very expected

12. **Positivity**

To what extent was communication in your group positive or negative? Was it friendly and pleasant or uncooperative, unfriendly, and unpleasant?

Very negative 1 2 3 4 5 6 7 Very positive

13. **Composure**

Did group members seem calm, composed, relaxed, and comfortable or nervous, tense, and uncomfortable?

Not at all composed 1 2 3 4 5 6 7 Very composed

14. **Task Focus**

To what extent did your group stay on task? Were members work-oriented, business-like and focused on the task, or did they "goof off"? Rate the group on its overall degree of staying on task.

Not at all task focused 1 2 3 4 5 6 7 Very task focused

The following questions pertain to your impressions of the **individual members** of your group. Please rate **each person** on a 1 (not at all) to 7 (very much) scale.

Member Role

Involved

Trustworthy

Intelligent

Believable

Reliable

Talkative

Thoughtful

Persuasive

Interested

Forceful

Participative

On a 0 (not at all) to 10 (completely) scale, please rate the extent to which you and your group members were truthful.

	Not at all Truthful								Completely Truthful	
Member Role	1	2	3	4	5	6	7	8	9	10
Air										
Intel										
Space										

Appendix C: Descriptive and Test Statistics for Factorial ANOVAs used in H1a, H1b, H1c, H2a, and H2b

Statistical Results for Analysis on Perception of Deception

Between-Subjects Factors

		N
ROLE	AIR	28
	INTEL	28
MODALITY	FTF	28
	TXT	28

Descriptive Statistics

Dependent Variable: MOTV 352

ROLE	MODALITY	Mean	Std. Deviation	N
AIR	FTF	2.93	1.192	14
	TXT	3.24	1.136	14
	Total	3.08	1.153	28
INTEL	FTF	3.17	1.777	14
	TXT	4.45	1.465	14
	Total	3.81	1.727	28
Total	FTF	3.05	1.490	28
	TXT	3.85	1.427	28
	Total	3.45	1.501	56

Tests of Between-Subjects Effects

Dependent Variable: MOTV 352

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	19.625(a)	3	6.542	3.264	.029
Intercept	665.161	1	665.161	331.897	.000
ROLE	7.383	1	7.383	3.684	.060
MODALITY	8.907	1	8.907	4.444	.040
ROLE * MODALITY	3.335	1	3.335	1.664	.203
Error	104.214	52	2.004		
Total	789.000	56			
Corrected Total	123.839	55			

a R Squared = .158 (Adjusted R Squared = .110)

Statistical Results for Analysis on Perception of Task Difficulty

Between-Subjects Factors

		N
MODALITY	FTF	28
	TXT	28
ROLE	AIR	28
	INTEL	28

Descriptive Statistics

Dependent Variable: TSDF 2345

MODALITY	ROLE	Mean	Std. Deviation	N
FTF	AIR	3.0357	1.36529	14
	INTEL	2.6964	1.28669	14
	Total	2.8661	1.31318	28
TXT	AIR	3.6786	1.33528	14
	INTEL	4.2500	1.49358	14
	Total	3.9643	1.42028	28
Total	AIR	3.3571	1.36495	28
	INTEL	3.4732	1.58017	28
	Total	3.4152	1.46418	56

Tests of Between-Subjects Effects

Dependent Variable: TSDF 2345

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	19.977(a)	3	6.659	3.536	.021
Intercept	653.153	1	653.153	346.808	.000
MODALITY	16.885	1	16.885	8.966	.004
ROLE	.189	1	.189	.100	.753
MODALITY * ROLE	2.903	1	2.903	1.541	.220
Error	97.933	52	1.883		
Total	771.063	56			
Corrected Total	117.910	55			

a R Squared = .169 (Adjusted R Squared = .122)

Statistical Results for Analysis on Modality versus Game Score

Between-Subjects Factors

		N
MODALITY	FTF	28
	TXT	28

Descriptive Statistics

Dependent Variable: SCORE

MODALITY	Mean	Std. Deviation	N
FTF	.20029	.192495	28
TXT	.20386	.189127	28
Total	.20207	.189084	56

Tests of Between-Subjects Effects

Dependent Variable: SCORE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.000(a)	1	.000	.005	.944
Intercept	2.287	1	2.287	62.800	.000
MODALITY	.000	1	.000	.005	.944
Error	1.966	54	.036		
Total	4.253	56			
Corrected Total	1.966	55			

a R Squared = .000 (Adjusted R Squared = -.018)

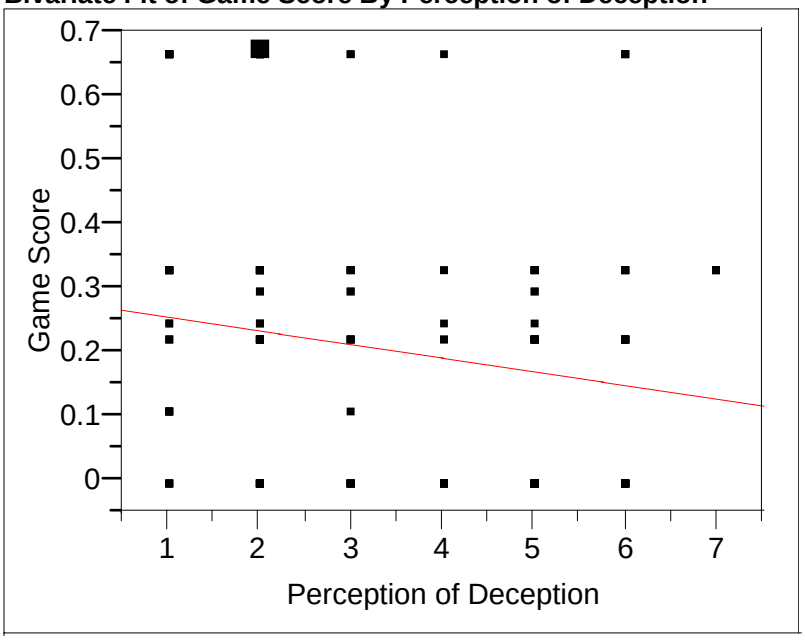
Appendix D: Complete Descriptive Statistic Table for H1a and H2a

Category	Categorized Participants	Percent	Face-to-Face	Percent	Text-Chat	Percent
Total Participants	56		28		28	
Air	28		14		14	
Intel	28		14		14	
Successful ID Deceiver	14 of 56	**25.0**	5 of 28	**17.9**	9 of 28	**32.1**
Air	5 of 28	**17.9**	2 of 14	**14.3**	3 of 14	**21.4**
Intel	9 of 28	**32.1**	3 of 14	**21.4**	6 of 14	**42.9**
Correctly ID Deceiver	9 of 56	16.1	3 of 28	10.7	6 of 28	21.4
Air	5 of 28	17.9	2 of 14	14.3	3 of 14	21.4
Intel	4 of 28	14.3	1 of 14	7.1	3 of 14	21.4
Positive Mistrust	5 of 56	8.9	2 of 28	7.1	3 of 28	10.7
Air	0	0	0	0	0	0
Intel	5 of 28	17.9	2 of 14	14.3	3 of 14	21.4
Equal Mistrust	4 of 56	7.1	2 of 28	7.1	2 of 28	7.1
Air	0	0	0	0	0	0
Intel	4 of 28	14.3	2 of 14	14.3	2 of 14	14.3
Unsuccessfully ID Deceiver	8 of 56	14.3	4 of 28	14.3	4 of 28	**14.3**
Air	1 of 28	3.6	1 of 14	7.1	0	**0**
Intel	7 of 28	**25.0**	3 of 14	**21.4**	4 of 14	**28.6**
Negative Mistrust	4 of 56	7.1	0	0	4 of 28	14.3
Air	0	0	0	0	0	0
Intel	4 of 28	14.3	0	0	4 of 14	28.6
False ID	4 of 56	7.1	4 of 28	14.3	0	0
Air	1 of 28	3.6	1 of 14	7.1	0	0
Intel	3 of 28	10.7	3 of 14	**21.4**	0	0
Unaware	30 of 56	**53.6**	17 of 28	**60.7**	13 of 28	**46.4**
Air	22 of 28	**78.6**	11 of 14	**78.6**	11 of 14	**78.6**
Intel	8 of 28	**28.6**	6 of 14	**42.9**	2 of 14	**14.3**

Table Definitions:
1. Correctly ID Deceiver: Those whom gave a lower truth rating to space and an equal or higher rating (when compared to their own score) to their counterpart.
2. Positive Mistrust: Those whom gave a lower truth rating to space & their counterpart but gave the lowest rating to space.
3. Successful ID Deceiver: The sum of the Correctly ID Deceiver and Positive Mistrust categories.
4. Equal Mistrust: Those whom gave an equal and lower rating to both space & their counterpart.
5. Negative Mistrust: Those whom gave a lower truth rating to space & their counterpart but gave the lowest rating to their counterpart.
6. False ID: Those whom gave a lower rating to their counterpart and an equal or higher rating (when compared to their own score) to Space.
7. Unsuccessfully ID Deceiver: The sum of the Negative Mistrust and False ID categories.
8. Unaware: Those whom gave equal scores to all within their group.

Appendix E: Descriptive and Test Statistics used in Linear Regression to Test H3 and H4

Bivariate Fit of Game Score By Perception of Deception



Linear Fit

Game Score = 0.276248 - 0.0215227 Perception of Deception

Summary of Fit

RSquare	0.04739
RSquare Adj	0.041652
Root Mean Square Error	0.183993
Mean of Response	0.202071
Observations (or Sum Wgts)	168

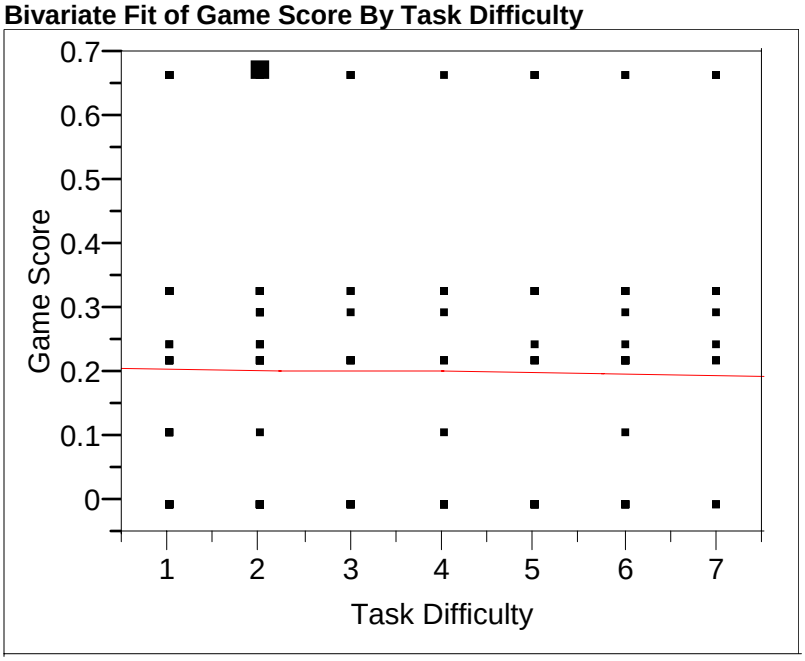
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.2795665	0.279567	8.2581
Error	166	5.6196686	0.033853	Prob > F
C. Total	167	5.8992351		0.0046

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.276248	0.029458	9.38	<.0001
Perception of Deception	-0.021523	0.00749	-2.87	0.0046

Bivariate Fit of Game Score By Task Difficulty



Linear Fit

Linear Fit

Game Score = 0.2076717 - 0.0017208 Task Difficulty

Summary of Fit

RSquare	0.000352
RSquare Adj	-0.00415
Root Mean Square Error	0.188198
Mean of Response	0.202071
Observations (or Sum Wgts)	224

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	0.0027672	0.002767	0.0781
Error	222	7.8628797	0.035418	Prob > F
C. Total	223	7.8656469		0.7801

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.2076717	0.023655	8.78	<.0001
Task Difficulty	-0.001721	0.006156	-0.28	0.7801

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14. ABSTRACT

The goal of this research was to investigate how changes in modality (communication type) and external conditioning (warnings of player deception) relate to perceptions of deception and task difficulty and in turn how these perceptions relate to the final group game scores in a cooperative effort with conflicting goals. One hundred and eight participants were grouped into teams of three, given similar instructions but different goals, and asked to play a cooperative game called StrikeCOM that mimics the intelligence gathering needed to develop an air tasking order and subsequent air strike on three military targets. The analysis of the post-game surveys showed support for participants in games using a face-to-face communication method to have lower perceptions of deception and task difficulty when compared to games using real-time plain text chat.

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communication, deception, deception cues, deception detection, media type, modality, StrikeCOM, task difficulty

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