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A USER'S COGNITIVE WORKLOAD PERSPECTIVE IN NEGOTIATION SUPPORT SYSTEMS: AN EYE-TRACKING EXPERIMENT

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Abstract

Replying to several research calls, I report promising results from an initial experiment which compares different negotiation support system approaches concerning their potential to reduce a user's cognitive workload. Using a novel laboratory-based non-intrusive objective measurement technique which derives the user's cognitive workload from pupillary responses and eye-movements, I experimentally evaluated a standard, a chat-based, and an argumentation-based negotiation support system and found that a higher assistance level of negotiation support systems actually leads to a lower user's cognitive workload. In more detail, I found that an argumentation-based system which fully automates the generation of the user's arguments significantly decreases the user's cognitive workload compared to a standard system. In addition I found that a negotiation support system implementing an additional chat function significantly causes higher cognitive workload for users compared to a standard system.

Keywords: Human Computer Interaction, Negotiation Support Systems, Cognitive Workload, Pupillary Responses, Eye-Tracking Experiment.

1 INTRODUCTION

In the last ten years in particular, negotiation support system (NSS) research has developed and evaluated many promising negotiation models including auction-based models, semi-structured negotiation approaches and argumentation-based models. Since IT acceptance is a key factor for later IT success, a variety of research has already examined negotiations from a user-oriented perspective and evaluated the user acceptance of one particular negotiation model or its presentation (Bapna, Jank & Shmueli 2008; Etezadi et al., 2006; Lee, Kang & Kim 2007; Pommeranz et al. 2009; Turel & Yuan, 2007). However, no research has been conducted on the problem of whether these NSSs actually reduce the cognitive workload of their users. Nevertheless, as NSSs are information systems (IS) which should have an appropriate support character, IS research is very interested in empirical results on the support differences of NSSs. It is human nature to “off-load cognitive work onto the environment" (Wilson 2002, p. 628). Because of the limits of human's information-processing abilities, e.g., limits to the attention and working memory of the human brain, we tend to exploit the environment in order to reduce cognitive workload. IS should support users’ efforts to lower their workload. That is why IS scholars have traditionally investigated a user's cognitive workload and its derivatives, such as concentration, mental strain, or mental stress. However, most of the corresponding research is either primarily based on user-perceived/non-objective measures (e.g. Ahuja & Thatcher 2005; Ahuja et al. 2007; Ayyagari, Grover & Purvis 2011; Chilton, Hardgrave & Armstrong 2005; George 1996; Nelson 1990; Grisé & Gallupe 1999; Gupta, Li & Sharda 2013; Igbaria & Guimaraes 1993; Li & Shani 1991; Ragu-Nathan et al. 2008; Rutner, Hardgrave & McKnight 2008; Speier & Morris 2003; Tarafdar et al. 2007; Tarafdar, Tu & Ragu-Nathan 2010; Weiss 1983) or the researcher only discusses the need for user workload measurements without any measurement proposal (Wastell 1999).

That is why my aim is to contribute to both these gaps in IS-research by empirically studying different NSS approaches concerning their potential to reduce the user’s cognitive workload using a novel non-intrusive objective measurement technique. Hence I set up three different negotiation models (test system A, B, and C) and evaluated their cognitive workload implications in the application domain of temporary employment. These three models were evaluated and compared using an identical test setting within a laboratory experiment.

My IS-research contributions are twofold: First, I provide the first empirical study comparing different NSS approaches from a user’s cognitive workload perspective. Second, I conduct a novel method which objectively derives the user’s cognitive workload from its pupillary responses using modern eye-tracking technology (Buettner 2013a, Buettner et al. 2013). Hence I additionally reply to current research calls from several IS scholars to foster the conducting of objective psychophysiological measures in IS research (Dimoka 2010; Dimoka, Pavlou & Davis 2011; Ren et al. 2013), in particular on objective measurement techniques of a user’s cognitive workload and its derivatives (Sun, Lim & Peng 2013). Since I apply a non-intrusive objective cognitive workload measurement technique (Buettner et al. 2015), I further directly reply to the research call made by Steinfeld et al. (2006): “At this point in time, there is a need to identify non-intrusive measures of workload” (p. 38).

The paper is organized as follows: Next, I present the research background and derive the hypotheses. After that I describe the research methodology before I present the results and their discussion. Finally, I summarize the contributions and limitations of the results and indicate future work.

2 RESEARCH BACKGROUND

2.1 Assistance Approaches in Negotiation Support Systems

Negotiation support systems (for overviews, see Kersten & Lai (2007), Lopes, Wooldridge & Novais (2008), Buettner (2006a,b, 2007a,b) facilitate their users within electronic negotiations where a negotiation is defined as an iterative communication and decision-making process, as suggested by Bichler, Kersten & Strecker (2003). Particularly in the last decade, negotiation support system (NSS) research has developed and evaluated many promising negotiation models, including game-theoretic and auction-based models (Adomavicius, Gupta & Sanyal 2012; Aloysius, Deck & Farmer 2013; Bichler, Shabalin & Ziegler 2013; Guo, Koehler & Whinston 2012; Petrakis, Ziegler & Bichler 2013; Scheffel et al. 2011, Buettner & Kirn 2008; Buettner 2009; Landes & Buettner 2011), semi-structured negotiation approaches (Gettinger, Koeszegi & Schoop 2012; Schoop, Jertila & List 2003; Buettner & Landes 2012), and argumentation-based models (Amgoud & Vesic 2012; Berges et al. 2013; Chow et al. 2013; El-Menshawy et al. 2013; Heras et al. 2013; Monteserin & Amandi 2013; Monteserin & Amandi 2011; Navarro et al. 2013; Yang, Singhal & Xu 2013; Teacy et al. 2012; Landes & Buettner 2012).

In order to assist the users of NSSs two research directions emerged in the past: First, process-support systems (PSS) such as INSPIRE/INSS, CrossFlow, CBSS or ebay.com facilitate the users within the process of the negotiation (Schoop, Jertila & List 2003). Second, in argumentation-based negotiation (ABN) systems agents have the possibility of reasoning their positions. When the negotiation partner is persuaded, she will change her negotiation position. ABN systems assist their users when generating, moving and evaluating arguments (Amgoud & Vesic 2012; Landes & Buettner 2012).

Previous conceptual work shows that some differences exist in the utility and the quality of the outcome of different forms of these different negotiation approaches. For example, Amgoud & Vesic (2012) demonstrated that argumentation can improve the quality of a negotiation outcome, but never decreases it. Empirical work indicates that the graphical presentation of information and the design of the NSS influence the negotiator's behavior and the negotiation outcome (Delaney, Foroughi & Perkins 1997; Gettinger, Koeszegi & Schoop 2012; Köhne, Schoop & Staskiewicz 2005; Schoop, Köhne & Staskiewicz 2004). Since IT acceptance is a key factor for later IT success (DeLone & McLean 1992; DeLone & McLean 2003; Legris, Ingham & Collerette 2003; Turel & Yuan 2007), a variety of research has already examined negotiations from a user-oriented perspective and evaluated user acceptance of one certain negotiation model or its presentation (Bapna, Jank & Shmueli 2008; Etezadi et al. 2006; Lee, Kang & Kim 2007; Pommeranz et al. 2009; Turel & Yuan 2007). However, to the best of the author's knowledge no research has been conducted on the problem of whether these NSSs actually reduce the cognitive workload of their users. As NSSs should have an appropriate support character, IS-research is very interested in empirical results on the support differences of NSSs.

2.2 Pupillary Responses as Workload Indicators in Psychophysiology

Despite the high level of interest in cognitive workload, there is still no universally accepted definition of this mental construct (Cain 2007). However, it is clear that cognitive workload results from mental processes when performing tasks – depending on the user's capabilities and the task demands, e.g. (Ahern & Beatty 1979; Beatty 1982; Granholm et al. 1996; Hess & Polt 1964; Kahneman & Beatty 1966; Buettner 2014b, 2015c, 2016b). Corresponding user's cognitive workload measurement techniques can be roughly separated into two categories (Cain 2007): subjective self-assessment and rating scales (e.g., NASA Task Load Index), and objective psychophysiological measures (e.g., pupillary responses). In this and the following sections I concentrate on pupillary-related psychophysiological measures indicating cognitive workload and measurable by eye-tracking technology.

The initial work on the relationship between cognitive workload and pupillary responses stems from Hess & Polt (1964). They measured the cognitive workload of five participants by capturing the task-evoked pupillary diameter, but only based on simple multiplication tasks. There has subsequently been a lot of research investigating the fundamentals of task-evoked pupillary responses (e.g., Beatty 1982; Beatty & Wagoner 1978; Bradshaw 1967; Richer & Beatty 1987; Siegle, Steinhauer & Thase 2004; Stanners & Headley 1972; Van Gerven et al. 2004; van der Meer et al. 2010; Verney, Granholm & Dionisio 2001; Verney, Granholm & Marshall 2004)) with the result that the amount of a user's cognitive workload clearly correlates with the pupillary dilation. The task-evoked enlargement of the pupillary is mainly caused by both the cortical inhibition of the parasympathetic system and the activation of the sympathetic system (Steinhauer et al. 2004).

2.3 Pupillary Responses as Workload Indicators in IS Research

IS scholars have traditionally investigated user's cognitive workload and its derivatives (Cain 2007) primarily based on user-perceived/non-objective measures (e.g., Ahuja & Thatcher, 2005; Ahuja et al. 2007; Ayyagari, Grover & Purvis 2011; Chilton, Hardgrave & Armstrong 2005; George 1996; Nelson 1990; Grisé & Gallupe 1999; Gupta, Li & Sharda 2013; Igbaria & Guimaraes 1993; Li & Shani 1991;

Ragu-Nathan et al. 2008; Rutner, Hardgrave & McKnight 2008; Speier & Morris 2003; Tarafdar et al. 2007; Tarafdar, Tu & Ragu-Nathan 2010; Weiss 1983) or even discussed the need for user workload measurements without any measurement proposal (Wastell 1999). Other IS-relevant disciplines echo the same situation concerning user-perceived/non-objective cognitive workload measures. For example, Loft et al. (2007) summarizes the state of the art concerning 22 existing models which predict cognitive workload in air traffic control. It is remarkable that all of the 22 developed models were based on subjective workload ratings. In the rare case of the use of objective psychophysiological measures, IS research has mainly applied pupillary-based techniques indicating cognitive workload within the human-computer interaction domain, especially for adaption and personalization purposes (e.g., Bailey & Iqbal 2008; Baltaci & Gokcay 2012; Iqbal et al. 2005; Wang et al. 2013; Bee et al. 2006; Ren 2011; Ren et al. 2013; Zhai & Barreto 2006).

The discourse on measuring the machine intelligence of human-machine cooperative systems (e.g., Park, Kim & Lim 2001) showed the need to quantify the cognitive workload of machine users and postulated the need for research on workload measures based on objective parameters such as behavioral signals, eye scanning movements, or physiological variables. The discussions about metrics for human-robot interaction also emphasized the need for research into a more objective cognitive workload measurement technique, e.g., "*At this point in time, there is a need to identify non-intrusive measures of workload*..." (Steinfeld et al. 2006, p. 38). Accordingly a lot of trials and rudimentary/simple approaches on measuring the user's cognitive workload when using IS exist. For example, Pomplun and Sunkara (2003) used the pupillary dilation as a cognitive workload indicator within a simple visual experiment asking users to find numbers in ascending order and read them out loud. Longo (2011) sketched a very rudimentary framework for cognitive workload assessment using information technology. Cegarra and Chevalier (2008) experimentally evaluated the cognitive workload of users solving a Sudoku puzzle by capturing pupil diameter data from eye-tracking. Xu et al. (2011) experimentally studied pupillary responses indicating cognitive workload when performing arithmetic tasks given by a computer under luminance changes.

However, it is noticeable that the IS-work on objective measuring the user's cognitive workload is rudimentary (games, simple/trivial (arithmetic) tasks, non-evaluated frameworks, etc.). There is a research gap concerning empirical work on objective measuring the user's cognitive workload in laboratory experiments adequately reflecting realistic working/business situations. In line with this identified research gap more and more IS scholars call for objective measurement techniques of user's cognitive workload and its derivatives (Sun, Lim & Peng 2013) and a small group of IS researchers currently fosters the conducting of objective psychophysiological measures in IS research and have formulated corresponding research calls (Dimoka 2010; Dimoka, Pavlou & Davis 2011; Ren et al. 2013).

2.4 Hypothesizing

Cognitive workload is negatively related to perceived ease of use (Davis 1989; de Guinea et al. 2014; Dimoka et al. 2011; van der Heijden 2004). Since – ceteris paribus – any additional function decreases ease of use, I consequently hypothesize:

(H1) A negotiation support system implementing an additional chat function causes higher cognitive workload for users compared to the standard negotiation support system.

(H2) A negotiation support system which fully automates the generation of the user's arguments causes lower cognitive workload for users compared to the standard negotiation support system.

(H3) A negotiation support system which implements an additional chat function causes higher cognitive workload for users compared to that negotiation support system which fully automates the generation of the user's arguments.

All three hypotheses will be evaluated using all four cognitive workload indicators PD_μ, PD_δ, GF, and SS as described in the methodology section. A hypothesis will only be confirmed if at least three of the four indicators differ coherently at a significant level ($p<0.05$) from the hypothesized direction.

3 METHODOLOGY

In order to manage the study with only a few participants I utilize a within-subject design. To ensure both a stable and repeatable test procedure as well as the possibility to test information systems which adequately reflect real-world situations (e.g., working/ business environments) I propose a laboratory setting as the analysis-framework. Without any disturbance within such a laboratory setting the pupillary responses indicating cognitive workload can be proper captured by eye-tracking technology. For instance, the lighting conditions have to be kept strictly constant since the pupillary diameter response in general (Verney, Granholm & Marshall 2004) as well as the task-evoked response in particular (Verney, Granholm & Dionisio 2001) were primarily influenced by luminance.

3.1 Pupillary Responses as Workload Indicators using Eye-Tracking

To separately capture the pupil diameters of both participants' eyes, I use the binocular double EyegazeEdgeTM System eye-tracker paired with a 19'' LCD monitor (86 dpi) set at a resolution of 1280x1024, whereby the eye-tracker samples the position of participants' eyes and pupillary responses at the rate of 60Hz for each eye separately. The eye-tracker was installed under the monitor and tracked the participant's eyes during the entire test cycle (Figure 1).

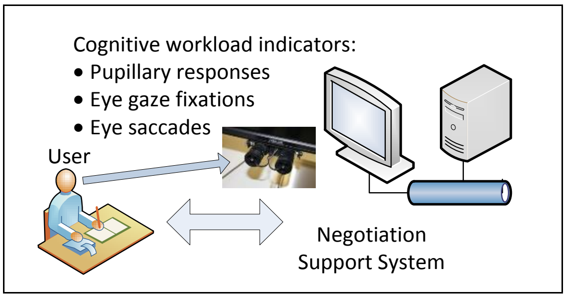

Figure 1. Laboratory Setting.

The following four cognitive workload indicators all captured from eye-tracking data were used:

1. pupillary diameter mean (PD_μ): the tonic dilation measured by the time series mean of the pupillary diameter (Beatty 1982; Kahneman, Beatty & Pollack 1967; Steinhauer et al. 2004),
2. pupillary diameter standard deviation (PD_δ): the phaseal/dynamic aspect of pupillary dilation and reduction measured by the standard deviation (Beatty 1982; Kahneman & Beatty 1966),
3. number of gaze fixations (*GF*): the time-normalized number of gaze fixations >500ms (Just & Carpenter 1976; Just 1980; Rayner 1998; Van Orden et al. 2001),
4. saccade speed (*SS*): the speed of saccades (Rayner 1998; Van Orden et al. 2001).

3.2 Description of the Test Procedure

Prior to the data collection, each test participant is welcomed by the experimenter (supervisor of the experiment). After that, the participant has to fill-out the consent form and a questionnaire with demographics, individual attitudes, etc. (stage 1). In stage 2, the supervisor gives the task-sheet, including a short note about the negotiation task to be fulfilled, to the participant and reads the task out aloud. After this the participant has time to read the task again and to ask questions. In stage 3, I take the necessary precautions for the experiment, for which I make use of the eye-tracker. Hence, the eye-tracker is calibrated. In stage 4, the experiment starts with the negotiation task that the participant has to accomplish. I recruited extra-occupational MBA and bachelor students with professional working experience for the experiment.

3.3 Data Cleansing

The eye-tracking system is able to track participants' eye movements and pupillary responses when the participants are looking in the direction of the monitor. The more complex and realistic a task is, the more participants look away from the monitor, e.g. at the keyword, and the eye-tracking system is no longer able to record every movement of the eye. In real business/working conditions, participants look in the direction of the monitor for about 70% of the time.

To be able to clean some naturally determined artifacts from the signal, e.g., by eye blinks, I have developed a data cleansing approach. In more detail, I use a low pass filter cutting high frequencies caused by naturally determined artifacts such as eye blinks, cf. Verney, Granholm & Dionisio (2001). In order to adequately set the correct filter limits I determine the maximum natural ability of the pupils to dilate and contract. Thus, a prior experiment with 13 participants was conducted in which the participants were asked to look at a monitor turning several times from black to white and vice versa. Meanwhile, eye-tracking data was recorded. For each eye and each participant I calculated the maximum increase (white to black) or decrease (black to white) in pupil size for a period of 250 ms (15 data points). Thus, for pupillary dilation I got a maximum value of 0.194 mm and for pupillary contraction a maximum value of -0.495 mm. For safety reasons I doubled these values so as not to be too strict with data cleansing and divided them by 15 to obtain maximum permissible values for dilation (0.026 mm) and contraction (-0.066 mm) for two successive data points. Data cleansing consists of calculating differences between adjacent pupil size values and setting a measurement value x at time t to invalid if (a) $x_t - x_{t-1} < -0.066$ and $x_{t+1} - x_t > 0.026$ (negative outlier) or (b) $x_t - x_{t-1} > 0.026$ and $x_{t+1} - x_t < -0.066$ (positive outlier). This procedure is conducted twice.

3.4 Data Analysis

Data may now be analyzed in two ways. The static method to analyze changes in mental workload is used to investigate changes on a micro level or when examining short and clearly defined tasks, as for example simple single arithmetic tasks. In this type of task the task-evoked pupillary diameter changes are often obvious to the naked eye. To analyze more complex and interfering tasks where mental workload decreases and increases several times, static analysis is largely insufficient and a variance analysis is needed as this provides a dynamic and more precise and granular analysis method for pupil size changes and therefore also for changes in mental workload. I calculate changes in mental workload by changes in mental workload = $\frac{\sum_{i=1}^{n}(measured\ pupil\ size - average\ pupil\ size)^2}{n}$, where n denotes the number of measurement values.

3.5 Prototyping of Negotiation Support Systems differently facilitating Users

To compare different NSS approaches concerning their potential to reduce the user's cognitive workload I prototyped the three most promising alternatives (standard NSS, PSS, and ABN) in the application domain of temporary employment (Figure 2).

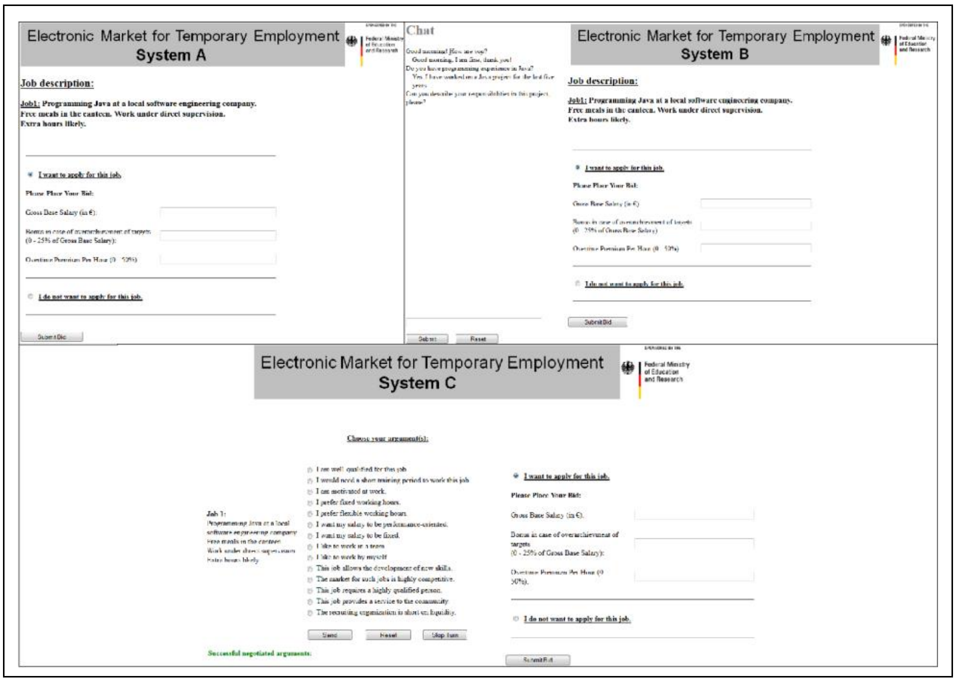

Figure 2. Screenshots of the prototyped systems A, B and C.

System A has prototyped a plain user interface without any assistance function or functions which are demanding for users (standard NSS). Hence system A becomes the reference for comparison with systems B and C concerning the causes of the user's cognitive workload. System B realized a chat function in order to help users feel more comfortable by having the opportunity to communicate informally (PSS). System C prototyped an argumentation-based approach (ABN) and fully automated the generation of arguments. In this case the users do not need to devise the arguments; they have only to choose one appropriate argument from a given list.

In order to avoid any emotional arousal during the experiment, the answers given through the opposite human negotiation partner in system B (chat) follow a prepared protocol without emotive words. The computer chosen arguments in system C also did not contain emotive words.

4 RESULTS

Table 1 presents the objectively measured cognitive workload indicators on systems A, B, and C and the test of significance results needed for the evaluation of the three hypotheses H1, H2, and H3.

Cognitive workload indicator (scale unit)	System			Test of significance (t-test, 1-sided)		
	A	B	C	A/B	A/C	B/C
Corresponding hypothesis				H1	H2	H3
pupil diameter PD_{μ} (mean, in mm)	3.096	3.206	3.032	$p < 0.01$	$p < 0.01$	$p < 0.001$
pupil diameter PD_{δ} (std. deviation, in mm)	0.162	0.227	0.134	$p < 0.001$	$p < 0.01$	$p < 0.001$
number of fixations *GF* (>500ms, in 1/sec)	0.266	0.574	0.211	$p < 0.001$	n.s.	$p < 0.01$
saccade speed *SS* (in m/sec)	0.673	0.697	0.887	n.s.	$p < 0.01$	$p < 0.01$

Table 1. Results and hypotheses evaluation by test of significance (t-test, one-sided).

5 DISCUSSION

As I found that in all three hypotheses at least three of the four corresponding cognitive workload indicators PD_{μ}, PD_{δ}, *GF*, *SS* coherently differ at a significant level ($p<0.01$) in the hypothesized direction (see Table 1) all three hypotheses are confirmed. The results indicate that a higher support of NSSs actually leads to a lower user cognitive workload. In addition, the results emphasize the meaningfulness of the development of argumentation-based negotiation models using intelligent software agents (Amgoud & Vesic 2012; Lopes, Wooldridge & Novais 2008) from a human workload perspective since the ABN-based NSS caused the lowest level of cognitive workload for users.

That the chat-based NSS caused the highest cognitive workload for their users is interesting because from a user acceptance perspective, users clearly tend to prefer informal chat systems within negotiation processes (Gettinger, Koeszegi & Schoop 2012; Köhne, Schoop & Staskiewicz 2005; Schoop, Köhne & Staskiewicz 2004). Hence, the results seem to be contrary to the IS-acceptance findings concerning user-preference for informal chat systems within negotiation processes (Gettinger, Koeszegi & Schoop 2012; Köhne, Schoop & Staskiewicz 2005; Schoop, Köhne & Staskiewicz 2004) – indicating a need for future research on the user's cognitive workload – user's acceptance relationship. In more detail, it may be that the need to solve problems takes priority for humans, followed by the tendency to offload cognitive workload to other people or to the computer. This speculation is supported by the IS acceptance research findings, in particular that system functionality influences the acceptance of a system the most, cf. TAM (Davis 1989) and UTAUT (Venkatesh et al. 2003).

6 CONCLUSION

As a response to corresponding research calls, in this paper I provided the first study to empirically compare different NSS approaches concerning their potential to reduce a user's cognitive workload using a novel non-intrusive objective measurement technique. That is why I prototyped three different NSS approaches (standard NSS, PSS, and ABN) and evaluated their cognitive workload implications in the application domain of temporary employment. These three approaches were evaluated and compared using an identical test setting within a laboratory experiment.

Within the experiment I used four psychophysiological measures all indicating the user's cognitive workload. The results indicated that a higher support of NSSs actually leads to a lower user cognitive workload. In more detail, I found that an argumentation-based NSS which fully automates the generation of the user's arguments significantly decreased the user's cognitive workload compared to a standard NSS. In addition I found that a NSS implementing an additional chat function significantly causes higher cognitive workload for users compared to a standard NSS.

This work contributes to IS-research by providing the first empirical study which compares different NSS approaches from a user's cognitive workload perspective. The results emphasize the meaningfulness of the development of argumentation-based negotiation models using intelligent software agents (e.g. Amgoud & Vesic 2012; Lopes, Wooldridge & Novais 2008) from a human workload perspective. Furthermore, as I conducted a novel method which objectively derives the user's cognitive workload from its pupillary responses using modern eye-tracking technology, I reply in addition to research calls by several IS scholars to foster the conducting of objective psychophysiological measures in IS research (Dimoka 2010; Dimoka, Pavlou & Davis 2011; Ren et al. 2013), in particular on objective measurement techniques of a user's cognitive workload and its derivatives (Sun, Lim & Peng 2013). Since I applied a non-intrusive objective cognitive workload measurement technique, I further directly reply to the research call made by Steinfeld et al. (2006, p. 38).

7 LIMITATIONS AND FUTURE RESEARCH

The main limitation at this stage of research is rooted in the use of only five participants due to high laboratory costs for each test person. However, as shown in Table 1 these five participants were sufficient to confirm all three hypotheses to a very good level of significance. Further limitations concern generalization problems rooted in the laboratory setting. Because of the fact that luminance and emotional arousal are confounding factors of the task-evoked cognitive workload – pupillary diameter relationship (cf. Baltaci & Gokcay 2012; Ren et al. 2013; Wang et al. 2013; Zhai & Barreto 2006) lighting conditions have to be kept constant while emotional arousal should be avoided. These conditions can only be guaranteed within a laboratory setting. But laboratory results can only generalized to a limited degree. Despite the approach used deriving the user's cognitive workload as a non-intrusive approach using objective psychophysiological measures it is cost intensive due to the need for a laboratory setting. The final limitation concerns the empirical theorizing based on the "cognitive workload" construct as there is no universally accepted definition of this mental construct (cf. Chain 2007).

In order to deepen our understanding of the NSS caused decrease of a user's cognitive workload, future work should: (a) systematically extend the experiments on other NSS in order to re-test the hypotheses, (b) distinguish between "positive" workload (stimulating cognitive abilities) and "negative" workload inducing stress (Ayyagari, Grover & Purvis 2011), (c) broaden the objective measurements from eye-tracking data to other physiological signals such as electroencephalogram, or electrodermal-activity, and (d) compare the objective measured cognitive workload indicators with perceived indicators. In addition, as discussed earlier, the results indicated a need for future research about the user's cognitive workload – user's acceptance relationship.

In order to increase the external validity of the findings, future work will apply negotiation support systems within a queue of recruiting projects, all funded by the German Federal Ministry of Education and Research under contracts 17103X10 and 03FH055PX2 to sophisticate employee contracting in Germany through automated negotiation (Buettner 2006a,b; 2007a,b, 2009; Buettner & Kirn 2008; Buettner & Landes 2012). In the next step this work will be extensively evaluated in my laboratory (Buettner 2013a,b, 2014b, 2015c, 2016b; Buettner et al. 2013a; Buettner et al. 2013b; Buettner et al. 2015), before being implemented in external recruiting software, i.e., career-oriented social networking sites (Buettner 2015b, 2016a) and crowdsourcing platforms (Buettner 2014c, 2015a).

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