Using Shared Priorities to Measure Shared Situation Awareness

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Sammanfattning

Under de senaste 15 åren har konceptet situationsmedvetande uppmärksammats en hel del, och många mått har utvecklats och blivit testade. Däremot har inte konceptet delat situationsmedvetande kommit lika långt i form av metodutveckling och validering.

Syftet med denna rapport är att operationalisera begreppet delat situationsmedvetande och pröva det mot andra koncept.

Inom ramen för detta arbete utvecklades ett nytt mått för delat situationsmedvetande som också testades empiriskt. Måttet mäter hur väl ett team har delade prioriteringar. Varje deltagare genererar fem faktorer för vad som är viktigt för god teamprestation i situationen och rangordnar dem i prioritetsordning. Dessa faktorer blandades sen om och delas ut till den andre teammedlemmen som i sin tur rangordnar faktorerna i prioritetsordning. Hur väl faktorernas rangordning korresponderar med varandra antogs vara ett mått på teamets delade situationsmedvetande.

Resultatet visar att rangordningsmåttet inte har något samband med subjektivt bedömt delat situationsmedvetande. Flera metodologiska problem identifierades som kan ha påverkat resultatet. Däremot korrelerade rangordningsmåttet med hur väl samarbetet i teamet ansågs fungera, vilket tyder på att måttet fångar aspekter av hur teamet fungerar som team.

Rangordningsmåttet var enkelt att använda, krävde lite förberedelse, har hög face-validity och verkar vara en möjlig väg att fortsätta studera team.

Nyckelord: Team, teamprestation, delade prioriteringar, delat situationsmedvetande, metodutveckling

Summary

While the concept of situation awareness have received a lot of attention over the past 15 years and many different measures have been developed and tested, the concepts of team situation awareness and shared situation awareness have not gotten as much attention and less progress has been made in developing a meaningful and validated measure.

Thus, the purpose of this study is to operationalize the concept of shared situation awareness and test its consequences and relation to other concepts.

In this study a new measure for shared situation awareness was developed and its potential evaluated. The measure was a shared priorities measure where the participants of the study each wrote down and rank ordered five factors they thought were important for good team performance in the situation. The factors were then scrambled and handed over to the other participant who once again ordered them according to priority. The correspondence between the two participants' ratings was hypothesized to correlate with shared situation awareness. The results show that the shared priorities measure in this study did not relate to shared situation awareness. Several methodological concerns was identified which could have affected the results. The measure did relate to subjective ratings of cooperation which is very interesting and it is suggested that the measure captured aspects of teamwork.

The shared priorities measure was easy to employ, required little preparation, has a high face-validity and is a promising addition to team research.

Keywords: Team, team performance, shared priorities, shared situation awareness, measurement development

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Abbreviations

SA	Situation Awareness
ISA	Individual Situation Awareness
SSA	Shared Situation Awareness
IP	Individual Performance
TP	Team Performance
Com	Communication
Pos	Position (Frequently used as “certainty of teammate’s position”)
WL	Workload
Coop	Cooperation
SP	Shared Priorities

1 Introduction

Imagine being able to quickly and with no preparation measure to what extent a team has a shared understanding of a complex situation. Imagine having a computer based tool doing this for you, requiring almost no prior knowledge to use. Imagine this taking very little time and affecting the task itself in such a small extent it could be employed in a real, time-stressed, situation. Keep imagining, because we are quite far away from having that type of measure just yet. This study takes a small step towards that goal by developing and evaluating a new measure for measuring shared situation awareness, in the form of a shared priorities measure. By letting two persons come up with and rank order factors that are important to them in a situation, as well as letting them order each other's factors, you can get data on how much the persons agree with each other on factors regarding the situation. This study explored the possibility of using this kind of measure to measure shared situation awareness by letting two participants cooperate playing a computer game. Two conditions were used, one were the participants had shared vision and one where they did not. The game was paused at a few times where the participants subjectively rated different variables such as situation awareness and performance, the shared priorities measure was also administered. The shared priorities measure was then compared to the subjectively rated data and it was also explored if the measure could pick up a change in shared situation awareness between the two conditions.

1.1 Purpose

The purpose of this study was to define and operationalize the concept of Shared Situation Awareness, and test its consequences and relation to other concepts.

1.1.1 Delimitations

This study is interested in generalizing the results to the domain of military command and control, further generalization might very well be possible, but will not be taken into consideration here. The definition and operationalization of the concept will focus on being simple and usable and the study will have a focus on method.

1.2 Background Theory

The background theory will mainly consist of four areas. A team effectiveness model will be presented as a framework for different team aspects. A few different definitions of situation awareness (SA), shared situation awareness (SSA) and team situation awareness (TSA) will be dealt with, as well as

underlying models of SA. Last but not least a few different approaches to measuring SA will be considered.

1.2.1 Teamwork and Taskwork

A distinction between teamwork and taskwork is made (Morgan, Glickman, Woodard, Blaiwes & Salas, 1986; Winfred, Edwards, Bell & Villado, 2005), where teamwork refers to the team members' efforts to facilitate interaction between the members in the accomplishment of team tasks. These team processes are generally generic and not task specific. Taskwork refers to the team's efforts to understand and perform the requirements of the job or task at hand.

1.2.1.1 The CTEF-model

The Command Team Effectiveness model was developed by Essens et al. (2005) and there is currently a draft for version 2 of the model (Essens et al., Draft). It consists of critical factors of command team effectiveness. The model is built on the idea that effective teamwork is the result of conditions, processes, outcomes and feedback factors. The conditions involve: mission context, task characteristics, organization, team leader, team member and team. These conditions affect two processes, task focused behaviors and team focused behaviors. Team focused behaviors affect task focused behaviors as well as team outcomes. Task focused behaviors affect task outcomes and both outcomes affect the processes in a process feedback loop.

The model is built with military command and control teams in mind but is general and assumed to work with any kind of command teams.

1.2.2 Situation Awareness (SA), Team SA and Shared SA

There are a lot of different definitions of SA. Fracker (1991) defined SA as "the combining of new information with existing knowledge in working memory and the development of a composite picture of the situation along with projections of future status and subsequent decisions as to appropriate courses of action to take". Dominquez (1994) based a definition of SA on a synthesis of 15 different definitions of SA. The definitions was an individual's "continuous extraction of environmental information, and integration of this information with previous knowledge to form a coherent mental picture, and the use of that picture in directing future perception and anticipating future events".

The most widely used definition of SA is probably that of Endsley's (1995a): "the perception of the elements in the environment within a volume of space and time, the comprehension of their meaning and the projection of their status in the near future".

Endsley and Jones (1997) also define team SA as “The degree to which every team member possess the SA required for his or her responsibilities.” and shared SA is defined as “The degree to which team members possess the same SA on shared SA requirements.” which are the definitions used in this paper.

So to phrase it differently, they consider team SA to be the sum of all the team members SA and shared SA as the overlap in SA between the different team members.

The concept of SA has been criticized for being a folk model where the explanation relies on substituting it for another concept which has also not been explained instead of decomposing it into smaller, measureable, specifics (Dekker & Hollnagel, 2004). They go on by saying that the concept is immune to falsification and that it is often used to overgeneralise situations it was never meant to speak about. This criticism has been met by for example Parasuraman, Sheridan and Wickens (2008) who claims that Dekker & Hollnagel (2004) neglects to mention a large body of empirical research as well as focuses on non-peer-reviewed results and the applied community.

1.2.2.1 Models

The most widely known and used model for SA is probably Endsley’s (1995a) model, based on information processing. This model consists of three levels. Level 1 is Perception, where we perceive information about the situation, level 2 is Comprehension where we build an understanding of the situation and level 3 is Projection where we project what might happen in the near future. Each level represents a deeper understanding of the situation, so to reach the Projection phase you need to already comprehend the situation.

Smith and Hancock (1995) have an alternative model of SA based on Niesser’s (1976) Perceptual Cycle Model. They argue that we have internally held mental models containing information about certain situations. According to them the process of assessing a situation revolves around these mental models and proposes that the assessment is done in three iterative steps. The model proposes that our interaction with the world is directed by these models, that the interaction modifies the original model and that this in turn directs further exploration. (Smith & Hancock, 1995)

Another model of interest is the CECA-model (Bryant, 2003). This model is built for a larger organization and is not built for SA in particular. It is especially focused on military command and control which is what makes it particularly interesting. The model consists of three layers, the Information Gathering, the Situational Model and the Conceptual Model. Information Gathering consists of both actively searching for information and passively receiving it. The Situational Model is the model of how we interpret the current situation and the Conceptual Model is how we want the situation to be. This does not have to be

the goal-situation, but rather how we think the situation should look at this moment if we are to reach our goals.

CECA stand for Critique, Explore, Compare and Adapt. In the Critique-phase we formulate questions and define informational needs. In the Explore-phase we retrieve this information and update our Situational Model. The Compare-phase consists of comparing our Situational Model to our Conceptual Model so that we can then move into the Adapt-phase where we ignore the differences, change our way of reaching the goals or change the goals themselves. Bryant, Lichacz, Hollands and Baranski (2004) propose that this framework works well for addressing SA in command and control environments.

1.2.3 Measurement

A lot of different approaches have been taken when it comes to measuring SA and shared SA. Pew (2000) differentiated between four main approaches to measuring SA. Direct System Performance Measures which is only useful when the performance of the system is mainly based on SA. Direct Experimental Techniques are the most commonly used and contains questions or probes as well as measures of information seeking. Verbal Protocols and Subjective Measures are the two other approaches Pew (2000) accounts for.

Measurement methods are also often split into one of two categories, on-line and off-line measurement (Durso & Dattel, 2004). On-line measurements measure SA during an actual task. In off-line measurement you stop the task, do the measurements and then resume the task alternatively measure SA after the task has been performed, drawing upon the participant's memory. SPAM is one example of an on-line measurement while SAGAT is the most popular off-line measurement. (Salmon, Stanton, Walker & Green, 2006)

1.2.3.1 SAGAT

SAGAT is an abbreviation for Situation Awareness Global Assessment Technique and is a widely used measure of SA (Pew, 2000). It is a probe-recall technique which works by first doing a deep analysis of the situation and tasks to be done in the situation, often by doing a Goal-Directed Task Analysis. From this analysis several questions about the situation are created, these questions are related to the different levels in Endsley's (1995a) model of SA. When performing the actual measurement the task is paused at random times and a number of random questions are asked from the pool of questions created. This way the participants of the study can not prepare for the test or the questions that are to be asked. This method of measurement has been shown to have a good reliability and validity. (Endsley, 2000)

1.2.3.2 SPAM

SPAM stands for Situation Present Assessment Method and is an example of an on-line measure of SA (Durso & Dattel, 2004). This means it can be used in real time during the performance of an actual task. The measure involves presenting that a question is in queue to be answered and letting the subject choose when to have it presented to them. The time between the presentation for the subject that a question is in queue to the subject accepting to hear the question is a measure of workload. The question asked can be binary (yes/no), multiple-choice or open. The time it takes from the presentation of the question to the subjects answer is used as a measure of SA, with the rationalization that it takes more time to find the answer when SA is low. (Durso & Dattel, 2004)

1.2.3.3 SART

SART or the Situation Awareness Rating Technique is the most popular subjective measure of SA (Salmon et al., 2007). It uses ten dimensions to measure operator SA: familiarity of the situation, focusing of attention, information quantity, information quality, instability of the situation, concentration of attention, complexity of the situation, variability of the situation, arousal and spare mental capacity. It is administered post-trial and the participants rate each dimension on a seven point rating scale (1 = Low, 7 = High) based on their performance during the task. The ratings are then combined to calculate a measure of their SA. The ten dimensions can also be condensed into a quicker three dimensional (3-D) SART, which involves rating attentional demand, attentional supply and understanding (Salmon et al., 2006). As with all subjective rating techniques, SART has been criticized for a number of reasons. Endsley (1995b) noted that a participant that performs well in a trial automatically rates their SA as good. Participants may also be prone to remembering only the periods when they possessed a superior level of SA and since a subjective measure relies on remembering the situation, the measure might catch only the end of the task under analysis. (Endsley, 1995b)

1.2.3.4 Measuring Shared SA/Team SA

To date there seems to be few or no measures specifically developed for shared SA or team SA. The measures that exist are adopted versions of measures intended for measuring individual SA and no measure has been properly validated and tested for shared SA or team SA (Salmon et al., 2006; 2007). Mainly three categories of team/shared SA measures can be identified, team probe-recall techniques, observer rating team SA techniques and team task performance-based SA assessment techniques. In probe-recall techniques a SAGAT-like approach is used in a team setting. Observer rating team SA techniques involves using subject matter experts observing team performance to rate the level of individual, team and/or shared SA. Team task performance-based SA assessment techniques are based on using responses to changes in the

task and environment to assess how aware a team and its components are. (Salmon et al., 2007)

“The concept of team or shared SA requires much further investigation in itself, which in turn requires the provision of reliable and valid measurement procedures. There are two potential solutions. The first solution would be to develop a novel approach to the assessment of SA, a daunting prospect, and one that requires a great deal of further investigation. The second solution would be to combine the most successful current SA measurement techniques in order to form a battery or toolkit of SA measures.” -Salmon et al. (2006)

The following study investigates the first potential solution by developing and evaluating a new way to measure shared SA.

1.3 Research Questions

1. How is shared SA, in terms of a shared priorities measure, related to shared SA in terms of subjective assessments?

2. Can a shared priorities measure detect a change in shared SA?

3. Is a shared priorities measure easy applicable during a test?

2 Method

The experiment was designed around the idea of testing a shared priorities measure in a way that was applicable to the military command and control domain. This was done using the computer game Starcraft which is a real-time strategy game where one or more players control different military units. Two players cooperated during two maps, controlling a set of own units towards three sequential goals per map. After each goal the measure was used and a questionnaire about self-rated performance, situational awareness and a few other things was answered. The maps looked different but were essentially the same, with the same goals and the same encounters. The only thing manipulated between the two maps was if the participants could see only their own units and the surrounding area, or if they could also see the other participants units and their surrounding area. This should give two different conditions where the shared situation awareness is lower where the participants did not have access to the same information than when they did. The measurements should be able to pick up on this change.

2.1 Design

The experiment had a within-group design where the independent variable was the absence or presence of shared vision between the participants. The dependent variables were subjective ratings about performance and situational awareness on a questionnaire as well as ratings from a shared priorities measure. The number of units both players lost was also recorded as a dependent variable.

2.2 Pilot Studies

Two pilot-studies were performed before the experiments. The first was performed solely to test the different maps used and the second was performed to test the procedure and the measures as well as a final test of the maps. Observations about improvements were written down and the final procedure was adjusted accordingly.

2.3 Participants

The 40 participants were between 20 and 35 years old with a mean of 23.85 years. The participants had all played some kind of strategy game on a computer before but had varying amounts of experience. The mean self-rated experience with strategy games were 5.18 on a scale 7-graded scale where 1 meant a small and 7 meant a large amount of experience. The mean self-rated motivation for the experiment was 6.08 where 1 meant low motivation and 7 meant high. No

consideration was taken regarding the participants gender when choosing them but only 5 out of 40 participants were female. Out of the 40 participants 38 were students, most of these studying cognitive science but among the participants were also students from other programs and two were software engineers. Each pair of participants had known each other for a mean of 21.73 months, but 8 pairs did not know each other at all. The background questionnaire can be seen in Appendix 1. The participants got one movie ticket each for participating.

2.4 Apparatus

Two networked computers were used to perform the experiment. The computers had a processor speed of 2 GHz and had 786 Mb of ram, each computer had a CRT-monitor which had a resolution of 640x480. Both computers had identical keyboards and mice. Beside the computers and the game described below the experiment also used a digital camera to record the shared priorities measurements.

2.4.1 Starcraft

Starcraft is a sci-fi computer game in the genre of real-time strategy. The original game contains three different races, humans and two alien races. It is focused around building bases, collecting resources, training military units and then fighting either computer controlled enemies or human controlled enemies over a computer network. The game also features a very powerful map-editor to build your own maps and this is the reason it was chosen for the study. The maps produced for the study did not contain any elements of building bases, collecting resources or training units. Both participants played the human race with troops that was as close to today's military as possible, that is, infantry and armored troops. A screenshot from the game can be seen below in Figure 1.

Figure 1. Screenshot from the game Starcraft

2.5 Material

The measure developed for the study was a shared priorities measure. Each participant was given five pieces of paper and was instructed to write down what they thought was the five most important factors in the situation. They were instructed to think especially about goals, threats, enemy units, friendly units and specific things needed to be communicated to the other player. They were instructed to be as specific but still concise as possible. They were then instructed to order these pieces of paper on top of another, larger, paper which had a scale from 1-25 marked out. The placement on the larger paper indicated how important they thought the given concern was with the most important being on top. Not only the order of the factors was important but also the distance between them, this distance indicated how important they were in regard to each other. These were then recorded by the experiment leader resulting in the five factors perceived to be most important in this situation and their related importance to each other. When both participants had done this, they were presented to the other participants five factors and were asked to rate these in the same way,

putting them on the larger piece of paper with the scale 1-25, these ratings were also recorded. One of the specific measurements is shown in Figure 2 below:

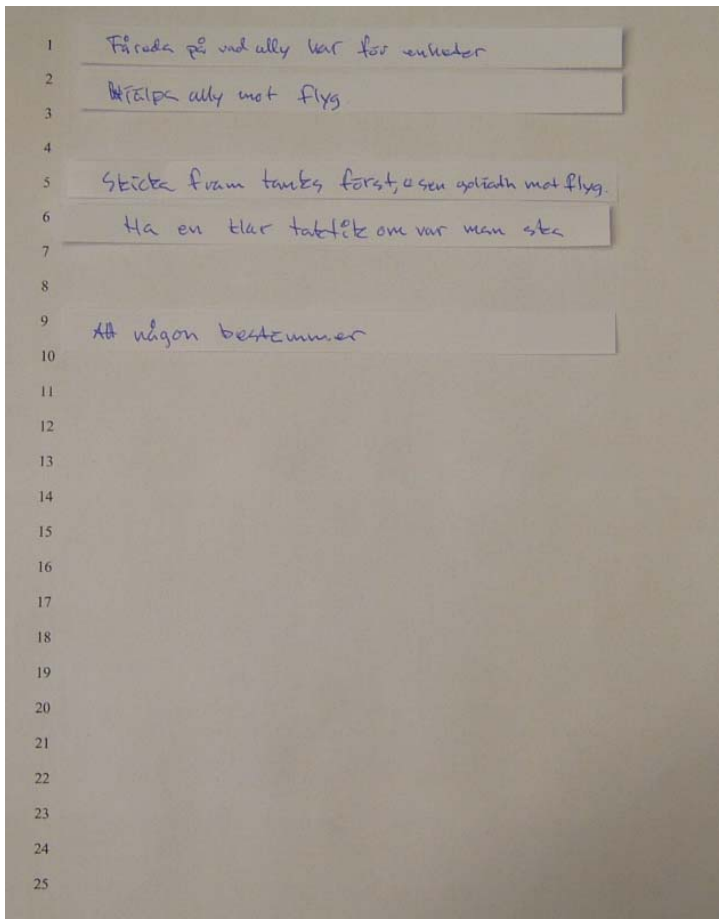

Figure 2. An example of a Shared Priorities measurement

A questionnaire was also used during the study, it had 8 questions and each question had a 7-graded scale with each number marked out. The endpoints of the scales had written descriptions so that they could range from for example “Very bad” to “Very good” and they were answered by circling the number that was perceived to be most correct by the participant. The questionnaire was written in Swedish since that was the native tongue of the participants. The questions were concerning their impression of both their own and the team’s performance and situation awareness as well as communication, their certainty of their teammate’s position, their mental workload and the cooperation between the two participants.

A debriefing-questionnaire was used after each map was played which included 6 questions and 1 field where the participants could leave comments. The questions were formulated a bit different than the ones in the regular questionnaire but had about the same meaning, except that no questions regarding individual performance or SA was asked. They were also ordered in a different way to encourage the participants to really think about the whole map and not just the last event.

Both questionnaires can be found in Appendix 1.

2.6 Scenarios

In the experiment two different scenarios were used. In one scenario the participants map within the game showed only their own units and the area around them and in the other case they could see their own as well as the other participant's surroundings.

There were two different maps used to minimize the effects of participants learning the map between the two scenarios. In one of the maps the participants attacked from south to north and in the other map they attacked from east to west and it was also mirrored. The graphical surroundings of the two maps were also different to confuse the participants from knowing the map had only been rotated. One map had jungle surroundings while the other had desert surroundings. Beside the 90 degree rotation, the mirroring and the different surroundings the maps were the same, with the same objectives and the same encounters.

To balance out training-effects half the participants played the first map and half played the second map in the first trial. To further balance out training-effects half of the participants played the first scenario (seeing only their own surroundings) in the first trial and the second half played the second scenario in the first trial. This created four different terms as seen in Table 1.

Table 1 - Table showing the four distinct terms used in the experiment as well as which groups played under which condition.

Term	Group nr	First trial	Second trial
1	1, 5, 9, 13, 17	South-North No shared vision	East-West Shared vision
2	2, 6, 10, 14, 18	South-North Shared vision	East-West No shared vision
3	3, 7, 11, 15, 19	East-West No shared vision	South-North Shared vision
4	4, 8, 12, 16, 20	East-West Shared vision	South-North No shared vision

The scenario where the participants saw both their own and their teammate's surroundings should have given them a higher shared SA because they had access to exactly the same information. In the scenario where they only saw their own surroundings they did not have access to the same information and important information not available to the other teammate had to be communicated via text-messages since the participants were in separate rooms, this should mean a lower shared SA.

Each mission consisted of three parts. In the first part the participants took turns being attacked by units they could not handle on their own, requiring their teammate to rush over to aid them. In the second part they assaulted an enemy base from two directions with orders to keep an even pace through the base. The enemy base was built so that one participant met less resistance thus forcing him to wait for the other, in case he did not he would reach the middle faster and there be attacked by units he could not handle on his own, therefore taking more casualties before his teammate could reach him. The third part consisted of guarding this base from attacks. Four different entrances were to be guarded and each participant had the responsibility for two of them. At times larger attacks were launched against a specific entrance, requiring the teammate not present at that entrance to rush to aid its defense.

2.7 Procedure

Each session started off by letting the participants read a welcoming text that explained the experiment in general, told them that the data would not be connected to the actual individuals, that they could, at any point, abort the experiment and where to turn to if they had any questions about the experiment later on. They then filled in a short background survey, see Appendix 1, and were

then given the instructions for a first practice level. After they had read the instructions a verbal explanation of the shared priorities measure was given. They were led to two adjoining rooms were they sat down in front of a computer and started playing the practice-level which was designed to teach them about the different units that were used in the actual experiment. When both participants had finished the practice-level the experiment leader gave the participants written instructions for their first goal and started the first of two levels that were going to be played. After the first goal was completed the participants were instructed to turn off their monitors and asked to read written instructions for the shared priorities measure. They used this measure and then answered a questionnaire about the event, see Appendix 1.

They were given the instructions for goal two and when these had been read by both participants they were instructed to turn on their monitors and to place their troops just at the enemy base entrance. When done they were instructed to execute the second goals. After they were done with this the exact same procedure as after the first goal was used and they were given the instructions for goal three. They were asked to place their troops to prepare to defend the enemy base they had just conquered and when they were done the experiment leader started the third event, a number of attacking waves. After finishing this goal the earlier mentioned procedure was used again with two additions. They also filled in a debriefing survey about the whole level, see Appendix 1, and the experiment leader saved the replay and wrote down how many troops the two players had lost.

The experiment leader then started the second level and the whole procedure repeated itself again, except reading the goals since the exact same goals were used as in the first level. After the second level was completed the experiment leader told them what the purpose of the experiment was, the participants were allowed to ask questions and could also see their performance result for the two maps, that is, the total number of units lost. All the written instructions, seen in Appendix 2, were in Swedish which were the participants' native tongue.

2.8 Scoring

Each of the shared priorities measures consisted of five values between 1 and 25 for the player that created the five factors and five more values between 1 and 25 for the other player that also rated these factors. To find out if there was a relation between the two player's ratings a correlation test was computed. This was also done where the other player was the creator of the factors which gave two different correlation values for each event. To get just one score for each event the mean of the two correlations was used.

Both participants rate what they thought about the team performance and shared SA each event so to get a team value for each event the mean was used.

3 Results

The results are mainly divided into three categories. The first is correlations between the team level variables, that is, exploring if the shared priorities measurements, mean subjective ratings of shared SA and mean subjective ratings of team performance correlate with each other. The second is correlation between the individual level variables, that is, exploring how the other six questions in the questionnaire as well as the shared priorities measurements correlate. The last category is that of comparing the two conditions in the experiment, that is, shared vision vs. not shared vision. This is done for all of the variables. The last section of the results will contain the remaining results, exploring the objective and team performance measures.

Correlation between the team variables

To explore how shared SA (SSA), in terms of a shared priorities (SP) measure, was related to SSA in terms of subjective assessments, a correlation test between the mean correlation of the SP measurements and the mean subjective rating of SSA was done. The relation was almost non-existing ($r=0.04$, n.s.).

To then explore if the SP measurements was related to the subjective ratings of team performance (TP), a correlation test between the mean correlation of the SP measurement and the mean subjective rating of TP was done. The relation was very weak ($r=0.09$, n.s.).

To determine if the subjectively assessed SSA was correlated to the subjectively assessed TP, a correlation test was done between the subjectively rated SSA and the subjectively rated TP. The relation was very strong ($r=0.81$, $p<0.01$).

The first two results show that on a team level, the SP measurements was not connected to the subjective ratings of the participants. On the other hand, subjectively rated SSA and subjectively rated TP had a very strong correlation.

Correlation between the individual variables

The correlation between the rest of the questions in the questionnaire as well as the shared priorities measurements was computed to find all correlations in the data. They are presented in Table 2 below.

Table 2 – Correlation-matrix of the individual variables.

Correlation-matrix of the individual variables							
	SP	**IP**	**ISA**	**Com**	**Pos**	**WL**	**Coop**
SP	-						
IP	-0,06	-					
ISA	-0,02	**0,72****	-				
Com	0,09	**0,4****	**0,34****	-			
Pos	-0,04	**0,15***	**0,35****	**0,34****	-		
WL	0,11	-0,05	**-0,15***	-0,08	-0,12	-	
Coop	**0,14***	**0,57****	**0,62****	**0,75****	**0,31****	-0,02	-

* - significant at p<0.05, ** - significant at p<0.01

The abbreviations are as follows: SP = Shared Priorities, IP = Individual Performance, ISA = Individual SA, Com = Communication, Pos = certainty of teammate's Position, WL = Workload, Coop = Cooperation.

As Table 2 shows, the only thing that the shared priorities measurements correlates with is cooperation. A lot of other correlations exist in the subjectively rated data such as between workload and individual SA as well as between individual SA and performance.

Comparing the two conditions

Three different ANOVA-tests (shared vision/not shared vision) were computed with the mean correlation of the two participants SP measurements, subjectively rated SSA and subjectively rated TP as the three different dependent variables. This was done to see if any of these variables differed between the two conditions and the results can be seen in Table 3 below.

Table 3 - Mean values and ANOVA-results for the team variables for the two conditions. Standard deviation is shown within the parenthesis.

	Shared Vision	**No Shared Vision**	**ANOVA-results**
Shared Priorities	0.27 (-)	0.30 (-)	$F_{(1,118)}=0.194$, n.s.
Shared SA	5.38 (1.04)	4.72 (1.13)	$F_{(1,118)}=11.33$, $p<0.01$
Team Performance	5.26 (0.95)	5.11 (0.94)	$F_{(1,118)}=0.75$, n.s.

To explore if the subjective ratings of individual SA (ISA) or the subjective ratings of individual performance (IP) differed between the two conditions (shared vision/not shared vision) two ANOVA-tests were computed with subjectively rated ISA and subjectively rated IP as the dependent variables accordingly. The results as well as the mean values for the two conditions can be seen in Table 4 below.

Table 4 - Mean values and ANOVA-results for the individual SA and performance variables for the two conditions. Standard deviation is shown within the parenthesis.

	Shared Vision	**No Shared Vision**	**ANOVA-results**
Individual SA	5.13 (1.48)	4.52 (1.44)	$F_{(1,238)}=10.65$, $p<0.01$
Individual Performance	4.77 (1.33)	4.75 (1.27)	$F_{(1,238)}=0.2$, n.s.

Four ANOVA-tests (shared vision/not shared vision) were computed to determine if the subjective ratings about communication, certainty of the teammate's position, mental workload and/or cooperation differed between the two conditions. The results as well as the mean values for the two conditions can be seen in Table 5 below.

Table 5 - Mean values and ANOVA-results for the individual variables for the two conditions. Standard deviation is shown within the parenthesis.

	Shared Vision	No Shared Vision	ANOVA-results
Communication	5.43 (1.24)	5.17 (1.32)	$F_{(1,238)}$=2.60. n.s.
Teammates Position	6.07 (1.19)	5.15 (1.88)	$F_{(1,238)}$=20.31, p<0.001
Workload	3.47 (1.45)	3.59 (1.50)	$F_{(1,238)}$=0.43. n.s.
Cooperation	5.51 (1.19)	5.18 (1.37)	$F_{(1,238)}$=3.85, p<0.06

As we can see from these results, the only measurements that significantly changed between the two conditions was subjectively rated shared SA, subjectively rated individual SA and certainty about the teammate's position. No other measurements differed significantly between the two conditions. Cooperation was very, very close to being significant at p<0.05 and can be considered a very strong tendency. Below in Figure 3 is a diagram showing the mean values of the subjectively rated variables and how they differed between the two conditions.

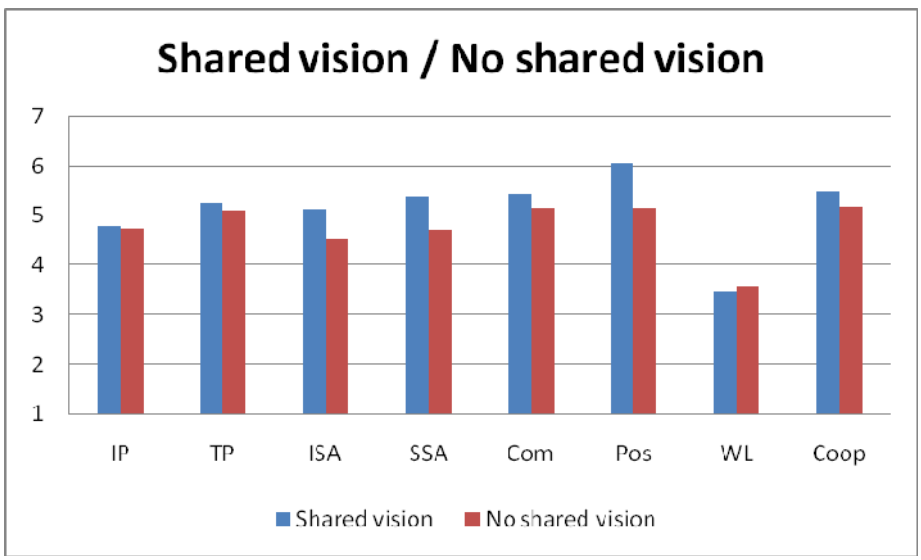

Figure 3. Diagram showing how the subjectively rated variables differed between the two conditions.

Other results

In order to explore how the objective performance measure related to the participants subjectively rated the team performance after each map, a correlation-test was computed giving $r=-0.22$ ($p<0.05$).

Two different ANOVA-tests (shared vision/not shared vision) were computed to explore if the objective TP or the subjectively rated TP (as rated after each map) differed between the two conditions. The results as well as the mean values can be seen in Table 6 below.

Table 6 - Mean values of the objective performance measure of lost troops and the subjectively rated team performance after each map. Standard deviation is shown within the parenthesis.

	Shared Vision	**No Shared Vision**	**ANOVA-results**
Nr of lost units	153.30 (41.79)	119.95 (55.62)	$F_{(1,38)} = 4.60$, $p<0.05$
Team Performance	5.26 (0.95)	5.11 (0.94)	$F_{(1,38)} = 0.75$, n.s.

4 Discussion

Perhaps the most interesting result is that the shared priorities measure did not correlate with the subjectively rated shared SA or the subjectively rated team performance and it did not change between the two conditions. This means that the measure did not seem to measure what was intended. Further implications of this will be discussed below together with a lot of other interesting results found in the data. Why the measure did not measure what it was intended to measure and the method in general will be discussed in the method discussion.

4.1 Result

The following discussion only focuses on the subjectively rated performance. The rationale behind this is that when observing the participants it was quite clear that they had a very weak understanding about what the study considered to be good or bad performance. It is most likely that this has mainly two explanations, first of all the instructions might not have pressed this issue enough. Secondly, the participants had no prior experience with the particular situation and therefore had no frame of reference for what was good or bad performance, even if they had understood the part of the instructions that dealt with performance. Their behavior included things like killing off their own wounded units to get a fresh one before the next event, something that affected their objective performance negatively. We can see that the subjectively rated performance after each map had a very weak correlation with the objective performance measure, even if it were indeed significant. Because the participants did not seem to have a clear understanding of what good performance was, they obviously did not play accordingly; therefore it makes more sense to use their subjectively rated performance values. As seen in Table 6 in the results, the number of lost troops was actually significantly higher when the participants saw each other, which is very counter-intuitive.

4.1.1 Questionnaire Data

The data from the questionnaire regarding the variables that were connected to the individual participants had a lot of significant correlations. All of the correlations will not be discussed, mainly because not all of them are relevant or interesting. The most interesting connection seems to be that workload correlates negatively with SA and that SA in turn correlates positively with subjectively rated performance. Based on earlier findings (e.g. Castor, 2009) this seems to mean that when the perceived workload of the participant went up, the perceived SA went down which in turn seems to mean that the perceived performance went down.

Communication, certainty about the teammate's position and cooperation are all significantly positively correlated to subjectively rated SA. Because the scenarios demanded that the participants cooperated, communicated and knew of each other's positions (or at least found the other teammate at times) it comes as no surprise that the participants rated these variables in a similar fashion. It could also very well be connected to their underlying SA since these variables were either means of assessing the situation, distributing knowledge of the situation, or as is the case with certainty of the teammate's position, part of the SA. All variables except workload and the shared priorities measurements were significantly and positively correlated with subjective performance.

4.1.2 Shared Priorities Measure

As seen in the results, the shared priorities measure does not seem to measure what it was intended for, namely shared SA. Neither does it have any significant correlation with subjectively rated performance. However, interestingly enough it does correlate with cooperation, and although the correlation is quite weak it is significant. This does not have to be as strange as it seems. As mentioned before, the participants did not seem to have been aware of what constituted good performance in the study. Therefore, they can not possibly have known the specific elements leading to good performance either, and it was those elements, or factors, that they were supposed to use for the shared priorities measure. The results from the measure and the measure itself will be further discussed in the general discussion.

4.2 Method

Overall the method worked well and gave a lot of data and insight into the shared priorities approach to measuring shared SA. There were different strengths and weaknesses which will be further discussed below.

Most of the participants in the study were male students in their mid twenties. All the participants had to have at least some prior experience with computer strategy games and this is probably the reason so many participants were male. They were recruited mainly through different mailing-lists and a little over half of the pairs that signed up knew each other from before. Since the participants are from such a homogenous group it is obviously hard to generalize the results of the study to a broader population, but in the same time, there are no known reason to why there should be any difference in how people from this group assess a new situation compared to most other groups.

4.2.1 The Experiment

When it comes to the experiment, several advantages and disadvantages can be seen by using the given method. First of all, using a real-time strategy game gave it a loose closeness to the domain of military command and control, an area where there exists a need to explore the measurement of SA and shared SA (Salmon et al., 2005). The map-editor of this particular game was very easy to use and gave a good way to control each event in a precise way. The main advantage though, was that it was easy to manipulate what information each participant had access to, or rather if they had access to the same information. Since there was such a big element of cooperation and communication in the map (often about position), it seemed obvious that if the participants saw each other's troops or not, should also affect both the individual SA and the shared SA of the team. This is based on the idea of Endsley's (1995a) model of SA where level 1 SA (perception) is necessary for forming level 2 SA (comprehension) and level 2 SA is necessary for level 3 SA (future projection). Restricting perception and the information the participants could see should by this theory also affect higher levels of SA.

This is also what the subjective ratings of SA points at, since it was significantly lower for both individual and shared SA in the condition where the participants did not see each other's troops. Even so, subjective measures of SA has been criticized (e.g. Endsley, 1995b) for many reasons and especially since this was a new situation for the participants, the perceived SA and shared SA might very well be unrelated to the participants real SA and/or shared SA.

There were many other advantages as well. The repeated measurements over different occasions and with different conditions gave a lot of data to interpret under slightly varied conditions. Another advantage, perhaps not for the study itself but for the execution of it, was that it was very easy to find people willing to play and participate in the study.

Despite the obvious advantages there were also many disadvantages and problems with the design of the study. Overall there was a lot of written information handed out to the participants. They often had to be reminded of the instructions during play and often asked questions about them when forgetting what to do. At times they completely disregarded them to go their own way to solve the goal, for example joining the two forces until told by the experiment leader to pursue their own objectives. All in all this points to that the written information was too comprehensive and hard to interpret.

The main disadvantage was the lack of a good, clear and objective performance measure and definition of performance. The performance measure was how many troops the players lost during the whole map which made it impossible to use for each event. As previously explained, the players seemed to have had a bad understanding of what the study considered to be good performance and

therefore the objective performance measure was disregarded. This has further implications which make the method unsuitable for evaluating the measure. These implications will be discussed further below. Another thing worth mentioning about this performance measure is that it was a defensive measure, in the sense that defensive playing was rewarded by the measure. Because the scenarios were inherently offensive in nature there was a lack of connection between the measure and the scenarios on a design-level as well.

4.2.2 Questionnaires

The questionnaires had 8 questions with a 7-graded scale. The scale was chosen so that the participants had a chance to give a neutral answer by answering a 4 but still had enough options on each side before the endpoint so that they could easily take a small or a large stand towards any endpoint. The labels at the endpoints were carefully designed so that the scale would not be skewed and all questions except those regarding performance were chosen so that they would be related in some way to SA or shared SA. Using subjective measures for SA is risky and has received a lot of criticism. Endsley (1995b) had several points of criticism that can be applied here, first of all the tendency to rate performance and SA in a similar way. If the participants rate their performance high there is a large effect of rating SA high as well, regardless of how high SA they felt they had. Another concern raised by Endsley is how well the participants can really rate poor SA, considering they might not realize that they have poor SA in the first place. Still, the questionnaires asked about many aspects of SA and were only meant as one part of many in investigating the shared priorities measure.

Some of the participants found the question about certainty of their teammate's position to be a bit confusing. They asked if the question regarded their actual teammate or the position of the teammate's units within the game. This question should have been more clearly formulated, but it should not have affected the results significantly.

4.2.3 Shared Priorities Measure

Using shared priorities concerning different factors of a situation as a form of measure for shared SA has a high face validity. If two or more persons agree on what is important concerning team performance in a situation and also agree on how important these factors are in relation to each other, it seems natural that they have the same awareness about the situation. If they on the other hand do not agree at all about what factors are important, it seems natural that they do not have the same awareness. It is important here to notice that this is concerning shared SA, not team SA, using Endsley and Jones (1997) definition where shared SA is the overlapping SA between the two participants. It is not always important to have the exact same awareness about a situation. People can have different

roles and goals to perform within the situation. Note that it is not “wrong” when the two participants rate the aspects differently, given that they are in somewhat different situations prioritizing things differently may very well improve performance. The measure is simply trying to measure to what extent the SA is shared between the participants.

The measure used five factors only because this seemed to be a good number to come up with and order. Despite this a lot of the participants had trouble coming up with five factors and it would be interesting to see what would happen if say three factors were used instead. One could also have a minimum of three factors but let the participants come up with as many as they wanted to. Then the factors ordered and exchanged between the participants might have been more thought through, but on the other hand a correlation would not have the same strength.

One could also have a set of predefined factors for the participants to use. This would allow for greater control of the used factors, but at the same time it would seriously hamper the ease of use for the measure and would require a lot of preparation. The ease of use and implementation is what is primarily so attractive with the shared priorities measure and therefore this is not a recommended approach, although it could be interesting to investigate further.

The instructions for the shared priorities measure can definitely be improved to be more specific about what kind of factors to write. No examples of “good” factors to write were given to the participants in fear that it would affect them to use these factors and not come up with their own, but some way to communicate what kind of factors they should write might be important for a successful use of the measure. Another good idea would be to let the participants practice using the measure before the real measurements are made, possibly with feedback on the factors written from the experiment leader.

It is not only its apparent face validity which makes the measure attractive to pursue and investigate. First of all, it requires virtually no preparation to use in a new situation. It has the potential of being able to test virtually any kind of situation where you are interested in two persons (or more, with some changes) shared SA, even without preparation. Secondly, it can be made to be very quick and easy to administer. In this particular experiment, loose pieces of paper, a paper with a scale on it and a digital camera was used to administer the measure. This was a very lengthy procedure, especially when it came to translating the data from pictures into raw data. With a computerized version all of this, including analyzing the data, could be completely automated.

4.3 General Discussion

Despite the high face validity the shared priorities measurements did not correlate with subjectively rated SA or performance and it did not change between the two different conditions where SA should have changed.

The subjectively rated SA has its flaws as discussed earlier and the fact that the shared priorities measure did not correlate with these measurements does not necessarily have to be a bad thing, even if we do assume the participants could rate the SA in a good way. It could just mean that the shared priorities measure caught another aspect of shared SA, having a perfect correlation between subjectively rated SA and the shared priorities measure would mean the shared priorities measure would not add anything unique to the measuring of shared SA. Another problem with the questionnaires is that it is uncertain how the participants interpreted the question about shared SA. It could also have been interpreted as a question about team SA, that is, the total SA of the team and not the shared SA between the members.

The shared priorities measure did not significantly change between the two conditions either, but before any conclusions can be drawn about this, the method of evaluating the measure has to be taken into consideration. Even if it seems like the possibilities of having a higher degree of shared SA should change when the participants could see each other there is no evidence that this was actually the case. They might very well be communicating well enough when they do not have shared vision to make up for the lack of shared vision. Because of the methodological issues it is hard to draw conclusions about the measure based on the empirical results.

In a SAGAT measure of individual SA, goals and subgoals as identified by a goal-directed task analysis are used to construct the actual measurement and the questions therein (Endsley, 2000). The idea about the shared priorities measure is that the participants themselves can identify these goals and subgoals as they are in the situation, but also that other aspects can be found that are important for the team performance in the specific situation. In this study the participants did have prior strategy game experience, but many had not played Starcraft before and even those that had was met by a scenario that differed very much to what they were used to. They were definitely novices in the situation and many had significant troubles formulating five factors that were important in each situation. Many of the factors were often synonyms to each other or just slight variations on a theme. Quite often several of the factors seemed to get written just to get it done but even more importantly, the factors were very seldom tied specifically to the situation but were instead quite general.

The factors used for the shared priorities measure were meant to be specific factors that affected the team performance in the specific situation. If the participants do not have a shared, clear and precise understanding of what

constitutes this team performance and the factors leading to it in different situations, they can obviously not come up with and rate relevant factors either. As argued before, the participants in this study did not seem to have a shared, clear and precise understanding of the team performance. The factors written by the participants included things like “coordination”, “use each others strengths”, “communicate” and “go step by step”. Coordination about what? Use which strengths? Communicate about what? Go step by step with what? These factors are obviously not very tied to a specific situation but instead quite general and indeed they were often re-used in multiple situations.

Because they could not find and write down these factors, they seem to have had two alternatives. Either they could use factors that were important in their own subjective sense of performance, or write down factors that were important parts of the two participant’s cooperation instead. The distinction between taskwork and teamwork is particularly interesting here (Morgan et al., 1986; Winfred et al., 2005).

While the method and measure was designed around the idea of taskwork, it seems to instead have picked up on the teamwork aspect. This would also explain the relation between the shared priorities measurements and subjectively rated cooperation.

If the measure was instead used in a situation where people were very good at what they were doing, had a deep knowledge of the situation and had a good understanding of their goals and what constituted good performance, the different factors might very well have been more specific, to the point and relevant. A more goal- and subgoal-focused approach to the factors could be essential as well. There is also a possibility that the measure just is not fit for measuring shared SA. Even if this is the case, it is quite clear that it has great potential of measuring different shared team aspects; all depending on what kind of factors are used in the measure.

4.4 Future Directions

The next step in exploring the use of an shared priorities measure in measuring shared SA is definitely to test it on experts in a situation they are used to, while also finding a way to be clear on what kind of factors should be used in the measure. For easier administration of the measure a computer based approach is recommended. Comparing the measure against something other than subjective ratings of shared SA is another step forward, but since no properly validated methods of measuring shared SA exist just yet, using two conditions which naturally limits or allows a highly shared SA could prove to be the best approach for evaluating the measure. Efforts should be made to clearly distinguish these two conditions from each other so that one can be sure the manipulation of shared SA works and is strong enough.

5 Conclusion

The developed shared priorities measure initially seems like an interesting new way to measure shared SA. This study's purpose was investigating the potential of the developed measure by comparing it to shared SA in terms of subjective assessments and by investigating if it could detect a change in shared SA as manipulated by the conditions in the experiment.

The measure had no correlation with subjective assessments of shared SA and it did not change significantly between the two conditions, meaning it could not detect a change or that no significant change was manipulated. A possible explanation for this was discussed and it was found that besides the possibilities that the measure is not suitable for measuring shared SA or that the lack of results were because of methodological concerns, there is also a strong possibility that the lack of connection with shared SA depended on the participants' lack of experience with the situation. The measure is designed to be used with factors affecting team performance and because the participants in the study did not seem to have a shared, clear and precise understanding of what constituted team performance, they could not produce relevant factors to order.

The measure did correlate significantly with subjectively rated cooperation and the hypothesized reason for this is that instead of using factors that affected team performance, the participants might have used factors that affected the cooperation in a larger extent. This seems plausible considering the participants could directly assess the teamwork, while not having direct access to taskwork performance. Therefore a high degree of teamwork might indirectly have affected the participants into thinking the taskwork was good as well.

Despite the apparent lack of relation between the measure and shared SA a lot of methodological concerns were raised and the measure definitely deserves further investigation. It has potential of being able to measure shared SA, or other shared team variables, in a range of different scenarios while at the same time being easy to administer and requires almost no preparation. Measuring shared SA is still a relatively uncharted territory, and it is in desperate need of further study, this might be one way forward.

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7 Appendix

1. Questionnaires

Bakgrundsenkät

Linköping april 2009

1. Ålder: _____

2. Kön: _____

3. Sysselsättning: _____
   (Om student, även utbildning)

4. Egen bedömd erfarenhet av strategispel:

   Liten 1 2 3 4 5 6 7 Stor

   Kommentar: _____

5. Egen bedömd erfarenhet av datorspel:

   Liten 1 2 3 4 5 6 7 Stor

6. Känner du den andra försökspersonen sedan tidigare och om ja, sedan hur länge?
   (Fyll i eller ringa in)

   Ja, sedan ____ månader. Nej.

7. Din motivation inför försöket?

   Låg 1 2 3 4 5 6 7 Hög

Enkät

Händelse: 1

RINGA IN DET SVARSALTERNATIV SOM STÄMMER BÄST.

ENKÄTEN GÄLLER DET JUST UTFÖRDA MOMENTET.

1. Hur presterade **du** under detta moment?

   Mycket dåligt 1 2 3 4 5 6 7 Mycket bra

2. Hur presterade ni som grupp under detta moment?

   Mycket dåligt 1 2 3 4 5 6 7 Mycket bra

3. I vilken grad hade du koll på läget under detta moment?

   Liten grad 1 2 3 4 5 6 7 Hög grad

4. I vilken grad hade ni som grupp koll på läget under detta moment?

   Liten grad 1 2 3 4 5 6 7 Hög grad

5. Hur väl fungerade kommunikationen under detta moment?

   Mycket dåligt 1 2 3 4 5 6 7 Mycket bra

6. Hur säker är du på var din medspelare befinner sig just nu?

   Mycket osäker 1 2 3 4 5 6 7 Mycket säker

7. Hur är din mentala arbetsbelastning?

   Mycket låg 1 2 3 4 5 6 7 Mycket hög

8. Hur väl fungerade samarbetet under detta moment?

   Mycket dåligt 1 2 3 4 5 6 7 Mycket bra

Debriefing 1

RINGA IN DET SVARSALTERNATIV SOM STÄMMER BÄST.
ENKÄTEN GÄLLER HELA DEN SPELADE BANAN.

1. Hur väl fungerade kommunikationen under denna bana?

   Mycket dåligt 1 2 3 4 5 6 7 Mycket bra

2. Hur säker var du på din egen och din medspelares positioner under banan?

   Mycket osäker 1 2 3 4 5 6 7 Mycket säker

3. Hur var din mentala arbetsbelastning?

   Mycket låg 1 2 3 4 5 6 7 Mycket hög

4. I vilken grad hade ni som grupp koll på läget under denna bana?

   Liten grad 1 2 3 4 5 6 7 Hög grad

5. Hur väl fungerade samarbetet under denna bana?

   Mycket dåligt 1 2 3 4 5 6 7 Mycket bra

6. Hur väl lyckades ni slutföra uppgifterna?

   Mycket dåligt 1 2 3 4 5 6 7 Mycket bra

7. Kommentarer:

2. Instructions

Försök - Information

Välkommen och tack för att du ställer upp! Mitt namn är Fredrik Höglund och följande studie som handlar om delad lägesförståelse är en del av min kandidatuppsats vid det kognitionsvetenskapliga programmet.

I dagens försök kommer du att få spela datorspelet Starcraft på två olika banor samt en övningsbana. Du kommer att samarbeta med den andra försökspersonen mot ett gemensamt mål och under varje bana kommer ni också att få svara på enkäter, två gånger under banan och en gång efter. Det går inte att pausa spelet under en bana så tänk på att ta eventuella toalettpauser och annat mellan banorna.

Viktigt att veta är att försöken är helt frivilliga och anonyma. All data som samlas in kommer att avpersonifieras så att ingen enskild individs svar kan spåras tillbaka till denne. Du kan när som helst välja att avbryta försöket. När försöket är genomfört kommer du att få en biobiljett som kan användas på någon av SFs biografer. Har du några frågor så tveka aldrig att ställa dessa till mig och får du frågor i efterhand kan du alltid ringa mig på 070-5796980 och ställa dem!

Starcraft – Instruktioner

Övningsbana

Du kommer nu att få spela en träningsbana för att testa de olika enheter du kommer att använda senare samt lära dig mer om fiendens enheter. Följ instruktionerna som ges på skärmen och fråga försöksledaren om något är oklart eller om du inte kommer vidare. En bra taktik är att fokusera alla dina enheter på en fiendeenhet åt gången för att döda enheterna så fort som möjligt. Du kan inte misslyckas med någon av banorna i det här försöket utan din prestation mäts istället i hur många egna enheter du förlorar, desto fler av dina enheter som dör, desto sämre presterar du. Efter träningsbanan är färdig kommer du att få fylla i den enkät som också används senare i försöken, detta för att förbereda dig på den typ av frågor som kommer att ställas.

Kontroller:
(Du kan använda det här papperet som lathund under försöken.)

För att markera en grupp enheter drar du en fyrkant kring dessa med musen. Maximalt 12 enheter kan markeras åt gången.

För att få de valda enheterna att gå högerklickar du på marken, du högerklickar på en fiende för att få dem att angripa fienden.

Om du vill skapa en grupp av enheter för att snabbt kunna markera dessa senare så trycker ctrl-# där # är en siffra mellan 1-9. För att senare välja dessa enheter igen behöver du bara trycka på den siffra som du angav när du skapade gruppen.

För att flytta kartbilden för du endast musen mot kanten av skärmen, alternativt använder piltangenterna. Du kan också klicka på minikartan i det nedre vänstra hörnet för att snabbt flytta kartbilden till detta område.

Tryck enter, skriv ett meddelande och tryck sedan enter igen för att skicka ett textmeddelande. Detta kommer att vara mycket användbart i de riktiga försöken.

Har du några frågor så fråga försöksledaren!

Rangordning

Du ska nu ta fram och prioritera de 5 aspekter/faktorer som var viktigast för att ni som grupp skulle lyckas i det senaste momentet. Detta kan vara saker som specifika delmål, specifika hot, specifika fiendeenheter att nedkämpa, egna enheter att skydda, specifik information som behövde kommuniceras till medspelaren eller information som behövde införskaffas. Försök att vara så specifik men ändå koncis som möjligt och tänk på att det endast är det senaste momentet som avses.

Tillvägagångssätt

1. Skriv ner 5 viktiga aspekter på de små papperslappar du har framför dig, skriv inga nummer på dessa.

2. Rangordna dessa 5 papperslappar på det ark som är numrerat 1-25. Den viktigaste aspekten placerar du högst upp och den minst viktiga längst ner. Lägg den viktigaste aspekten på 1, men ingen behöver ligga på 25. Det är avståndet mellan lapparna som markerar hur stor skillnad det är på hur viktiga de är i förhållande till varandra. Det är alltså ordning och avstånd mellan lapparna som är det viktiga.

3. När du är färdig kommer försöksledaren att registrera din rangordning samt låta dig prioritera medspelarens 5 aspekter på arket.

Starcraft – Instruktioner

I detta försök kommer du samarbeta med din medspelare för att uppnå tre mål. Efter att varje mål är uppnått kommer ni bli instruerade att slå av skärmarna och svara på några enkäter innan ni börjar med nästa mål. Varje gång ni förlorar en enhet kommer denna att återfödas, men varje egen förlust ger en negativ poäng. Platsen där trupperna återföds flyttas desto längre fram ni tar er på banan. Även tiden är viktig så försök att vara effektiva. Kommunikation är viktigt under alla tre delarna så håll utkik efter medspelarens chattmeddelanden. Målen är som följer:

1. Förflytta längs er egen rutt mot fiendebasen och undvik tills största mån förluster av egna enheter.
2. Anfall och förgör fiendebasen, inklusive alla enheter och byggnader.
3. Försvara området där fiendebasen fanns mot angrepp.

Mål 1:
I början av banan kommer ni via skärmen bli instruerade vilken som är er väg till fiendens bas. Trots att ni har en specifik rutt att följa är det inte förbjudet att hjälpa er medspelare att undvika förluster så kommunicera frekvent via spelets textmeddelanden. Bekämpa alla fiender utanför deras bas innan ni närmar er denna. Ni blir varnade av försöksledaren om ni kommer för nära fiendebasen i detta skede. Ni kommer att bli instruerade via ett textmeddelande på skärmen när det är dags att stänga av skärmen och svara på frågor.

Mål 2:
Det finns två ingångar till fiendebasen och ert mål är att attackera och inta er egen ingång, avancera genom fiendelägret och förstöra detta i en **jämn takt** med er medspelare. Målet är att komma fram till mitten av basen samtidigt, från varsin sida och hjälpas åt med den byggnad som finns där. Denna byggnad ser ni båda på era kartor redan från början. Även under denna fas gäller det alltså att kommunicera. Målet är avklarat när inga fiendeenheter eller byggnader finns kvar i basen, ni blir då instruerade att slå av era skärmar med ett textmeddelande på skärmen. Gå ej ut genom utgångarna bortom basen under denna fas.

Mål 3:
Under denna fas kommer området ni just anföll att stå under attack från fyra håll. Attackerna kan komma mot vilken som helst av de fyra ingångarna och det gäller att hindra fiendens enheter från att komma in i basen. Du ansvarar för de två ingångar som ligger på den sida som du anföll. Även om ni har huvudansvar för olika ingångar så är det inte förbjudet att hjälpa medspelaren när denne behöver hjälp, så använd textmeddelanden för att kommunicera även under denna fas. En smart idé är att från början dela upp dina enheter mellan dina två ingångar, säg sedan till försöksledaren så startar han momentet. När alla attacker är avvärjda visas ett meddelande om att ni vunnit banan, klicka inte på End Mission utan stäng genast av skärmen och svara på den kvarvarande enkäten.