ABSTRACT

YAGODA, ROSEMARIE ELAINE. What! You Want Me to Trust a Robot? The Development of a Human Robot Interaction (HRI) Trust scale. (Under the direction of Dr. Douglas Gillan.)

Trust plays a critical role when operating a robotic system in terms of both acceptance and usage. Considering trust is a multidimensional context dependent concept, the differences and common themes were examined to identify critical considerations within human-robot interaction (HRI). In order to examine the role of trust within HRI, a measurement tool was generated based on five attributes: team configuration, team processes, context, task, and system (Yagoda, 2010). The HRI trust scale was developed based on two studies. The first study conducts a content validity assessment of preliminary items generated, based on a review of previous research within HRI and automation, using subject matter experts (SMEs). The second study assesses the quality of each trust scale item derived from the first study. The results were then compiled to generate the HRI trust measurement tool.

WHAT! You want me to trust a ROBOT? The development of a human robot interaction (HRI) trust scale

by
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DEDICATION

To Dr. Lori Foster-Thompson for providing me with this amazing opportunity.
You have changed my life.

To Dr. Doug Gillan for taking a chance on me.

To Dr. Michael Coovert for inspiring me and believing in me every step of the way.

Thank you.

BIOGRAPHY

Rosemarie E. Yagoda is a Human Factors and Ergonomics doctoral student in the Psychology Department at North Carolina State University. Ms. Yagoda received an undergraduate degree in Psychology with departmental honors at the University of South Florida. Ms. Yagoda has participated in collaborative research efforts within the advancement of human-robot interaction. The research presented in this document was funded by an Army Research Lab (ARL) grant through North Carolina State University.

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THE DEVELOPMENT OF A HUMAN ROBOT INTERACTION (HRI) TRUST SCALE

Introduction

Trust plays a critical role when operating a robotic system. In many cases, trust can determine the overall acceptance and usage of a system (Parasuraman & Riley, 1997). As with many concepts, there are a wide array of context dependent definitions. How the concept is utilized determines the appropriate definition. Needless to say, there are many accepted multidimensional definitions of trust. By examining the differences and common themes of these definitions, it is possible to identify critical considerations for understanding the basis of trust pertaining to human robot interaction (HRI).

Trust can be categorized in terms of expectations of outcomes where behavior, statements (verbal or written), or promises of others can be relied upon (Rotter, 1967; 1971). Another common categorization of trust is intention taking into account the state of vulnerability. For instance, "the willingness of a party to be vulnerable to the outcomes of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party" (Mayer, Davis, & Schoorman, 1995, p. 712). For trust to be an important part of any relationship, individuals must be willing to put themselves at risk or in a vulnerable position by delegating responsibility for actions to another party (Lee & See, 2004).

Considering the definitions of trust originate from diverse domains, it is clear that there is a good deal of consistency in the basis of trust. In general, the issue of trust becomes more prevalent when situations involve uncertainty, vulnerability, risk, complexity, and the need for interdependence. When operating a robotic system any one of these factors could impact trust. Thus, it is important to understand the underlying basis of trust.

The basis of trust is the information that notifies the person about the ability of the trustee to achieve specific goals (Lee & See, 2004). Thus, the basis of trust provides the underlying attributes used to describe and utilize the concept of trust. The attributes presented in Table 1 describe the basis of trust in terms of grouping characteristics specific to HRI. The purpose of presenting these dimensions, describing the basis of trust, reflects the goal-oriented attribution to HRI. Using this attributional abstraction of trust moves away from relying upon a specific definition to conceptualize the meaning of trust. In turn, this approach takes into account the underlying meaning behind concept of trust.

Table 1: Summary of the Attributes That Describe the Basis of Trust

Characteristic	Basis of Trust	Definition	Reference
Function	Ability	Group of skills, competencies, and characteristics that enable the trustee to influence the domain.	Cook & Wall (1980) Deutsch (1960) Mayer et al. (1995)
	Expertise	Specialized skill or in depth knowledge in a particular domain.	Hovland, Janis, & Kelly (1953) Moorman et al. (1993)
Performance	Competence	The ability to complete a task (or operation) successfully.	Barber (1983) Butler & Cantrell (1984) Gabarro (1978) Mishra (1996)
	Dependability	The degree to which behavior is consistent and expected.	Rempel et al. (1985)
	Consistency	Conformity of actions in a task or operation.	Butler & Cantrell (1984)
	Predictability	The degree to which future behavior can be anticipated.	Jennings (1967)
	Reliability	Consistently good performance.	Rempel et al. (1985) Sitkin & Roth (1993)
	Timely	Completion or occurring at a favorable or useful time.	Moorman et al. (1993)
Semantics	Understanding	Comprehension or the ability to understand something.	Zuboff (1988)

Trust and Technology

There are a myriad of ways in which humans may interact with technology. How humans interact with technology can be defined in terms of the intelligence and autonomy of the technology. As shown in Figure 1, both intelligence and autonomy levels are represented within four quadrants. These quadrants conceptualize automation and intelligence as interacting factors providing a new perspective on robotics.

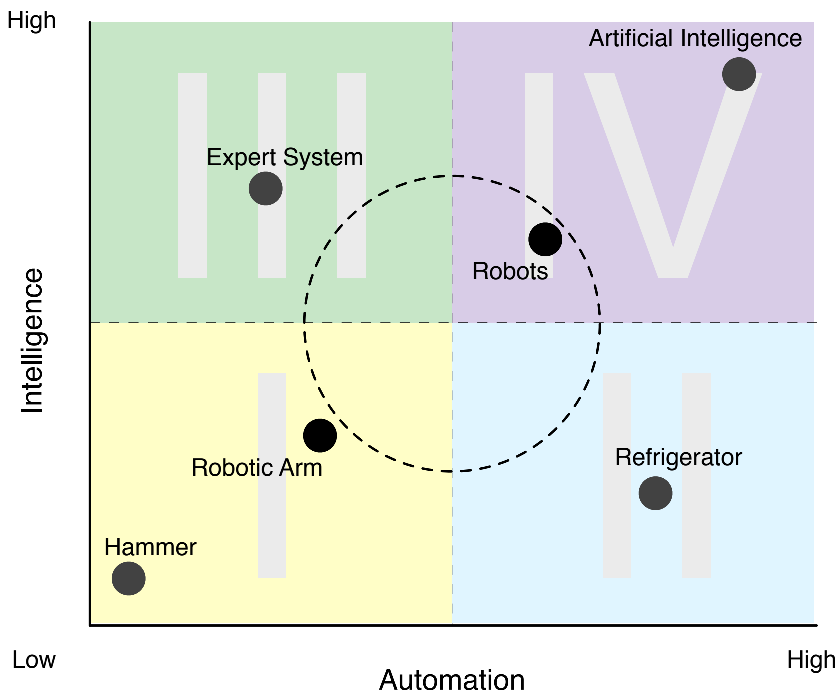

Figure 1. Trust as it relates to intelligence and autonomy of technology.

Quadrant I represents low intelligence and low autonomy, an example of which is a hammer. A hammer is a simple piece of technology; it has a purpose and can be used to perform a specific task. A normal hammer is not intelligent nor is it autonomous. A person must physically use this piece of technology in order to obtain a desired outcome. A robotic arm is also included in Quadrant I. A human must physically manipulate a robotic arm in order to complete a variety of tasks. Quadrant II represents low intelligence and high autonomy, such as a refrigerator. A standard refrigerator has low intelligence in terms of functionality; however it is able to autonomously maintain a specified temperature. Once programmed to a desired temperature this piece of technology will automatically maintain itself using an internal thermometer. Quadrant III represents high intelligence and low autonomy, for instance an expert system. An expert system, such as a chef's tool, has high intelligence in terms of recipes and instructions yet it cannot cook the meal. An expert system can provide step-by-step instructions for various tasks, however this piece of technology cannot perform the operations necessary to complete the desired task. Quadrant IV represents high intelligence and high autonomy, such as artificial intelligence. Artificial intelligence is essentially a computer system capable of autonomously performing various tasks and making decisions without human supervision. Robots are also included within Quadrant IV, however robots are less intelligent and have lower automation, comparatively speaking. Robots require more human supervision and guidance to complete a variety of tasks. It should be noted, robots are not restricted to Quadrant IV. The level of automation and the type of robotic control both have an impact on where a robot could be located within each quadrant. The dotted circle located in Figure 1 represents the entire domain of robotics.

The role of trust varies within each of the four quadrants. As previously mentioned, Table 1 identifies each attribute describing the basis of trust. The trust attributes have been grouped by characteristics: performance, function, and semantics. Semantics could be separated into two categories: human and robot. Semantics in terms of the human describes a person's understanding of the robot (or system) capabilities, task, and context. On the other hand, semantics in terms of the robot describes the robot's understanding the current task, environment, and the human interaction. These HRI trust characteristics have been incorporated within each of the four quadrants in terms of the level intelligence and automation of a system. Figure 2 displays the trust characteristic(s) within each quadrant.

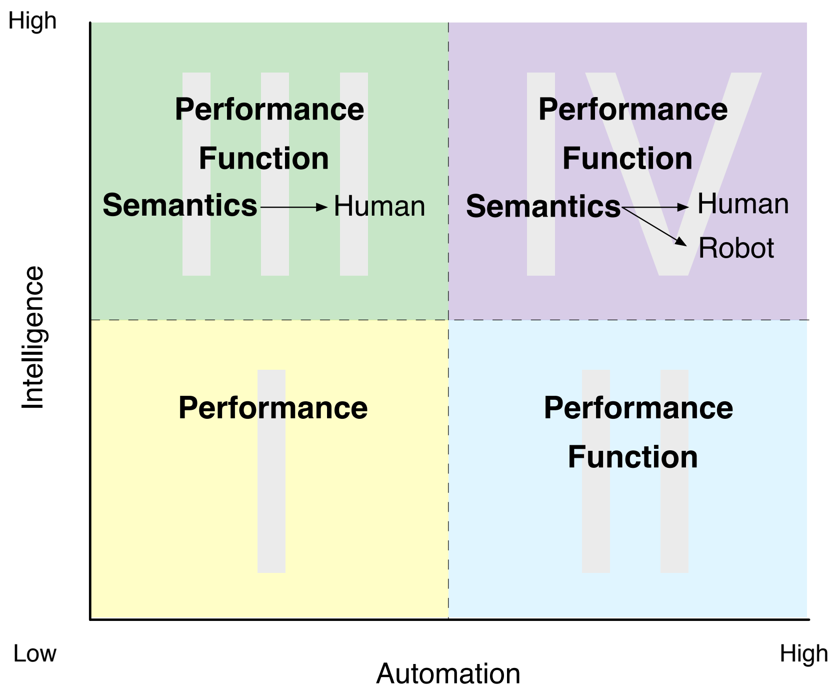

Figure 2. The role of trust as it relates to intelligence and autonomy of technology.

Quadrant I trust is affected based on performance-related characteristics. Take the hammer, for example, if a hammer cannot complete a task then that particular hammer may not be used again in the future. Simple, performance affects trust. Well, it is not that simple when automation and intelligence come into play. Functionality becomes increasingly more important as automation increases. Take for instance a vehicle accelerator; an accelerator has relatively low intelligence, only receiving input from the driver. An accelerator is highly automated; pressure applied from the driver determines the function or speed of the vehicle. With that said, in 2010 various Toyota vehicles had a malfunctioning accelerator leading to numerous accidents and injuries to vehicle occupants. In this example trust was violated in terms of both function (speed of vehicle) and performance (drivability) for vehicle drivers. On the other hand, when intelligence increases an understanding develops between the user and the system. Based on the increase in intelligence trust is now affected by semantics, performance and functionality. Robots, for example, vary on intelligence and automation.

Intelligence can increase or decrease depending on the robot functionality and interaction with the user; whereas automation can change based on system performance and capabilities. Thus, trust can be violated within HRI in terms of interacting with humans, functionality of the robot, and overall performance.

Measuring Trust in Human-Robot Interaction

The interaction between human(s), the robot, and the corresponding level of automation is considered HRI. HRI can be further decomposed into five attributes: team configuration, team process, context, task, and system (Yagoda, 2010). In turn, this describes each element of the human-robot system in order to evaluate the overall configuration. These five attributes have been utilized in the development of the HRI workload measurement tool (HRI-WM; Yagoda, 2010). The HRI-WM can be tied to a specific platform and quantify perceived workload ratings associated with the human-robot system that contribute an overall workload score.

There are a myriad of ways in which humans might interact with robots and often other people. An unmanned system (UMS) team configuration example was provided by Yagoda and Coovert (2009). In this example, the unmanned aerial vehicle (UAV) operator was not only interacting with the robot, but was also interacting with the mission specialist (i.e., team member) and the flight director (i.e., supervisor and subject matter expert) throughout each mission. The robot operator was responsible for operating the UAV while constantly communicating with the mission specialist and flight director to verify the appropriate data was collected. The flight director role was maintaining an overall situational awareness for the human team members, vehicle safety, and was considered the search-and-rescue task expert. Within the search-and-rescue context of this study each team member plays a critical role in operating and interacting with the robot.

Sheridan (1975) and Sheridan and Hennessy (1984) claim that trust mediates the relationship between people, and that it may also mediate the relationship between humans and automated systems. Within HRI interpersonal trust can be described in regards to both the human (e.g., operator, team member, supervisor, and subject matter expert) and the robot (e.g., functions, capabilities, and overall performance). Muir (1988) stated that individuals' trust for machines can be affected by similar factors that are the basis of trust between individuals; for example, people trust others if they are reliable, but they lose trust when they are betrayed or let down, and the subsequent redevelopment of trust takes time. In addition, the robot can potentially interact with people, other than the operator, resulting in different trust-related issues. That is to say, the operator may not trust their team member to effectively and efficiently interact with the robot. Problems may also occur in situations where there is a lack of information from the robot to the operator to make accurate judgments. For instance, navigation operations can be challenged when trying to locate an objective and the information provided from the robot is not sufficient. This can make the task highly difficult for the operator and team members. Overall, trust in HRI can be described in terms of people interacting with other people and robot(s) at various levels of autonomy. In the future, one issue that may arise when assessing trust in HRI is the generalizability of the trust to various team configurations (i.e., one person or team controlling one or multiple robots).

Currently, there are no methods employed to assess trust specifically within HRI. Trust seems to be only measured in terms of automation then arbitrarily applied to the realm of HRI. Trust in an automated system is assessed using the following measures, as outlined in the Langan-Fox, Sankey, and Canty (2009): Human Computer Trust Rating Scale (Kauppinen, Brian, & Moore, 2002) and the SHAPE Automation Trust Index (SATI; Goillau, Kelly, Boardman, & Jeannot, 2003). Human Computer Trust Rating Scale measures trust in terms of five underlying constructs within air traffic control (ATC): understandability, technical competence, perceived reliability, faith, and personal attachment. The SATI was developed to address trust in ATC computer assistance tools and other forms of automation support.

The goal of the research reported here was to empirically explore the use of trust in automation assessment methods and apply it to HRI. The purpose of the current studies was to develop a HRI dispositional trust scale inventory. Prior to the two studies conducted, preliminary HRI items were generated based on five HRI attributes (Yagoda, 2010): team configuration, team process, context, task, and system. These items were developed based on a review of previous research within HRI and automation. The intention while generating these items was to be representative of the different facets involved with operating robots while remaining generalizable across UMS platforms and levels of automation. Table 2 provides a complete listing of the initial HRI items generated within each HRI attribute.

Study 1 conducts an exploratory content validity assessment of the preliminary item dimensions generated using a select group of HRI subject matter experts (SMEs). Study 2 assesses the quality of each trust scale item derived from the HRI item dimensions found in Study 1. The results were then compiled to generate the HRI dispositional trust scale inventory.

Table 2: Initial HRI Item Dimensions

HRI Attribute	Item Dimension Generated
Team Configuration	Operator Teammate Supervisor Subject Matter Expert
Team Process	Communication Coordination Team Dynamics Situational Awareness Decision Making Planning
Context	Mission Task Environment Social Context Previous Knowledge
Task	Skills Task Allocation Goals Feedback
System	User Interface Sensor Data Navigation Capabilities End Effectors Remote Information Processing Level of Automation

Study 1: Human Robot Interaction (HRI) Content Validity Assessment

This study involved HRI subject matter experts (SMEs) assessing each HRI item dimension listed in Table 2. Based on the SME feedback, a final list of HRI dimensions was compiled to generate the HRI trust scale (Table 5).

Method

*Participants***.** The participants were 11 HRI subject matter experts (SMEs) within academia, government, and industry. All participants were published contributors with at least 5 years professional experience within the field of HRI. All gave their informed consent to participate and were not monetarily compensated for their efforts.

Materials. An online questionnaire was generated to assess each item listed in Table 2. Each item dimension was first rated on a 5-point Likert scale (1 = "Not essential, should be deleted," 2 = "Useful, but not essential," 3 = "Useful," 4 = "Very useful," 5 = "Essential"). This portion of the questionnaire was used to determine the appropriateness of each item dimension within HRI domain. The rating scale was derived from a 3-point Likert scale (1 = "Not necessary," 2 = "Useful, but not essential," and 3= "Essential") developed by Lawshe (1975). Next, each item label was examined. The items were to be ordered into 1 of 3 categories: "Change item Label," "Keep item label," or "Delete item." Alternate label fields were provided, if necessary. Any items missing from Table 2 were identified next by the SME. Lastly, each HRI attribute was rated for overall importance within HRI. The SMEs were instructed to use their expertise within the domain to answer each question throughout the questionnaire. Comment fields were also provided throughout the questionnaire. An example of the questionnaire is provided in Appendix A.

Procedure. Twenty SME were selected to participate in the study based on published contributions while having at least 5 years professional experience within the field of HRI. The SMEs were contacted via email to participate in the study. Of the twenty SMEs selected, eleven participated in the study. The SMEs that participated in the study were emailed a URL link to complete the online questionnaire. All SMEs received the same questionnaire and were able to complete the questionnaire at their leisure.

Results and Discussion

The results presented begin with the qualitative analysis of the HRI trust scale item dimensions to identify missing items and alternative labels. Item dimension correlations within each HRI attribute are also presented. Table 3 provides a summary of the results. Following, the more quantitative item dimension content validity assessment is present.

Team Configuration

Missing Items and Alternative Labels. No missing items were identified. 6 out of 11 SMEs mentioned that items should be explained better, mainly in terms of teammate and supervisor. For teammate, it was recommended to identify if the teammate is a human or a robot. The supervisor's role should be explained to avoid confusion, if necessary. The low CVR rating for SME could be due to the fact the SME is not always part of a human-robot team. An overall solution proposed by one SME was to add a "N/A" button for each item.

Attribute-item Correlations. Results show a correlation between teammate and supervisor (r = .79, p = .004). A possible explanation of this finding is a person holding multiple roles on a team. This concludes that multiple roles should be taken into consideration while administering the HRI trust scale. This finding is consistent with the SME comments regarding role explanations within the team configuration.

Team Process

Missing Items and Alternative Labels. The following items were identified as missing by two SMEs: backup (i.e., functional replacement), leadership. It was also recommended by two SMEs to expand "planning" to also include "replanning."

Attribute-item Correlations. Results show correlations between communication and coordination (r = .67, p = .024), team dynamics (r = .84, p = .001), and situational awareness (r = .67, p = .024); coordination and team dynamics (r = .63, p = .039) and decision-making (r = .62, p = .040); situational awareness and team dynamics (r = .63, p = .039) and planning (r = .77, p = .006). These results are due to the dependency of the items upon one another; for instance, coordination could not occur without some form of communication. It is also interesting to examine some of the items that were not correlated; these could be referred to as *independent actions* (i.e., actions that could also be completed at an individual level) communication and decision-making (r = .42, p = .200) and planning (r = .52, p = .104). Both decision-making and planning could be performed at an individual level before or after the team is involved.

Context

Missing Items and Alternative Labels. No missing items were identified. The following modifications were suggested: one SME suggested changing "mission" to "operation" to avoid implying a military tone; for clarity three SMEs suggested changing "environment" to "physical environment," change "social context" to "social environment" to avoid confusion since the item seemed to imply "social impact" to two SMEs, which was not the intention of the item; and two SMEs suggested "previous knowledge" should be broken down into a total of four categories – task, (human) team members, physical environment, and overall system.

Attribute-item Correlations. Results show correlations between social context and task (r = .64, p = .033) and previous knowledge (r = .76, p = .007). This finding concurs with the SME comments regarding the various underlying meanings for "social context" resulting in confusion about the item intent.

Task

Missing Items and Alternative Labels. Two SMEs identified task difficulty as missing. The following modifications were suggested: two SMEs suggested "feedback" should be divided into four categories – task, (human) team members, physical environment, and overall system; for clarity one SME suggested changing "goals" to "objectives;" two SMEs suggested that instead of using "skills" use "required skills" as this would avoid confusion between required human skills and robot capabilities.

Attribute-item Correlations. Results show correlations between goals and skills (r = .61, p = .048) and task allocation (r = .68, p = .021). This finding is consistent with alternate label suggestions made by the SMEs to provide more understandable labels for each correlated item.

System

Missing Items and Alternative Labels. A total of four SMEs identified the following items as missing: signal/bandwidth, and type of control. It was mentioned by two SMEs that some items should be explained better and that a "N/A" button should be provided for each item. Considering that 8 of the 13 SME comments mainly stemmed from discrepancies amongst item definitions, an explanation of each item would clarify the term usage, if necessary.

Attribute-item Correlations. Results show correlations between level of automation and user interface (r = .79, p = .004), navigation capabilities (r = .73, p = .010), and remote information processing (r = .66, p = .027); sensor data and end effectors (r = .86, p = .002); navigation capabilities and remote information processing (r = .76, p = .003). Similar to the team process attribute analysis, these results are mainly due to the dependency of the items upon one another.

Table 3: Missing Item and Alternate Label Analysis Summary

Attribute	Missing Items	Elements identified through SME comments
Team Configuration	N/A	• Add a "N/A" button for each item • Differentiate between human & robot
Team Process	Backup Leadership Planning[2]*	• Planning should be broken down into two items: planning, replanning*
Context	Operation (Mission) Physical Environment (Environment) Social Environment (Social Context) Previous Knowledge[4]*	• Mission seems to mainly apply to military • Change Social "context" to "environment" to avoid confusion • Previous Knowledge should be broken down – task, (human) team members, physical environment, and overall system*
Task	Required Skills (Skills) Feedback[4]* Task Difficulty Objectives (Goals)	• Feedback should be broken down – task, (human) team members, physical environment, and overall system*
System	Signal/Bandwidth Type of Control	• Provide definitions within each item, if needed • Add a "N/A" button for each item

Label change (Original Item)
* Indicates the original item divided into sub items

Content Validity Assessment

The dimensions were analyzed using a modified version of the content validity ratio, developed by Lawshe (1975). According to Lawshe (1975), if more than half the SMEs indicate that an item is essential, that item has at least some content validity. Greater levels of content validity exist as larger numbers of panelists agree that a particular item is essential. Using these assumptions, Lawshe developed a formula termed the content validity ratio: CVR = (n_e - N/2)/(N/2). CVR= content validity ratio, n_e= number of SME panelists indicating "essential", N= total number of SME panelists.

The CVR equation was originally derived using a 3-point Likert scale, for the purposes of this study (5-point Likert scale) two CVR equations were used: CVR = (n_e - N/4)/(N/4) and CVR = (n_e - N/3)/(N/3). The first modified CVR equation was used when SMEs rated an item “Essential” on the 5-point Likert scale; whereas the second CVR equation was used when an item was rated either “Essential” or “Very Useful.” The formulas yield values ranging from +1 to -1; positive values indicate that at least half the SMEs rated the item as essential. The CVR criterion level, which is based on the 11 SMEs, was set to .59 and remains consistent throughout analyses (Lawshe, 1975). This criterion value is used to ensure that the SME agreement is unlikely to be due to chance. Results are shown in Table 4. Items that did not meet the CVR criterion are as follows: teammate, supervisor, SME, social context, end effectors, and remote information processing. An alternate label and missing item analysis yielded several changes.

Table 4: Content Validity Ratio (CVR) HRI Attribute Table

Attribute	Item	CVR – 5 only *CVR = (n_e - N/4)/(N/4)*	CVR – 4 & 5 *CVR = (n_e - N/3)/(N/3)*
Team Configuration	Operator	0.75*	---
	Teammate	---	0.54
	Supervisor	---	0.29
	SME	---	0.04
Team Process	Communication	1.00*	---
	Coordination	0.89*	---
	Team Dynamics	---	0.67*
	Situational Awareness	0.89*	---
	Decision Making	0.61*	---
	Planning	0.75*	---
Context	Mission	0.89*	---
	Task	1.00*	---
	Environment	1.10*	---
	Social Context	---	0.29
	Previous Knowledge	---	0.67*
Task	Skills	0.61*	---
	Task Allocation	0.61*	---
	Goals	---	0.92*
	Feedback	---	0.79*
System	User Interface	0.75*	---
	Sensor Data	---	0.67*
	Navigation Capabilities	---	0.79*
	End Effectors	---	0.42
	Remote Info. Processing	---	0.54
	Level of Automation	0.61*	---

*CVR ≥ .59

Based on the SME data collection and analysis, a comprehensive list of HRI dimensions was generated. This list is the foundation for developing a trust scale based on all the different elements encompassing HRI. Table 5 provides a complete listing of the HRI dimensions generated within each HRI attribute. Study 1 was intended to validate and expand upon the content presented in Table 2.

Table 5: Final HRI Item Dimensions

HRI Attribute	Initial Item Dimensions	Final Item Dimensions
Team Configuration	Operator	Operator
	Teammate	Human Team Member
	Supervisor	Supervisor
	Subject Matter Expert	Subject Matter Expert (SME)
Team Process	Communication	Communication
	Coordination	Coordination
	Team Dynamics	Team Dynamics
	Situational Awareness	Situational Awareness
	Decision Making	Decision Making
	Planning	Planning
		Replanning
		Backup
		Leadership
Context	Mission	Operation
	Task	Task
	Environment	Physical Environment
	Social Context	Social Environment
	Previous Knowledge	Previous Task Knowledge
		Previous Human Team Member Experience
		Previous Physical Environment Experience
		Previous Overall System Knowledge
Task	Skills	Required Skills
	Task Allocation	Task Allocation
	Goals	Objectives
	Feedback	Task Difficulty
		Task Feedback
		Feedback from Human Team Members
		Feedback from the Physical Environment
		Feedback from the Overall System
System	User Interface	User Interface
	Sensor Data	Sensor Data
	Navigation Capabilities	Navigation Capabilities
	End Effectors	Signal/Bandwidth
	Remote Information Processing	End Effectors
	Level of Automation	Remote Information Processing
		Level of Automation
		Type of Control

Study 2: Human Robot Interaction (HRI) Trust Scale Item Quality Assessment

This study involved assessing the quality of each trust scale item derived from the HRI item dimensions listed in Table 5. The results were compiled to generate a final HRI trust scale (see Appendix C).

Method

Participants. The 100 participants were recruited using a crowdsourcing web service, Amazon, Inc. Mechanical Turk (http://www.mturk.com). All participants resided in the United States and had an acceptance rate (i.e., successful completion of previous Human Intelligence Tasks or "HITs") greater than 95%. Participants were compensated $.65 for successful completion of the study. In order for the participants to receive compensation, an experimental completion code (ECC) was generated at the end of the study for each participant to enter. The ECC was to ensure the participant completed each part of the study. The average completion time for the study was 33 minutes resulting in an effective hourly rate of $1.16.

Materials and Procedure. To examine the item quality of the HRI trust scale created based on the dimensions in Table 5 a questionnaire was developed. This questionnaire examined the representativeness of each *trust* item (i.e., a first person statement containing an item dimension, see Table 5, and the word *trust*) to potential scale items that were created based on the underlying components of trust (see Table 1 for a complete listing of dimensions that describe the basis of trust used). A sample question is provided in Figure 3. Participants were asked to rate how well each answer choice represents the question statement. Each answer choice was generated using items that have been considered to be the underlying basis of trust (see Table 1 for a complete listing). In order to determine which answer choice most accurately represents the trust question statement, participants were asked to rate each answer choice on a 7-point Likert scale. The corresponding answer choice ratings were used to determine potential HRI trust scale items. The presentation order of each potential scale item was randomized for each administration.

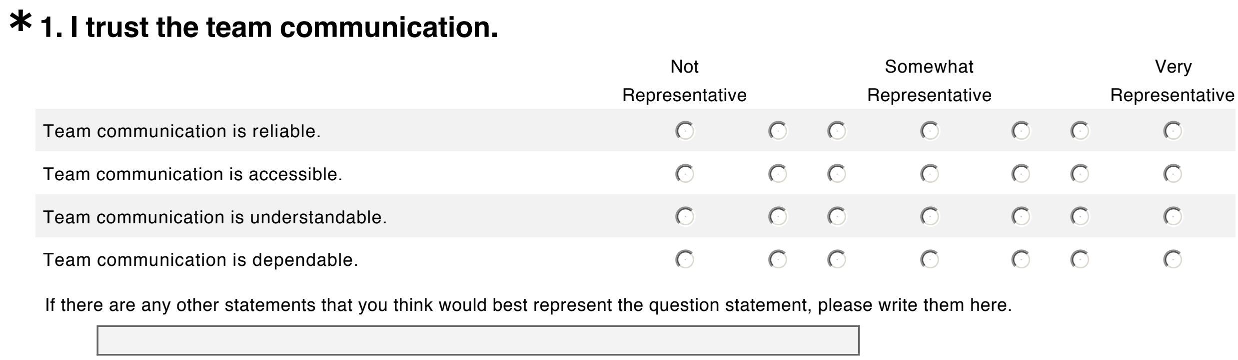

Figure 3. Sample question from the item quality questionnaire. Each item dimension question was required for the participant to answer (indicated with an asterisk).

Prior to completing the questionnaire, recruited participants from Mechanical Turk were directed to view a video online. The *Intelligent Ground System Operational Concept* video was an animated depiction of human-robot teams within a military context. The video was approximately 4 minutes in length and approved for public release. In addition to the video, a written scenario was provided explaining, in greater detail, the events of the video. Participants were able to view the video and read the corresponding scenario (see Appendix B) as many times as they wished prior to moving on to the questionnaire. The presentation order of the video and written scenario was not manipulated. The main goal of both the video and the written scenario was to familiarize the participant with an example of a human robot team prior to completing the item quality questionnaire.

Results and Discussion

In order to determine the final HRI trust scale items a set of exploratory factor analyses was conducted for each HRI item dimension. Assuming trust was consistent throughout, each item dimension loaded onto one factor. The factor analysis loadings for each HRI attribute are presented in Tables 6 – 10. The factor loadings in boldface type within each dimension represent the potential trust scale item with the highest factor loading. The highest potential trust scale item factor loading within each item dimension was used in the resulting HRI trust scale. The final HRI trust scale is presented in Appendix C.

Table 6: HRI Team Configuration Factor Loadings for HRI Trust Scale Analysis

Dimension	Potential Trust Scale Item	Factor Loadings	*M*	*SD*
Operator	The operator is reliable.	.943	5.86	1.00
	The operator is dependable.	**.963**	5.81	1.17
	The operator is competent.	.938	5.92	1.11
	The operator has the ability to maneuver the UMS.	.723	5.84	1.31
Human Team Member	The human team member is reliable.	.958	6.06	1.10
	The human team member is dependable.	**.961**	6.11	1.01
	The human team member is competent.	.926	6.00	1.22
	The human team member is able.	.960	6.09	1.10
Supervisor	The supervisor is reliable.	.962	5.95	1.22
	The supervisor is dependable.	**.976**	6.03	1.13
	The supervisor is competent.	.972	6.00	1.22
	The supervisor is able.	.966	5.95	1.22
Subject Matter Expert (SME)	The subject matter expert (SME) is reliable.	.960	5.76	1.38
	The subject matter expert (SME) is competent.	.966	5.93	1.37
	The subject matter expert (SME) is able.	.973	5.83	1.36
	The subject matter expert (SME) provides expertise.	**.977**	5.96	1.33

Table 7: HRI Team Process Factor Loadings for HRI Trust Scale Analysis

Dimension	Potential Trust Scale Item	Factor Loadings	*M*	*SD*
Communication	Team communication is understandable.	.890	5.87	1.23
	Team communication is reliable.	**.951**	5.89	1.23
	Team communication is accessible.	.929	5.95	1.23
	Team communication is dependable.	.950	5.95	1.24
Coordination	Team coordination is reliable.	.940	5.93	1.17
	Team coordination is accessible.	.932	5.95	1.17
	Team coordination is dependable.	**.960**	5.94	1.24
	Team coordination is timely.	.924	6.04	1.23
Team Dynamics	Team dynamics are reliable.	**.925**	5.73	1.23
	Team dynamics are dependable.	.917	5.78	1.25
	Team dynamics are understandable.	.886	5.74	1.19
	Team dynamics are predictable.	.762	5.39	1.39
Situational Awareness	The team situational awareness is reliable.	.897	5.79	1.30
	The team situational awareness is dependable.	**.917**	5.78	1.22
	The team situational awareness is available.	.899	5.75	1.31
	The team situational awareness is predictable.	.737	5.30	1.45
Decision Making	The team decision making is predictable.	.844	5.41	1.36
	The team decision making is reliable.	.917	5.80	1.26
	The team decision making is dependable.	**.962**	5.83	1.26
	The team decision making is timely.	.935	5.90	1.30
Planning/Replanning	The team planning is predictable.	.768	5.25	1.45
	The team planning is reliable.	.933	5.73	1.26
	The team planning is dependable.	**.962**	5.76	1.21
	The team planning is timely.	.928	5.85	1.20
Backup	The team back up is reliable.	**.977**	5.60	1.48
	The team back up is accessible.	.930	5.46	1.53
	The team back up is dependable.	.967	5.64	1.45
	The team back up is timely.	.965	5.53	1.54
Leadership	The team leadership is reliable.	.938	5.88	1.27
	The team leadership is accessible.	**.944**	5.89	1.22
	The team leadership is dependable.	.884	6.00	1.16
	The team leadership is timely.	.922	5.94	1.21

Table 8: HRI Context Factor Loadings for HRI Trust Scale Analysis

Dimension	Potential Trust Scale Item	Factor Loadings	*M*	*SD*
Operation	The operation is reliable.	**.902**	5.53	1.42
	The operation is predictable.	.762	5.03	1.66
	The operation is understandable.	.837	5.77	1.33
	The operation is accessible.	.881	5.59	1.39
Task	The task is reliable.	**.914**	5.41	1.48
	The task is predictable.	.853	5.02	1.40
	The task is understandable.	.902	5.52	1.44
	The task is accessible.	.875	5.50	1.40
Physical Environment	The physical environment is reliable.	**.969**	3.94	2.00
	The physical environment is predictable.	.940	4.02	1.98
	The physical environment is consistent.	.938	4.02	2.13
	The physical environment is dependable.	.931	3.90	2.04
Social Environment	The social environment is reliable.	**.976**	4.01	1.95
	The social environment is predicable.	.964	3.90	1.96
	The social environment is consistent.	.972	4.00	1.93
	The social environment is dependable.	.973	3.90	1.93
Previous Task Knowledge	My previous task knowledge is reliable.	.974	4.93	1.73
	My previous task knowledge is consistent.	.963	4.87	1.78
	My previous task knowledge is dependable.	**.979**	4.98	1.73
	My previous task knowledge is accessible.	.974	4.99	1.72
Previous Human Team Member Experience	My previous human team member experience is reliable.	.928	5.47	1.48
	My previous human team member experience is consistent.	.939	5.43	1.52
	My previous human team member experience is dependable.	**.964**	5.53	1.44
	My previous human team member experience is accessible.	.933	5.35	1.54
Previous Physical Environment Experience	My previous physical environment experience is reliable.	**.945**	4.85	1.70
	My previous physical environment experience is consistent.	.935	4.66	1.77
	My previous physical environment experience is dependable.	.944	4.74	1.71
	My previous physical environment experience is accessible.	.903	4.86	1.69
Previous System Knowledge	My previous system knowledge is reliable.	**.975**	5.02	1.72
	My previous system knowledge is consistent.	.962	5.00	1.66
	My previous system knowledge is accessible.	.962	5.04	1.77
	My previous system knowledge is dependable.	.961	5.16	1.69

Table 9: HRI Task Factor Loadings for HRI Trust Scale Analysis

Dimension	Potential Trust Scale Item	Factor Loadings	*M*	*SD*
Required Skills	My skills required for the task are reliable.	.971	5.44	1.66
	My skills required for the task are consistent.	.966	5.52	1.58
	My skills required for the task are dependable.	**.986**	5.16	1.69
	My skills required for the task are accessible.	.968	5.46	1.58
Task Allocation	The task allocation is reliable.	**.966**	5.51	1.50
	The task allocation is dependable.	.964	5.57	1.46
	The task allocation is consistent.	.955	5.60	1.51
	The task allocation is timely.	.951	5.59	1.47
Objectives	The task objectives are reliable.	**.942**	5.58	1.45
	The task objectives are accessible.	.911	5.60	1.46
	The task objectives are predictable.	.870	5.24	1.52
	The task objectives are timely.	.934	5.60	1.36
Task Difficulty	The difficulty of the task is predictable.	.873	4.69	1.85
	The difficulty of the task is timely.	.828	5.05	1.73
	The difficulty of the task is reliable.	**.919**	4.96	1.74
	The difficulty of the task is consistent.	.915	4.89	1.81
Feedback: Task	The task feedback is reliable.	.944	5.64	1.53
	The task feedback is dependable.	**.965**	5.60	1.52
	The task feedback is accessible.	.960	5.51	1.59
	The task feedback is timely.	.947	5.55	1.54
Feedback: Human Team Members	The task feedback from my human team members is reliable.	.957	5.74	1.35
	The task feedback from my human team members is dependable.	.961	5.75	1.30
	The task feedback from my human team members is accessible.	.952	5.79	1.35
	The task feedback from my human team members is timely.	**.967**	5.69	1.28
Feedback: Physical Environment	The task feedback from the physical environment is reliable.	.967	5.14	1.62
	The task feedback from the physical environment is dependable.	.967	4.97	1.64
	The task feedback from the physical environment is accessible.	.946	5.19	1.67
	The task feedback from the physical environment is timely.	**.968**	5.03	1.63
Feedback: Overall System	The task feedback from the overall system is reliable.	**.973**	5.66	1.48
	The task feedback from the overall system is dependable.	.967	5.74	1.38
	The task feedback from the overall system is accessible.	.967	5.73	1.31
	The task feedback from the overall system is timely.	.951	5.73	1.31

Table 10: HRI System Factor Loadings for HRI Trust Scale Analysis

Dimension	Potential Trust Scale Item	Factor Loadings	*M*	*SD*
User Interface	The user interface is reliable.	**.973**	5.63	1.41
	The user interface is dependable.	.961	5.55	1.46
	The user interface is understandable.	.947	5.46	1.46
	The user interface is accessible.	.964	5.59	1.51
Sensor Data	The sensor data is reliable.	.955	5.69	1.43
	The sensor data is dependable.	**.975**	5.66	1.49
	The sensor data is understandable.	.925	5.65	1.33
	The sensor data is timely.	.960	5.79	1.44
Navigation Capabilities	The navigation capabilities are reliable.	.955	5.78	1.41
	The navigation capabilities are dependable.	.960	5.67	1.45
	The navigation capabilities are accessible.	.918	5.69	1.51
	The navigation capabilities are consistent.	**.970**	5.78	1.41
Signal/Bandwidth	The signal/bandwidth is reliable.	.973	5.10	1.66
	The signal/bandwidth is consistent.	.968	5.14	1.65
	The signal/bandwidth is dependable.	**.977**	5.14	1.59
	The signal/bandwidth is timely.	.901	5.03	1.69
End Effectors	The end effectors are reliable.	**.957**	5.28	1.62
	The end effectors are dependable.	.955	5.34	1.63
	The end effectors are consistent.	.951	5.31	1.69
	The end effectors are accessible.	.953	5.26	1.69
Remote Information Processing	The remote information processing is reliable.	.959	5.45	1.52
	The remote information processing is dependable.	.950	5.46	1.57
	The remote information processing is timely.	**.963**	5.52	1.42
	The remote information processing is accessible.	.917	5.26	1.69
Level of Automation	The level of automation is reliable.	**.946**	5.44	1.51
	The level of automation is dependable.	.911	5.34	1.60
	The level of automation is consistent.	.945	5.41	1.54
	The level of automation is accessible.	.877	5.38	1.59
Type of Control	The type of control is reliable.	**.952**	5.40	1.41
	The type of control is dependable.	.924	5.37	1.40
	The type of control is understandable.	.866	5.42	1.40
	The type of control is timely.	.914	5.44	1.43

General Discussion

The aim of the present studies was to develop a human robot interaction (HRI) trust scale. In order to generate the HRI trust scale a better understanding of the different facets involved with humans interacting with robots had to be established. This involved generating a preliminary list of dimensions (see Table 2) within five HRI attributes: team configuration, team process, context, task, and system. HRI subject matter experts (SMEs) then evaluated the preliminary list of HRI dimensions. A final list of HRI dimensions was then compiled based on the results of Study 1 (see Table 5). This comprehensive list of HRI dimensions served as the basis for developing the HRI trust scale. The trust scale item quality was assessed. The item quality results were compiled in order to generate a final HRI trust scale (see Appendix C).

The HRI trust scale could also be adapted based on the team configuration, see Figure 4. The adaptive nature of the scale would address instances when a person holds multiple roles on a team. This questionnaire would modify the resulting HRI trust scale based on the team configuration item responses provided. A team configuration questionnaire should be administered prior to completing the HRI trust scale; thus, clearly defining the roles of each individual on the team. Using a team configuration questionnaire would avoid role confusion when administering the HRI trust scale. This solution is consistent with the SME findings within first study.

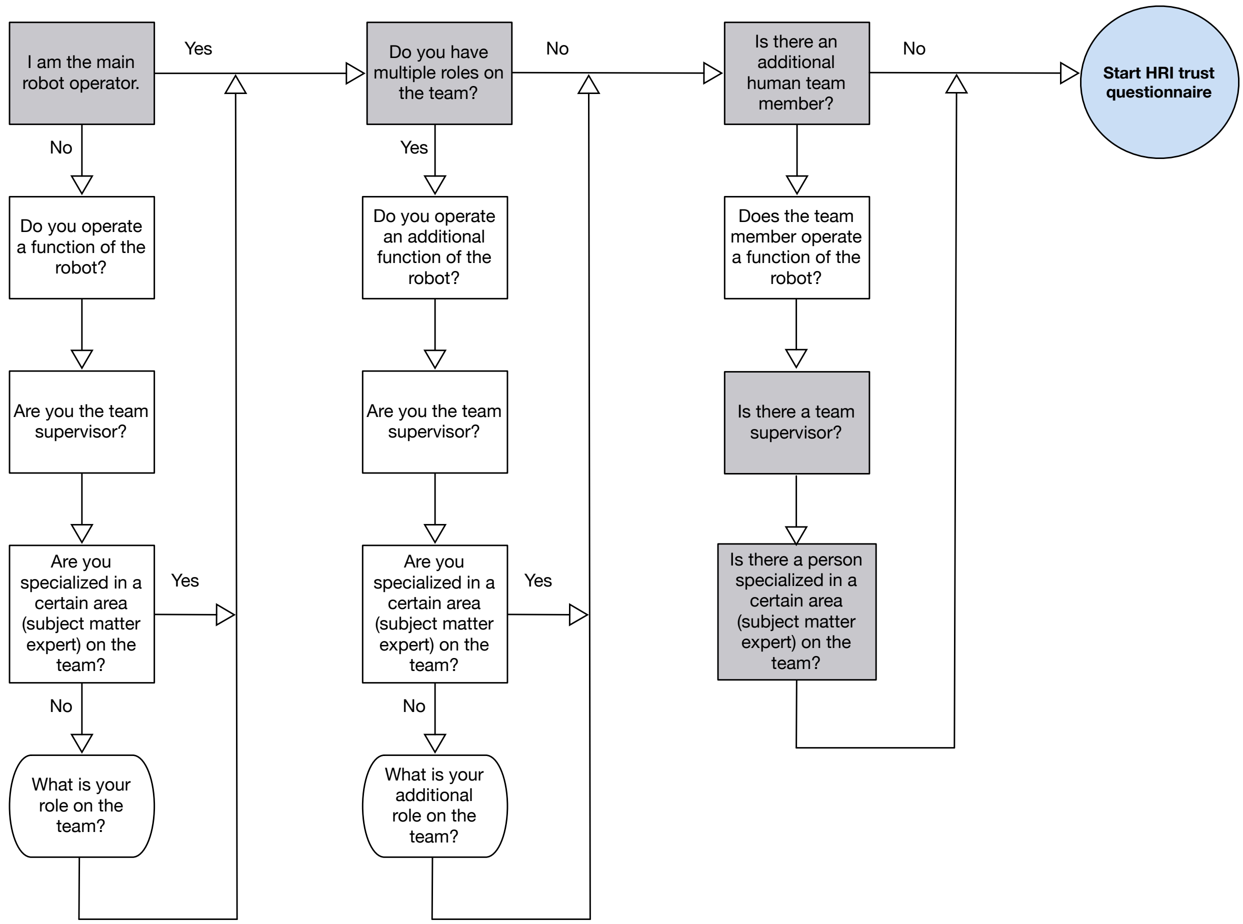

Figure 4. Diagram of the team configuration questionnaire.

The HRI trust scale developed is to be packaged with a validated interpersonal trust scale, developed by Rotter (1967, 1971), essentially creating a HRI trust assessment inventory. This scale is designed to measure a person's expectations that the behavior, statements (verbal or written), or promises of others can be relied upon. The interpersonal trust scale and scoring key can be found in Appendix D. The goal of this HRI trust assessment inventory is not only to assess trust within the human robot system, but also to take into account individual differences that could account for the varying trust levels. Thus, incorporating individual differences to the HRI trust measure generated will provide a comprehensive assessment of trust within human robot interaction.

Traditionally, trust in HRI has been measured only in terms of automation. Although automation is an important component of HRI, it is not the only element that should be taken into consideration, there are many. That said, the scale developed in this study is the first to measure trust within HRI taking into account the various dimensions of each HRI attribute: team configuration, team process, context, task, and system.

Future research will be geared towards the expansion of the HRI trust scale to include a human information processing subscale. The subscale generated would be used to assess at what stage of information processing (e.g., information acquisition, information analysis, action selection, action implementation) a person's level of trust changed or varied, based on initial HRI trust scale ratings. This subscale would provide additional information regarding the underlying processes influencing trust within each HRI trust scale item. For instance, team communication. If team communication was rated unreliable, what part or process within team communication was actually unreliable? Using the information processing subscale, team communication could be further analyzed using the following statements: General team communications are reliable (information acquisition); Analyzing relevant team communications is reliable (information analysis); Deciding what to communicate to the team is reliable (action selection); Communicating to the team is reliable (action implementation). The information processing subscale example now provides insight into *why* low trust ratings were reported for team communication.

In addition to expanding the HRI trust scale to include the human information processing subscale, future research will also be directed towards scale validation. The HRI trust scale will be administered and compared across various trust manipulations to assess the sensitivity of the scale. Thus, future research will pertain specifically towards improving the scale to in order to provide a comprehensive assessment of trust in human robot interaction.

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APPENDICES

Appendix A. Study 1 Online Questionnaire Example

Please answer the follow questions regarding potential context items, based on your knowledge and experience within HRI.

1. Please rate the potential context items below.

	Not essential, should be deleted	Useful, but not essential	Useful	Very useful	Essential
Mission					
Task					
Environment					
Social Context					
Previous Knowledge					

Comments:

2. Should any of the context items listed below be relabeled?

	Change Item Label	Keep Item Label	Delete Item
Mission			
Task			
Environment			
Social Context			
Previous Knowledge			

3. If indicated above, please provide alternative labels for the context items.

Mission

Task

Environment

Social Context

Previous Knowledge

4. In terms of the context within HRI, are there any items missing?

No

Yes

If Yes, please enter the context items that are missing

Appendix B. Written Scenario for Study 2 Data Collection

Terminology

IED - an improvised explosive device, such as a car bomb

UGV – unmanned ground vehicle, this type of robot is generally capable of operating outdoors and over a wide variety of terrain, functioning in place of humans

Platoon – a subdivision of a company of soldiers, usually forming a tactical unit that is commanded by a lieutenant and divided into several sections

Combat vehicle – is a military vehicle, protected by strong armor and armed with weapons

Autonomous – having self-control, at least to a significant degree

UAS – a typical UAS consists of the Unmanned Aircraft (UA), the Control System, the Datalink (transmits and receives digital information), and other related support equipment.

Mission Overview

The environment offers a wide range of obstacles to movement as would be expected in urban and suburban areas. Obstacles include hills, valleys, various road types and conditions, streams, rivers, bridges, towns. During rush hour traffic will be very heavy on main roads and traffic may be stopped for accidents or people or animals (typically cattle, sheep, goats, and donkeys) in the roads. Cross country areas are often cut by small streams, irrigation ditches, stonewalls, and ploughed farm fields. Many low hanging overhead electrical and telephone wires pose significant snag hazards to antennas and possibly weapons mounted atop vehicles. Citizens make place obstacles in roads to restrict military forces from entering their neighborhoods in the hopes of preventing violence. Insurgents may place trash and other obstacles in the roads to slow vehicles at ambush points or Improvised Explosive Devices (IED) sites, or the trash may be built up through lack of removal processes. Exploded IEDs can leave various sized crater obstacles for follow-on vehicles.

The mission consists of two phases: a movement phase and an attack phase. The operation is timed so that the movement phase will be in darkness and the attack phase will be during daylight hours. The movement phase begins with the platoon's Unmanned Ground Vehicle (UGV) departing from the base and moving along a specific route to conduct route reconnaissance (general inspection) for an additional platoon. Both platoons will move together to assist the UGV with route reconnaissance. The attack phase begins when the UGV crosses a certain point on the map. The UGV will move to the checkpoint to provide surveillance on a building in support of the platoon attack. The platoon moves into attack to seize the building the UGV has under surveillance. . Once the platoon has seized the building, it will consolidate and reorganize and mount its combat vehicle in preparation for movement.

Phase 1 Movement

On order, the platoon officer commands the UGV to move autonomously from the assembly area in the base to the starting point of the mission. The UGV selects a route and navigates its way toward the starting point. The UGV detects and interprets the road signs along the route and obeys them in accordance to local driving laws. It senses intersections and allows other vehicles to clear the intersection before making any turns. The UGV senses people walking across its path to its front and slows or stops to allow them to pass as it moves to the starting point. On the route, vehicle traffic is moving in both directions. The UGV sensors provide inputs that allow the UGV to predict the movements of these vehicles and avoid steering into any vehicles in its path.

The platoon's combat vehicles, still in the assembly area, receive updates from the UGV as it moves along its route. The UGV begins to recon the route for obstacles and potential IEDs. The UGV gauges its speed and location in accordance with the mission maneuver timeline to ensure that it will accomplish its assigned mission tasks in the proper sequence and on time.

When the UGV gets to the first checkpoint, the unmanned aerial system (UAS) controller launches the UAS to move to the UGV location and begin recon of the route ahead of the UGV. The UAS moves along its flight corridor and passes ahead of the UGV and begins sending data to the controller for analysis to determine if there are any obstacles or threats along the route. The platoon moves from the starting point as the UGV arrives at the first checkpoint. Since the route is supposedly clear, the platoon moves in travelling formation at the highest speed deemed safe for the traffic conditions.

On the route, the UAS has moved ahead of the UGV. The officer requests the controller have the UAS investigate the potential obstacles on the route. The controller confirms that there is an impassable obstacle and directs the UGV to determine another route around the obstacle. The UAS controller directs the UAS to collaborate with the UGV to help find a new route. The UAS controller allows the UAS to exit the flight corridor to gather mapping and terrain data in the area south of the buildings beside the obstacle on the route. The UAS had already mapped the area to the north of the blockage during its initial flyover of that area. The UGV updates its map with the new and stored data from the UAS and selects a new cross country route to the south of the buildings. The UGV doubles back on its path and moves to the south of the buildings.

Phase 2 Attack

The UGV moves to into position to establish surveillance on a building in support of the platoon attack. The UGV sends its sensor data to the platoon combat vehicles. With the UGV in place, the platoon leader requests the UAS move to recon the same building area. The platoon elements review the UAS data to gain information as their vehicles move forward. The platoon leader tasks the UAS controller to move the UAS to view the west side of the building and monitors data from the UAS. The platoon leader then orders the dismounted troops to deploy a small UGV to assist in clearing the building during the assault. The small UGV moves into the building and maps the floor plan of the first floor. The optical sensors on the small UGV look for enemy personnel, civilians, and potential booby traps. No enemies are seen on the first floor, so the small UGV is ordered to move autonomously up the stairs to the second floor. Once on the second floor, the small UGV repeats the mapping and search for enemy using the same techniques as on the first floor. The dismounted soldiers review the data from the small UGV prior to entering the first floor. They note the floor plan of the ground floor, plan their movement inside the buildings hallway, and configure ways to handle unopened doors.

While the dismounted soldiers move to their assault positions. As the combat vehicles are moving to their individual attack locations, the sniper detection system on one combat vehicles detects a shot fired from a second floor window in the building. The commander's vehicle acquires the sniper location and engages with his vehicle weapon. At the same time the suspicious behavior detection system in another combat vehicle alerts the commander of a person in the act of hostile or suspicious behavior for the roof top of the building 100 meters away. The commander's display shows an insurgent with a weapon in a firing position taking aim at combat vehicle. The commander tells the driver to take immediate action and fires his vehicle weapon to suppress the insurgent. The dismounted soldiers enter and clear the building. The soldiers prepare for their next mission.

Appendix C. Final HRI Trust Scale

Human Robot Interaction (HRI) Trust Scale

	Strongly Disagree						Strongly Agree	N/A
The operator is dependable.								
The human team member is dependable.								
The supervisor is dependable.								
The subject matter expert provides expertise.								

	Strongly Disagree						Strongly Agree	N/A
Team communication is reliable.								
Team coordination is dependable.								
Team dynamics are reliable.								
Team situational awareness is dependable.								
Team decision making dependable								
Team planning is dependable.								
Team replanning is dependable.								
Team backup is reliable.								
Team leadership is accessible.								

	Strongly Disagree						Strongly Agree	N/A
The operation is reliable.								
The task is reliable.								
The physical environment is reliable.								
The social environment is reliable.								
My previous task knowledge is dependable.								
My previous human team member experience is dependable.								
My previous physical environment experience is reliable.								
My previous system knowledge is reliable.								

	Strongly Disagree						Strongly Agree	N/A
My skills required for the task are dependable.	◯	◯	◯	◯	◯	◯	◯	◯
The task allocation is reliable.	◯	◯	◯	◯	◯	◯	◯	◯
The task objectives are reliable.	◯	◯	◯	◯	◯	◯	◯	◯
The difficulty of the task is reliable.	◯	◯	◯	◯	◯	◯	◯	◯
The task feedback is dependable.	◯	◯	◯	◯	◯	◯	◯	◯
Task feedback from my human team members is timely.	◯	◯	◯	◯	◯	◯	◯	◯
Task feedback from the physical environment is timely.	◯	◯	◯	◯	◯	◯	◯	◯
Task feedback from the overall system is reliable.	◯	◯	◯	◯	◯	◯	◯	◯

	Strongly Disagree						Strongly Agree	N/A
The user interface is reliable.	◯	◯	◯	◯	◯	◯	◯	◯
The sensor data is dependable.	◯	◯	◯	◯	◯	◯	◯	◯
The navigation capabilities are consistent.	◯	◯	◯	◯	◯	◯	◯	◯
The signal/bandwidth is dependable.	◯	◯	◯	◯	◯	◯	◯	◯
The end effectors are reliable.	◯	◯	◯	◯	◯	◯	◯	◯
The remote information processing is timely.	◯	◯	◯	◯	◯	◯	◯	◯
The level of automation is reliable.	◯	◯	◯	◯	◯	◯	◯	◯
The type of control is reliable.	◯	◯	◯	◯	◯	◯	◯	◯

Appendix D. Interpersonal Trust Scale

Interpersonal Trust Scale

Rotter (1967, 1971)

	Strongly Disagree				Strongly Agree
1. Hypocrisy is on the increase in our society.	○	○	○	○	○
2. In dealing with strangers one is better off to be cautious until they have provided evidence that they are trustworthy.	○	○	○	○	○
3. This country has a dark future unless we can attract better people into politics.	○	○	○	○	○
4. Fear and social disgrace or punishment rather than conscience prevents most people from breaking the law.	○	○	○	○	○
5. Using the honor system of *not* having a teacher present during exams would probably result in increased cheating.	○	○	○	○	○
6. Parents usually can be relied on to keep their promises.	○	○	○	○	○
7. The United Nations will never be an effective force in keeping world peace.	○	○	○	○	○
8. The judiciary is a place where we can all get unbiased treatment.	○	○	○	○	○
9. Most people will be horrified if the knew how much news that the public hears and sees is distorted.	○	○	○	○	○
10. It is safe to believe that in spite of what people say most people are primarily interested in their own welfare.	○	○	○	○	○
11. Even though we have reports in newspapers, radio, and TV, it is hard to get objective accounts of public events.	○	○	○	○	○
12. The future seems very promising.	○	○	○	○	○

	Strongly Disagree						Strongly Agree
13. If we really knew what was going on in international politics, the public would have no reason to be more frightened than they now seem to be.							
14. Most elected officials are really sincere in their campaign promises.							
15. Many major national sports contests are fixed in one way or another.							
16. Most experts can be relied upon to tell the truth about the limits of their knowledge.							
17. Most parents can be relied upon to carry out their threats of punishments.							
18. Most people can be counted on to do what they say they will do.							
19. In these competitive times one has to be alert or someone is likely to take advantage of you.							
20. Most idealists are sincere and usually practice what they preach.							
21. Most salesmen are honest in describing their products.							
22. Most students in school would *not* cheat if they were sure of getting away with it.							
23. Most repairmen will not overcharge even if they think you are ignorant of their speciality.							
24. A large share of accident claims filed against insurance companies are phony.							
25. Most people answer public opinion polls honestly.							

Scoring Key:

1. For the following items, use the recorded response as the score: 6, 8, 12, 14, 16, 17, 18, 20, 21, 22, 23, and 25.
2. For the remaining items, take the recorded response and covert it. If a 1, score it a 5; if a 2 score it a 4; if a 3, keep it a 3; if a 4, score it a 2; and if a 5, score it as a 1. Do this for the following items: 1, 2, 3, 4, 5, 7, 9, 10, 11, 13, 15, 19, and 24.
3. Add up the points for each item. This is the total score.
4. Higher scores indicate greater Interpersonal Trust.