Behavioural Affect and Cognitive Effects of Time-pressure and Justification Requirement in Software Acquisition: Evidence from an Eye-Tracking Experiment

Completed Research Paper

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Abstract

Decision makers often have to make decisions in high-pressure situations in which time is limited and competing alternatives are similar. However, research on how time-pressure influences decisions in an information system (IS) context is relatively limited. This study examines the influence of time-pressure on behavioural affect and cognitive effects using eye tracking technology in a behavioural experiment on a software acquisition task. Further, it explores the independent and interactive influence of justification requirement. Results indicate that time-pressure creates discomfort and limits the amount of time spent examining the available information, both in terms of the number of fixations (gazes at part of the screen) and the duration of those fixations. However, this does not mean that information was ignored. Instead, decision-makers under time-pressure actually examined more information under certain circumstances, i.e. the justification requirement seems to interact with time-pressure.

Keywords: time-pressure, justification, eye tracking, decision strategy, software acquisition

Introduction

Time is a fundamental element of all human activities, and many human activities are subject to limited time frames. Past research indicates that time-pressure impacts an individual's decision strategy and affective state (Maule et al. 2000). For example, analysis for an important decision might normally be performed using a deliberative processing strategy, which is slow, highly analytic, and based on a conscious appraisal of facts and cause-and-effect relationships (Epstein 1998). Under time-pressure, however, a more intuitive processing mode might be used in which processing is fast and based on heuristics learned from past experience (Epstein 2008).

A careful deliberative approach is arguably most suited to software selection decisions because even relatively inexpensive programs, such as computer design or spreadsheet packages, often require significant expenditure on training, support, and other services on an ongoing basis. Unfortunately, managers often have to make decisions in high-pressure situations in which time is limited and competing alternatives are similar. Decision-support tools have an important role in supporting and facilitating individuals' decisions under time-pressure; however, research on how time-pressure influences decisions in an information system (IS) context (e.g. software selection) is relatively limited (Hwang 1994, Eckhardt et al. 2012).

In this study we examine the influence of time-pressure on performance for a software acquisition task. Software selection is a common activity in all types of enterprise, but although mundane, it is nevertheless a key business decision, particularly when selecting software to support business processes. Typical steps in the software acquisition process for a major purchase include defining the organization's requirements, requesting bids from rival vendors, inviting short-listed vendors to present their business case, and ultimately, selecting a solution (Halingten and Verville 2001). Our research sits at the end of such a process and investigates the final decision for a software solution.

We investigate whether time-pressure affects the decision strategy employed and whether negative impacts of time-pressure are mitigated or exacerbated by forcing the decision-maker to justify the decision, which is a common requirement for purchasing decisions. If time-pressure leads to negative affect and to avoidance behaviour, employing techniques that reduce these effects may lead to improved decision making. Particularly avoidance behaviour leading to delays can lead to high costs for organizations (O'Donoghue and Rabin 1999). Managers could reduce negative affect and avoidance behaviour either directly by not putting employees under time-pressure or indirectly by helping people to change the way they respond to time-pressure. To allow us to assess the completeness of information search for each participant, eye-tracking technology is employed.

Results indicate that time-pressure creates discomfort and limits the amount of time spent examining the available information, both in terms of the number of fixations (gazes at part of the screen) and the duration of those fixations. However, this does not mean that information was ignored. Instead, decision-makers under time-pressure actually examined more information under certain circumstances, i.e. the justification requirement treatment variable seems to interact with time-pressure. Participants examined *less* information under time-pressure as compared to no time-pressure, but they examined *more* information under time-pressure than no time-pressure when there was a justification requirement. Consequently, requiring an explicit justification of the decision improved the completeness of information search *only* when the decision was made under time-pressure.

Literature Review and Hypotheses

Time-pressure in IS-related decisions

Examining the effect of pressure to perform is part of a major research stream across disciplines as diverse as management, social psychology, physiology, and music (Wright 1974, Freedman and Edwards 1988). Somewhat surprisingly, given the amount of research into decision-support system, comparatively little work has been done in the IS discipline (Eckhardt 2012 et al). Hwang (1994) provides a general model for decision making under time-pressure to perform for IS research. However, this model has not yet sparked a broad research stream into IS-related decisions and time-pressure. A related field in IS is

the research on technostress which looks at effects of stress on users' perception of IT application (Tarafdar et al. 2010-2011). However, this field does not specifically deal with decision-making under time-pressure.

In the IS discipline, time-pressure is involved most often in studies of the utility of different presentation formats. Marsden et al. (2002a, 2002b, 2006) is arguably the most systematic of these studies, which examined behaviour under time-pressure with different information sources and performance-based financial incentives. They found that individuals were adverse to time-pressure when processing information, generally preferring the slowest speed over the highest speed of presenting information. Benbasat and Dexter (1986) also investigated decision making with different presentation formats under varying time constraints and found that time-pressure led to more accurate decisions using tabular reports while graphs facilitated faster decision making.

Behavioural Affect

Psychology research generally suggests that time-pressure reduces both the quality of judgment and decision making and individuals' confidence in the quality of their decisions (Maule and Edland 1997 for a review of this literature). Time-pressure can also change one's affective state by increasing feelings of anxiety (Maule et al. 2000). Lazarus (1991) in his theory of emotions proposes that individuals cope with this type of negative affect through two strategies: *emotion-focused coping* and *problem-focused coping*. The problem-focused coping strategy deals with negative affect by resolving a situation, thereby eliminating the source of the threat. Emotion-focused coping, by contrast, is used when the threat cannot be resolved. Using this strategy, a person reduces the level of perceived threat by changing how the situation is perceived; for example, the person may change the personal meaning of a situation, change the intensity of the response, or redirect attention away from the threat. In other words, if the threat cannot be resolved, the individual will be motivated to cope by avoiding making a decision or at least avoiding dealing with certain features of a decision. There is some empirical support for this theory: Luce (1998), for example, reports that individuals show lower levels of negative affect after avoiding a choice.

On the basis of this discussion of the use of choice avoidance as an emotion-based coping strategy and the evidence that time-pressure leads to negative effect, we propose the following hypothesis:

H1: Time-pressure influences affective states, such that individuals under time-pressure to make a decision feel increased uneasiness, decreased confidence and an increased willingness to postpone the decision.

Up to this point we have discussed only negative effects of time-pressure on one's affective state and behaviour. However, time-pressure may also have positive influences. Hwang (1993) posits that time-pressure increases task difficulty, and that increased difficulty increases goal commitment, providing the goal is still perceived to be achievable. More commitment typically results in more effort being applied to a task, and through this, increased performance may occur. Maule and Hockey (1993) similarly argue that for important decisions, time-pressure may induce adaptive behaviours so that individuals can achieve their goals.

One way that individuals are believed to adapt to time-pressure is modifying the way in which information is processed, specifically, by changing from conscious deliberative processing to intuitive, experience-based processing (Epstein 2008). Ensuring that information processing requirements and task speed are compatible should, in principle, improve task performance (Epstein 1998; Evans 2008). Our distinction between deliberative and intuitive processing is derived from Epstein's Cognitive Experiential Self Theory (CEST) (Epstein 1998), a dual-process theory. The defining feature of this class of theory is the idea that learning and reasoning occur through experience and abstract rules via two parallel information processing systems (Evans 2008). In the specific theory we describe here, Cognitive Experiential Self Theory (CEST) (Epstein 1998), they are labelled the analytical-rational and experiential systems respectively.

CEST proposes that everyone uses both systems to learn how to adapt to the environment, but we rely on each system for different information processing needs (Epstein 1998). The *rational system* uses an analytical-rational processing style in which assessment is intentional, analytic, and primarily verbal.

Using this system, reality is encoded and understood best using abstract symbols, words, and numbers (Epstein 1998). The *experiential system*, on the other hand, uses an intuitive-experiential style in which assessment is fast, holistic, associationistic, emotional, and image-based (non-verbal). Using this system, reality is encoded and understood via concrete images, metaphors, and narratives (Epstein 1998).

Setting up a task so that an appropriate system is utilised is potentially important because when the design of instructional materials supports how an individual wants to process that information, that person will not only believe he or she is learning more effectively, but will actually perform in an objectively superior manner (Hayes and Allinson 1998). Indeed, the environment tends to induce the processing mode employed, with tasks requiring fast decisions tending to use the experiential system; and tasks requiring a slower, more deliberative and reasoned approach tending to use the rational system (Epstein 1998).

In other words, if the environment supports the decision-maker's style (e.g. intuitive processing is suited to fast processing under time-pressure), the decision-maker will exploit the material more effectively (Workman 2004). On the other hand, if the environment is not supportive (e.g. requiring deliberative processing under time-pressure), it is hard to exploit the material as effectively. We further predict that environments that do not completely suit the required style, such as requiring deliberative processing under time-pressure, will generate negative perceptions because the processing style needing to be employed will not be compatible with the environment, and processing will therefore be sub-optimal. On the other hand, confidence in the decision should be higher in environments that do support the required style, such as a justified decision with no time-pressure, or a fast decision that does not require justification.

On this basis, we predict:

H2a: Requiring justification of a decision without time-pressure will influence a person's affective state, such that, compared to a condition where no justification is required, that person will feel reduced uneasiness, increased confidence and a reduced willingness to postpone the decision.

H2b: Requiring justification of a decision under time-pressure will influence a person's affective state, such that, compared to a condition where no time-pressure is present, that person will feel increased uneasiness, decreased confidence and an increased willingness to postpone the decision.

Thus, with H2a and H2b we essentially expect an interaction of time-pressure and justification requirement.

Cognitive Effects

Judgment and decision-making research also indicates that the effect of time-pressure depends on the decision strategy adopted in that time-pressure causes a decision-maker to vary both the *micro* and *macro* decision strategy employed (Maule and Edland 1997). Micro changes to decision making strategies are associated with acceleration and selectivity. Acceleration refers to the use of techniques to process information more quickly, including increasing the speed of information processing or eliminating pauses or other interruptions during processing. Selectivity describes the reduction of the total amount of information processed. It is most likely conducted according to importance perceptions of the different information cues.

Macro changes to decision making strategies are related to the adaption of the underlying decision rule. Time-pressured individuals tend to adopt rather non-compensatory as compared to compensatory decision strategies. Compensatory decision-making strategies regard all available information through alternative wise or dimension wise comparisons, whereas non-compensatory decision making strategies aim at simplifying decision processes through heuristics. Heuristics may be conjunctive, lexicographic or elimination-by-aspect strategies (Payne et al. 1993). Ford et al (1989) suggest that individuals under time-pressure show an increased use of attribute-based rather than alternative-based processing. Additionally,

time-pressured individuals may change their information processing priorities by placing more weight on certain categories of information and processing them to a greater extent (Wright 1974).

Beach and Mitchell (1978) explain these strategy changes by a contingency model of strategy selection. According to this theory decision makers have a repertoire of decision rules and adopt some of these rules depending on particular situations. The adoption is driven by a cost-benefit analysis. Costs involve the resources necessary to adopt the decision strategies, associated with both internal resources (e.g. energy) and external resources (e.g. finance). Benefits are associated with the value derived from adopting the decision strategy. The basic assumption is that for every situation there is a strategy which optimises the cost-benefit consideration. Time-pressure, as a variable, is considered to change the cost-benefit calculation and may eventually lead to a change in strategy.

H3: Time-pressure changes individuals' micro and macro decision strategies.

Beach and Mitchell (1978)'s contingency model may also accommodate an interactive influence of time-pressure and justification requirement, such that individuals react differently to time-pressure when they are required to justify the situation as this requirement may change the optimal decision strategy with or without time-pressure.

H4: A justification requirement influences the effect of time-pressure on micro and macro decision strategies.

Method

We used a 2x2 in-between participant experimental design. The two treatments were time-pressure (no/yes) and justification (no reasoning/explicit reasoning). Participants were presented a hypothetical case with a decision task in which they had to decide between two ERP systems: system A and system B. They assumed the role of a senior information systems analyst responsible for the decision. Participants were students from a second year Accounting and Information Systems unit of a major Australian University. 122 participants took part on a voluntary basis.

Procedure

Participants completed the experiment in a behavioural laboratory of the University. Participants were seated individually in boxes in front of computers. At the beginning of the experiment participants' eyes are calibrated using a nine-point fixation technique in order to adjust for participants individual differences in seating position or eye characteristics. Thus, despite the non-intrusiveness of the technology participants are aware that their eyes are recorded.

After the calibration of the eye-tracker, a web-based survey was initiated which contained the experimental instructions and post questionnaires. The experimental treatments were randomly assigned by the web tool.

The case material asked the participants to act as a senior information systems analyst who is responsible for the selection and implementation of a new enterprise resource planning (ERP) system in his/her company. After the initial search for appropriate systems he/she and his/her team had identified two preferred systems (A and B) and had rated them on relevant criteria between 1 (= very poor) and 10 (= very good).

Participants were informed that the sum of the ratings for each system ended up to be the same. Thus, the decision depended on the weights they placed on the individual criteria.

Before presenting the ratings for the systems the manipulations were performed. In the control condition (no time-pressure, no reasoning), participants were merely told that their boss asked them to make a final decision. Time-pressure was manipulated by telling them that the final decision is time critical which is why their boss asked them to make the decision as fast as possible today. Before proceeding participants were re-affirmed that given the situation they should make their decision on the following screen as fast as

possible. Justification with explicit reasoning was manipulated by telling participants that they should state reasons for their decision and summarize the key factors leading to the decision in a report (the instructions are displayed in the Appendix). The decision screen was then presented, and each participant selected a software package.

In the 'explicit reasoning' treatment condition, an open-ended request to justify the decision was shown, but no such request was made for the 'no reasoning' treatment group. Each participant was then asked several post-experimental questions about confidence, tendency to postpone the decision and uneasiness, and finally a manipulation check question about whether a feeling of time-pressure was experienced.

Variables

Time-pressure (no/yes) and justification (no reasoning/explicit reasoning) serve as independent variables.

Dependent variables to investigate behavioural affect are the post-experimental questions on *confidence*, *uneasiness* and *postponement* (see Appendix).

In order to measure cognitive effects and approximate decision strategies we use *fixation durations*, *fixation counts*, *time to first fixation* during information processing of the screen, which shows information about the ratings of the two systems, as dependent variables. Participants can review this screen only once. After clicking on continue they cannot go back to the statements.

Completeness of Search is a count of how many information cues were investigated by the participants. '*Completeness of Search of Values'* refers the 16 values representing the attribute ratings per system (refer to Appendix). If a value is investigated, the measure increases by one. '*Completeness of Search of Labels*' refers the eight labels describing the selection criteria (e.g. usability). Again, if a label is investigated, the measure increases by one. '*Values in Proportion to Labels*' describes the proportion in fixation duration for all attribute labels as compared to all values for System A and System B. Horstmann et al. (2009) have successfully used a similar measure denoted amount of inspected information.

We define several areas of interest (AOI). The main AOI is a 794 x 828 pixel rectangle covering all information in the decision screen besides the next button (refer to Appendix). In order to cover eye behaviour for single information cues (dimension labels, criteria labels, criteria values) we define rectangular AOI of 150 x 45 pixels covering the information cue. Additionally, we defined AOIs of 209 x 407 to cover all criteria labels, all System A criteria values and all System B criteria values.

Eye Tracking Device

We use a Tobii T120 eye tracking system to record eye movements while participants were reading through the performance evaluation case. The Tobii T120 eye tracking system uses infrared corneal and pupil reflection to follow the eyes on screen (Tobii 2010). The camera is built into the rim of a 17-inch TFT monitor in order to not distract subjects. Recordings are taken with a frequency of 120Hz. Chin rests to prevent participants head movements are not necessary with this technology as slow head motions are allowed. Thus, the experimental situation is more similar to respondents using their own computer without feeling constrained in their movements. However, because of the non-existence of constraints interruptions in tracking the eyes may happen. These interruptions are assumed to be random disturbances in the sample.

Results

Validity Checks

A t-test shows the success of the time-pressure treatment ($t = 4.923$, $p = .00$). On a 1-5 scale participants in the time-pressure treatment indicated that they felt more time-pressure (3.82) as compared to participants in the control treatment (2.46). 15 participants did not respond to an open-ended question asking for reasoning of decision change. They were not considered for final data analysis, as we cannot determine whether they took the task serious enough. From one out of the remaining 107 participants we

did not get eye tracking data, which is why the analyses including eye tracking data are based on a sample of 106 participants.

Behavioural Affect and Consequences (H1 & H2a/b)

We expect that time-pressure and justification requirement influence individuals' affective states. We measure affective states in terms of uneasiness, confidence and willingness to perform. Table 1 shows means and standard deviations of the three measures per time-pressure and justification condition.

Table 2 shows summary statistics of ANOVA's performed to test our hypotheses H1 and H2a/b. The ANOVAs include the main effects of time-pressure and justification as well as an interaction term. Levene's Test of Equality of Error Variances is insignificant for the dependent variables.

Influences on Uneasiness

The analysis shows a highly significant influence of time-pressure on uneasiness ($p = 0.015$) and a moderately significant influence of justification on uneasiness ($p = 0.07$; Table 2). In the time-pressure condition participants felt more uneasy (mean = 3.27) than in the control condition (mean = 2.71) and the justification requesting from participants to reason explicitly made individuals to feel less uneasy (2.80) than in the condition in which this justification was not present (3.18). This trend of reduced uneasiness through justification holds for both time-pressure conditions. Thus, for uneasiness there is indication for the validity of H2a, but not H2b.

The question for uneasiness is the most subtle question referring to the feeling of participants while making the decision. Uneasiness exhibits the strongest main effects resulting from time-pressure and justification requirement. Panel A of Figure 1 plots the estimated marginal means of uneasiness dependent on time-pressure and justification conditions. The increasing slopes for both the dashed (no reasoning) and continuous (explicit reasoning) lines indicate that uneasiness increases with time-pressure. The fact that the dashed line is at a higher level indicates that the absence of a justification requirement leads to higher uneasiness. The lines are parallel which indicates that there is no interaction evidenced. This is confirmed by the insignificant interaction term in Table 2 ($p = .967$).

Time-pressure	Justification	Uneasiness	Confidence	Post-ponement	Time-pressure	N
No	No reasoning	2.89 (1.286)	4.321 (.9049)	2.89 (1.286)	2.25 (1.266)	28
	Explicit Reasoning	2.50 (1.216)	4.625 (.7109)	2.67 (1.204)	2.71 (1.367)	24
	Total	2.71 (1.258)	4.462 (.8275)	2.79 (1.242)	2.46 (1.320)	52
Yes	No reasoning	3.45 (1.325)	4.034 (.7784)	3.10 (1.235)	3.86 (1.407)	29
	Explicit Reasoning	3.08 (1.440)	4.038 (.8237)	3.15 (1.567)	3.77 (1.657)	26
	Total	3.27 (1.380)	4.036 (.7926)	3.13 (1.389)	3.82 (1.516)	55
Total	No reasoning	3.18 (1.325)	4.175 (.8477)	3.00 (1.254)	3.07 (1.557)	57
	Explicit Reasoning	2.80 (1.355)	4.320 (.8192)	2.92 (1.412)	3.26 (1.601)	50
	Total	3.00 (1.346)	4.243 (.8337)	2.96 (1.324)	3.16 (1.573)	107

Table 1: Descriptives for Behavioural Affect, Means (Standard Deviations)

Dependent Variable	Uneasiness		Confidence		Postponement	
Source	F	Sig.	F	Sig.	F	Sig.
Intercept	541.595	.000	2933.361	.000	525.448	.000
Time-pressure	4.889	.015**	7.727	.003***	1.832	.090*
Justification	2.227	.070*	.958	.170	.116	.370
Time-pressure * Justification	.002	.484	.909	.153	.288	.297

Table 2: Anova Summary for Behavioural Affect

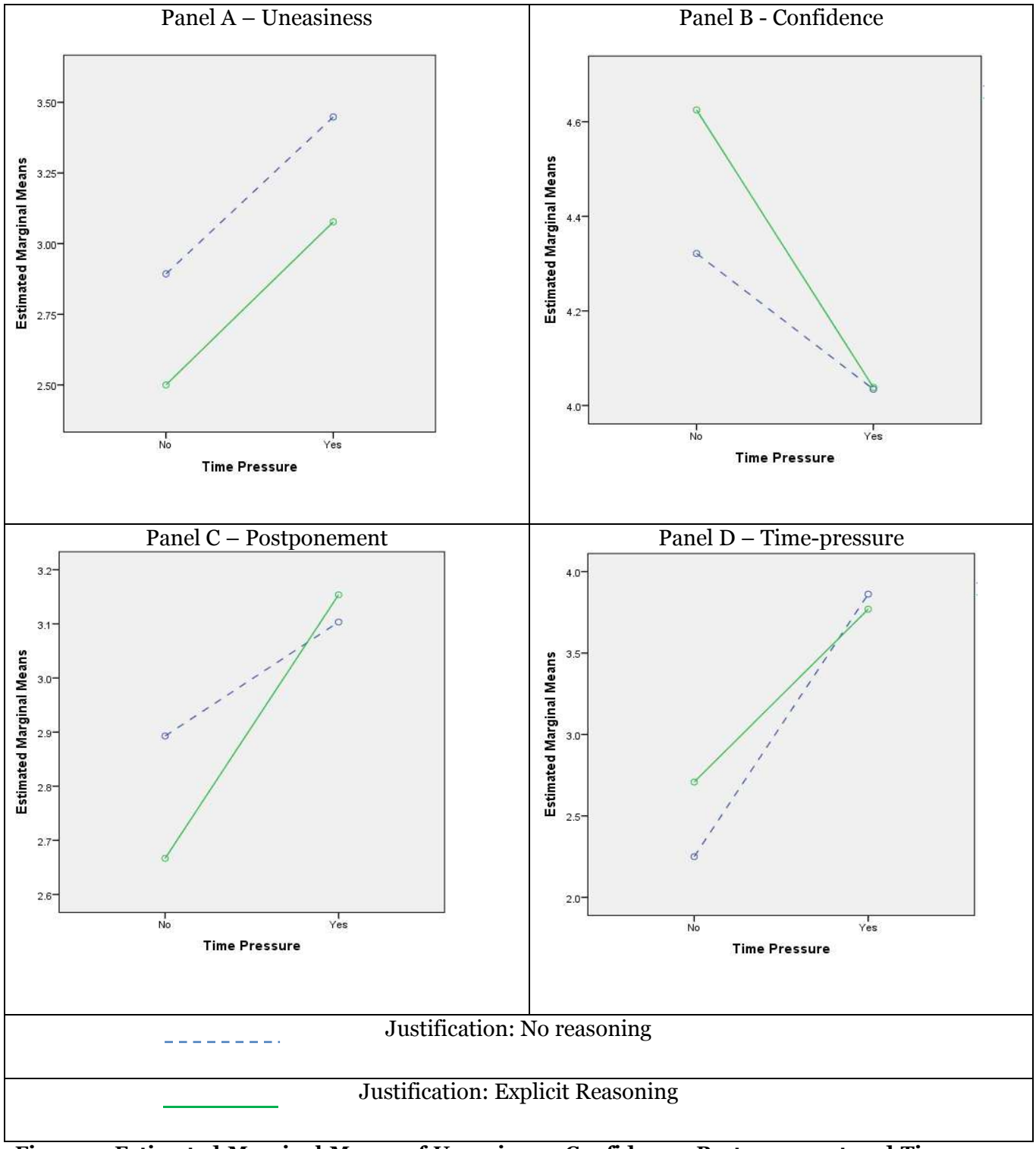

Figure 1: Estimated Marginal Means of Uneasiness, Confidence, Postponement and Time-pressure

Influences on Postponement
We find that willingness to postpone is increased through time-pressure. The evidence of the influence of time-pressure on postponement is not very strong. We attribute this to the fact that we worded the question on postponement in a way which indicates further conflict if the decision is postponed (*Would you tell your boss that the decision between the two systems should be postponed?)*. Mentioning the 'boss' frames the question as more action oriented. A question asking for the own perception whether the decision should be postponed may show a stronger difference between the conditions. Even though we framed our question very conservative in not asking about the personal preference of postponing the software acquisition decision, but about individuals' recommendation to their superior in postponing the decision, we find a significant effect.

With respect to H2a we observe that without time-pressure the justification requirement decreases willingness to postpone (2.89 vs. 2.67, Table 1). This is in line with our expectation in H2a, but statistically not significant. With time-pressure the justification requirement slightly increases the willingness to postpone (3.15 vs. 3.10) which is in line with H2b. However, again the difference is marginal and non-significant.

Influences on Confidence
We find (Table 1, Table 2, Figure 1) that time-pressure decreases confidence (H1). Panel B of Figure 1 indicates an interaction effect, such that individuals without justification do not suffer as strongly from loss of confidence through time-pressure as compared to participants with a justification requirement (explicit reasoning). However, the interaction term is not significant ($p = .153$). In the time-pressure condition confidence levels between explicit and no reasoning are similar (4.034, 4.038; Table 1), i.e. there is no evidence for H2b, whereas in the absence of time-pressure confidence is higher without time-pressure (4.625) than with time-pressure (4.321) supporting H2a. This, indicates that time-pressure may make the positive influence of the justification in terms of decision confidence obsolete. However, future research needs to explore this more closely.

Cognitive Effects (H3 & H4)
We expected in **H3** and **H4** that time-pressure influences the use of micro and macro changes in decision strategies and that justification changes the influence of time-pressure on these changes. Table 3, Table 4 and Figure 2 regard micro changes in decision strategies, Table 5, Table 6 and Figure 3 deal with macro changes.

Micro changes in decision strategies are associated with increased speed. Table 3, Table 4 and Figure 2 evidence that time-pressure leads to a reduced *number of fixations* and a reduced length of *total fixation duration*, but there is no evidence of a significant effect on *time to first fixation* (Table 4, $p = 0.101$).

Regarding macro changes in response to time-pressure, Table 3 shows that time-pressure leads to an omission of more information cues in terms of values (12.56 vs. 13.38), but not labels (6.91 vs. 6.63). The differences are not significant (Table 6). The values/labels proportion measure shows that in total the fixation duration of values is 45.12 percent of the fixation duration of labels. For the time-pressure condition this proportion decreases to 42.5 percent, without time-pressure the proportion increases to 47.8 percent. This difference is significant ($p = 0.022$, Table 6).

Thus, we find evidence for **H3**, that time-pressure influences micro and macro decision strategies. In particular, we find that time-pressure directs the relative attention away from values to labels. Thus, individuals focus more on the overall categories. This can be interpreted as indication that individuals potentially rather use elimination-by-aspect strategies under increased time-pressure, such that they focus on identifying the most important categories (labels) and only in a second step compare the values of these system categories. Thus, overall they spend less relative attention to the values.

We find partial evidence for **H4**. Whereas we cannot find evidence for an interactive influence of time-pressure and justification on micro decision strategies, we find evidence for an interactive influence on macro decision strategies. Specifically, Table 6 indicates statistical significance for the interaction on completeness of search for values and labels.

This is supported by the crossing lines in Figure 3. The direction of this interaction seems puzzling in the first place. When there is no justification requirement time-pressure reduces the completeness of search for attributes as well as labels. This is of no surprise. However, when there is a justification requirement, time-pressure increases the amount of information search for in terms of labels as well as values. Thus, the justification requirement changes the direction of the influence of time-pressure. A potential explanation might be as follows. A justification requirement signals general importance of a task to a decision maker and puts him into a state of alertness. Additional time-pressure signals the importance of the task to an individual even more, which is why, given justification, the search picture, is more complete under time-pressure as compared to no time-pressure. This holds for values as well as for labels.

However, it needs to be noted, that despite the completeness of search might be higher given time-pressure under certain circumstances, there is the general strong tendency that time-pressure has a negative effect on macro decision strategies, in terms of how much time is spent on the information cues.

		Fixation Number		**Fixation Duration**		**Time to First Fixation**		
Time-pressure	Justification	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	N
No	No reasoning	139.79	74.294	26.3311	16.31646	1.9561	9.40566	28
	Explicit Reasoning	152.29	103.495	29.1733	22.53582	1.6917	7.29760	24
	Total	145.56	88.274	27.6429	19.28800	1.8340	8.41842	52
Yes	No reasoning	106.86	67.621	21.0421	15.33342	.5650	2.02612	28
	Explicit Reasoning	119.88	42.666	21.1142	9.55976	.0627	.25260	26
	Total	113.13	56.844	21.0769	12.76262	.3231	1.47837	54
Total	No reasoning	123.32	72.322	23.6866	15.91330	1.2605	6.77767	56
	Explicit Reasoning	135.44	78.892	24.9826	17.36531	.8446	5.07007	50
	Total	129.04	75.374	24.2979	16.54671	1.0643	6.00846	106

Table 3: Descriptives for Micro Changes in Decision Strategies

Dependent Variable	Fixation Number		Fixation Duration		Time to First Fixation	
Source	F	Sig.	F	Sig.	F	Sig.
Intercept	320.997	.000	233.402	.000	3.302	.072
Time-pressure	5.091	.013**	4.360	.020**	1.647	.101
Justification	.777	.380	.208	.649	.106	.745
Time-pressure * Justification	.000	.493	.188	.333	.010	.460

Table 4: Anova Summary for Micro Changes in Decision Strategies

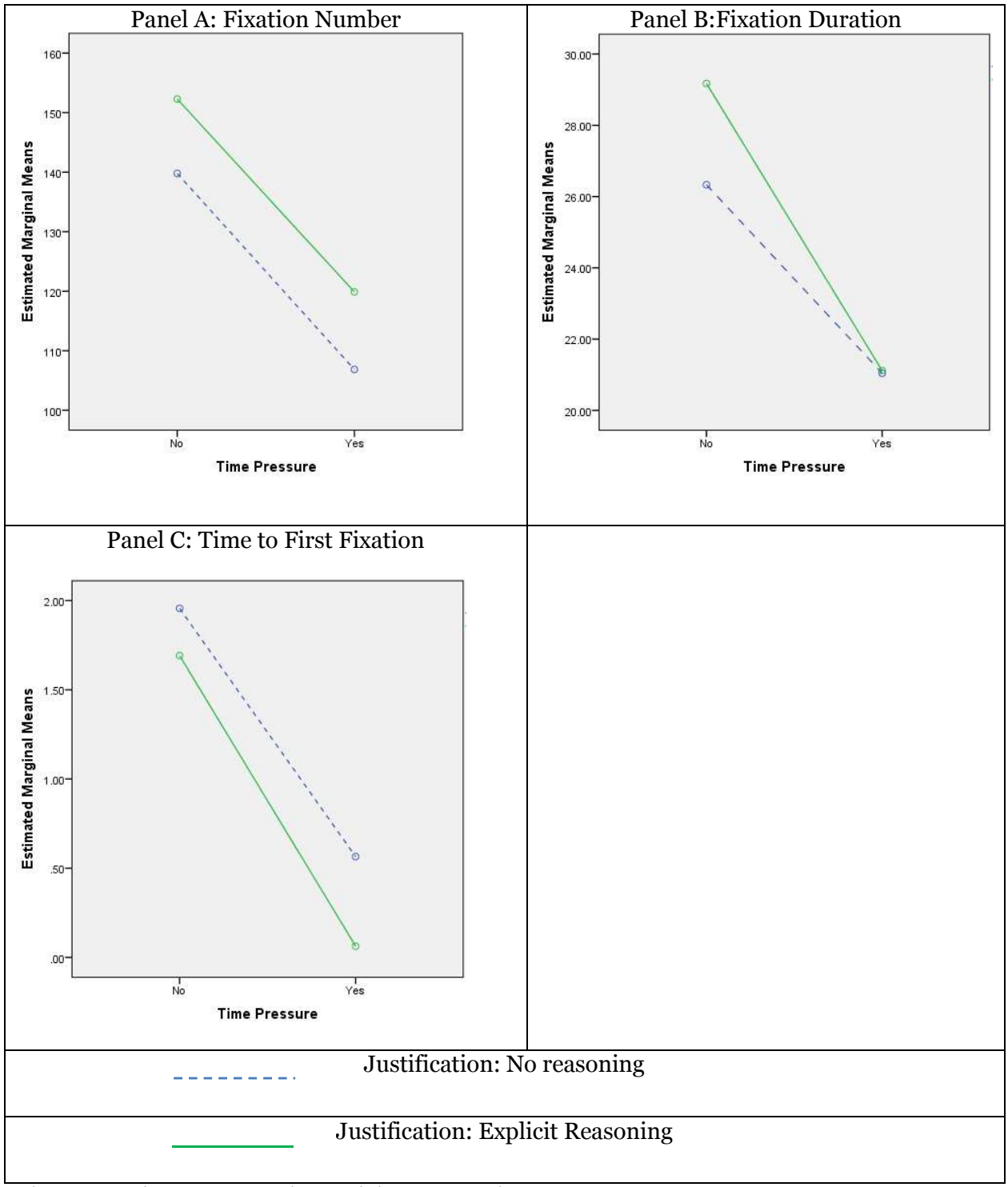

Figure 2: Micro Changes in Decision Strategies

		Completeness of Search of Values		**Completeness of Search of Labels**		**Values in Proportion to Labels (Fixation Duration)**		
Time-pressure	Justification	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	N
No	No reasoning	14.07	2.308	7.14	1.557	.4783	.12321	28
	Explicit Reasoning	12.58	4.800	6.04	2.528	.4768	.16377	24
	Total	13.38	3.711	6.63	2.115	.4776	.14189	52
Yes	No reasoning	11.36	5.445	6.36	2.527	.4075	.13734	28
	Explicit Reasoning	13.85	1.974	7.50	.812	.4440	.08500	26
	Total	12.56	4.303	6.91	1.974	.4254	.11508	54
Total	No reasoning	12.71	4.364	6.75	2.117	.4435	.13396	56
	Explicit Reasoning	13.24	3.634	6.80	1.969	.4597	.12864	50
	Total	12.96	4.026	6.77	2.039	.4512	.13108	106

Table 5: Descriptives for Macro Changes in Decision Strategies

Dependent Variable	**Completeness of Search Values**		**Completeness of Search Labels**		**Values in Proportion to Labels (Fixation Duration)**	
Source	F	Sig.	F	Sig.	F	Sig.
Intercept	63.137	.000	41.230	.000	1269.959	.000
Time-pressure	.902	.344	.759	.386	4.168	.022**
Justification	.429	.514	.003	.957	.476	.492
Time-pressure * Justification*	6.774	.006***	8.445	.002***	.560	.456

Table 6: Anova Summary for Macro Changes in Decision Strategies

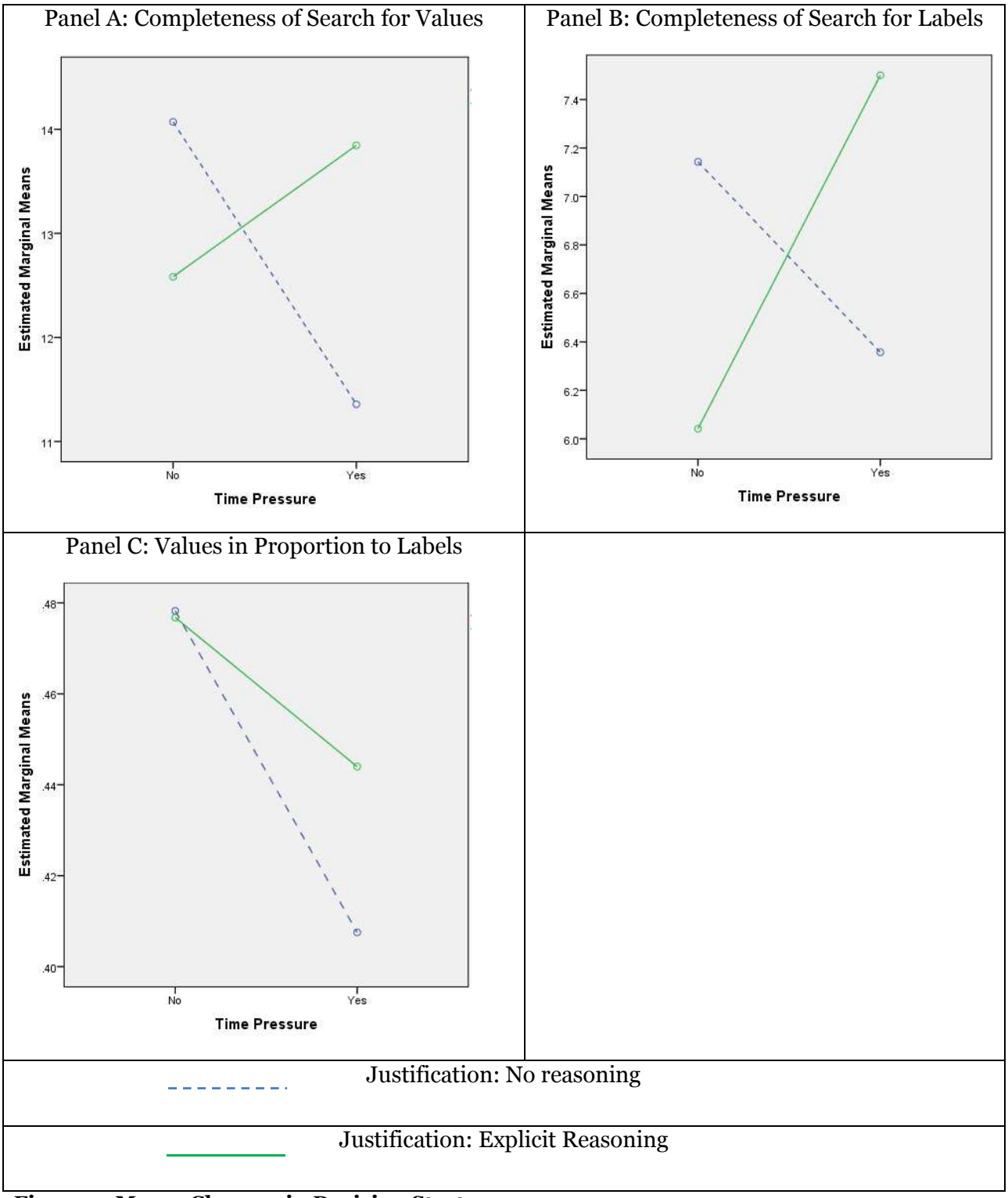

Figure 3: Macro Changes in Decision Strategy

Discussion

Results from this research project contribute insights into effects of two management tools by means of which IS managers can control software acquisition projects, i.e. time-pressure and justification requirement. We find that time-pressure as well as justification requirement influences cognitive and affective states of individuals. Drawing on theory of emotions (Lazarus 1991) and Cognitive Experiential Self Theory (Epstein 1998) we find evidence that time-pressure leads to increased uneasiness and decreased confidence and some indication that justification requirements can help to mediate negative affect.

An individuals' negative affect can have an array of negative consequences for organizations. We directly investigate one negative consequence: postponement of a decision. Postponing decisions can lead to high costs for organizations (O'Donoghue and Rabin 1999). These costs can be magnified when it comes to software selection as a key business decision. We find some evidence that time-pressure can increase the willingness to postpone.

As expected we further find that individuals increase their processing speed with time-pressure, i.e. change their micro decision strategies. This by itself is not surprising. However, we predict and discover an interactive influence of time-pressure and justification requirement on macro decision strategies. Despite the increased processing speed indicating intuitive processing, individuals under time-pressure show a more complete scanning of information when they are asked to justify their decision. Thus, a justification requirement without time-pressure might be less effective to increase the amount of information processed.

Our results also have implications for the design of management control systems. The large gap in confidence and uneasiness scores between the time-pressure and no time-pressure groups coupled with the dramatically lower scores in fixation duration and number of fixations for the time-pressured group indicates that making selection decisions under time pressure is potentially risky. The selection decision that participants made was not nearly as complex as a real software selection task so the differences between groups suggests that we can potentially expect even poorer outcomes in the more complex considerations made when making real decisions under time pressure unless the process is designed carefully.

Reason (1990) notes that accidents involving technologies that are both complex and high-risk tend to originate from judgment failures that occurred long before the system entered the emergency state. Time pressure is inevitable for many decisions, but our results indicate that there are some benefits associated with adding a justification requirement to selection tasks. Specifically, the decision-makers felt decreased unease, and the eye-tracking data showing the amount of data examined suggests that the overall judgment was actually based on a more complete information set. In other words, time pressure is only undesirable if management control systems are not designed to mitigate its negative effects.

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Appendix: Instrument

Case Information

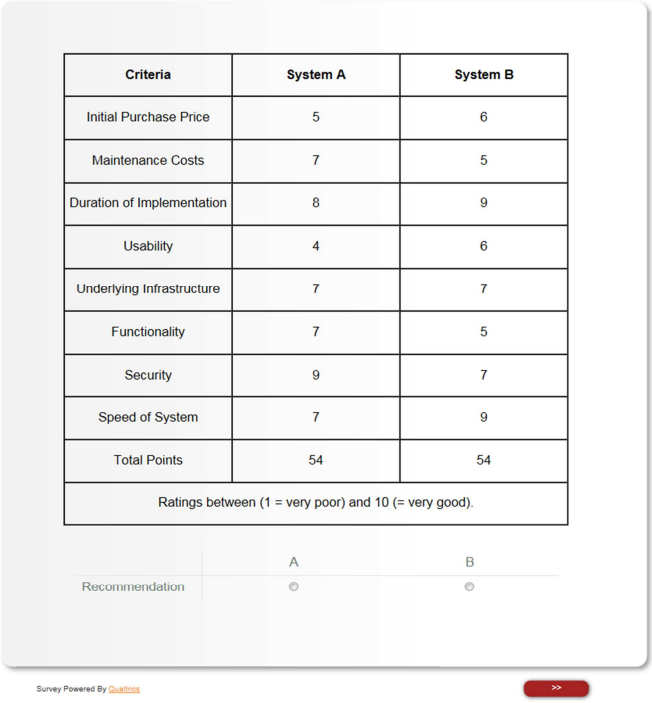
The brackets indicate the information which is only shown for the relevant conditions.

You are a senior information systems business analyst. You are responsible for the selection and implementation of a new enterprise resource planning (ERP) system in your company. After the initial search for appropriate systems you and your team have identified two favourite systems (A and B) and have rated them on relevant criteria between 1 (= very poor) and 10 (= very good). The sum of the ratings for each system ended up to be the same. Thus, your decision depends on the weights you place on the criteria.

Your boss asked you to make a final decision [today as fast as possible.] [After you have made your decision, you will be asked to state reasons for your recommendation and summarize the key factors leading to your recommendation in a report.]

[As the final decision is time-critical, you are asked to make your recommendation as fast as possible on the next page.]

Decision Screen



Criteria	System A	System B
Initial Purchase Price	5	6
Maintenance Costs	7	5
Duration of Implementation	8	9
Usability	4	6
Underlying Infrastructure	7	7
Functionality	7	5
Security	9	7
Speed of System	7	9
Total Points	54	54
Ratings between (1 = very poor) and 10 (= very good).		

	A	B
Recommendation	○	○

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Post-Experimental Questions

Open ended question:

Please state reasons for your recommendation and summarize the key factors leading to your recommendation in the following.

Likert scale questions on a scale from 1-6

How confident do you feel with your recommendation? (1 = not confident, 6 = very confident)

Would you tell your boss that the decision between the two systems should be postponed? (1 = not postpone, 6 = definitely postpone)

Did you feel uneasy while comparing the two systems? (1 = not at all, 6 = very much)

Did you feel time-pressure while comparing the two systems? (1 = not at all, 6 = very much)

Validity Check (effort related)

After you made your recommendation, would you have changed your recommendation to the other ERP system at any point? (yes/no)

Please state why in referring to the previous question: (open ended)