Designing Mobile Applications with Empathizing User Experience

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Abstract
User Experience is recognized as an important aspect for designing mobile applications. Each application satisfies different user needs and hence demands for a different evaluation criteria. The aim of this study was to devise a user centered design framework to objectively evaluate and enhance user experience of mobile applications. Using the Empathizing-Systemizing theory, we conducted a user study to understand the cognitive needs of users in user-technology interactions of mobile applications. We found out that even though user preferences are varied and contextual, the user experience is optimum when applications are designed for inclusivity of both the "Empathizing (E)" and "Systemizing (S)" aspects. We have assessed the same for a few popular reminder applications on mobile as a use case to explain and validate our proposed framework. This study also provides insights into the process of evolving such a framework.

Author Keywords
User Experience; Empathy; User Centered Design; UX Evaluation; Mobile Applications

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

Designers of mobile applications always strive to provide optimum user experience for their products by continuously making user-centric design decisions. However, in a corporate setting design decisions are often influenced by business requirements and technological constraints. For any product development organization, it is imperative to retain its presence in the market by churning out products to cater to rapidly changing market needs. The underlying intent is to attract more users to use their products compared to the other competing products. One of the most common business strategies has been to identify potential target groups and cater to their specific needs by providing new features and experiences. But with the increasing complexity of products with new features, users find it difficult to understand and use them. Moreover, in designing for users with different functional needs, we often tend to ignore the less visible psychological differences among them. From our preliminary interaction with few users of our smartphone product, we observed different levels of user fulfillment on using an interface. They look for something beyond mere functional requirements. It was hence very crucial for us to understand what makes users prefer a product.

Each mobile application being different in terms of its usage context, target users, engagement and overall user experience, the design decisions are crucial and must be approached systematically. For instance, the user experience design principles to be followed to design different communication applications, like video conferencing application, instant messaging application and email may be completely different. Therefore it is important for such applications to be aligned to the cognitive needs of its target users. Thus we felt an immense need to create a design framework to evaluate our existing products and also propose design implications for future product development. We used the existing cognitive behavior tests of "Empathizing Quotient (EQ)" and "Systemizing Quotient (SQ)" [1,2,3] to understand and categorize users with different cognitive profiles. Further we identified user needs and system attributes relevant to "Empathizing (E)" and "Systemizing (S)" aspects of user experience. The outcome was a framework that contributes a method to map the user experience attributes to cognitive needs of users. It can be used to objectively evaluate and enhance the user experience of mobile applications. We also derived design principles for creating an empathizing user experience, exempting the predominantly task-driven systemizing behavior of existing interfaces. We have assessed this framework to evaluate the task of setting a reminder in the mobile phone as a case study for reference. Cognitive requirements of various application may vary, and therefore what we have proposed is not a generic framework which is applicable across all application design. Our contribution rather lies in proposing a user centered design process to evolve such a reference framework suitable for mobile applications.

Background

The existing usability heuristics are useful for reviewing interfaces but they are quite generic to be used as a reference for taking informed design decisions for different mobile applications. Earlier work argued that the usability heuristics may be more suitable for reviewing only software application that fall under productivity genre [11]. There have been attempts to propose refined heuristics specific for gamming

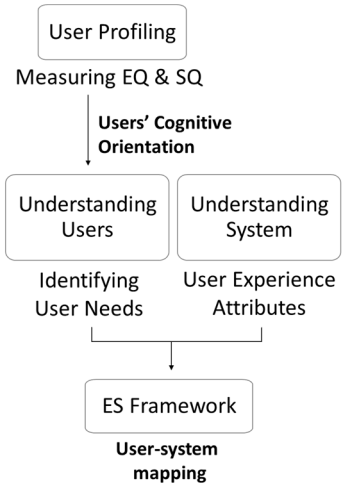

Figure 1: User Centered Design Process to evolve the ES Framework

Categories	Cognitive Profile
EQ>>SQ	Very High E
EQ>SQ	High E
EQ=SQ	Balanced
EQ<SQ	High S
EQ<<SQ	Very High S

Table 1: User Profiles based on cognitive behavior orientation

applications [4], as for such applications 'Playability' was crucial. Dorflinger [6] proposed that the cognitive behavior of human being is related to their interaction behavior with products. Based on this he finally proposed segmentation of target users and its practical implications in the context of ICT products.

There are several research reported in the literature [7] [8] [15] which provide guidelines on understanding the user experience. One significant approach has been to look at user needs beyond instrumental or the task-oriented needs. Different authors have proposed alternative lists of non-instrumental needs to complement the traditional, task-oriented approach. AttrakDiff [9] is one such model that proposes different product attributes that make up a product character. It considers both pragmatic (task-oriented) and hedonic attributes (self-oriented) to define user experience. Our objective in this study was to identify user needs and resulting product attributes beyond these two categories by also considering the Empathizing (people-oriented) needs of the users. In prior work [13] EQ and SQ have been correlated with psychological behavior like gender differences, personality types and interests. In our approach we relate the EQ and SQ to the user experience attributes relevant for the mobile applications. The outcome is a framework that can be used to evaluate the user experience of mobile applications in terms of E and S aspects.

Research Methodology

The study was conducted in following three phases:

- User Profiling: online survey to measure EQ & SQ of users
- Understanding Cognitive Preferences of Users: user interviews to understand cognitive needs of users in mobile interactions
- Understanding System & User-System Mapping: analysis session with designers to map user needs to relevant user experience attributes

User Profiling

The Empathizing Quotient (EQ) and Systemizing Quotient (SQ) tests developed by Simon Baron-Cohen [1] were used to examine the cognitive behavior orientation of users. The test consisted of 120 statements to be responded using a five Likert's scale ranging from strongly agree to strongly disagree. We conducted an online survey to recruit a good distribution of the participants. Responses received from 149 participants (32% females) in the age group 25-40 were used to calculate the EQ and SQ scores. This further formed the basis of profiling users into different categories as shown in Table 1. We got a fair distribution of users, both males and females across all these categories except fairly less number of women in the 'Very High S' category.

These tests also gave us a better understanding of the two cognitive behaviors. An affinity analysis of the statements in the questionnaire helped us in deriving their underlying behavioral attributes. The statements with similar underlying behavior were grouped, for instance statements: 'I am good at predicting how someone will feel' and 'I can easily tell if someone else wants to enter a conversation' along with other similar statements were grouped together under the behavioral attribute 'Intuitive' and so on. Having a clear understanding about these two dimensions in terms of user behavior, the challenge ahead was to understand how it gets reflected on product attributes. Looking at these behavioral attributes, we further categorized them across three phases: stimulus, process &

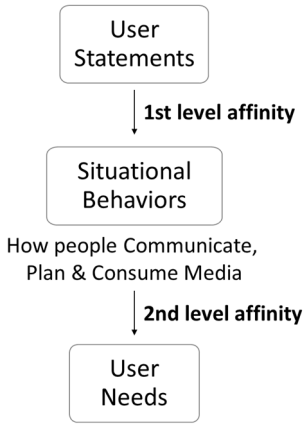

Figure 2: Affinity analysis process to derive user needs

outcome. The reason for categorizing across these phases was to understand the sequential journeys of the two behaviors and compare them granularly by looking at what drives the behavior (stimulus), how it affects them (process) and how they respond to it (outcome). It would also help us to map them to relevant system attributes across different phases of user experience journey.

Cognitive Behaviors	Stimulus	Process	Outcome
Empathizing	Intuitive, Sensitive (Sense)	Humble, Considerate (Feel)	Amiable (Express)
Systemizing	Curious, Attentive (Informed)	Analytical, Structured (Analyze)	Efficient (Control)

Table 2: Cognitive behavior attributes across three phases: Stimulus, Process and Outcome

Understanding Cognitive Preferences of Users

The objective of the second phase of study was to understand user needs due to varied cognitive behavior in how people communicate, plan & consume media, the most basic functionalities fulfilled by mobile applications. A total of 20 users (40% females), 4 from each of the cognitive profile mentioned in Table 1 were chosen for in-depth user interviews. During the interview, different real life situations were given to the user as stimulus to understand the manifestation of cognitive behavior on their phone usage. The situations varied across three domains: communication (e.g. call, messaging), planning (e.g. setting reminder, tracking expenses) and media consumption (e.g. browsing, music, gallery) across varied context (work, home, travel etc.). The users were probed about their response to these situations to understand their underlying needs. Significant differences were observed in the behavior of people with different cognitive profiles. For e.g. a person with high E, being people oriented, would prefer to stay connected always with their close ones through personalized and intimate ways to communicate. Whereas for people with very high S behavior, clarity in communications was identified as their primary need. Even their planning behavior had stark differences. Quoting a person with high EQ, "I don't keep a track of my expenses as I always value relationships over the money I spent for them" as opposed to High S people who are mostly decisive planners to avoid any uncertainties. However we also observed that these needs vary depending on the nature of task and the context. We observed differences in how people deal with similar situations differently at home and at workplace. Thus we realized that the EQ and SQ scores of a user cannot be indicative of their behavior across all scenarios. An affinity analysis of their varied responses to different situations helped us in deriving their underlying needs. In the first level of affinity, we grouped user statements with similar behavior for each situation. These situational behaviors gave us insights about how people communicate, plan and consume media differently. We further grouped these situational behaviors to derive their underlying needs. We could broadly group them into two categories:

1. Task-oriented (S Needs): Control, Convenience, Explorability
2. People-oriented (E Needs): Affection, Codependency, Self-sufficiency

With the help of EQ and SQ scores of the users and their corresponding needs we could quantify these needs relatively. These needs were thus plotted on a graph, by considering their varying levels of E and S.

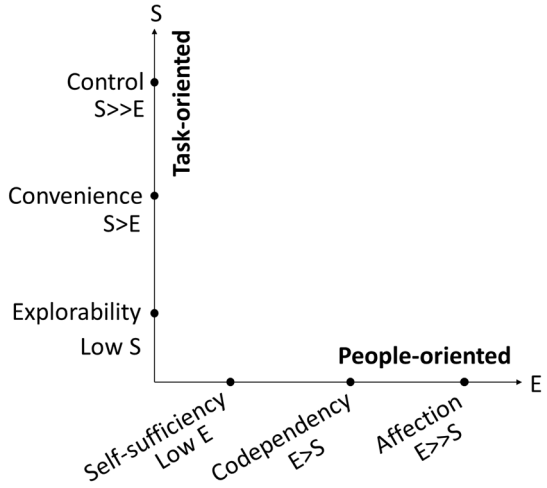

Figure 3: Task and People oriented user needs corresponding to different levels of E and S

User-system Mapping

To substantiate the user needs in terms of user-technology interaction, a set of 14 attributes were mapped to these needs by an expert review process. We looked at the Heuristic Principles [14] and the AttrakDiff Model [9] as reference to derive a consolidated list of parameters that fulfill the user needs identified in the second phase of the study. During this exercise we identified that 'Affection' and 'Codependency' were the most undermined needs in the above two reference models. Thus attributes like 'Forgiving', 'Intuitive' & 'Assistive' were introduced in our model to give an Empathizing aspect to the user experience.

System Attributes (E)	Weight (E)
Intuitive	3
Forgiving	3
Familiarity	2
Assistive	2
Flexible	1
Accommodating	1
Empowering	1

System Attributes (S)	Weight (S)
Transparency	3
Consistency	3
Accuracy	3
Minimalistic	2
Intelligent	2
Appealing	1
Joyful	1

Table 4: System Attributes and corresponding E/S Weights

Cognitive Behavior	User Needs	System Attributes
Empathizing	Affection	Intuitive
		Forgiving
	Codependency	Familiarity
		Assistive
		Flexible
	Self-sufficiency	Accommodating
		Empowering
Systemizing	Control	Transparency
		Consistency
		Accuracy
	Convenience	Minimalistic
		Intelligent
	Explorability	Appealing
		Joyful

Table 3: Mapping user needs to system attributes

Framework

Though usability principles might implicitly cater to both E and S aspects in some way, but there is no way to objectively evaluate them. Mapping system attributes to user needs helped us in substantiating system attributes quantitatively on a 3-point Likert scale, 1 being Low and 3 being High, based on their varying levels of E and S. Transparency, Consistency and Accuracy, mapped to the user need 'Control' corresponds to the highest level of S (Weight=3) and Minimalistic and Intelligent to lower level of S (Weight=2) and so on. Thus each system attribute was

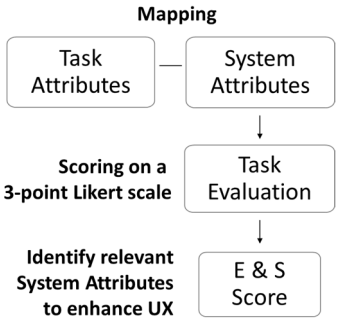

Figure 5: Evaluation Process

Task Attributes	System Attributes
Discoverability	Transparent Flexible
Structure/ Flow	Minimalistic Flexible Assistive Forgiving
Language	Familiarity Accommodating Accuracy
Medium of input	Consistent Flexibility
Suggestive	Intelligent Intuitive
Visual Appeal	Appealing Joyful
Advanced features	Intelligent Empowering

Table 5: Mapping Task Attributes to System Attributes for 'setting a reminder' task

assigned a weight to quantify its cognitive behavior based on the level of user need it caters to. This completed the circle from mapping the cognitive behavior of users to the user needs, the user needs to corresponding system attributes and the system attributes to the different levels of the two cognitive dimensions.

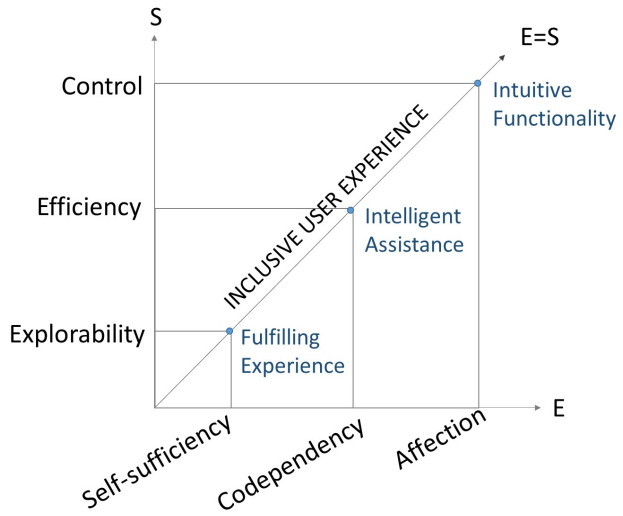

Figure 4: User needs and design principles for an Inclusive User Experience Journey

We further defined different phases of a user experience journey (Stimulus-Process-Outcome) by mapping them to relevant user needs:

1. Stimulus-driven: Control & Affection
2. Process-driven: Convenience & Codependency
3. Outcome-driven: Explorability & Self-sufficiency

For any user experience to be complete, it must satisfy both the E and S aspects through these phases.

Thereby we defined following design principles for creating an inclusive user experience journey by incorporating all user needs:

1. Intuitive Functionality: To begin with, any application should be easy to use and provide the functionalities for its intended use.
2. Contextual Assistance: Each user is different and hence their needs are different too. The system should assist the user by providing contextual suggestions relevant to the user and the context.
3. Fulfilling Experience: Beyond fulfilling the user's intent the system should instill a sense of empowerment and joy to make the user feel good having accomplished the task.

Case Study

To further explain and evaluate the above proposed framework we describe a case study to evaluate the task of 'setting a reminder'. It was one of the situations given to the users in the user interviews wherein we observed varied behavior and therefore we decided to evaluate it across different applications preferred by users. 'Discoverability' and 'Flexibility' were identified as the primary user needs during user interviews. A total of five existing popular applications (Alarm, Reminder, Calendar, Notes and Voice Assistant) were chosen based on user preferences for most commonly used application for setting a reminder. We have refrained from using their exact brand names to ensure anonymity. Not all system attributes identified in the framework were applicable for all applications, therefore we decided to identify the task attributes relevant to an application. The task was elaborated by breaking it down into basic elements of an interface relevant to reminder application. Each of these task attributes was mapped to the relevant system

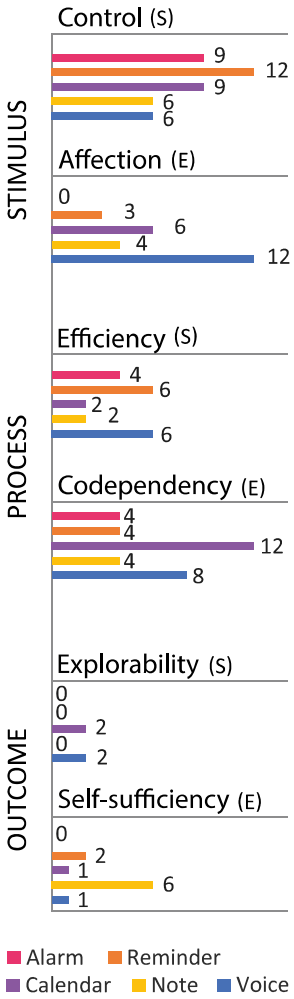

Figure 6: E and S scores for different apps across the different phases of the task of setting a reminder

attributes of the framework as shown in Table 5. Each product was then evaluated against these system attributes on a 3-point Likert scale, 1 being Low and 3 being High. The participants for this evaluation were clearly explained all the system attributes with examples relevant to the reminder application. This score was then multiplied with corresponding weight of the system attribute. A total of these weighted scores for different system attributes gave E and S scores for each product. Looking at their E and S scores as in Table 6 and Figure 6, we analyzed what makes an application more preferable than others:

1. The Familiarity and Minimalism of the Alarm application makes it easy to use.
2. A dedicated application only for setting reminders reduces the cognitive load and hence makes the task quick and easy. Reminder scores high on Transparency and Consistency hence provides better Control to the user.
3. Calendar provides assistive & contextual suggestions for setting a reminder. This Intuitive and Assistive behavior positions it high both on Codependency and Affection.
4. Taking a note is the most quick and handy way to remember tasks. The Flexibility of the medium and structure of input in Notes application makes it high on Flexibility and Accommodating.
5. High empathizing score of a Voice Assistant to set a reminder is due to its human-ness to listen, respond and assist.

System Attributes	Alarm	Reminder	Calendar	Note	Voice
Transparency	3	6	3	3	0
Consistent	6	6	6	3	0
Accuracy	0	0	0	0	6
Intelligent	0	2	2	0	4
Minimalistic	4	4	0	2	2
Appealing	0	0	2	0	0
Joyful	0	0	0	0	2
S Score	13	18	13	8	14
Intuitive	0	3	6	0	0
Forgiving	0	0	0	0	6
Flexible	0	0	0	4	6
Familiarity	4	2	8	4	6
Assistive	0	2	4	0	2
Accommodating	0	0	0	4	1
Empowering	0	2	0	2	0
E Score	4	9	18	14	21

Table 6: Heat map for weighted scores of system attributes and E and S scores for different apps for setting a reminder

Mapping these applications to the ES Framework also gave us insights about the unfulfilled needs of the users and the specific improvements that would make these applications more preferable. For e.g. Calendar being a text-oriented application, with a structured layout gives user a better Control but makes it low on Affection. Also the constraint of fixed modality makes it low on Self-sufficiency. A multi-modal chat interface would make the Calendar application high on these attributes by being Assistive and Flexible in terms of input. We could similarly look at other applications to refine their user experience.

Limitations of the study

In our study we focused only on cognitive aspects of user experience. Thus our framework considers only E and S as the relevant parameters. However, designing user experience may also consider various other user needs such as: physiological, social, cultural etc., which are again quite subjective. Thus, based on the current study we do not attempt to generalize our framework to objectively evaluate all the other possible aspects of user experience. To consider other aspects, our framework may have to evolve further, but the process would still be valid. Therefore our study can be used as a reference to carry out such a process.

Conclusion

In this study, we examined the cognitive behavior of users in user-technology interactions for different mobile applications. Our aim was to refine the user experience of our existing products by considering both the functional & emotional needs of the users. The key contribution of this study was the process to devise a framework to measure the E and S aspects of any mobile application in terms of different system attributes and corresponding user needs. In a R&D setup, the design decisions are often influenced by various stakeholders. Thus, there is a constant need for designers to iterate on various possible design alternatives for their products. Our proposed framework can be used to objectively evaluate and compare these different design solutions. This objective evaluation allows for identifying specific system attributes that can enhance the user experience of a mobile application. Depending upon the target users and the application to be evaluated, we can define an optimum user experience for each application with varying levels of E and S. This framework can help us substantiate it in terms of different user needs and corresponding system attributes. For example- a reminder application for business professionals may demand higher levels of 'S' aspect to cater to their need for Control and Efficiency. Thus we should make a conscious decision to prioritize user needs, depending upon the context of use. Designers can also try out different variations of their proposed solutions by considering different levels of E and S and evaluate them with users to identify the relevant user needs.

The most important learning for us in this process was to refrain from designing a generic framework for evaluating all types of applications. Each application satisfies different user needs and hence would demand for a different evaluation criteria. Therefore above all, the user needs should be clearly identified and mapped to relevant system attributes. We further aim to use the insights from the case study to develop a new experience for a reminder application that is inclusive of different cognitive needs. This would facilitate us to test it with the users and incorporate their feedback to evolve the framework further. We also wish to take this work further by refining this framework for specific genres of mobile applications.

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