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Understanding the Mobile User's Purchase-Decision Involvement

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ABSTRACT

With smart devices starting to become truly context-aware and mobile devices establishing themselves within the on-line purchasing cycle we are finding m-commerce becoming more astute to our needs. In our efforts to facilitate this we investigate the relationship between physical and modal contexts and levels of purchase-decision involvement. We aim to increase knowledge and establish methods for increasing the level of engagement of consumers and a specific product.

Previous research has shown a positive correlation between purchase-decision involvement and positive-negative user emotions. We aim to extend this by not only demonstrating that different situations can reduce or increase this correlation but that other aspects of affective state are also important when considering the mobile device user. We introduce a new term *unfavourable physical situations* and explore how environment stressors and level of familiarity with people and environments impact on the user's purchase-decision involvement.

Results demonstrate that extreme situations influence the relationship between different aspects of affective state and show potential in informing context-aware systems for optimising engagement with the consumer's decision processes.

KEYWORDS

Recommender systems, affective computing, context-aware, purchase-decision involvement, mobile users

1 INTRODUCTION

Understanding the effectiveness of m-commerce and advertisement messages presented via small devices is still in its infancy. While the cognitive processes involved are still not fully understood [1] it is expect that mobile devices will become increasingly entrenched in the product purchase cycle [2], providing an increased capacity in understanding behaviors using on-board sensors [3].

Development in knowledge of user on-line behaviors, including search activities, and the effect of situational contexts upon these behaviors will support a systems ability to determine a device user's capacity for decision involvement processes. Systems would then be able to provide appropriate advertisements at the right time and place.

While mobile devices are being adopted to facilitate the on-line purchase cycle it is when they are most effective which is important to the advertiser and is the focus of our research. Holmes et al. [4] presents evidence that information search, review of alternatives and purchase activity via mobile devices primarily takes place at home. They also suggest that locations including retail locations, travelling and simply 'out and about', were all found to be used by mobile users as part of the purchasing cycle, especially for high-involvement products.

Important aspects of marketing are consumer involvement [5] and purchase-decision involvement. Mittal [6] describes this as a concept which is used to capture the user's mind-set towards an anticipated purchase and is measured as close as possible to planned marketing events. This paper utilises findings by Hansen [7] who states that emotion correlates positively with purchase-decision involvement that is positively motivated. Our aim is to show that this relationship could be used to identify when recommender systems should present product information to a potential purchaser and therefore increase return on m-commerce investment. Through understanding a shopper's emotion it should be possible to determine the likely level of purchase-decision involvement they would give certain products, in particular high involvement products. The rise in the use of mobile devices for purchasing items on-line increases the complexity of engaging with the user due to the wider variation of contexts that are inherent to being mobile and the shape and size of the device. We therefore expect that not only will the level of positivity have a relationship with the level of decision involvement but also other aspects of emotions including arousal and dominance.

We explore the concepts discussed above to see how the user is effected by situational contexts with the aim to leverage purchase-decision involvement in order to advance m-commerce recommender system success rates. The rest of this paper is structured as follows. In section 2 we discuss elements of consumer involvement and how they are affected by the environment. We then discuss the implementation of a questionnaire based study, see section 3. In section 4 we present and analyse our results and in section 5 we present our conclusions with a discussion on limitations and opportunities for further research.

2 THE USER CONTEXT AND DECISION INVOLVEMENT RELATIONSHIP

2.1 Purchase-Decision Involvement

Product Involvement is relatively well understood concept that provides insight into how consumers engage with products, brands and the general advertisement process. Product involvement is reliant on constructs that make up the purchaser-product relationship. These include personal preferences and perceptions, as summarised by [8], influencers of buying choice [1] and manipulation of product perception [9]. Product involvement is considered as a layered concept most commonly separated into *enduring involvement* and *situational involvement* as first coined by Houston and Rothschild [10]. The concept of enduring product involvement is simply a person's level of involvement that is always present, this may be static or may slowly change as taste, behavior and other personally related contexts develop over time. Parallel to enduring involvement is said that we also are subject to situational involvement, fundamentally the setting in which the product will be consumed [9].

It is obviously difficult to determine situational product involvement from user behaviour without explicitly asking. It does however seem more plausible to establish a general understanding of enduring, or indeed an element of both enduring and situational through the analysis of behaviours such as knowledge acquisition via search and other on-line activities. This is particularly true with the mobile device which is becoming ever more entrenched in the product purchase cycle. It therefore seems reasonable to agree with Kim [8] that methods of product involvement measurement such as those developed by Laurent and Kapferer [9] are suitable for broader analysis of product involvement for achieving results that we seek.

Research into consumer product involvement has generated a considerable amount of research findings, including a number of measurement tools focussing on widening knowledge of the product-user relationships. The most cited examples include the Consumer Involvement Profile (CIP) [11], and the Personal Involvement Inventory (PII) [12]. While still considered key to our understanding of product involvement these models have received criticism and revision, in the case of PPI by the author's own hand [13]. Most noteworthy in their assessment of these tools are Mittal [6] and Mittal and Lee [14] who identify that only one of the four CIP facets are real measures of involvement with the others three being antecedents which shape in part the development of the purchasers involvement. These concepts formed Mittal's [6] development of the Purchase-Decision Involvement measurement tool which has been likened by Michaelidou [15] to situational involvement.

The development of Purchase-Decision Involvement (PDI) [6] was to demonstrate the difference between product involvement and the decision process associated with purchasing a product. In doing so PDI is defined as a nonresponsive state of mind that identifies the benefit of a specific product purchase, reiterating the distinction between 1) enduring and 2) situational involvement and 3) responsive behaviors that manifest themselves in the decision making process. Adopting the term PDI as opposed to situational involvement enables researchers to imply with clarity that a decision process is in place which is governed by the consumer's motivation [6].

Through the understanding of a user's level of involvement a system can enhance the method of persuasion a m-commerce recommender system or embedded advertisement message and therefore influence how a person will respond. Park et al. [16] suggest that high involvement requires cognition, reasoning and comprehension whereas low involvement only a routine behaviour choice, relying on product experience and peripheral cues such as size and colour of the advert. Processes including behavior and the evaluative aspects of cognition have been shown to be affected by different environment contexts [17]. Using this understanding we aim to show the extent different contexts can affect levels of PDI and the likelihood of purchaser engagement within a specific situation. This is essential in our understanding of how mobile devices can be used to effectively deliver product information via mobile recommender systems, including online advertising.

2.2 The Unfavourable Physical Situation

Typically mobile devices, in particular smart-phones, are small and designed for an on-the-move, multi-tasking lifestyle. Depending on their situation users may not always have the ability or intention to undertake more demanding or sensitive tasks via their smart device. Therefore they may only engage when in an environment favourable to the task i.e. somewhere quiet to consider the options calmly and securely. Mallat et al., [18], found that independency of contexts, including time and place, were essential when completing activities using mobile devices. Kaasinen [19], discusses how that there is a high requirement for a systems' ease-of-use and ability to adapt to user behaviour. Environmental contexts could not only have an impact on the user's preferences [20] but also their ability to process information or make decisions. From the above we can take situational factors as likely to be key to understanding a user's likelihood of engagement with an advertisement message. This could be an indicator that decision processes become more complex where situations become unfavourable physically and where devices are limited in ability in delivering relevant information at an appropriate time.

The context label 'location' has been used successfully to identify that mobile device users are most likely to undertake consumer behaviors (e.g. information search, review alternatives, purchase) when they are at home [4]. However studies are often limited in that they rely on reflection of habits and not a clear picture of the contexts associated with that location. All situations should be regarded as complex and dynamic with a range of contexts that are not static, consistent or necessary repeatable in nature.

While a user may associate different locations with different emotions [21], [22], or seek particular places likely to be sought to regulate mood [23], or undertake tasks [4] these are choices selected via experience or habit. Specific moods could be associated with particular locations it seems probable that contexts that make up each scenario will collaborate to form different outcomes that will then influence the current mood or emotions. Therefore we state that emotions are not directly related to specific contexts and we hypothesise that:

H1: Individual environmental contexts will not have a direct correlation with positive-negative affective state

Environmental stressors such as noise and overcrowding can affect both behavior and the evaluative aspects of cognition [17]. A person's perceived control within a physical environment has also been shown to be crucial in mediating emotional and behavioral responses [24]. Therefore where perceived control is reduced or where annoyance is increased then contexts including crowding [24], interruptions [25] and noise [26] could all be implied to have an effect on behavior by affecting cognition ability. Similarly, research into exercise has been regularly shown to improve our cognitive function [27] and has an overall benefit to our well-being and behaviours. It can be suggested that a lack of recent activity could be detrimental thus producing a similar result to negative situational contexts. However contrary to this is that a highly active mobile device user is going to use aspects of their device differently and have different levels of involvement than that of an inactive user. Therefore under alternative situations results associated with activity may present different results to that suggested above. It has also been shown that people prefer to make purchase decisions when based on positive motivation [7], so where affective state is negative within negative situational contexts it is probable that we are less likely to engage. We hypothesise that negative environmental contexts will have a detrimental effect on decision involvement when we are feeling negative and therefore increase this correlation. See the following hypothesis:

H2: Individual environmental stressors will show an increased level of positive correlation between positive-negative affective state *and purchase-decision involvement*

Paulos et al. [28] show us that our perception of a place is dominated by the people we share it with. Typically within familiar places these tend to be friends, family and colleagues however even strangers that we repeatedly encounter can become familiar. Familiarity is also a cognitive variable that facilitates performance [29], improves feeling and attitudes [30] and facilitates trust [31]. Vries et al. [32] state that a happy mood has different requirements to a sad mood in terms of familiarity stimulus, we therefore hypothesise:

H3: An increased level of positive correlation between positive-negative affective state and purchase-decision involvement will be achieved when we are subjected to unfamiliar contexts (people and/or environment)

Building upon the hypotheses presented above we utilise familiarity and situation stressors as components of *unfavourable physical situations* i.e. where the user is subjected to unfamiliar elements as well as one or more situation stressors. Note that it is probable that the values of both unfamiliarity and environmental stressors could be to a lesser degree than as single contexts and yet combined will produce similar if not higher correlations. We expect an *unfavourable physical situation* to affect cognition to such an extent that the correlation between affective state and purchase-decision involvement would become significant. We therefore hypothesise:

H4: An increased level of positive correlation will be achieved between positive-negative affective state and purchase-decision involvement when we are subjected to an unfavourable physical situation

Hypotheses 1 to 4 have focussed upon how context can affect the positive-negative affective state and PDI relationship as derived by Hansen [7]. However in the text above we have indicated that the mobile user is subject to more complex, disruptive and inconsistent environments which will require a more complex set of emotions that would be associated with the average user in a controlled, familiar situation.

The mobile user is required to form a greater level of trust of both information presented by the device and the actual environment. They are also potentially influenced by traits described by Broekens [34], i.e. approach versus avoidance, coping, control, power and influence which in turn suggests that a level of user dominance is involved [34]. Mobile device users are also generally required to process information in a wider range of situational types so processing styles may vary depending on surrounding contexts [35]. This suggests that the positive correlation will be prevalent for users in relatively controlled environments using suitable devices, i.e. a PC in an office whereas it is more likely that for mobile device users will rely on additional aspects of their affective state to engage in a decision process, e.g. arousal and dominance. We hypothesise that:

H5: The positive correlation between positive-negative affective state and purchase-decision involvement will be more important for use with larger devices than smaller devices

H6: That other facets of affective state will also show correlative relationships with purchase-decision involvement where users of smaller devices are under extreme situational contexts

The above hypotheses will enable us to investigate whether selected situational context can influence the relationships between affect state and purchase-decision involvement. The result should provide a platform on which to model the management of output for context-aware recommender systems and on-line advertising. This in turn will inform development of context-aware tools that can be utilised for m-commerce decision systems.

3 METHOD

We expect that environment contexts and user activity will play a major part in understanding fully how best to engage with the consumer. In Adomavicius et al.'s work [36] user context is sorted into four types that impact a mobile service environment, these are physical, social, interaction media, and modal. We describe our method for capturing elements of these in turn.

Physical: As per hypothesis two we limit the physical contexts we capture to situation stressors in order to understand the impact of negative situations. These stressors comprise of level of noise, amount of distraction, amount of activity (current or very recent) and number of people in the immediate vicinity. Users are requested to rate themselves for each using 7 point psychometric Likert scales from 1 to 7. With labels as follows:

- Noise - Very quiet ~ Very noisy
- Distraction - None at all ~ Lots of distractions
- Activity - Very low ~ Very high
- Number of people - I am alone ~ it is very crowded

Social: For social context we ask the user to rate their immediate environment and the people therein to a level of familiarity, see hypothesis three. Both use a Likert scale from 1 to 7. With labels as follows:

- Familiarity of environment - Very unfamiliar ~ Very familiar
- Familiarity of people - Unknown to me ~ Well known to me

Interaction media: For this experiment our approach is to simply request the user to identify which kind of device they are using i.e. PC, laptop, tablet or smart-phone. As discussed later this allow us to investigate phenomena for both large and small devices.

Modal: Modal contexts are potentially the most complex ranging from user's goals, motivations to mood and cognitive capabilities [36]. We limit our test to capturing contexts of user's affective state and their purchase-decision involvement for a range of high-involvement products. We adopt Mehrabian's [37] Pleasure-displeasure, Arousal-nonarousal, Dominance-submissiveness (PAD). PAD as it is a dominant dimensional model and the pleasure-displeasure scale directly correlates with the positive-negative affect scale required in our hypotheses. To implement this we use a popular graphical representation called the Self-Assessment Manikin (SAM) as developed by [38]. Note that each scale is measured from one to five with five being the most positive value.

To measure purchase-decision involvement we utilise Mittal's revised version of the PDI scale [39] to capture user feedback on high-involvement products. The scale is very simple to replicate and comprises of three questions that determines the users view on how much they care about a product, whether it is important to make the correct choice and whether they were concerned with the outcome of making that choice.

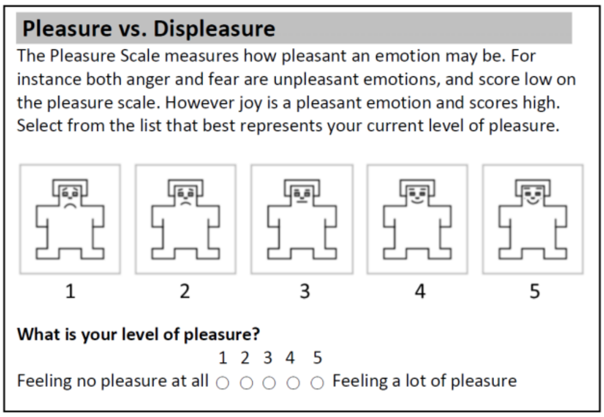

Fig. 1 Snapshot of section of the google form representing the pleasure-displeasure scale for capturing levels of negative-positive affect

Using a Google form the respondents (anonymous) are requested to answer the following sections; basic demographics (sex and age), interactive media (device), representation of PAD, see figure 1, then physical and social contexts. This is followed by PDI questions for five high-involvement products and services (smart-phones, holidays, laptops, insurance, and fridges). The questions come with no product information or images so feedback is provided based entirely on existing subjectivity. The Google form was distributed to University staff and students via email and the University's virtual learning platform. In addition to this friends and family were contacted via Facebook with a request participate.

4 RESULTS

Our experiment collected 140 responses with 74% of responses completed by male participants. The spread of age groups were as follows, 21 years and under (8%), 22 to 34 years (53%), 35 to 45 years (32%), greater than 45 years (44%). Thirty eight percent of responses were completed using a smart-phone.

We test for two-tail correlation the results of which are represented as *r*. The probabilities of these are measured using *p-values* and where statistically significant are shown as $p<0.05$ (confidence level of 95%) or $p<0.01$ (confidence level of 99%).

Our results are presented in two sections. Firstly the data is analysed as a single dataset and then following a split to form groups for larger and smaller devices a second round of analysis is presented.

The results for the five high-involvement products that the test subjects responded to are all very similar so to reduce repetitiveness and confusion we report the average of the five in the results that follow. Analysis produced trends of increasing correlations as context become more extreme. Rather than reporting the sequence of results for each trend we only present points in trends where the correlation starts to exceeds a moderate value (r=0.3) or where the result has a significant p-value.

Context	Value	Result	p-value
noise	>5	0.94	<0.01
distractions	>5	0.47	<0.05
activity	<2	0.49	<0.01
number of people	>2	0.41	<0.01
familiarity of people	<4	0.57	<0.01

Table 1: Individual context splits applied to all data

We initially ensure that there is a correlation between positive-negative affective state and purchase-decision involvement (PDI). Our results show a significant positive correlation of (r=0.2, p<0.05) so we can confirm Hansen's [7] hypothesis is proven for high involvement products.

We find no significant correlation between positive-negative affective state and the six physical/social contexts, therefore we accept *H1* as proven for the individual contexts addressed in the test. In our analysis of results to address *H2* we find that individual contexts of noise, distractions, activity and number or people produce significant results, see table 1. In view of these results we state that *H2* is proven for the environmental stressors considered.

We find that as an individual context *familiarity of environment* provides no useful increase in correlation however *familiarity of people* does produce a significant result, table 1, therefore we accept *H3* as proven in part. Figure 2 provides an example graphical representation of the correlations for all data and the increase in correlation for low familiarity with people.

To test the concept of an *unfavourable physical situation* we focus upon distractions and then familiarity. We produce three sets of data that focus upon a high level of distractions and then add an additional focus for activity, noise and number of people as shown in table 2.

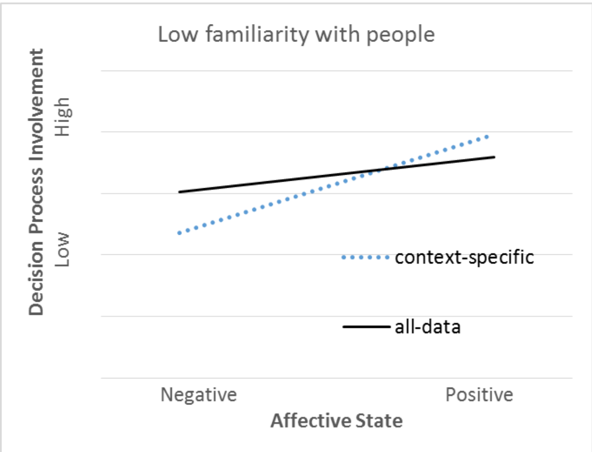

Fig. 2 Correlation for users with unfamiliar people (*r=0.57, p<0.01*)

Obviously some paring produced better results than others but as expected all three datasets produce increased correlations between PDI and positive-negative affective state. The correlations produced are also greater than the correlations for the individual context label distractions.

The second group of paired logic focus upon familiarity, we find both expected and unexpected results. The first two pairs use low familiarity of people with a secondary focus of both familiarity of environment and the number of people. Both show the expected increase in correlation with both correlations higher than the individual context, see table 2. Figure 3 presents the increased correlation for low familiarity with people and high activity. Note that the context familiarity with environment produces an effect when considered as part of a situation whereas as an individual context it produced no correlation. This shows us that an unfamiliar environment may not be an issue in itself however if physical stressors are in place then issues with environment become accentuated.

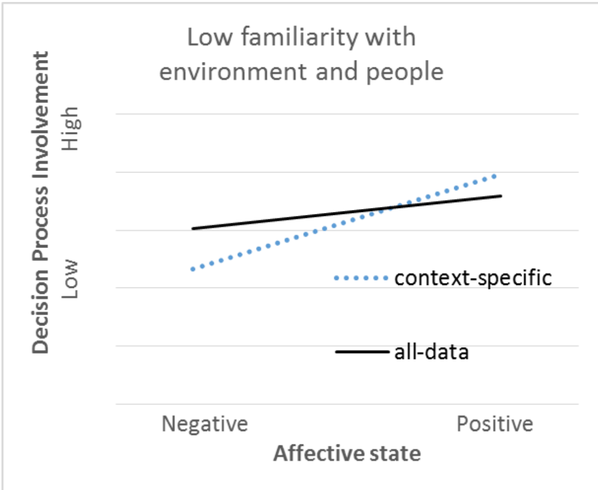

Fig. 3 Correlation for users subjected to unfamiliar environment and unfamiliar people (*r=0.64, p<0.05*)

The results show that familiarity is affected by activity in two ways, both at low levels of activity as hypothesised, and also at high levels of activity. Where lower activity is present both familiarity of people and environment produce stronger correlation. Where higher activity is present our results show negative correlations, see figure 4. The effect of high activity could be a cause of complete disengagement from decision involvement as the user focuses preference on the current activities when the user is in a positive mood. Increases in decision involvement when in a negative mood could be due to needing to take the opportunity to stop the current activity. From the above we see that combinations of context can produce an increased correlation and therefore accept *H4* as proven.

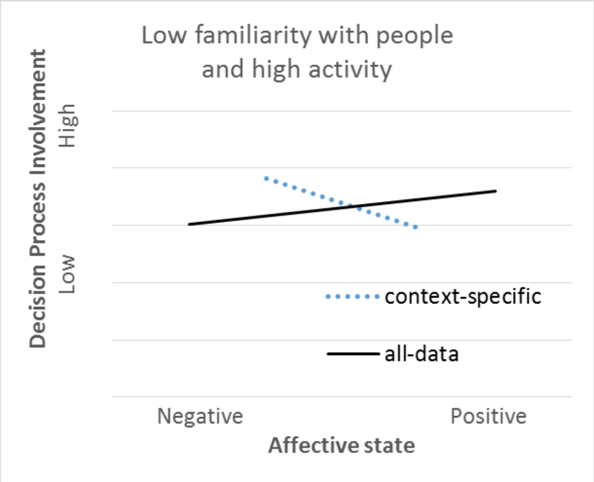

Fig. 4 Correlation for users subject to unfamiliar people and high activity (*r=-0.56, p<0.05*)

Though the results presented above show strong evidence that the hypothesis 1 to 4 are proven we also investigate whether different devices and their use follow this trend of being focussed around the positive-negative affective scale. This is particularly important for the smaller mobile device, i.e. smart-phone which is subjected to a wider and varying range of contexts. We thus split the dataset between larger and smaller devices, i.e. PC's and laptops vs. smart-phones. Not only do the devices in these two groups differ in physical size but the smaller devices are also truly mobile devices that fully enable the concept of convenience and on-the-move device use. In addition to this they are also generally equipped with multiple sensors that can provide elements of context measurement and so should be the focus of our investigation.

Interestingly the smart-phone data across all the situational contexts show a very close to zero correlations whereas the PC and laptop data show a significant positive correlation for all three PAD scales, see table 3 and figure 5. This potentially suggests that the mobile user is far more difficult to consistently engage with regarding PDI and further investigation should establish whether these results are location specific.

As shown in table 4 the PC and Laptop results show slight increases in correlation for all of the separate context focuses are applied except for *number of people* and *familiarity of environment*. The greatest, significant result is for noise which when it reaches a high value it produces a result of r=0.95 p=<0.05. We also find that a lower familiarity with people also produces a large increase of the positive correlations between purchase-decision involvement and both arousal and dominance.

Primary Context	**Value**	**Secondary Context**	**Value**	**Result**	**p-value**
distractions	>5	activity	<3	0.73	<0.05
distractions	>5	noise	>4	0.71	<0.05
distractions	>5	number of people	>4	0.56	<0.05
familiarity of people	<4	familiarity with environment	<7	0.64	<0.05
familiarity of people	<4	number of people	>2	0.66	<0.05
familiarity of people	<5	activity	<3	0.76	<0.01
familiarity with environment	<7	activity	<4	0.4	<0.05
familiarity of people	<5	activity	>4	-0.56	<0.05
familiarity with environment	<7	activity	>4	-0.58	<0.05

Table 2: Primary and secondary context splits applied to all data

	Pleasure		**Arousal**		**Dominance**	
Device group	**Result**	**p-value**	**Result**	**p-value**	**Result**	**p-value**
Larger devices (PC and Laptops)	0.43	<0.01	0.23	<0.05	0.26	<0.05
Small devices (smartphones)	0.04	>0.05	0.05	>0.05	0.11	>0.05

Table 3: All data split by device size

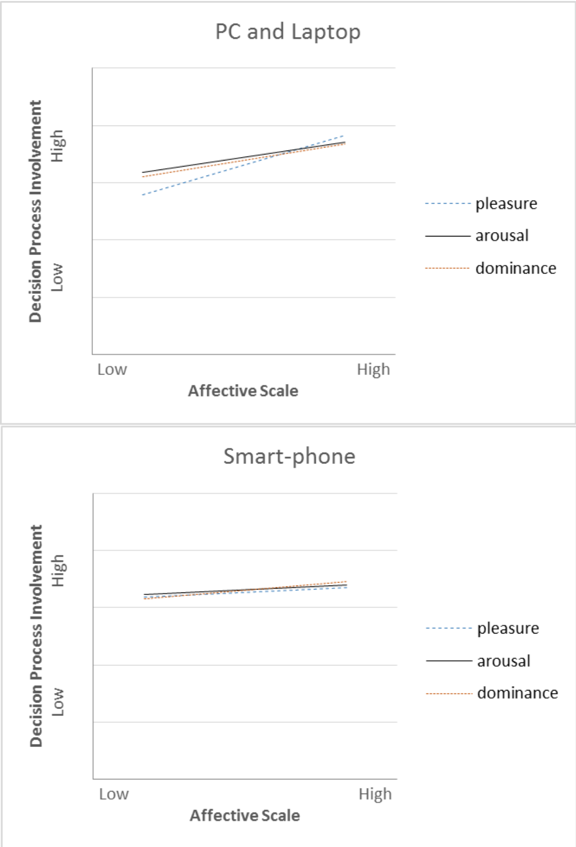

Fig 5: PAD values for all data split by device size

These findings show that for the larger devices using a positive-negative scale for affective state to ascertain levels of PDI should be effective due to the relatively high correlations. With some contextual elements having an influence on the PDI-affective state relationship we can show that even a basic understanding of the user context will increase the ability to leverage the use of PDI to gauge user engagement. For example the correlation will be higher in a distracting environment with unfamiliar people, i.e. an internet café compared to a quiet office or home. So assuming the targeted user was typically in a negative mood the place to select for presenting a particular high involvement product advert would be at the office or home when the user is familiar with the people present.

The following results present findings that all three PAD scales have their place when a system needs to ascertain a user's level of PDI under different contexts when using smaller mobile devices. As shown in table 3, without splitting data by individual contexts results produce close to zero correlations for all three PAD scales. However we do find strong evidence to suggest that correlations exist between both arousal and dominance scales and the level of PDI under different situational contexts. This suggests that the user undertakes a more complex decision process when using smaller devices especially within extreme situational contexts. Traits such as risk aversion are also likely to become more prevalent within the more changeable, disruptive environment.

Where the smart-phone dataset is separated per individual context for high and low values we find no significant results. We do however see an interesting trend where the dominance scale has a strong positive correlation with PDI where some contexts are high, see table 5. Through consideration of the results show in tables 3, 4 and 5 we can see that the relationship between positive-negative affective state and PDI together with the effect of individual contexts on this relationship is more apparent for the larger device, therefore we accept *H5* as proven.

		Pleasure		**Arousal**		**Dominance**	
Context	**value**	**Result**	**p-value**	**Result**	**p-value**	**Result**	**p-value**
noise	>5	0.95	<0.05	0.5	>0.05	-0.19	>0.05
distractions	>5	0.54	<0.05	-0.15	>0.05	0.17	>0.05
activity	<4	0.53	<0.01	0.24	>0.05	0.23	>0.05
number of people	>3	0.31	>0.05	-0.02	>0.05	0.06	>0.05
familiarity of people	<5	0.5	<0.05	0.42	>0.05	0.53	<0.05
familiarity with environment	<7	0.44	<0.05	0.06	>0.05	0.2	>0.05

Table 4: Context splits applied to PC and Laptop data

		Pleasure		Arousal		Dominance	
Context	**value**	**Result**	**p-value**	**Result**	**p-value**	**Result**	**p-value**
noise	>3	0.2	>0.05	0.1	>0.05	0.4	>0.05
distractions	>3	0.2	>0.05	0.16	>0.05	0.4	>0.05
activity	>3	-0.27	>0.05	-0.23	>0.05	-0.1	>0.05
activity	<3	0.2	>0.05	0.23	>0.05	0.23	>0.05
number of people	>2	0.3	>0.05	-0.48	<0.05	-0.02	>0.05
familiarity of people	<5	0.23	>0.05	-0.01	>0.05	-0.1	>0.05
familiarity with environment	<5	0.24	>0.05	0.28	>0.05	0.28	>0.05

Table 5: Context splits applied to smart-phone data

To investigate further the term *unfavourable physical situations* and the trends within the smart-phone dataset we analyse the effect of individual contexts after the data has been grouped into high vs. low values for *familiarity of people, familiarity of environment* and *level of activity*. These three groups are chosen as they are key to the variability of the mobile user in terms of absorption [40], enjoyment [41], and perception of risk [42]. We produce sets of data that focus on individual contexts and apply them to the dataset of low *familiarity of people*, results are shown in table 6. Here we see that low levels of secondary contexts produce an overall trend and some significant results for a positive correlation between dominance and PDI, whereas with high levels in individual contexts we see no useful changes in correlations. This suggests that while the person is with those unfamiliar to them then dominance holds a relationship with PDI and that while the person is not affected by intrusive contexts such as distractions, then the correlation between dominance and PDI will be strong. However once the intrusive contexts rise in value then the dominance – PDI correlation decreases considerably. This phenomena produced both close to zero and negative results the most significant being where unfamiliarity of environment is high (r=-0.99, p<0.05).

We also explore similar relationships for the user's familiarity with their environment, table 7. Where familiarity of environment is low and contexts of noise and distraction are high then a trend of positive correlations across the dominance scale is found. However these results are not shown to be significant and go against the logic formed for *familiar of people* and lower secondary context values. This suggests, and rightly so, that the familiarity with the environment is a more complex concept than familiarity of people and requires greater understanding to be used in this way.

				Pleasure		Arousal		Dominance	
Primary Context	**Value**	**Secondary Context**	**Value**	**Result**	**p-value**	**Result**	**p-value**	**Result**	**p-value**
familiarity of people	<5	noise	<3	-0.03	>0.05	0.2	>0.05	0.84	<0.05
		distractions	<3	0	>0.05	-0.4	>0.05	0.4	>0.05
		activity	<4	0.22	>0.05	0.06	>0.05	0.63	<0.05
		number of people	<3	-0.05	>0.05	0.2	>0.05	0.69	<0.05
		familiarity with environment	>5	-0.15	>0.05	-0.56	>0.05	0.34	>0.05

Table 6: Familiarity of people and secondary context splits applied to smart-phone data

				Pleasure		Arousal		Dominance	
Primary Context	**Value**	**Secondary Context**	**Value**	**Result**	**p-value**	**Result**	**p-value**	**Result**	**p-value**
familiarity of environment	<7	noise	>3	0	>0.05	0.2	>0.05	0.49	>0.05
		distractions	>3	0.19	>0.05	0.4	>0.05	0.58	>0.05
		activity	>2	-0.3	>0.05	-0.08	>0.05	-0.02	>0.05
		number of people	>2	0.45	>0.05	-0.52	>0.05	0.03	>0.05
		familiarity with people	<5	0.23	>0.05	-0.01	>0.05	0.41	>0.05

Table 7: Familiarity of environment and secondary context splits applied to smart-phone data

				Pleasure		Arousal		Dominance	
Primary Context	**Value**	**Secondary Context**	**Value**	**Result**	**p-value**	**Result**	**p-value**	**Result**	**p-value**
activity	<3	noise	>3	0.16	>0.05	0.11	>0.05	0.64	<0.05
		distractions	>3	0.49	>0.05	0.49	<0.05	0.74	<0.05
		number of people	>3	0.17	>0.05	0.15	>0.05	0.34	>0.05
		familiarity with people	<5	0.5	>0.05	0.23	>0.05	0.73	>0.05
		familiarity with environment	<5	0.68	>0.05	0.34	>0.05	0.37	>0.05
activity	>2	noise	<4	-0.5	>0.05	-0.25	>0.05	0.07	>0.05
		distractions	<3	-0.43	>0.05	-0.28	>0.05	-0.05	>0.05
		number of people	<3	-0.53	>0.05	-0.19	>0.05	0.16	>0.05
		familiarity with people	>4	-0.63	>0.05	-0.78	>0.05	0.3	>0.05
		familiarity with environment	>5	-0.39	>0.05	0.17	>0.05	0.15	>0.05

Table 8: High and Low Activity and secondary context splits applied to smart-phone data

We finally explore *activity* as an important context that is key in the use of mobile devices. Levels of higher activity show a trend of negative correlations between pleasure and PDI when values for secondary contexts are low, see table 8. In addition to this where there is lower activity and secondary contexts are high in value then we find positive correlations for pleasure and significant increases in positive correlations between dominance and PDI. However a decrease in this correlation is produced when secondary context values are lower. This suggests that active users are relying on pleasure, potentially through the stimulus produced by the activity, to dominate their decision involvement and that levels of dominance can become more important as the secondary context values increase or if the user becomes less active.

Overall the results above show that where we see increases in secondary context values an increase in the correlation produced by the primary context, whether positive or negative, is also found. Though not all results are significant the trends presented suggests that under different levels of primary contexts, e.g. activity or familiarity, and when subjected to varying levels of secondary contexts that users of small device have a greater reliance upon levels of dominance when engaging in PDI. We therefore tentatively accept *H6* as proven but suggest that this phenomenon be the focus of further investigation to explore this phenomena further.

5 CONCLUSIONS

Smart-phone technology is constantly developing and context-aware mobile systems are increasingly becoming part of our everyday lives. This benefits m-commerce considerably as it already has relatively few obstacles regarding information delivery [1].

Our results show that physical context including stressors and familiarity can be used to understand a user's potential level of purchase-decision involvement with high-involvement products. Individual contexts, in particular *familiarity of people* and *distractions* proved to be useful when used as individual contexts for all devices. The use of additional contexts of *activity* and *number of people* providing additional depth to our understanding when considered with other contexts as part of a situation.

Results for users of larger devices presented even stronger evidence that the relationship between PDI and positive-negative affective state and that some disruptive contexts increase this relationship. Results for users of smart-phones is more speculative but provides strong indication that the PDI and positive-negative affective state relationship has limited bearing. However we do see that user dominance in particular develops a relationship with PDI when users are under extremes of environmental contexts in particular for low *familiarity of people* and low levels of *activity*. The increase in a dominance related decision involvement process when smart-phone users are under extremes of situational contexts is relatively simple to explain and fits with many research findings as discussed in the text. Mobile users are prone to higher perceptions of risk, interruptions, distractions and physical issues so are simply more vulnerable in their use of the device when in *unfavourable physical situations* and therefore need to feel dominant of their situation to be able to form a decision effectively.

The value of this report's findings are important in that if a recommender system can determine values for affective state and other contexts such as environment stressors it should then be able to determine when to present particular product information to a device user. This would be particularly useful via mobile devices and their inherent situation variability. Through knowledge of a user's decision involvement a system can optimise cost savings by targeting when to present specific advertisements. To help manage this the introduction of the term *unfavourable physical situation* has potential to be used as a useful descriptor for developing understanding within context-aware recommender systems. The concept provides focus on particular contexts to exploit their impact on the relationship between affective state and purchase-decision involvement. Deepening the understanding of this concept will also support a strategy for developing a m-commerce system that uses contexts to determine when to advertise certain projects but also how to leverage consumer decision processes and engagement.

This study has limitations in that it relies on user subjectivity of their affective state and environment contexts, it also relies on a relatively small dataset when determining smart-phone user phenomena. Research focus should now be to build upon our findings through larger, more focussed datasets to provide definitive evidence that the affective state – PDI relationship is more complex than previously thought. Research also needs to identify suitable methods of context measurement that do not impact on user privacy or device performance. Considerable efforts have already been applied to this area. However effective solutions are still some way off, with focus being on specific tasks rather than the more generic requirements of m-commerce. Our future research will be directed towards effective m-commerce related context-awareness, and the understanding of situational behaviours.

To conclude, our main contribution is to have widened the understanding of a number of contexts, device use and their influence on the affective-purchase decision relationship. For mobile device users we have also shown that this relationship is more complex than that for the larger device and that dominance is an important consideration requiring further exploration. We have also, through the introduction of the term *unfavourable physical situations* presented the research area of context-aware recommender systems a new direction that supports the development of m-commerce capabilities.

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