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Emotions and ERP information sourcing: the moderating role of expertise

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Abstract

Purpose – The purpose of this paper is to report on a laboratory experiment in which the paper investigated how expert and novice users differ in their emotional responses during use of an enterprise resource planning (ERP) system in a decision-making context, and how such a difference affects information sourcing behavior.

Design/methodology/approach – In a simulated SAP business environment, participants' emotional responses were physiologically measured based on electrodermal activity (EDA) while they made business decisions.

Findings – Results show that both expert and novice users exhibit considerable EDA activity during their interaction with the ERP system, indicating that ERP use is an emotional process for both groups. However, the findings also indicate that experts' emotional responses led to their sourcing information from the ERP, while novices' emotional responses led to their sourcing information from other people.

Research limitations/implications – From an academic standpoint, this paper responds to the recent call for more research on the role of emotions for information systems behavior.

Practical implications – The paper discusses the implications of this finding for the development of ERP system trainings.

Originality/value – Because emotions often do not reach users' awareness level, the paper used EDA, a neurophysiological measure, to capture users' emotional responses during ERP decision making, instead of using self-report measures that depend on conscious perception. Based on this method, the paper found that emotions can lead to different behavioral reactions, depending on whether the user is an expert or novice.

Keywords Emotion, ERP, Expertise, Electrodermal activity (EDA), Novice, Physiology, Enterprise resource planning (ERP) system

Paper type Research paper

1. Introduction

The objective of this paper is to investigate how the use of an enterprise resource planning (ERP) system is influenced by user's emotional response and level of expertise. ERP systems are configurable software packages that facilitate the integration of business data, both transactional and analytical, and business processes across organizations (Brehm *et al.*, 2001; Hitt *et al.*, 2002; Umble *et al.*, 2003; Al-Mashari, 2003). ERP usage has been widely studied using cognitive and behavioral approaches (e.g. Calisir and Calisir, 2004; Amoako-Gyampah and Salam, 2004), but only a limited number of studies have considered the role of user emotion in usage behavior.

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In this paper, we focus on the moderating role of expertise on the relationship between user emotion and ERP use in a decision-making context. We report that the emotional reactions of expert and novice managerial end users differ significantly in an ERP decision-making context, and that this difference has important behavioral implications. In a simulated business environment, managers' emotional responses were monitored while they made business decisions with an ERP system. The contribution of this paper relies primarily on the fact that, because emotions often below the threshold of awareness, we used electrodermal activity (EDA), a neurophysiological measure, to capture emotional responses during the decision-making process, instead of using self-report measures that depend on conscious perception.

Studying emotional response in the context of ERP systems is also relevant for both theory and practice. In recent decades, ERP systems have primarily been implemented in large organizations; today, though, software vendors are increasingly offering their systems to mid-sized organizations, often based on cloud technology (Lenart, 2011). According to Gartner Group, the worldwide market for ERP systems amounted to more than US$23.3 billion in 2011 (Hestermann *et al.*, 2012). A better understanding of user's emotional reactions in ERP usage could lead to more attuned change management and training curriculums.

The paper is structured as follow. We first build on two streams of research, namely, the literature on the role of emotion in information systems (IS) enabled decision making and IS research on perceptual and behavioral differences between expert and novice users. What follows is a presentation of our research method and a report on the research findings. We conclude with a discussion and implications for both research and practice.

2. Theory

2.1 Role of emotion in IS enabled decision making

Evidence indicates that accurate decision making is not possible without the involvement of emotions (Damasio, 1994; Bechara *et al.*, 1997; Bechara and Damasio, 2005). An emotion is defined as a "collection of changes in body and brain states which are triggered by a dedicated brain system that responds to specific contents of one's perceptions, actual or recalled, relative to a particular object or event" (Damasio, 1994, p. 71). Emotions serve the adaptive function of both focussing and prioritizing attention on significant events.

Research in cognitive neuroscience and related fields (e.g. neuroeconomics) has shown that emotions play a crucial role in social and economic decision making (Bechara *et al.*, 1997; Cohen, 2005). This insight has resulted in the development of the somatic marker hypothesis (SMH) (Bechara and Damasio, 2005). The SMH provides a neuroanatomical and cognitive framework for emotional decision making. It asserts that human decision making is influenced by a body-related (somatic) response. Specifically, the hypothesis postulates that decision behavior in healthy people is associated with unconscious somatic responses based on the recall of information related to an emotionally charged stimulus. In other words, "somatic responses are activated by the mere thought of an option, and either encourage or discourage the option" (Suzuki *et al.*, 2003, p. 82). Damasio (2009) also describes the SMH as memory traces learned from past experiences involving decision making that prompt action and result in specific outcomes.

One of the famous cases used to illustrate the consequence of damage to brain regions related to emotion processing was provided by Damasio (1994). He describes the case of a young patient with damage to the prefrontal cortices who lost his emotions. This patient was unable to make decisions due to his inability to weigh options. Bechara *et al.* (1997) provided further empirical support for the SMH, based on skin conductance measurement in a decision-making context. After being conditioned to be averse to risk, healthy subjects experienced an emotional response that inhibited a risky decision. In contrast, subjects with lesions in brain regions that are important for emotion processing (e.g. ventromedial prefrontal cortex, or amygdala) exhibited a preference for risky decisions. Thus, the problem for these people is that, due to the damage in their emotion-related brain regions, they find it difficult to imagine (even at an unconscious level) the possible adverse consequences of a decision, such as the financial loss that may result from the selection of a risky option. Taken together, theoretical research on emotions has proven to have wide practical implications, and has contributed to a better understanding of financial decision making (Bossaerts, 2009).

Research on the role of emotion in the context of IS use has also gained significant momentum in recent years (e.g. Ortiz de Guinea and Webster, 2013). For example, negative emotions have been found to play a major role in people's interaction with IS. It has been suggested that emotion felt by users such as anxiety can have detrimental consequences on IS use, especially in in the early phase of an implementation (Venkatesh, 2000; Beaudry and Pinsonneault, 2010). Moreover, evidence from IS research indicates that interruptions in human-computer interaction tasks may lead to significant negative emotions, such as the perception of physiological stress (Riedl *et al.*, 2012; Riedl, 2013; Love and Irani, 2007). Ortiz de Guinea *et al.* (forthcoming) report that the effect of emotion on behavioral beliefs might not be linear; they show, for example, that the effect of memory load on perceived ease of use changes from positive to negative as frustration increases.

Other recent research findings even suggest an emotional dimension of the usefulness construct, which has traditionally been framed based on the theory of reasoned action (TRA) in technology acceptance research (Dimoka *et al.*, 2011; Loos *et al.*, 2010; Riedl *et al.*, 2010a). Ortiz de Guinea and Markus (2009), therefore, argue that new theoretical lenses are needed to better understand IS behaviors, such as continuing IS use, because theories based on concepts that frame human decision making as an entirely rational activity (e.g. TRA) fail to account for the automatic and unconscious information processing underlying human judgment and decision making, as postulated, for example, by theories that do consider emotions in human decision making such as the SMH.

2.2 IS research on perceptual and behavioral differences between expert and novice users

Whether a user is an expert or a novice is also of paramount importance in developing a sound understanding of IS behaviors (Yang, 1997). The IS literature, as well as publications in other management disciplines, reports differences between experts and novices with regard to problem solving (Barfield, 1986), information search strategies (Tabatabai and Shore, 2005), cognitive processing (Bateson *et al.*, 1987), and conceptual modeling (Batra and Davis, 1992). For example, the study by Tabatabai and Shore (2005) specifically investigated how expertise in seeking information on the web affects search success (defined as "finding a target topic within 30 minutes"). Participants were recruited from three different groups, varying in the level of expertise (i.e. novices, intermediates, experts). Subjects' verbal protocols were analyzed, along with other complementary sources of data (e.g. questionnaires). In essence, the study found the following attributes to correlate with success, and that expertise is related to these attributes: first, using clear criteria to evaluate sites; second, not excessively navigating; third, reflecting on strategies and monitoring progress; fourth, having background knowledge about information seeking; and fifth, approaching the search with a positive attitude.

In the context of decision making, it has been found that users with a higher degree of computer self-efficacy spend less time making a decision, and they also use less information; moreover, their perceptions of a system's usefulness and their satisfaction are greater (Hung, 2003). Within the context of video games, Hong and Liu (2003) found that expert players are better at using analogical thinking processes than novices, who are more inclined to use trial-and-error approaches.

It is a well-established fact that training novice users is a crucial phase in the implementation of software systems, and that it has a significant influence on the adoption, acceptance, and use of systems such as ERP (Compeau and Higgins, 1995; Nelson and Cheney, 1987). Neuroscientific research can provide insight into this learning processes (i.e. gaining experience by shifting from the novice to the expert stage) based on structural changes in the brain, as well as changes in brain activity (Hill and Schneider, 2006). In an IS context, in the first phase in which a new skill is acquired to perform a task, a novice user has to invest considerable cognitive effort in order to orient him- or herself and learn basic navigation and transactional skills. During this first phase, the user is confronted with a number of new stimuli and events and must learn more about appropriate behavioral responses in order to use the system properly. This learning requires what is generally referred to as controlled processing, and entails significant cognitive involvement of brain regions related to both task control and working memory (especially the dorsolateral prefrontal cortex). As users gain more experience and become more comfortable interacting with the IS, they are likely to move toward a state of more automatic processing, which is characterized by less cognitive effort compared to controlled processing. Evidence indicates that, as an individual becomes more competent at a task, the activity in prefrontal brain regions declines significantly (Hill and Schneider, 2006).

With regards to ERP systems, one key aspect is for novice user to learn how and where to source the relevant information in the system in order to inform his/her decision making. A reallocation of decision rights is a consequence of ERP system implementation (McAfee, 2006). The reengineering of business processes, which usually underlies the implementation of an ERP system, changes decision rights along with business processes (Davenport, 1998). Some managers of organizations structured on the basis of functional units are likely to see their decision rights erode in favor of business process champions who oversee operational performance across organizational functions. As such, the novice user not only has to learn the technical aspect of sourcing information, but they must understand the new decision rights that result from the ERP implementation. McAfee and Brynjolfsson (2012), for example, suggest that being able to harness the analytical potential of this data does not only require training at the technical level to learn how and where to source the data, but also requires training at the cultural level as one must learn how to use the data effectively.

Considering the evidence presented by different research disciplines, there is reason to assume that expert and novice users differ significantly in their perceptions and behaviors toward a new system. Specifically, one would expect significant differences in managers' usage behavior in an ERP decision-making process.

2.3 Behavioral differences in ERP use in a decision-making context: research model and hypothesis

Building upon our theoretical discussion, this paper argues that previous exposure to an ERP system is likely to change the individual's perspective and may alter the emotional conditioning related to the ERP system. In other words, we argue that expert ERP users are likely to approach ERP decision making, and specifically information sourcing, from a different perspective. In this section, we theorize that ERP expertise will change the way a user will behaviorally react to the emotion elicited by his/her interaction with the system.

Based on predictions derived from the SMH and evidence from neuroscience on learning processes, decision-making differences are likely to be a function of differences in pre-decisional emotions, which, in turn, are considerably affected by a person's experience with a specific stimulus (Damasio, 2009). Because of their previous experience in managing business in an ERP context, experts should feel more in control of using business data that is directly available in the ERP system to make their business decisions (Raggad, 1997). The experts' previous experience is likely to have shaped their mental model of managing an organization with real-time integrated information. Without experience, the degree of novelty of a stimulus, including the context in which that stimulus is perceived, is high. A high degree of novelty implies a high level of uncertainty, which, in turn, may cause stress or arousal, thereby leading to increased attention. Because of this higher level of attention (more controlled processing), an individual becomes more familiar with the stimulus and context; in other words, experience is gained. In future situations in which the individual faces a similar situation (or one that resembles a familiar situation), the degree of automatic processing becomes higher. This, in turn, demands less cognitive effort and may also result in increased task performance (Haier *et al.*, 1992).

At the same time, because fewer cognitive resources are needed for the neural implementation of task control and working memory, experts have more cognitive capacity available for the neural implementation of other cognitive processes, including deliberate thinking. Thus, other things being equal, experts, unlike novices, should be better able to recognize patterns in data and to engage in deductive reasoning, which can potentially improve their decision-making performance. Thus, experts should be better able to use their somatic responses to trigger more deliberate thinking processes in the decision-making process. Building on previous research, therefore, experts should identify irregularities in data more quickly than novices.

There is a long tradition in IS research of studying emotion using questionnaires. While these questionnaires are widely used and have certainly contributed to knowledge on user attitudes, beliefs, behavioral intentions, and actual behavior, they also have limitations. With respect to measuring emotion, self-reported measures "cannot capture automatic use states or patterns that occur outside individuals' awareness" (Ortiz de Guinea and Webster, 2013, p. 1166). One way to capture individuals' somatic responses, without disturbing the natural human-computer interaction situation, is the application of neurophysiological measures, particularly EDA (e.g. Riedl *et al.*, 2013). This measure, which is also referred to as galvanic skin response or skin conductance, is a reliable index of autonomic nervous system activity, measured by the potential conductance difference between two areas of the skin (Dawson *et al.*, 2007). Specifically, EDA measures electrical skin conductance, which varies with the production of sweat located in the eccrine sweat glands (Boucsein, 2012). This process is controlled by the sympathetic division of the autonomic nervous system, and it is used widely in the literature as an objective measure of emotional arousal (Bradley *et al.*, 1993; Lang, 1995). We therefore chose for a NeuroIS strategy of inquiry, which has been defined as follows: NeuroIS "seeks to contribute to (i) the development of new theories that make possible accurate predictions of IT-related behaviors, and (ii) the design of IT artifacts that positively affect economic and non-economic variables (e.g. productivity, satisfaction, adoption, well being)" (Riedl *et al.*, 2010b, p. 245).

Figure 1 presents our research model. We expected that somatic responses in the ERP decision-making process would affect the behavior of expert and novice users differently. Specifically, we focus our inquiry on the information sourcing behavior during the decision-making process, as this specific aspect has been shown as a key learning element in becoming an expert ERP user (McAfee and Brynjolfsson, 2012; Davenport, 2012). Based on their previous experience when using an ERP system, experienced users should be conditioned to source the data available in the system to support their decision making process. In a context that requires users to draw on their emotional resources in the decision-making process, experienced users should be more likely to source information from the data available in the ERP system. In contrast, novice users, who have little experience using transactional data in the ERP to solve business problems, would likely tend to turn to sources available outside the system, such as colleagues, to inform their decision making.

Moreover, novices' greater inclination toward stress perception in ERP use situations is likely to facilitate an expertise-based difference in information sourcing behavior. A possible strategy for novice users to cope with higher levels of stress perception is to search for and consider more information, because information typically leads to a higher level of confidence in a decision (Hall *et al.*, 2007). However, because novice users have difficulties in searching for information within the ERP system, they will search for information elsewhere. Specifically, we predict that they will start communication with other humans, thereby increasing their information level and reducing their perceived stress levels. Against the background of the previous discussion, and building on the SMH, memory traces learned from past experiences involving decision making with an ERP system will prompt action and thus moderate the effect of user emotion on information sourcing behavior. Specifically, we pose the following two hypotheses:

H1. User emotion affects ERP information sourcing behavior.

H2. User expertise moderates the relationship between user emotion and ERP information sourcing behavior.

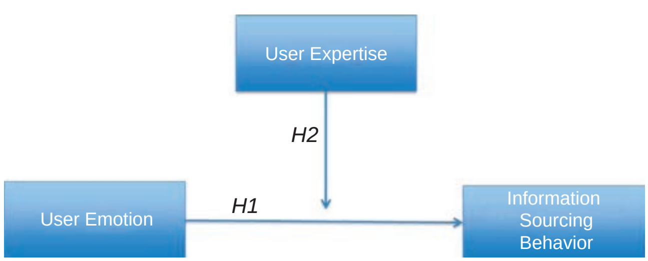

Figure 1.
Research model

3. Methodology

3.1 Experimental setting

A laboratory experiment was performed with subjects who had to use an ERP system in order to make managerial decisions in a simulated business environment called ERPsim (Léger, 2006; Léger *et al.*, 2007). The sample consisted of 21 MBA students (12 males and nine females) of a Midwestern American University who voluntarily agreed to take part in the study. The average age of participants was 28.3 years old with as standard deviation of 4.4 years. This project was approved by the IRB of the university.

Subjects had little or no previous experience with the specific ERP system used in this study, namely SAP. However, eight out of the 21 subjects had experience with the use of another ERP system in a previous managerial position, which also involved decision making within an ERP system. Subjects were given a one day introductory training session by a seasoned instructor; so they could use the SAP system for this simulation (see Léger *et al.*, 2011).

During the simulation, each team had to manage critical business processes relevant to a manufacturing company using the SAP system. This ERP was chosen for this study by convenience; ERPsim is only compatible with this specific ERP software. The experimental task involved decision making on first, forecasting demand and planning production; second, replenishing and managing inventory; third, executing production; and fourth, promoting and distributing the finished product (see Léger *et al.*, 2012 for further details on the specific aspects of this simulation).

For the purpose of the study, the subjects were randomly assigned in teams (three teams of three persons + three teams of four persons = 21 participants). Each team played the same scenario against computer players. Within each team, every player was randomly assigned to one of the four decision categories. Based on Caya *et al.* (2012), a simulation lasted for 12 consecutive rounds of five minutes each , resulting in a total simulation time of 60 minutes (note that each round of five minutes gives sufficient time for a team to evaluate the operational situation, take appropriate action, and observe the resulting consequences). To reduce external and potentially confounding stimulation, players from the same team were separated by blinders, had to wear earplugs, and could only interact with their team members electronically (via Skype instant messaging). Room temperature and humidity were kept constant during the entire experiment to avoid confounding influences on EDA measurement.

3.2 Operationalization of variables

There are two decision-making process variables: Information Sourcing from ERP (*IS_ERP*) and Information Sourcing from Humans (*IS_HUM*).

IS_ERP. Following each simulation, SAP log files were extracted. The *IS_ERP* variable corresponds to the number of times per round of the simulation in which a user made a query in the ERP in order to extract a business report. For this variable, we aggregated the total number of system-generated reports viewed by team members during each five-minute period of each simulation (there are 12 periods of five minutes per simulation). In other words, it corresponds to the average number of reports executed by all team members in the system during a specific period. These data were extracted from the ERP database at the end of the simulation.

IS_HUM. Electronic communication between the confederates during the simulation was archived and coded. *IS_HUM* corresponds to the number of times a user sourced information that would have been otherwise available in the system directly from confederates via electronic communication during each five-minutes period of the simulation (e.g. What is the level of inventory?). In other words, this variable corresponds to the number of times that a user asked during a specific period his or her colleagues questions that he or she could have otherwise found directly in the business reports available in the system. To validate the coding, 10 percent of the communications were randomly selected and independently verified by the researchers, which yielded inter-rater reliability of 93.3 percent.

Expertise. This is a binary variable where Expert = 1 and Novice = 0.

Non-specific electrodermal response (SD.NS.EDR) and non-specific amplitude of electrodermal response (AMP.NS.EDR). During the experiment, EDA data were acquired from each participant. With their consent, pre-gel single use disposable electrodes were attached to the palms of the participants' hands to measure EDA. Data were collected at the value of 32 HZ, using a Procomp Infinity encoder (Thought Technology Inc, Montréal). A five-minute EDA, corresponding to each round, was manually corrected for artifacts. Following Boucsein (2012), we used Matlab to normalize and transform each sample in the percentage of the span from the signal within the experiment.

In this paper, the emotional response is measured by two EDA-related metrics, the amplitude and the variation of the physiological signal, which convey two different kinds of information about the emotional reaction of the participants. First, we examine the amplitude of the non-specific electrodermal response (AMP.NS.EDR), which is generally associated with the subject's overall arousal level (Dawson *et al.*, 2007). Second, we measure the variation relevant to this activity, as a proxy for the somatic response (variation of the emotional responses) during the simulation. In the context of an audio-visual stimulation, which lasts a few minutes (such as the use of a computer), Besthorn *et al.* (1989) suggest the use of the standard deviation in the non-specific electrodermal response amplitude (SD.NS.EDR) to capture the overall somatic response during a time interval. Both measures were calculated based on Boucsein (2012).

4. Results

4.1 Descriptive statistics

Table I presents the descriptive statistics and correlations of the variables of this study. Descriptive statistics are based on a panel data set of 252 valid observations (21 subjects × 12 rounds). It should be noted that there are no significant multicolinearities between the research variables (see Table I).

	AMP.NS.EDR		SD.NS.EDR		Expertise		*IS_ERP*		*IS_HUM*	
	Corr.	*p*-value	Corr.	*p*-value	Corr.	*p*-value	Corr.	*p*-value	Corr.	*p*-value
AMP.NS.EDR	1.00									
SD.NS.EDR	−0.06	0.355	1.00							
Expertise	−0.03	0.587	0.07	0.260	1.00					
IS_ERP	−0.38	0.000	0.13	0.039	0.14	0.022	1.00			
IS_HUM	−0.02	0.743	0.10	0.120	−0.08	0.188	−0.01	0.908	1.00	
Mean	0.57		0.08		0.38		0.74		10.42	
SD	0.19		0.05		0.49		1.07		8.17	

Table I. Descriptive statistics and correlations

4.2 Hypothesis testing

A repeated measures data set with 252 valid observations (21 subjects × 12 rounds) was used to estimate Model 1 (dependent variable: *IS_ERP*) and Model 2 (dependent variable: *IS_HUM*). For data analysis, we used STATA/SE 10.1 with XTreg command for the estimation (XTreg is used with longitudinal or panel data; it fits cross-sectional time series or panel data regression models with random effects; further information on this procedure can be found in StataCorp, 2007, p. 1691).

Our results provide support for *H1* and *H2*. Overall, data indicate that experts' emotional responses led to their sourcing information from the ERP (*IS_ERP*), while novices' emotional responses led to their sourcing information from other people (*IS_HUM*); the difference is statistically significant. Tables II and III summarize the statistics of Models 1 and 2. We describe these results in detail below.

In Model 1 (see Table II), AMP.NS.EDR has a strong significant negative direct effect on *IS_ERP* ($\beta = -13.93$, $p < 0.000$). This suggests that subjects with higher amplitudes of electrodermal response are less likely to use the ERP system to source information. We find a strong significant interaction between level of expertise and SD.NS.EDR ($\beta = 77.99$, $p < 0.000$). Thus, expert subjects had greater variation in the

Table II. Regression results with *IS_ERP* as dependent variable

	Model 1 Dependent variable: *IS_ERP* Direct effect			Model 1 Dependent variable: *IS_ERP* With interactions		
	Coef.	SE	$p > z$	Coef.	SE	$p > z$
Expertise	2.151	1.699	0.103	−6.316	4.123	0.063
AMP.NS.EDR	−13.926	2.708	0.000	−14.627	3.078	0.000
SD.NS.EDR	11.902	9.550	0.107	−15.486	11.539	0.090
Expertise × AMP.NS.EDR				3.153	5.947	0.298
Expertise × SD.NS.EDR				77.987	19.445	0.000
Constant	16.536	2.033	0.000	19.156	2.242	0.000
R^2	0.42		0.0000	0.44		0.0000

Notes: Panel regression with Stata XTreg. Data points: 252 (21 subjects × 12 rounds). Directional hypothesis: one-tail p-value

Table III. Regression results with *IS_HUM* as dependent variable

	Model 2 Dependent variable: *IS_HUM* Direct effect			Model 2 Dependent variable: *IS_HUM* With interactions		
	Coef.	SE	$p > z$	Coef.	SE	$p > z$
Expertise	−0.199	0.164	0.113	1.221	0.578	0.018
AMP.NS.EDR	−0.136	0.371	0.358	0.281	0.422	0.253
SD.NS.EDR	1.927	1.373	0.081	3.621	1.687	0.016
Expertise × AMP.NS.EDR				−1.757	0.861	0.021
Expertise × SD.NS.EDR				−4.998	2.853	0.040
Constant	0.730	0.264	0.003	0.353	0.299	0.119
R^2	0.14		0.000	0.23		0.000

Notes: Panel regression with Stata XTreg. Data points: 252 (21 subjects × 12 rounds). Directional hypothesis: one-tail p-value amplitude of their electrodermal responses, and consequently they were more likely to use the ERP system in response to this perception of stress (rather than communicating with other people). Taken together, these findings provide support for *H1*.

In Model 2 (see Table III), we find a weak significant effect of SD.NS.EDR on *IS_HUM* ($\beta = 1.927$, $p < 0.081$). This finding suggests that subjects with a higher electrodermal response are more likely to communicate with other people (rather than with the ERP system). However, taking expertise into account with interaction effects, we find a significant negative moderating effect for both AMP.NS.EDR and expertise ($\beta = -1.76$, $p < 0.021$) and SD.NS.EDR and expertise ($\beta = -4.99$, $p < 0.040$). Thus, when experts experience either a higher amplitude of electrodermal response, or a higher variation in this amplitude, they are more likely to decrease their communication with other humans. Taken together, these findings provide support for *H2*. In other words, we find evidence that user expertise moderates the relationship between a user's emotional response and the ERP information sourcing behavior.

To further substantiate our results, we have also verified that expertise does not have a mediating effect on the information sourcing behavior via the emotional response. To exclude this theorizing, we have used the Baron and Kenny (1986) criteria for a mediation effect to assess the influence of an independent on a dependent variable (see Table IV). While three of the four criteria are partially met, the second condition is never significant, excluding the possibility of a mediating effect.

5. Discussion and concluding comments

In this paper, we investigated how expert and novice users differ in their emotional responses during the use of an ERP system (SAP) in a decision-making context.

First condition Correlation between independent and dependent variables[a]	Second condition Correlation between the mediating and independent variables[a]	Third condition Correlation between the mediating and dependent variables[a]	Fourth condition Correlation between the mediating and dependent variables, controlling for the independent[b]
Partially accepted	Not accepted	Partially accepted	Partially accepted
Expertice vs IS_ERP *Corr 0.140, $p = 0.022$*	AMP.NS.EDR vs Expertice Corr 0.07, $p = 0.260$	*AMP.NS.EDR vs IS_ERP* *Corr −0.380, $p = 0.000$*	*AMP.NS.EDR vs IS_ERP* *Coefficient −13.926, $p = 0.000$*
Expertise vs *IS_HUM* Corr −0.08, $p = 0.188$	SD.NS.EDR vs Expertise Corr 0.012, $p = 0.894$	SD.NS.EDR vs *IS_ERP* Corr 0.130, $p = 0.390$	SD.NS.EDR vs *IS_ERP* Coefficient 11,902, $p = 0.107$
		AMP.NS.EDR vs *IS_HUM* Corr −0.02, $p = 0.743$	AMP.NS.EDR vs *IS_HUM* Coefficient −0.136, $p = 0.358$
		IS_HUM vs SD.NS.EDR Corr 0.100, $p = 0.120$	*IS_HUM vs SD.NS.EDR* *Coefficient 1,927, $p = 0.081$*

Notes: [a]Coefficients were also calculated using the XT Probit and XTReg in Stata and results are consistent; [b]regression coefficients were calculated using XTReg in Stata

Table IV. Conditions for mediating effect

We found that emotional reactions of expert and novice managerial end users differed significantly. Our results also reveal that this physiological difference has important behavioral implications for system usage. Specifically, our findings show that experienced users tend to use data available in the system in stressful situations to help them execute decision-making tasks. In contrast, novices with no experience with ERP system usage tend to source information from outside the system – they communicate with colleagues to complete the decision-making task. Against the background of these findings, our study highlights the fact that experts and novices do not differ only in their knowledge of a business application. They also behave differently due to unconscious emotional responses.

Moreover, we found that Model 1 (dependent variable: *IS_ERP*) explains more variance than Model 2 (dependent variable: *IS_HUM*). With the interaction terms, Model 1 explains 44 percent of the variance, whereas Model 2 explains 23 percent. Even though we consider these levels of explained variance as moderate to high (if IS research and human-computer interaction studies are used as benchmarks), it is important to note that other factors, which are not considered in this study, are also at play in the communication patterns during the experiment.

In this study, we have shown that in emotionally charged situations novice users tend to avoid interaction with an ERP system in a decision-making context. Instead, they tend to establish communication with other humans in order to perform their tasks. This behavior is disadvantageous at least for two reasons. First, not using the ERP system impedes the development of the benefits associated with ERP system usage, such as reduced cycle times and transparent workflows. Second, a desire to communicate with other employees when performing one's own tasks reduces the other employees' productivity because they are prevented from executing their own tasks.

These findings substantiate the relevance of affective components in IS training, a topic that has been studied very little so far (see a recent literature review by Gupta *et al.*, 2010). In essence, this review shows that, while skill-based and cognitive-based training goals are extensively covered in the literature, affective learning concepts (which are related to such concepts as anxiety, feelings of apprehension, tension, or uneasiness – all of which characterize novice users) are not. Against this background, our results have practical implications how users are generally trained in corporate settings. The more systematic inclusion of an affective training goal could be beneficial for novice managerial end users. Affective training goals (e.g. controlling one's own emotions) can give users a more positive attitude toward the system, thereby increasing their confidence in their own ability to use the system to complete their tasks.

Promising approaches suggested in the literature include the use of behavioral modeling (vicarious learning) and observation of self-actions (enactive learning) (Gupta *et al.*, 2010; Bandura, 2001). In vicarious learning, the trainee builds a mental model by observing the emotions, attitudes, and behaviors of a trainer who performs a given task. In enactive learning, the trainee learns from interactions with a live artifact and builds a mental model based on the consequence of his or her own emotions and behaviors. These two training methods are centered on providing a component of managerial end users' training.

From an academic standpoint, this paper responds to the recent call for more research on the emotional nature of IS behavior. In essence, evidence indicates that using IS is often not a conscious process (as assumed by theoretical frameworks such as TRA); instead, user behavior is strongly affected by unconscious and automatic somatic processes (Riedl *et al.*, 2010a; Dimoka *et al.*, 2011). Because such processes and the corresponding perceptions are often difficult to report in questionnaires, the use of tools that can capture a user's physiological reactions (in this case, EDA measurement) is indispensable for theoretical advances. This paper seeks to make a contribution in this domain with physiological evidence on user emotion in an ERP context.

This paper has several limitations, which offer potential for future studies. The study was conducted in a laboratory setting with a limited number of MBA students. Future field studies are recommended to test our results in natural settings. Also, even though we obtained statistically significant results based on a relatively small sample (which is, however, not uncommon in studies with physiological measurement), future studies should be conducted with larger samples in order to replicate our findings. Moreover, additional measurement tools could also be used to capture a richer and more comprehensive account of users' biosomatic responses. For example, it could be interesting to add a cognitive component via electroencephalography to this study by measuring cognitive load and engagement (Ortiz De Guinea *et al.*, 2013). Moreover, heart rate variability measurement or electroencephalography could also be used (Riedl, 2013).

In recent years, SAP and Oracle, two leading ERP system providers, have both invested significant amounts to acquire specialized software enabling simulation-based e-learning training (Oracle acquired Global Knowledge Software, and SAP purchased Datango). Companies are using these e-learning tools to reduce the cost of face-to-face training, and to give new users step-by-step instructions on how to use the system. In this changing training landscape, it is even more important to consider emotional training goals; incorporating this factor in distance learning is not a trivial concern.

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