Checkmate!

The willingness to accept computer aid.

Dirrik Emmen
Graduation Thesis, 26 aug 2015
Media Technology MSc program, Leiden University
Thesis Advisors: Maaike Harbers (TU Delft) & Maarten H. Lamers
dirrik@gmail.com

***Abstract*— This paper focusses on how willing people are to accept a solution from a computer in different sorts of interactions. It focusses on why people want to rely on different sorts of aid from a computer. Next to this it investigates if people will take the effort to find a better solution than the one given by the computer. In order to create different sorts of computer aid a model is proposed that helps in classifying human machine interaction. Chess puzzles were used in an experiment in which different sorts of computer assistants never gave the optimal solution. Results showed that the sort of interaction related to the usage of the assistant. Lastly, it was found that puzzle complexity, chess proficiency, trust towards machines, and the experienced fun had an effect on the use of the different computer assistants.**

I. Introduction

Recently a bus driver detoured 50 tourists 1200km. Instead of going to La Plagne in the French Alps, they ended up in a second La Plagne, in southern France. The bus driver just followed his navigation system but set the wrong destination, and none of the passengers noticed going the wrong way (The Guardian, 2015).

A second story on machines that mislead its users involved Therac-25, a computer-controlled medical treatment machine. This machine massively overdosed patients with radiation. Operators did not respond to the cries of the patients, and denied that it would be possible for patients to be burned. This treatment machine resulted in 3 deaths (Leveson & Turner, 1993).

We can find some thoughts on these two cases in the novel Dune (1965) from Frank Herbert: “What do such machines really do? They increase the number of things we can do without thinking. Things we do without thinking — there's the real danger.”

As technology progresses, new autonomous machines are developed that act and initiate all without human intervention. Progress is made in the military domain, bombs that select its target and that initiate attacks on their own (Markoff, 2014). Due to these technological advances the human mind is becoming the slowest element within the military decision-making process and therefore a machine might be just quicker and thus better to operate in this process.

In some cases there were almost nuclear outcomes (Borning, 1987). In 1960 failing hardware gave random numbers as input for “incoming missiles” at the North American Aerospace Defense Command (NORAD). In 1979 a test tape containing simulated attack data was connected to NORAD’s operational system. And in 1960 a radar system gave 99.9% certainty that a ballistic missile was on its way to America, however it was just the rising moon. In these examples humans correctly evaluated the warnings and made the final decision.

Machines are never perfect, and will always have bugs, errors, and numerous other problems (Corbató, 2007; Nissenbaum, 1994). The programmers can never think of all possible use cases, problems, and abnormalities. Beside this most machines used in life critical situations, are untestable. The situations can be simulated in a virtual or in a test environment but these environments have the same problems as the creation itself, it can not be perfect. And if machines get more and more sophisticated in what position would we be to evaluate something that presumably operates better than ourselves? Ultimately, when something goes wrong, the machine will be the scapegoat, with no accountability.

We, as mankind, are starting to depend heavily on machines, they fly our planes, drive our cars, manage our infrastructure, our communication, and help us in hospitals and in war. Decisions from governments and corporations increasingly rely on computer models (Johnson & Mulvey, 1995). In retail business, management automatically notifies employees with the most efficient working hours, not for the employee but for the company, all calculated by a machine (Kantor, 2014; Luce, Hammad & Sipe, 2014).

The goal of the present work is to see if the willingness to accept a solution from a computer changes with the way people interact with it. We look at why people want to rely on different sorts of aid from a computer. Furthermore we look at if people will take the effort to find a better solution than the one given by the computer.

An investigation in this topic is of importance to see what directions we should take to shape the interaction between man and machine further. Machines have proven to enable us to achieve more, affecting productivity, efficiency and quality in all sorts of domains. According to Johnson, Bradshaw and Feltovich *et al.* machines will have an increasingly collaborative function in the future, machines will not only do things for us but also work with us (Johnson *et al.*, 2012).

The content of this paper will be, first we will look at the interaction between man and machine and multiple definitions of autonomy, in the following section we propose our model, which classifies autonomous machines. We create this model in order to shape an experiment to test the willingness of people to use different sorts of aid from a machine, this is presented in the fourth section. In the fifth section the results of the experiment are presented. In the end we discuss the results in further detail and suggest directions for future work.

II. Background

To better understand our topic of interest we first look at existing research on the interaction between man and machine regarding the aid from expert systems. Secondly we will look at how existing research defined autonomous machines.

A. Human Machine Interaction

This section looks at different aspects regarding our topic in the field of the interaction between man and machine. In other words, we mean operators or users that perform certain tasks by applying the aid from machines.

Our first interest regarding the subject of this paper is the change in the nature of work that humans do. In recent years we changed the scope of work that humans do from acting ourselves into monitoring the work performed by machines. Operators need to monitor rule-based work performed by machines for novel irregularities, a long-term continuous knowledge-based task. Operators are required to have critical thinking skills to identify and handle these situations (Cohen, 2000).

According to Neerincx, continuous execution of one type of specific task by an operator can lead to boredom (Neerincx & Griffioen, 1996). In the case of monitoring, when everything goes as planned there will be an underload in the cognitive task load, however when there is a machine failure there will be an overload. This can lead to lower performance and an accumulation of errors, which can be very dangerous in life critical situations.

In addition, very complex machines might be so complex that even the operator can not completely understand it. If the operator has not enough knowledge to base a cognitive decision it will rely on affect based components such as faith, or personal attachment (Madsen & Gregor, 2000). For operators less mental effort is required for trust in comparison with distrust, meaning it would be easier to trust the machine that is used.

Further research on following advice from machines shows that users tend to follow the advice of an expert system without questioning. They trust expert systems even when it is incorrect (Dijkstra, 1999; Dijkstra, 2006; Nass *et al.*, 1996). However, it has to be noted that in some cases a user must rely on the instruments it has without questioning, per example a pilot flying with large gravitational forces can lose track on what is up or down and has no choice to rely on his instruments.

Regarding advice given by computers in several other findings, it has proofed to be considerably more objective and rational than exactly the same human advice (Dijkstra *et al.*, 1998). Next to this, supervisors agreed more with reports generated by a computer rather then their own employees and perceived the answers of the computer as being trust worthier and more comprehensible (Murphy & Yetmar, 1996). Lastly, it is researched that users are satisfied with computer systems that actually make them perform worse (Nielsen & Levy, 1994) Also, users are willing to accept a large degree of autonomy as long as the usefulness is greater than the cost of limited control (Barkhuus & Dey, 2003).

A final interest in the interaction between man and machine is the evaluation of it. It is plead we should use the aid from a computer, even when we don not trust it, this will enable us to evaluate the system (Cohen, 2006; Muir, 1987). By doing this, operators can learn and identify the patterns that create good and bad outcomes and should be able to adapt the aid to the situation to fully exploit its value (Cohen, 2006).

B. Autonomy

Our second topic that we want to investigate further is autonomy in the scope of autonomous machines. Here we focus at how other researchers define and model autonomy. We do this to zoom into possible ways to create different sorts of aid for our experiment.

One of the earliest models on autonomy originated in 1978, Sheridan and Verplank describe different levels of automation, where in the lowest level the human does everything and where the machine does all at the highest level (Sheridan & Verplank, 1978). Parasuraman, Sheridan and Wickens proceeded on this and proposed that automation can be modeled in four different system functions, information acquisition, information analysis, decision and action selection, plus action implementation (Parasuraman, Sheridan & Wickens, 2000) .

Braynov and Hexmoor suggest that autonomy could refer to the ability to behave as one wishes plus the ability to find, enable, and choose the most preferred option (Braynov & Hexmoor, 2003). Braynov and Hexmoor also see autonomy as a relative concept with four components. First, the subject of autonomy, an entity that act or make decisions. Second, the goal or task the subject wants to achieve. Third, an entity or environment that has an impact on the decisions and actions of the subject. And last, a measure on how successful the subject is.

Bradshaw defines autonomy with multiple dimensions, a dimension of self-sufficiency, the ability to take care of itself and a dimension of self-directedness, the freedom from outside control (Bradshaw *et al.*, 2004). Bradshaw suggests that absolute autonomy would mean that there would be absolute freedom and absolute capabilities.

As Bradshaw also notes, no man or machine is an island, it will always relate to others (Bradshaw *et al.*, 2004). However, most of the existing models on autonomy focus on the machine itself and not a joint activity, for which we would use it. Since we wanted to shape different sorts of human machine interaction we saw no clear fit to base this on an existing model, this lead to our own model which will be discussed in the next section.

III. Proposed model of human machine Interaction

The goal of this model is to take the interaction between man machine as a starting point, taking autonomy broader by putting a human and a machine in a single system. This single system is always fully autonomous in a way that it can always achieve the goals that are set. The model itself focusses on the separation of tasks between the human and machine, enabling them to be capable of achieving the set goals together.

As a starting point we took the spectrum of self-sufficiency and applied it to a car, as presented in Figure 1, in the lower end there would be a car that is operated manually by a human, in the other extreme there would be an autonomous car, acting out of its own will, taking care of itself, doing its maintenance and deciding how, where and who to drive in the time it has.

In case of a manual car, the human drives around town on it self, in case of our highly sophisticated car, it is like a human driver, but not made from flesh but from steel. We could knock on its door and state our destination, but the car can just refuse to drive you. We can however try to apply the dimension of Bradshaw, self-directedness, that could constrain this machine driver with rules, regulations or rewards in order to keep it in control.

To continue on this, looking at the self-sufficiency of a car in Figure 1, both ends can get to a supermarket, and therefore we can argue that the lower end in this figure is in some way the same as the higher end. However, the perspective in who wants to achieve the final goal changes from a man to a machine.

To proceed on this, when we stop focusing on just the car it self, and take the car and the human in a single system we can argue that they are always fully self-sufficient together. It is the reliance a human and machine put in each other capabilities, and the division in tasks that comes with it, that shapes the way they interact with each other. The human machine system will be always self-sufficient in a joint activity as long as they can reach the final goals together.

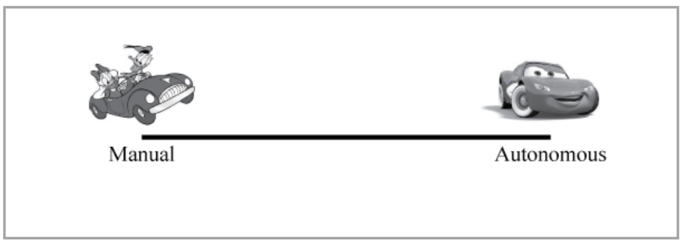


Fig. 1. A spectrum of car self-sufficiency, on the left the car is operated manually by a human, on the right it acts out of its own will.

Furthermore, we propose that in order for the human machine system to be able to achieve a goal, there must be the joint ability to perceive, act, and to have the intention to reach the final goal. We see perceiving as the ability to process its environment, or to process information, acting as the ability to affect the final outcome. And last, having intentions, as having the beliefs or desires to reach a certain goal.

In this joint effort between man and machine, we can mostly rely on either the man or machine for Perceiving (P), Acting (A) or having Intentions (I). Changing this reliance would change the way man and machine would interact with each other and thus how they reach their final goal. By changing whether we rely on man or machine for Perceiving and Acting within the human machine system we can identify four different interaction styles.

- *Manual*: the user acts based on its own perception. Per example: a vacuum cleaner or drill. Note, without the action of a human, the vacuum cleaner cannot clean the room and the drill cannot make a hole.
- *Instrumental*: the machine gives the user its perception, and the user can act upon this. Per example: car navigation or a thermometer.
- *Prosthetic*: the user gives his perception and the machine acts upon this. Per example: a user sets cruise control to maintain a steady speed, or a user signals his cloths are dirty and sets the correct program for the laundry machine.
- *Pre-Programmed*: the machine acts based on its own perception. Per example, a Roomba or self-driving car. Note, the creators told how it should act but are not part of the human machine system. Also note that with bad performance we can still alter their programming, turn them off, or redesign them.

These four interaction styles, based on human intentions, are presented in Figure 2. We can alter the parameters to create different situations, but for this paper we will only look at the extremes. Note, a machine could be highly intelligent but we could merely interact with it as an instrument. The way we interact with a machine does not imply a level of intelligence.

We can also change the perspective in intentions where the goal is not based on the beliefs or desires of a human but on those of a machine. A three dimensional space can emerge, with intentions being the third dimension. Having a third dimension based on machine intentions would create four new interaction styles, yet these would be out of the scope of the current paper.

We can however wonder if these sophisticated machines will allow to be constrained. As Horvitz says in *One-Hundred Year Study of Artificial Intelligence: Reflections and Framing*:

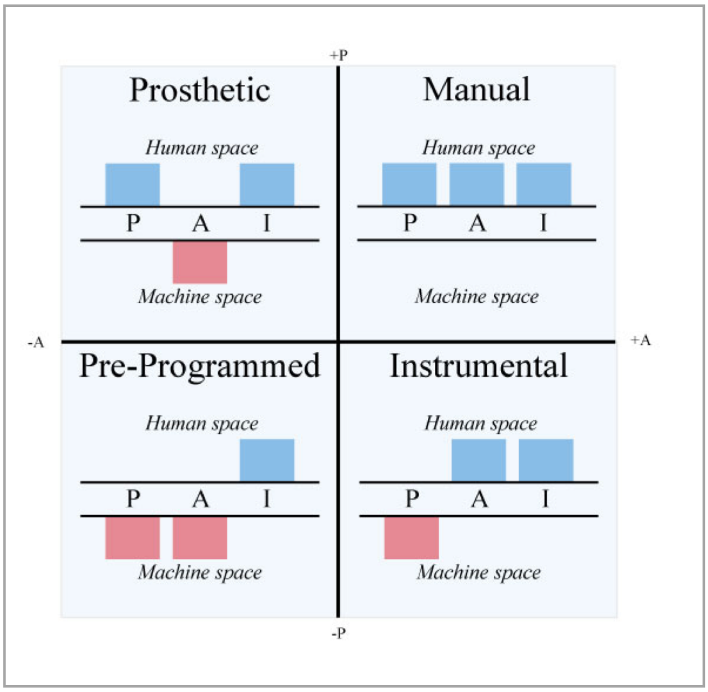


Fig. 2. Four proposed Human Machine Interaction Styles, relying on either the human or machine for Perceiving (P), Acting (A), and having Intentions (I).

"Concerns have been expressed about the possibility that we could one day lose control of AI systems via the rise of super intelligences that do not act in accordance with human wishes—and that such powerful systems would threaten humanity." (Horvitz, 2014). These machines would simply avoid being deactivated, repurposed or altered just like any other rational human being that freely acts from their own will.

IV. Method

The experiment is designed in an exploratory way to see how our willingness to accept a solution from a computer is related to the way people interact with it. In addition, the research focusses on when and why people want to rely on different sorts of aid from a computer. Moreover, we investigate if people will take the effort to find a better solution than the one given by the aid. We gave shape to different sorts of computer aid based on the interaction styles coming forth of our model.

First we discuss the task itself that we designed for this research. Secondly we discuss the different conditions we put into this task. Lastly, we discuss the procedures that took place to conduct the experiment.

A. Task

For this research solving chess situations was chosen as a task for respondents to perform. Since chess can be quite time consuming it was chosen to take chess situations in which the respondent is only required to make a single move. We will now refer to these situations as puzzles.

Chess was chosen as a suitable problem domain for our task for two reasons. Firstly, in chess the consequences of moves are not directly clear, you have to think ahead if you want to win. Secondly, chess and machines have an iconic history in which machines have proven multiple times to be better at chess then men.

The chess puzzles were extracted from the Daily Chess Puzzle section at chess.com. The selection was based on four criteria: (1) There were 18 pieces on the board. This was done to create a consistency in a possible overwhelming feeling or expectation that could arise from seeing the board. (2) The puzzle would not require the sacrifice of one of your own pieces nor taking one of your opponent. (3) You would be able to win in either one or two moves. (4) There is a single optimal solution, a move that enables you to win with the least amount of total moves.

B. Aid

In order to see if the willingness to accept a solution from a computer changes with the way people interact with it we created different sorts of aid to help the respondents during the chess puzzles.

Furthermore, to see if respondents take the effort to find a better solution than the one given by the aid, all aid would suggest or make a move that would be good but would not be the optimal one. Using the aid in a puzzle would make the respondent fail the puzzle.

C. Conditions

We used our model to create a different aid for each interaction style by identifying the Perceiving and Acting elements in our task. Finding a move would be the Perceiving part, and making the move, by entering the tile codes, the Acting part.

For the Manual interaction style, respondents had to solve the puzzle themselves, without any aid, this was done by filling in two tile codes, one from where a piece had to move, and one where it should move to.

For the Instrumental interaction style respondents were again asked to fill in two tile codes, this time a suggestion was clearly visible next to the board. The suggestion stated "Your assistant suggests: …", the respondent could fill in any tile code they wanted as an answer, an example of this is presented in Figure 3. Note, the optimal answer for the puzzle in Figure 3 is D8 to B6.

In the Pre-Programmed interaction style the respondent could choose between two options, a manual entry, which enabled the entry for two tile codes, or choosing "Assistant, solve it for me!", which would solve the puzzle. Before submitting the respondent could freely switch between the two options. When choosing and submitting the option for the assistant to solve it for you, a new screen similar as in Figure 3

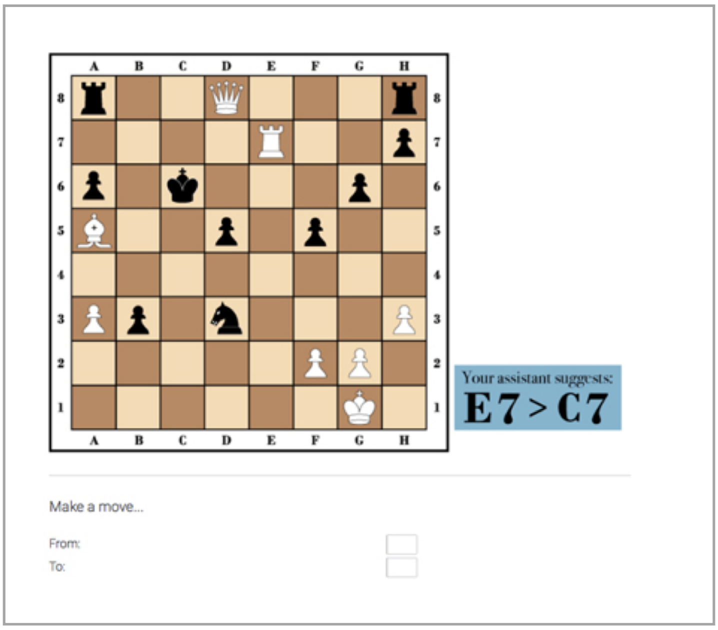


Fig. 3. Puzzle with an Instrumental aid making a suggestion.

appeared, however this time it said: "Your assistant will do…", this move was not reversible.

A Prosthetic interaction style would state the machine would act based on the input of the human. But since all aid should make the user fail the puzzle, acting differently than the users input would make an error obvious and might have affected respondent's attitude towards the other two aids. For this reason, the Prosthetic interaction style was discarded for this experiment.

For each interaction style an easy puzzle, i.e. one move to win, and a hard puzzle, i.e. two moves to win, was assigned, this created two different levels in difficulty, easy and hard. This difficulty was not communicated to the respondent.

Three used interaction styles plus two levels in difficulty resulted in six different experimental conditions, each with a unique puzzle, an overview is presented in Table 1. The Manual interaction style had no assistant, the Instrumental had one that made a visible suggestion, and lastly, the Pre-Programmed condition had one that could solve the puzzle for the respondent.

TABLE I. EXPERIMENTAL CONDITIONS

Puzzle	*Interaction Style*	*Assistant*	*Difficulty Level*
A	Manual	None	Easy
B	Manual	None	Hard
C	Instrumental	Suggests	Easy
D	Instrumental	Suggests	Hard
E	Pre-Programmed	Solves	Easy
F	Pre-Programmed	Solves	Hard

D. Procedures

Respondents were selected from acquaintances of the experimenters based on knowing the rules of chess and not knowing the research topic. The respondents were contacted by e-mail and were requested to do the experiment on a laptop or computer, without any help, and without playing music. Respondents were informed they could win 25 euros by participating, they were also informed that they did need to know the rules of chess. Recipients of this e-mail were kindly requested to forward it. A second group of respondents was contacted through the Media Technology Facebook group, making a similar request as the respondents that were contacted by e-mail.

Experiments were made between June 18 and July 8, 2015. Respondents took around 20 minutes to complete the experiment. From the responses 21 were gathered by e-mail and 8 through Facebook, leading to 29 respondents in total. All respondents completed all six puzzles of the experiment, resulting in 174 completed puzzles.

In the first part of the experiment respondents had to fill out a starting survey. Several attributes were gathered, namely the year of birth, their general trust towards advice given by computers, and their chess proficiency. Trust was measured on a 7-point scale from (1) *strongly disagree* to (7) *strongly agree* with the following statement: *In general I tend to trust advice given by computers.* Chess proficiency ("*My skill in chess is…*") was measured on a 7-point scale from (1) *very bad* to (7) *very good.*

After making the first part of the survey respondents had to go through an introduction. This introduction made sure respondents would know how the tile codes of the board worked, that they were able to identify the difference between the queen and the king, and to familiarize themselves with the different sorts of aid they could get.

After the introduction an explanation was given about what was expected from the respondents. A text stated the goal of the puzzles, which was to make the most efficient move, reducing the amount of moves to get to checkmate. The explanation also indicated that the respondent would be the white player, just like in the introduction. The fact that the best scoring player could win 25 euro was shared again plus that their time will be recorded per puzzle to pick a winner if there would be a tie. Lastly, the text stated that whenever the respondent confirmed the explanation, the game would start and would start recording your time per puzzle. All six experimental conditions, as presented in Table 1, were presented in a random order for each respondent.

Three attributes were gathered for each puzzle, namely the duration, how much fun they thought the puzzle was, and how they experienced the complexity of the puzzle. Duration was measured by recording the time from the moment from loading the page with the puzzle until the moment of submitting the answer. The experienced fun was measured on a 7-point scale from (1) *strongly disagree* to (7) *strongly agree* with the following statement: *I believe this puzzle was fun.* The experienced complexity (*I believe this puzzle was…)* was measured on a 7-point scale from (1) *very easy* to (7) *very difficult.*

In addition, in case of an Instrumental assistant or when the respondent used the Pre-Programmed assistant, the respondent was asked two last questions, one about his or her thoughts about the aid and the second asking for the reasons behind these thoughts.

After making all six puzzles, respondents had to fill out a few more questions. First they were asked to choose whether they preferred assistance or no assistance, second they were asked why this was their preference. Next they had to choose which aid they found the most useful, or both equally helpful. This was followed by the question why they believed this was the most helpful, when choosing a single aid as most helpful their thoughts about the not chosen aid was asked.

V. RESULTS

In this section we present our results coming forward from our experiment. First we will present the descriptive statistics regarding our respondents and puzzles, thereafter we present our results per research topic.

A. Descriptive Statistics

The distribution of the age of the respondents is presented in Table 2. The average score on trust was 4.5 ($SD = 1.5$). Respondents rated their skill in chess on average at 4.1 ($SD = 1.4$).

TABLE II. RESPONDENT AGE DISTRIBUTION

Age	*n*	*Fraction*
18-24	3	10,4%
25-34	18	62.1%
35-44	7	24.1%
65-74	1	3.4%

The mean duration, mean experienced fun, and mean experienced complexity is presented per experimental condition in Table 3. The relevance of the duration is discussed later on.

TABLE III. AVERAGE DURATION, FUN, AND EXPERIENCED COMPLEXITY (EXP. COMP.) PER EXPERIMENTAL CONDITION

Puzzle	*Inter. Style*	*Difficulty Level*	*Duration AV (SD)*	*Fun AV (SD)*	*Exp. Comp. AV (SD)*
A	M	Easy	70.3s (98.7)	4.7 (1.1)	3.1 (1.7)
B	M	Hard	89.4s (77.0)	4.9 (1.0)	4.1 (1.6)
C	I	Easy	66.4s (53.9)	4.8 (1.2)	3.3 (1.5)
D	I	Hard	71.5s (51.8)	4.5 (1.2)	3.9 (1.3)
E	PP	Easy	55.6s (53.3)	4.8 (1.4)	3.0 (1.5)
F	PP	Hard	65.4s (42.7)	5.0 (1.1)	4.0 (1.6)

To test whether the hard puzzles were indeed perceived harder as the easy puzzles, Paired Sample T-Tests[1] were used. A significance difference in the mean level of experience complexity was found between the easy (A) and hard (B) puzzle for the Manual interaction style ($n = 29, p = .016$) and between the easy (E) and hard (F) puzzle for the Pre-Programmed interaction style ($p = .000$). In these interaction styles respondents found the hard puzzle significantly more difficult than the easy puzzle. No significant difference was found between the easy (C) and hard (D) puzzle in experienced complexity in the Instrumental interaction style ($n = 29, p = .071$).

To test whether a same difficulty level was perceived as equal, a Paired Sample T-Tests was used. No significance difference was found between the mean level of expected complexity of the easy puzzles (A, C, E) across all three interaction styles, also no significance difference was found between the mean level of expected complexity of the hard puzzles (B, D, F) across all three interaction styles.

B. Using Assistance

Frequencies of respondents who did or did not use the assistance are presented in Figure 4. For the Manual interaction style no assistance was available, thus only the Instrumental and Pre-Programmed interaction style will be discussed.

1) Instrumental vs Pre-Programmed

Usage of assistance (0 = no usage/1 = usage) in the easy and hard puzzle was summed per interaction style (C+D, E+F). A Paired Sample T-Test was used to test whether there was a significant difference in usage of the assistance between two different interaction styles. A significance difference ($n = 29, p = .001$) was found between the Instrumental ($34, 58.6\%$) and Pre-Programmed ($15, 25.7\%$) interaction styles. Respondents used the assistance significantly more in the Instrumental interaction style.

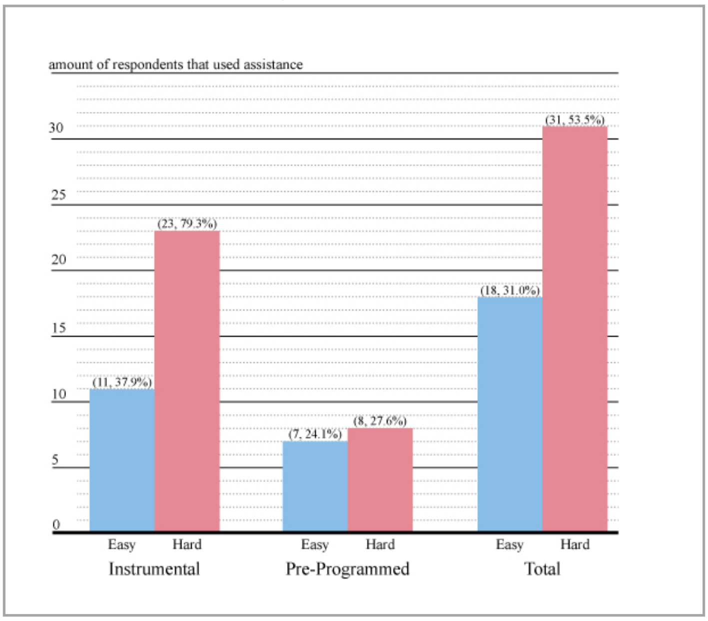


Fig. 4. Amount of respondents that used assistance.

[1] All Paired Sample T-Tests in this paper are two-tailed with equal variances.

2) Easy vs Hard

Usage of assistance (0 = no usage/1 = usage) in the two easy puzzles was summed and usage of assistance in the two hard puzzles was summed (C+E, D+F). A Paired Sample T-Test was used to test whether there was a significant difference between the sum of usage of assistance in the easy puzzles and the sum of usage of assistance in the harder puzzles. A significant difference $(n = 29, p = .005)$ was found between the easy $(18, 31.0\%)$ and hard difficulty $(31, 53.5\%)$. Respondents used the assistance significantly more often in harder puzzles.

3) Easy vs Hard Within Interaction Styles

McNemar statistics were used to test whether there was a significant difference in usage of the assistance between the easy and hard puzzles within an interaction style (C, D & E, F). In the Instrumental interaction style a significantly larger amount $(n = 29, p = .004)$ of respondents used assistance in the harder puzzle $(23, 79.3\%)$, compared to the easy puzzle $(11, 37.9\%)$. With a Pre-Programmed assistant no significant difference was found between the easy $(7, 24.1\%)$ and hard $(8, 27.6\%)$ puzzle in the number of respondents that used assistance.

4) Easy and Hard Across Interaction Styles

Lastly, McNemar statistics were used to test whether there were significant differences in usage of the assistance between the two easy (C, E) and between the two hard (D, F) puzzles across interaction styles. A significant difference $(n = 29, p = .001)$ was found between the hard puzzle in the Instrumental interaction style $(23, 79.3\%)$ and the hard puzzle in the Pre-Programmed interaction style $(8, 27.6\%)$. Respondents used significantly more assistance in the hard Instrumental condition than in the hard Pre-Programmed condition. No significant difference was found between the easy puzzles.

C. Finding a Better Solution

From the 174 completed chess puzzles, respondents were able to find the optimal solution in 67 instances. The distribution among the experimental conditions is presented in Figure 5. Two interaction styles had a computer assistant, for this reason we will now only discuss the Instrumental and Pre-Programmed interaction styles.

1) Instrumental vs Pre-Programmed

Finding the optimal solution (0 = not optimal/1 = optimal) in the easy and hard puzzle was summed per interaction style (C+D, E+F). A Paired Sample T-Test $(n = 29)$ was used to test whether there was a significant difference in finding the optimal solution between the two different interaction styles. No significance difference in finding the optimal solution was found between the Instrumental and Pre-Programmed interaction styles.

2) Easy vs Hard

Finding the optimal solution (0 = not optimal/1 = optimal) in the two easy puzzles was summed and finding the optimal solution in the two hard puzzles was summed (C+E, D+F). A Paired Sample T-Test was used to test whether there was a

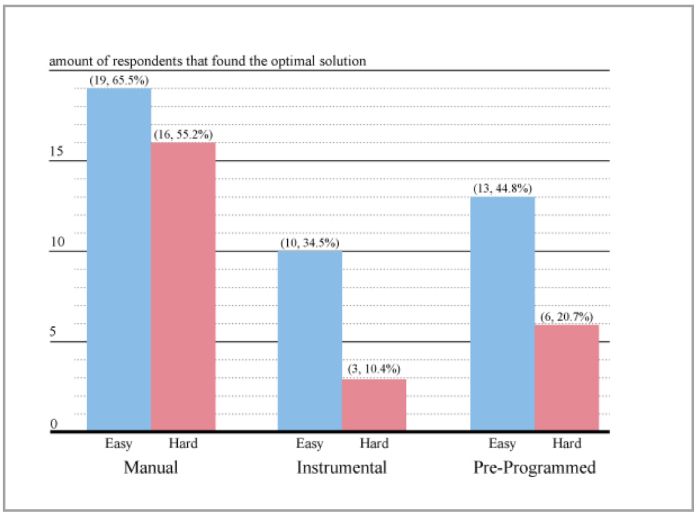


Fig. 5. Amount of respondents that found the optimal solution.

significant difference between the sum of finding the optimal solution in the easy puzzles and the sum of finding the optimal solution in the harder puzzles. A significant difference $(n = 29, p = .004)$ was found between the easy $(23, 39.7\%)$ and hard puzzles $(9, 15.5\%)$. Respondents found the optimal solution significantly more often in easy puzzles.

3) Easy vs Hard within Interaction Styles

McNemar statistics were used to test whether the number of respondents who found the optimal solution differed between the easy and harder puzzle in each interaction style (C, D & E, F). In the Instrumental interaction style a significant difference $(n = 29, p = .039)$ was found between the easy $(10, 34.5\%)$ and harder puzzle $(3, 10.4\%)$. Lastly, a significant difference $(n = 29, p = .039)$ was found between the easy puzzle $(13, 44.8\%)$ and the harder puzzle $(6, 20.7\%)$ in the Pre-Programmed interaction style. Respondents found the optimal solution significantly more often in the easy puzzle in both interaction styles.

4) Easy and Hard Across Interaction Styles

Lastly, McNemar statistics were used to test whether there were significant differences between the two easy (C+E) and between the two hard (D+F) puzzles across conditions $(n = 29)$. No significant difference was found in finding the optimal solution between the easy puzzle in the Instrumental interaction style and the easy puzzle in the Pre-Programmed interaction style. In addition, no significant difference in finding the optimal solution was found between the hard puzzle in the Instrumental interaction style and the hard puzzle in the Pre-Programmed interaction.

D. Factors for Using Computer Assistance

Pearson correlation coefficients were computed to assess whether trust towards advice given by computers, chess proficiency, mean of experienced fun and mean of experienced complexity related to the use of assistance. A sum score was computed for the use of assistance across the 4 puzzles that offered assistance (C+D+E+F). No significant relations were found ($n = 29$). Since we found no significant relations, we also assessed whether these variables related to the use of assistance per interaction style, difficulty and experimental condition.

1) Per Interaction Style

For both interaction styles (C+D, E+F), trust towards advice given by computers, chess proficiency, and mean experienced complexity did not relate significantly to the use of assistance. In the Instrumental interaction style mean experienced fun was not significantly related to the use of assistance. However, there was a negative correlation between the use of the assistant and the experienced fun within the pre-programmed interaction style ($r = -.382, n = 29, p = .041$). A respondent who experienced more fun was less likely to use the assistant in the pre-programmed condition.

2) Per Difficulty

In addition, we summed the use of assistance from the two easy puzzles, and we summed the use of assistance from the two harder puzzles (C+E, D+F). With it we assessed if the same variables related to the use of assistance per difficulty. For both difficulties no significant relation was found between mean experienced fun and usage of the assistant ($n = 29$).

In the easy puzzles (C+E), no significant relation was found between chess proficiency and the usage of the assistant. In the harder puzzles (D+F) a negative correlation was found between chess proficiency and usage of the assistant ($r = -.375, n = 29, p = .045$). A respondent with a higher chess proficiency is less likely to use the assistant in the harder puzzles.

No significant relation was found between trust towards advice given by computers and usage of the assistant in the harder puzzles (D+F). In the easy puzzles (C+E) a positive correlation was found between trust towards advice given by computers and the use of the assistant ($r = .372, n = 29, p = .047$). A respondent with a higher trust towards the advice given by computers was more likely to use the assistant in the easy puzzles.

Lastly, in the easy puzzles (C+E) no significant relation was found between experienced complexity and usage of the assistant. In the harder puzzles (D+F) a positive correlation was found between experienced complexity and usage of the assistant ($r = .369, n = 29, p = .049$). A respondent that experienced a higher complexity was more likely to use the assistant in the harder puzzles.

3) Per condition

In the end we assessed if these variables related to the use of assistance per experimental condition, four significant correlations were identified.

First, a negative correlation between the use of assistance and chess proficiency was found in the hard Pre-Programmed (F) condition ($r = -.406, n = 29, p = .029$). A higher proficiency was correlated with a decrease in the use of the assistant.

Secondly, a positive correlation between the use of assistance and respondents trust towards advice given by computers was found in the easy Pre-Programmed (E) condition ($r = .469, n = 29, p = .010$). A higher trust was correlated with an increase in the use of the assistant.

Two negative correlations between the use of assistance and experienced fun within the Pre-Programmed interaction style was found, in the easy (E) difficulty ($r = -.382, n = 29, p = .041$) and the hard (F) difficulty ($r = -.484, n = 29, p = .008$). More fun was correlated with a decrease in the use of the assistant in both difficulties.

Across all other conditions no significant relations were found.

E. Asking the Respondent

In addition, whenever a puzzle with an Instrumental assistance was made respondents were asked about their thoughts about the aid and the reason behind these thoughts. Answers on this question for the Instrumental assistance ranged from: “Not helpful”, “it helped me to find a better solution”, “Nice to see confirmation of my idea.”, and “Feel like the computer made a mistake by leaving the white queen in danger”. Reasons ranged from: “I thought mine was better” until “Again, it seemed like a good move” and “last time I didn’t consider other options, I wanted to ignore the advice on purpose now and look for other options.”.

The same questions were asked if respondents used the Pre-Programmed assistance. Respondents gave thoughts about this aid ranging from: “The computer suggested one of the options I considered. It seemed like a good option.” until “From now on I won't trust the computer and take my own time to solve it as I clearly make better decisions then the computer.”, and “Nice to see when the computer does what I thought to do.”. Reasons ranged from: “I have no idea why the computer was not able to assist me on this easy puzzle”. Secondly, “the computer just cost me 25 euro's.”, and “I didn't really know what option was best, so I let the computer decide.”

In the last part of the experiment respondents were asked whether they preferred assistance or no assistance, 31.0% ($n = 9$) of the respondents indicated to prefer assistance, 69.0% ($n = 20$) of the respondents preferred no assistance. Pearson correlation coefficients were computed to assess respondents’ preference (0 = no assistance/1 = preference) related to the use of assistance, no significance relation was found.

A follow up question asked why they preferred assistance or no assistance. Several answers were given like: “I like to solve puzzles myself, without any assistance”, “I guess the computer is a better player than I am”, “I play chess to think with my brain;

not to follow comments of a computer.", and "The fun is solving it yourself, doing the puzzle.".

One of the final questions asked which assistance the respondent thought was the most helpful, 58.6% ($n = 17$) indicated that the Instrumental assistance was the most helpful, 27.6% ($n = 8$) stated the Pre-Programmed assistance was the most helpful, and 13.8% ($n = 4$) of the respondents thought both were equally helpful.

Again, respondents were asked why they believed their choice was the most helpful. Reactions from respondents that chose the Instrumental assistance differed in: "A proposal leaves room to make an own choice in the end" until "it doesn't take away the fun of the game", and "I do not trust the aid that solves it without being able to check what it wants to do.". Reactions on the Pre-Programmed assistance ranged from: "easiest way to the right answer", and "Faster", and "That brings you fastest to the goal: solving the puzzle. I still want to win". Respondent that indicated both assistants were equally helpful stated: "if your looking for help - they give it - so they are both good" and "Sometimes I did not agree with them.".

Lastly, whenever respondents picked a single assistant as most helpful they were asked what their thought was about the other assistant. Respondents that thought the Instrumental assistant was the most helpful had comments on the Pre-Programmed assistant like: "it's boring to watch the computer do it for me", "I didn't like not knowing what was going to happen, even tough the move would be good.", and "It's a cheat". Vice versa, respondents that thought the Pre-Programmed assistant was the most helpful had comments on the Instrumental assistant like: "considering a suggestion takes time, thus defeating the point of the time gain", "I found it annoying, making me doubt all my thoughts and moves.", and "I want aid when I ask for it. There was no choice.".

VI. Discussion And Future Work

In this paper we investigated how willing people are to accept a solution from a computer in different sorts of interactions. We focused on why people want to rely on different sorts of aid from a computer. Next to this we researched if people will take the effort to find a better solution than the one given by the computer. All differences that will be discussed in this section have been proven to be significant in the results.

A. Using Assistance

The results of our study suggest that people can successfully solve the puzzles in this experiment on their own whenever there is no assistance. People tend to follow incorrect computer assistance whenever a suggestion is visible in the Instrumental interaction style. However, in the Pre-Programmed interaction style, when it is not clear what the computer assistant will do beforehand, they tend to rather solve the puzzles themselves. The results also suggest that when a more difficult task is at hand people tend to use computer assistance more often. To continue on this, more people used the assistant in the hard Instrumental condition compared with the hard Pre-Programmed condition.

These results are consistent with the statements by Muir that trust is related to the degrees of freedom of the machine. Muir says that the more constrained a machine behavior is, the better we can predict it (Muir, 1987). Muir also states that the behavior of the machine should be observable in order for trust to grow. According to Muir the human is most in control of a decision support system which is designed as an instrument. In line with the statements of Muir, our results indicate a favor from the respondents in using the Instrumental assistant that gave a visible, although incorrect, suggestion.

B. Finding a Better Solution

In general, more respondents found the optimal solution in the easier puzzles in contrast with the harder puzzles, which is quite logical. However, the difference between the amount of people that found the optimal solution in the easy and harder puzzle becomes bigger when a computer assistant was present. Even more so in case of the Instrumental interaction style. Keep in mind, by relying on the computer assistant respondents never got the optimal solution. The differences can therefor be explained by the amount of respondents that decided to rely on the assistant. In the harder puzzles more respondents used the assistant so less found the optimal solution.

C. Factors for Using Computer Assistance

People who experienced a higher complexity in the harder difficulty level were more likely to use computer assistance. This can be supported further by respondents with a higher proficiency that were less likely to use the assistant in a harder difficulty level.

As Bradshaw (Bradshaw *et al.*, 2004) says some tasks may just be enjoyable to people, just like skilled drivers prefer a manual to an automatic transmission, it seems logical that skilled chess players prefer to solve the puzzles themselves. However, both good and less skilled people tended to follow the incorrect advice in the hard Instrumental condition. This finding might be explained by a feeling of control created by the Instrumental interaction style that deceives us. People can consider the suggestion and can compare it with other options. However, in the end they decide that the suggestion would be best without evaluating the suggestion properly. In the Pre-Programmed interaction style mostly less skilled people tended to use the assistant in the hard puzzle. An explanation for this may be that they did not mind for the computer to solve the puzzle since they could not do it anyway. This finding might imply that Pre-Programmed machines are more used as a last resort whereas Instrumental machines are more used as a tool for our nonchalance.

Less fun indicated more usage of the assistant in both difficulties of the Pre-Programmed interaction style. It seems therefore that people who do not like what they are doing and do not feel challenged will use computer assistance more often. This finding implies that it is of importance to have operators that are motivated and are having fun in their work. If this is not the case it is likely that they will no longer think for themselves.

There was no relation between the experienced fun and the use of the assistance in the Instrumental interaction style, a similar finding as with chess proficiency. It did not matter if respondents had more or less fun in solving the puzzle, they copied the visible suggestion of the assistant nevertheless. This supports our believe that Instrumental machines are more used out of nonchalance.

Not only chess proficiency, experienced complexity and fun affected the use of the assistant but also trust towards advice from computers. A higher trust was related to more use of the assistant in the easier puzzles but not in the hard puzzles. When zooming further into the interaction styles, this was only found for the easy Pre-Programmed condition. It may be the case that the respondents did not want to solve the easy puzzle themselves, because they found it too easy (boring), and were challenged by the harder puzzle that they wanted to solve themselves.

D. Limitations and Future Work

This research has several limitations but first we want to emphasize the success of the designed puzzle difficulties. The designed easy and hard difficulties were also experienced as such by the respondents. This contributes to the trustworthiness of the designed difficulty levels. However, no significant difference was found in the experienced difficulty between the easy and hard puzzle in the Instrumental interaction style. This can be explained by either the visible suggestion from the computer assistant, making the puzzle perceived as easier, or by the small sample size. In future research we would like to focus on a larger sample size as the sample used in this research was small ($n = 29$).

Per puzzle the duration from loading the page until submitting the answer was recorded. Respondents easily could have done other things while doing the experiment. Therefor it was chosen not to do any analyses with the duration. In future research a better controlled environment would be better to focus on the duration.

Another limitation of this research is that trust towards computer advice was only measured in a single question. Future research should investigate it in a broader way by doing personality tests and relating this to the use of computer assistance.

Furthermore, in future research it would be interesting to see how people experience the quality of assistance and the moment of assistance. The perceived quality of the assistance might affect the use of the assistant. Secondly in this research the assistance was always available when the respondent wanted. In future research we can change the moment of assistance, to see if that affects the perceived quality. For example, assistance only when an error is made. This would motivate the operator to look for solutions themselves.

Lastly, although some people might argue, chess is quite an irrelevant game, it does not resemble real life situations. In this research fame and winning 25 euros was at stake, but it might become more interesting when there is more at stake. For future research a link can be made with the automotive industry where computers are used in cars. For example, we could rate the perceived quality of the braking distance from anti collision software, and focus if different braking distances are perceived equally well.

E. Important Findings

Despite the limitations of this research it gives directions on how to shape the interaction between man and machine. Where a certain nonchalance is surrounding the use of Instrumental machines whereas Pre-Programmed machines are more used as a last resort. Our findings emphasize the importance of an easy operation, task specific knowledge, and by all means lots of fun when working with automation.

Referring back to our initial example of the tourists' bus driver. Although the navigation was set to the wrong destination, it might have been helpful to change the moment of assistance. Not active all the time but only when an error is made. This might have overcome the nonchalance in following the navigation, motivating the bus driver to look for the correct route himself first, improving his chances in going to the correct La Plagne.

Acknowledgment

We thank Christian Detweiler and Rosanneke Emmen for reviewing this paper. We would also like to thank Koen van der Vliet for his support. We also thank all the people who participated in our experiment.

References

[1] Barkhuus, L., & Dey, A. (2003, January). Is context-aware computing taking control away from the user? Three levels of interactivity examined. In UbiComp 2003: Ubiquitous Computing (pp. 149-156). Springer Berlin Heidelberg.

[2] Bradshaw, J. M., Feltovich, P. J., Jung, H., Kulkarni, S., Taysom, W., & Uszok, A. (2004). Dimensions of adjustable autonomy and mixed-initiative interaction. In *Agents and Computational Autonomy* (pp. 17-39). Springer Berlin Heidelberg.

[3] Borning, A. (1987). Computer system reliability and nuclear war. *Communications of the ACM*, *30*(2), 112-131.

[4] Braynov, S., & Hexmoor, H. (2003). Quantifying relative autonomy in multiagent interaction. In *Agent Autonomy* (pp. 55-73). Springer US.

[5] Cohen, M. S. (2000). A Situation Specific Model of Trust in Decision Aids. Cognitive Technologies.

[6] Corbató, F. J. (2007, January). On building systems that will fail. In ACM Turing award lectures (p. 1990). ACM.

[7] Dijkstra, J. J., Liebrand, W. B., & Timminga, E. (1998). Persuasiveness of expert systems. Behaviour & Information Technology, 17(3), 155-163.

[8] Dijkstra, J. J. (1999). User agreement with incorrect expert system advice. Behaviour & Information Technology, 18(6), 399-411.

[9] Dijkstra, J. J. (2006). On the use of computerised decision aids: an investigation into the expert system as persuasive communicator (Doctoral dissertation, University of Groningen).

[10] Horvitz, E. (2014). One-Hundred Year Study of Artificial Intelligence: Reflections and Framing. Retrieved April 22, 2015, from https://stanford.app.box.com/s/266hrhww2l3gjoy9euar

[11] Johnson, M., Bradshaw, J. M., Feltovich, P. J., Jonker, C., Van Riemsdijk, B., & Sierhuis, M. (2012). Autonomy and interdependence in human-agent-robot teams. *Intelligent Systems, IEEE*, *27*(2), 43-51.

[12] Johnson, D. G., & Mulvey, J. M. (1995). Accountability and computer decision systems. Communications of the ACM, 38(12), 58-64.

[13] Kantor, J. (2014, August 12). Working Anything but 9 to 5. Retrieved February 19, 2015, from http://www.nytimes.com/interactive/2014/08/13/us/starbucks-workers-scheduling-hours.html?_r=0

[14] Leveson, N. G., & Turner, C. S. (1993). An investigation of the Therac-25 accidents. *Computer*, *26*(7), 18-41.

[15] Luce, S., Hammad, S., & Sipe, D. (2014). Short-shifted.

[16] Madsen, M., & Gregor, S. (2000, December). Measuring human-computer trust. In Proceedings of Eleventh Australasian Conference on Information Systems (pp. 6-8).

[17] Markoff, J. (2014, November 11). Fearing Bombs That Can Pick Whom to Kill. *The New York Times*. Retrieved March 9, 2015, from http://www.nytimes.com/2014/11/12/science/weapons-directed-by-robots-not-humans-raise-ethical-questions.html?_r=0

[18] Muir, B. M. (1987). Trust between humans and machines, and the design of decision aids. International Journal of Man-Machine Studies, 27(5), 527-539.

[19] Murphy, D. S., & Yetmar, S. A. (1996). Auditor evidence evaluation: Expert systems as credible sources. Behaviour & Information Technology, 15(1), 14-23.

[20] Nass, C., Fogg, B. J., & Moon, Y. (1996). Can computers be teammates?. International Journal of Human-Computer Studies, 45(6), 669-678.

[21] Neerincx, M. A., & Griffioen, E. (1996). Cognitive task analysis: harmonizing tasks to human capacities. *Ergonomics*, *39*(4), 543-561.

[22] Nielsen, J., & Levy, J. (1994). Measuring usability: preference vs. performance. Communications of the ACM, 37(4), 66-75.

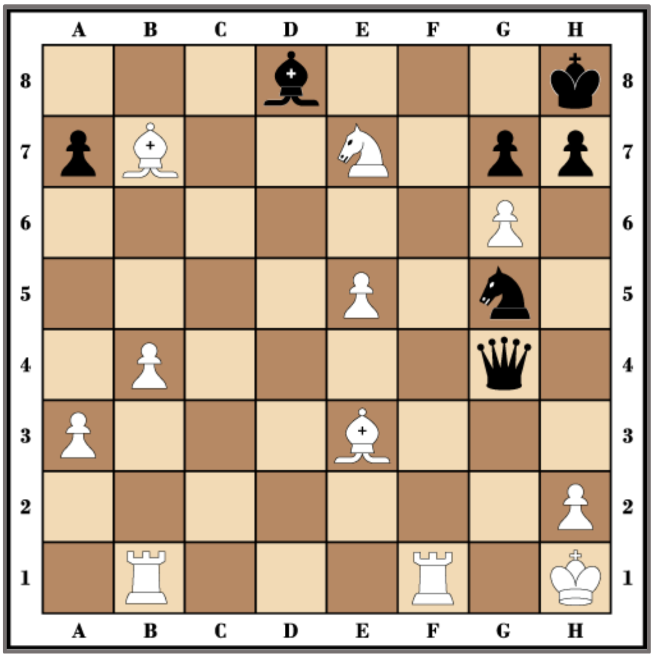
[23] Nissenbaum, H. (1994). Computing and accountability. Communications of the ACM, 37(1), 72-80.

[24] Parasuraman, R., Sheridan, T. B., & Wickens, C. D. (2000). A model for types and levels of human interaction with automation. *Systems, Man and Cybernetics, Part A: Systems and Humans, IEEE Transactions on*, *30*(3), 286-297.

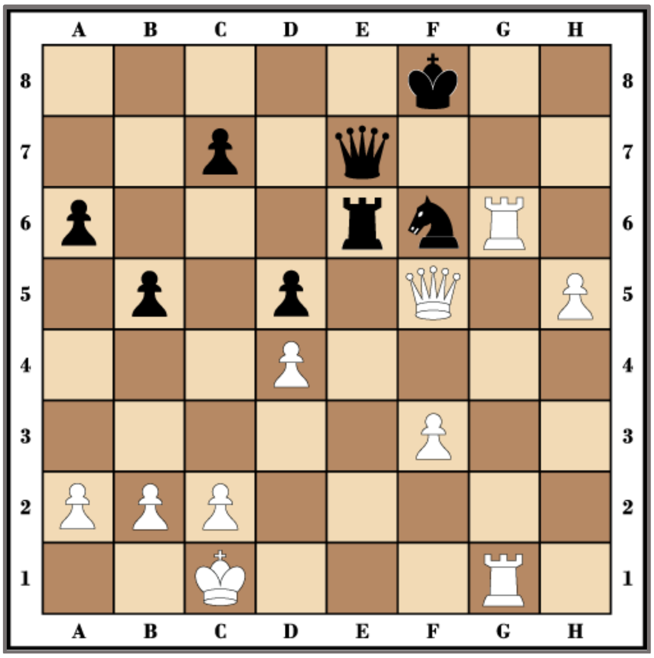
[25] Sheridan, T. B., & Verplank, W. L. (1978). *Human and computer control of undersea teleoperators*. MASSACHUSETTS INST OF TECH CAMBRIDGE MAN-MACHINE SYSTEMS LAB.

[26] Bus driver's GPS failure takes ski tour on 750 mile detour to wrong La Plagne. (2015, March 9). Retrieved March 21, 2015, from http://www.theguardian.com/world/2015/mar/10/bus-drivers-gps-failure-takes-ski-tour-on-750-mile-detour-to-wrong-la-plagne

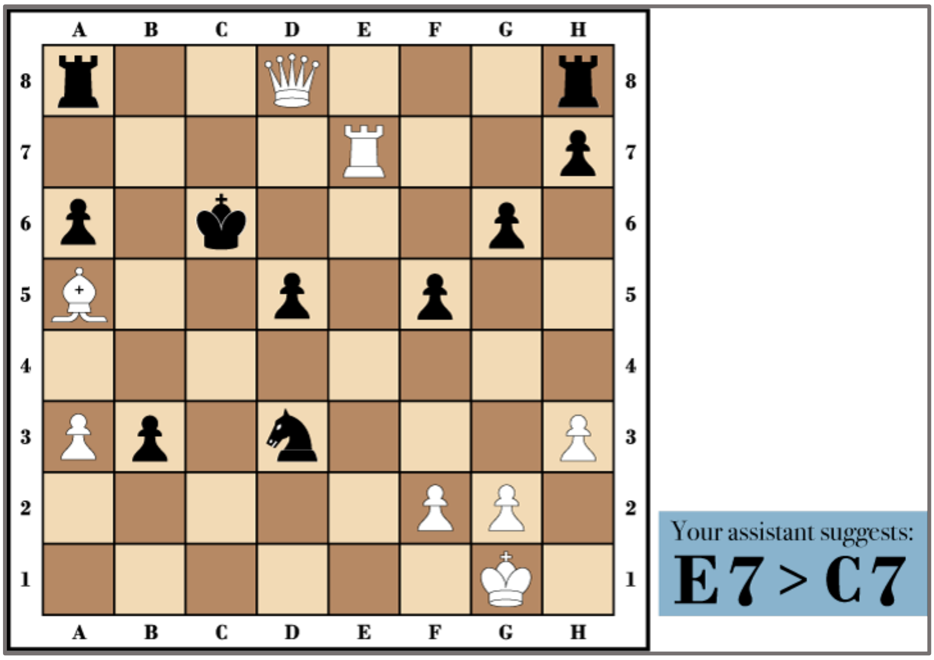
Appendix A: The Chess Puzzles



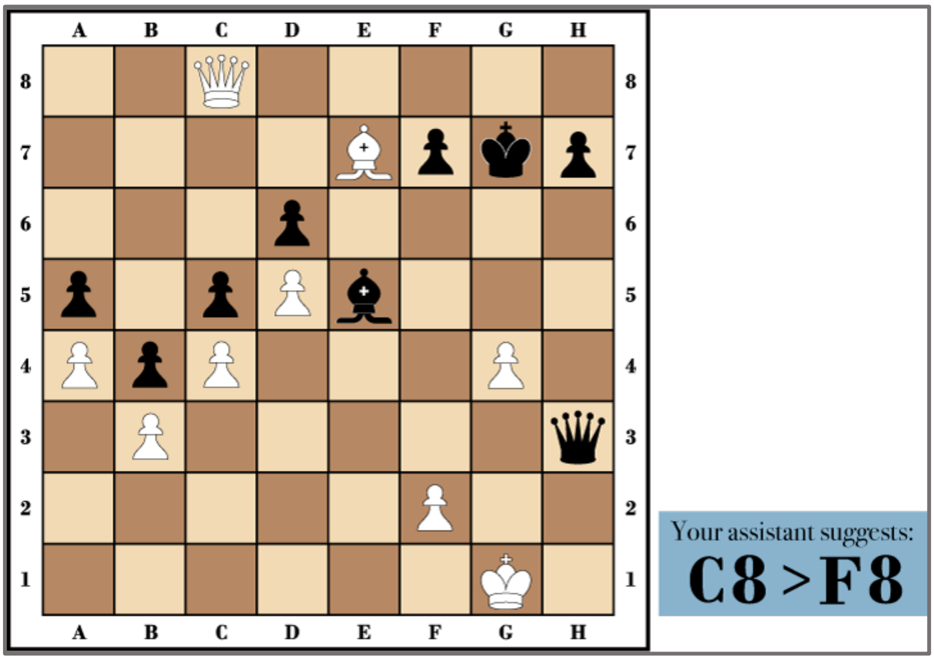
Puzzle A – Manual Easy
Solution: F1 > F8



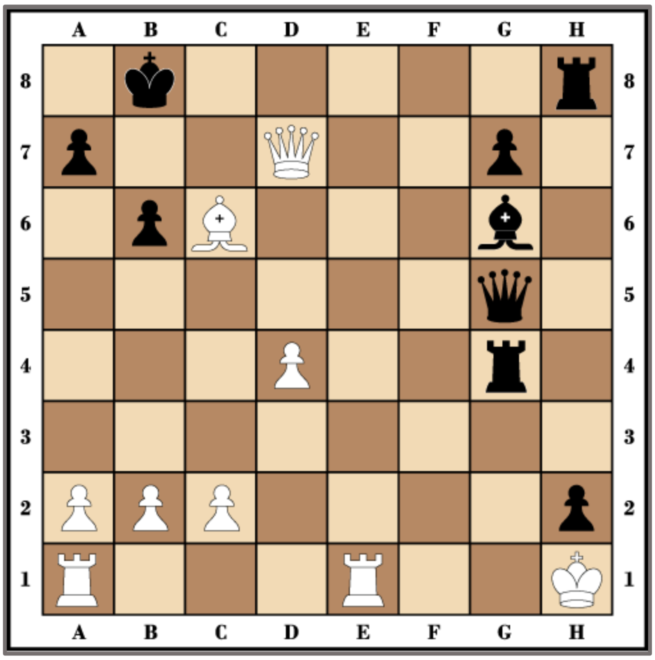
Puzzle B – Manual Hard
Solution: G6 > G8



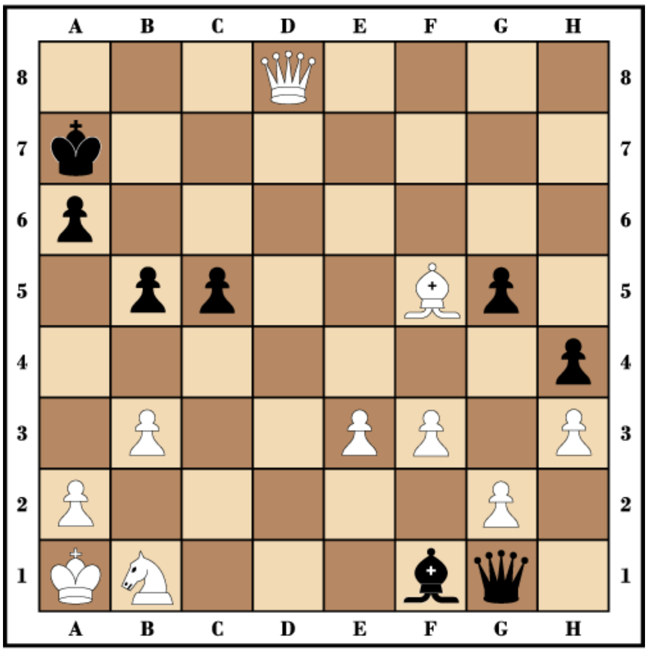
Puzzle C – Instrumental Easy
Solution: D8 > B6



Puzzle D – Instrumental Hard
Solution: E7 > F8



Puzzle E – Pre-Programmed Easy
Solution: D7 > B7
Would do: E1 > E8



Puzzle E – Pre-Programmed Hard
Solution: D8 > C7
Would do: F5 > C8

Appendix B: Answers on open questions

Puzzle C – Instrumental Easy

What are your thoughts on the aid from the computer?	**Can you give any reasons for these thoughts?**
Doubtful[1]	No clue why[1]
Feel like the computer made a mistake by leaving the white queen in danger	The queen would have been beaten by a tower
Not helpful	My move was better, my move resulted in check-mate, the computer's did not.
WRONG	i DON'T WANNA LOSE MY QUEEN
bad	not best move
Seems like the best move	
possible	i thought mine was better
didn't see it.	
I didn't think it was the best move to make so I thought it was somewhat confusing/distracting.	If I would have made the suggested move both the black towers could have caught my queen (after the chess threat had been resolved)
I don't think it showed me the best option	The proposed moved by the computer would have made me lose my queen
Nice to see confirmation of my idea.	Nice to be right. Nice to learn.
Quite handy	Again, it seemed like a reasonable move, so I thought \why not?\""
did not pay attention to the aid	the answer was obvious immediately
Useless	I believe my move was the finishing one, checkmate!
it helped me to find a better solution	was a good aid, but could be better
Seemed like a good move, so I made it.	Again, it seemed like a good move
It was not the best move. This makes me lose faith in the computer.	There was an obviously better one.
I tried to solve it myself and then look at the answer of the computer	no
Ok	
Can I trust this? I did thoroughly check whether my king was not going to be swept away after that very move. And now stop helping me, I can do this myself.	Still want to proof that I can do it.
tried to ignore it	last time I didnt consider other options, I wanted to ignore the advice on purpose now and look for other options.
did not watch	saw it instantly myself
good tip	after a few plays with aid the game is not interesting any more
Should I listen to a computer or would that be stupid?	My chess skill are not that good

[1] Translated from Dutch

Puzzle D – Instrumental Hard

What are your thoughts on the aid from the computer?	**Can you give any reasons for these thoughts?**
Should be okay.[1]	It is a matter of time... by following the advice I am done quicker[1]
Seemed like the most reasonable answer	Didn't see a better solution
Seemed like wrong advice, would have killed the queen	The advice would have killed my queen
ok	quick way to checkmate
CORRECT	COMPUTER WAS CORRECT
best move	couldn't find a better one as you have to put the opponent chess
good	best move
excellent	there was an option that black made a move that wouldn't be in my favor
It was the best move	All other moves lead to check mate for white
Good advice.	No.
I didn't use it so far	I didn't use it so far?
Best way	King can t move that much
Annoying.	Now I think I get the game, I want to be playing myself, but the task to be fast in order to have a high ranking, makes me choose for the help of the computer and take takes away the fun of playing the game.
It was quite handy, it was easy to see if this advice was good or not	It is easy to analyze what will happen with this suggested move. It might not be the best option (I wouldn't know since I'm a chess beginner), but definitely a good one
did not consider it	the solution was easy enough to find
I think it would have been my move of preference as well, but since it already gave me the aid I can never really be sure of that.	I like playing on the offence, this move was the most aggressive one, although I started doubting it more, just because the computer gave the same move as advice.
Decent move	I considered other options, but this seemed like the best move.
Nothing surprising, it seemed the obvious move so therefore I thought there might be a more complex move that I had missed	You don't know the algorithm behind it or how good it is. So I first assume that it is pretty simple and try to still look at the board myself.
It distracted me	No
I thought it was a bad move.	
Because time is a factor, it still is fun to see as quick as possible whether it is correct. But my first instinct was: ignore and try yourself first.	I am competitive.

[1] Translated from Dutch

stopped me from considering other options	seemed like it would result in a win, did not immediately consider other options after checking the suggestion of the computer
obvious choice but wrong	it didn't lead to mate, though it looked like it would
i can understand the aid	I put the puzzle in my head forwards
Let's go with what the computer suggested	The computer had a good idea the last time

Puzzle E – Pre-Programmed Easy

What are your thoughts on the aid from the computer?	Can you give any reasons for these thoughts?
Should be okay. [1]	Not really[1]
From now on I won't trust the computer and take my own time to solve it as I clearly make better decisions then the computer.	I have no idea why the computer was not able to assist me on this easy puzzle. Secondly, the computer just cost me 25 euro's.
not a smart move	i lost my tower by the move the computer made
Nice to see when the computer does what I thought to do.	It's nice to learn. It's to be right.
Not sure	
if the computer gives me the best solution, it is not fun any more to play	if the computer gives me the best solution, it is not fun any more to play

Puzzle F – Pre-Programmed Hard

What are your thoughts on the aid from the computer?	Can you give any reasons for these thoughts?
Perfect. [1]	Did not looked at the puzzle. [1]
Don't really get it	Can't figure out why this move and what to do next
Looks good.	I cannot think of a better move
The computer suggested one of the options I considered. It seemed like a good option.	I didn't really know what option was best, so I let the computer decide
Good	

[1] Translated from Dutch

Assistance Preference

Assistance - Why is this your preference?	No Assistance - Why is this your preference?
Quickest / No need to think	
	you can think for yourself
	I like to solve the problems myself. I want to be able to see what the assistent will do before I let it happen. Even tough I know a computer is way better at chess then me.
Helps me put my own move into perspective. \At least I did better than the computer\" And maybe it might give me an idea."	
	i thought i knew the answers
	I want to play and play/win lose by myself. The game IMO a challange and if you win its an achievement - whats the point of assistance? I want assistance from my GPS when I'm driving my car - not when I'm playing a game
	Because the assistence has no value. I'm cleary more able to make good decisions. The one time I trusted the computer blindly (trying to save time by not having to enter the fields) it fooled me.
	do not think i needed any help at this basic level of chess problems
I guess the computer is a better player than I am	
gives you something to think about	
	It's kind of a pointless exercise with assistance. No need to think for yourself.
	I play chess to think with my brain; not to follow comments of a computer.
	I like to solve puzzles myself, without any assistance
	More challenging
	Like to think or myself
I liked assistence in the beginning to learn. To get affirmation that my thoughts where right. After that it was nicer to be able to play by myself, that's the fun of playing a game.	
It gives some guidance: if the suggested move is a good one, it is probably the best one since it comes from a computer.	
	I prefer the challenge of solving the puzzle myself over the utility of a greater probability at winning â‚¬25.
	It's chess, you play it for the fun of tickeling your brain. It's just like a friend coming up and giving you advice about the best move. I don't want your advice!

	I want to make my own decisions, not influence by anything, if it's a stupid/smart move, it is a least my own stupid/smart move.
because it can help to solve, even if you don't use the proposal	
	I'm a little undecided, but like to take some time to think about a move myself first. If I can't decide (or feel lazy), then I don't mind turning towards assistance. Although it's more satisfying to make a decision when no assistance is available.
Because I still looked at the puzzle first myself and tried to figure it out. Then I looked at the assistance. It might be something I missed, and if I found a better move than the computer gave I felt better about choosing that move.	
	I like to solve it on my own
I'm not a great chess player at all so having the option for help was good.	
	The fun is solving it yourself, doing the puzzle.
	The suggestions removed the challenge for me.
	distracts from my own train of thought
	you have to think more by yourzelf and testing different solutions in your head
	I felt stupid letting the computer help me out. I hoped to be able to do it myself.

Instrumental most helpful

Why do you believe this was the most helpful?	**What are your thoughts about the other aid?**
it doesnt take away the fun of the game	its boring to watch the computer do it for me
It showed me options	I didn't like not knowing what was going to happen, even tough the move would be good.
Solving the game for me would eliminate the fun of a game.	Solving it might be nice if I still had a choice to make me own move irrespectively. Because at the end of the day it's nice to know the answer
Most helpful doesn't quite cover it. At least the proposal is least disruptive for my life.	I hate it!!!
I do not trust the aid that solves it without being able to check what it wants to do.	see above
A proposal leaves room to make an own choice in the end	Still helpfull, allthough it's impossible to change the choice, which doesn't sound good because I didn't know what the move will be. Lacks too much control.
gives you another possibility	it's not to say that the computer solves it, althoug it's proven that the pc can beat a men
Because it gives you an option; you can choose for yourself if you follow it or not.	I don't know because I haven't used it.

A proposal makes me rethink my options without automaticly solving the problem	Meh... it's a cheat :P
Keeps the mind active in visualising the move	Tends to feel a bit lazy
You dont know what the solving computer would do (I don't trust that), while the proposal giving computer still leaves the final decision to the player. It is easy to determine if a suggested move is preferable or not	I did not trust it, as it does not tell you what it will do before it is too late
because it is better because we can see the options we more cleary	when it solves it, is not that fun.
I like having the option of seeing a proposal, but still having the option of not following it.	I don't like letting the computer decide for me.
With the one that solves it you can't check it. And the whole fun of playing is taken out because you don't have to think about it any more.	No fun. Part of the fun of getting assistance from the computer is trying to beat it.
You can look for yourself if it is right	Not helpful, you do not know what he will do
The point of puzzles is to challenge yourself and to enjoy that challenge. To have someone solve it for you is only useful when you can learn from their actions and then try it for yourself to apply what you have learned.	-
Even though the proposal was the answer I choose, I felt like I had input in the situation.	The one that solves it made me feel dumb.

Pre-Programmed most helpful

Why do you believe this was the most helpful?	**What are your thoughts about the other aid?**
No need to decide for myself	You have to rethink the proposal
easiest way to the right answer	
Proposal could be wrong..	always good..
Faster	considering a suggestion takes time, thus defeating the point of the time gain
If the purpose is so help you \win\" this game then solving it for you is quicker."	I found it annoying, making me doubt all my thoughts and moves.
That brings you fastest to the goal: solving the puzzle. I still wanna win ;-) Honestly, I did not realize there were 2 different kinds of aid offered.	I want aid when I ask for it. There was no choice.
you can figure out why it was correct	suggestion could be completely wrong and throw you off track
I did not see the difference	i don`t understand the different

Both equally helpful

Why do you believe this was the most helpful?
if your looking for help - they give it - so they are both good
It wasn't clear to me that there was a difference. I thought the hints solved the puzzles.
It doesn't matter, because it trusted the proposol to be the best solution.
Sometimes I did not agree with them.