What is User's Perception of Naturalness? An Exploration of Natural User Experience

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Abstract. Natural User Interfaces (NUI) is now a well-researched topic. The principles of NUI in literature primarily focus on designing the user interfaces to be intuitively easy to use. But is it enough for a software product to just have an intuitive user interface to give a natural experience? Designing for a product imbibing overall naturalness requires encompassing of all the aspects of user experience, which is beyond just an interface design. This study contributes by taking a holistic approach in identifying what users perceive to be natural and what experiences make them feel so. We involved 36 participants with diverse demographics and personalities, giving them a variety of stimuli to elicit their perceptions of naturalness. These were found to be a combination of what they perceived to be natural through visual, cognitive as well as real life past and present experiences. The insights from this research helped us in deriving inferences on designing for what we call as Natural User Experience (NUX). We found that the level of naturalness does not remain same over time for the users; rather it goes through a stage based cycle. We also evolved strategies for improving the naturalness by advancing user's experience across these stages.

Keywords: Natural User Experience · Natural User Interfaces · Intuitive interaction · Intuitive use · Naturalness of interaction

1 Introduction

The frequency of users' encounters with the variety of digital devices has now increased many folds. From the office to home, from inside the car to inside gym, while sitting to while walking, everywhere users encounter a variety of interfaces with a variety of interaction. All of these interfaces are designed to compete for user's engagement. With exposure to wearable devices, VR devices, social robots, new biometric authentication methods, new interaction modalities such as air gesture or gaze, users would expect their interaction experience to be more natural. Among these multitudes of digital experiences, the ones which will provide Natural User Experience would be preferred. User Experience is not just the experience of the interface alone and therefore we consider Natural User Experience is not just the natural mechanisms of user's interaction with the system. Our understanding of *Natural User Experience (NUX)* is derived from the Alben's classical definition of quality of experience [1];

R. Bernhaupt et al. (Eds.): INTERACT 2017, Part II, LNCS 10514, pp. 224–242, 2017.
DOI: 10.1007/978-3-319-67684-5_14

focused on the naturalness aspect. It includes all the aspects of how people use an interactive product i.e. how naturally it feels in their hands, how naturally they understand its function from their existing skills, how natural do they feel while using it, and how naturally does it fits into their usage context.

Most of the prior literature dealing with naturalness were focused on Natural User Interfaces (NUI), which Wigdor and Wixon [2] defined as interfaces that make users act and feel natural. Being intuitive was considered the most fundamental for NUI design. There is high-level design guidelines for NUI in the literature as well [2, 3]. But the question we pitch is that, is it enough for a software product to just have an intuitive, easy to use interface to be close to being Natural for the users? Isn't it the experience that needs to be designed for naturalness and not just the interface? Norman [4] had also raised a valid question in these lines, "are natural user interfaces really natural?" Therefore, in this research, we took a holistic approach attempting to identify and understand what composes NUX.

In our research, we delved deeper to find out what are such cognitive processes and actions that drive naturalness and how those could be enabled through design. Although the results of this exploration on user's perceptions of naturalness may be generically applied across all digital experiences, but our objective was limited to NUX involved in the design of smartphones and similar products only. We investigated whether the perception of naturalness is similar across people or it differed; and does this perception of naturalness changed over time? Also, if it was ever changing then how should the design cater to it? It is important to understand these aspects to design a software product which imbibes NUX, which should not be intuitive for just the first encounter but should give natural experience in all subsequent usages.

2 Related Research

There have been some prior attempts to explore the experience aspects of NUI and tangible interfaces. Work by O'hara et al. [5] establishes naturalness aspects of touchless interfaces. Grandhi et al. [6] explored different aspects of touchless gesture interfaces like the motion, hand shape, form, imaginary object, and instruction; and derived what accounts for naturalness and intuitiveness. There are several prior works [7–9] that established various design methodology for intuitive interactions considering intuitiveness as an aspect of similar prior experiences. Hurtienne et al. [10] proposed designing intuitive tangible user interfaces with the help of 'image schemas' and their metaphorical extensions. Also, Asikhia et al. [11] had reported an approach for quantitatively evaluating the affective aspect or intuitive interaction. Also, similar to our exploration, Blackler et al. [12] had attempted to explore the notion of the intuitive use of the product and how to design for the same. Work by Baerentsen [13] and Turner [14] also explores intuitiveness of user interface. Most of these prior researches proved that intuition is a cognitive process that utilizes knowledge gained through prior experience, i.e. users' subconscious application of prior knowledge [15, 16]. Thus, there are several prior works which explore the intuitiveness aspect of user interfaces. But researches exploring the notion of naturalness and NUX are less. Celentano et al. [17] defined naturalness in using metaphors for designing tangible interfaces. To our

understanding, there is a lack of relevant literature for NUX which could tie the insights from cognitive psychology into design directions for designing digital products; which we attempted to contribute through this research.

3 Research Methodology

We wanted to explore the perception of naturalness which was something so abstract that it was neither easy for us to communicate our questions to the participants nor it was easy for them to convey their thoughts. Thus, we had to make use of a variety of research techniques and had to include participants with personality and lifestyles as diverse as possible. The user research was conducted to collect perspectives of diverse people from real life instances, preferences on what they considered to be natural.

3.1 Participant Demographics

Our user research involved qualitative semi-structured, in-depth, personal interviews with 36 participants. For diversity among participants, we included people from different age groups, genders, primary personality types and professions; which segregates them in terms of socio-economic segments. We started by recruiting participants from various personal or professional or social network contacts according to age group and gender. A total of 61 respondents were telephonically contacted and asked about their profession and basic lifestyle, and were asked to attempt an online or a telephonic 'Basic Personality Evaluation'. We used 10 questions based brief version of the 'Big Five Inventory' [18]. Respondents were then grouped into 6 groups based on primary demographics of age and gender as mentioned in Table 1. Among the 8 to 13 people in each group, we recruited 6 participants for each, i.e. 36 participants in total, taking care to involve people with different personality types and professions, the secondary demographics, as much as possible. We had a rich variety of participants involving students, businessmen, surgeons, dentists, software developers, entrepreneurs, architects, lawyers, teachers, technicians, tele-callers, personal assistants, shopkeepers, musicians, retired, home makers, just to name a few.

Table 1. Participants demographics and distribution into 6 groups

Age	15–25 years		25–40 years		Above 40 years	
Gender	Male	Female	Male	Female	Male	Female
Group no.	I	II	III	IV	V	VI
Initially recruited	13	10	13	9	8	8
Finally recruited for interviews	6	6	6	6	6	6

3.2 User Session Protocol

Each participant sessions lasted for around two hours wherein each of them was engaged in four perception elicitation exercises described in the following section as per the sequence illustrated in Fig. 1.

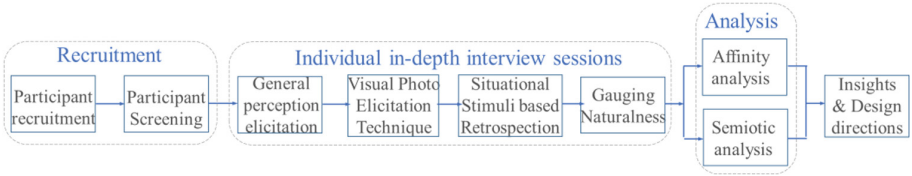

Fig. 1. Sequence of activities in the user research

3.2.1 General Perception of Elicitation of Naturalness

We began by asking participants to tell us what they consider as natural and unnatural by giving some examples from real life or from their personal awareness of digital gadget usage. Of course, this was a bit difficult for them to start responding to. The objective of this phase was to find the various attributes of "natural to use or do" to have a clear understanding of the term Natural and to also set the agenda of the session.

3.2.2 Visual Elicitation for Naturalness

Since the objective of our study was to extract the perception and preference of naturalness, which is abstract, subjective and not easy to convey, we conducted an activity based user-centered approach called Photo-elicitation technique [19]. A similar technique has been designed by Zaltman et al. [20] named as Metaphor Elicitation Technique which is applied to extract hidden knowledge, i.e. to find what people know subconsciously but can't articulate. Such research techniques have been popularly used in a variety of domains such as eliciting voice of the consumer in marketing [21], exploring the experience of powerlessness among women in sociology domain [22] etc. In this activity we printed 200 random photographs downloaded from the web and randomly spread them in front of the participants; see Fig. 2. They were asked to choose five images through which they wanted to convey what is the perception of naturalness to them or what is natural to use or to do. Post that, they were asked to explain the reason for their choices. They were asked to articulate what went in their minds while making those choices and were encouraged to give recent as well as past real life instances to support it. They were also asked to interpret the content in the chosen photographs and convey what aspect made it natural. This exercise acted as an ice breaker to motivate the users to share real life events and stories.

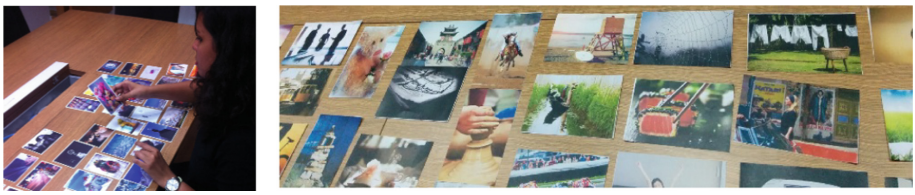

Fig. 2. Participant engaged in photo-elicitation technique with random photographs

3.2.3 Situational Stimuli Based Retrospection

In this activity, the participants were engaged in discussion around their interests, habits, routine with some retrospective account of how they developed those. For instance, we asked a musician how she discovered that she could sing, or to a lawyer on what made him interested in that career. They were asked to share how they progressed in their skills and how do they apply those skills in other aspects of life. How some things which they considered unnatural in the past have eventually become natural? Our objective was to understand the various stages of naturalness and reasons behind why something natural to someone may be unnatural to other.

3.2.4 Gauging Naturalness

During the three sessions mentioned above, participants mentioned various words that they related to the perception of naturalness. We kept hearing and noting those terms likes habit, instincts, addiction, reflex, routine, effortless, joy, to name a few along with relevant user stories and instances. As the fourth and last exercise participants were asked to relatively rank all those terms on a scale of low to high naturalness. On collating that we expected to get a progressive scale of various perceptions of naturalness. For each of the instances or stories shared by the participants, they were asked to categorize them into some action or cognition which made them feel natural. We expected to later infer some insights from these gathered experiences and stories focused on actions or cognition to derive naturalness. All the participant interactions were audio recorded and were transcribed later.

3.3 Analysis of Data

3.3.1 Affinity Analysis

We conducted affinity analysis of all the participant statements from all the activities with focus on two major aspects:

- What factors enabled naturalness (‘naturalness enablers’) and what role did they play in influencing NUX?
- How could those factors be utilized in design to enhance NUX?

In addition, we used two clusters in affinity analysis – naturalness driven from actions and naturalness driven from cognition, which were identified during the gauging naturalness activity. Most of the insights described later were derived from this analysis.

3.3.2 Semiotic Analysis of Visual Perception of Naturalness

Visual content can be examined from many points of view, such as intellectual, aesthetic, cognitive, social, etc.; ours was focused on personal preferences. We zeroed to the two most preferred photographs from the 36 participants. So, there were around 50 photographs for analysis (as some were common preferences). These were analyzed in a four step process using Saussure’s semiotic approach [23], as illustrated in Fig. 3. As the first step, every visual element such as color, form, layout, material, object, etc., from the selected images were identified and enumerated. Next, they were analyzed as is for physical and direct representations and were listed as ‘signifiers’. For instance,

the sky is blue and clear, an object has an implicit shadow on the opposite direction of light. All these signifiers were then correlated with the context of the image and metaphorical or conceptual representations were interpreted as 'signified'. For instance, the sky is interpreted as vastness with a presence everywhere. As the fourth and final step, this signified list was synthesized into various representative themes for all visual elements based on participants' statements and interpretations. While all the insights were derived from the affinity analysis, one of the insights on visual perception of naturalness was based on this semiotic analysis.

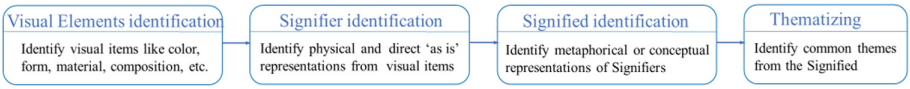

Fig. 3. Sequence of steps in semiotic analysis

4 What Composes NUX?

From our analysis of the qualitative data collected during the research, we arrived at various insights as to what is perceived as natural and how to enhance that aspect in NUX design. In summary, we found that there are three fundamental roots of naturalness, namely States of Naturalness, Action which drives Naturalness and Cognition which drives Naturalness. Now if people perceived what is natural based on the above-mentioned aspects, then why not the product UX use the similar philosophy to design a digital experience! Thus, for a product to elevate the NUX to a higher state either both or at least one of the two naturalness drivers (action and cognition) must elevate to a higher state. Further sections are focussed on these two naturalness drivers and various enablers for each of them, as summarized in Fig. 4. For each insight, we mentioned various observations that helped us derive it, and with some examples we explained related design directions for NUX.

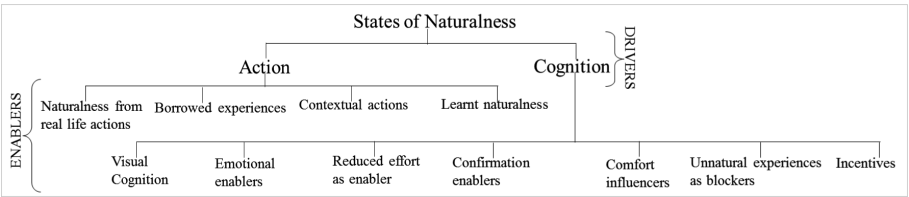

Fig. 4. Relationship among states of naturalness, naturalness drivers, and enablers

4.1 States of Naturalness

What we inferred regarding the changing states of naturalness was that, the transition from the 'State of Situational Control' to the 'State of Self Control' improved Naturalness. People felt relaxed and not being anxious when they were in their controlled environment or in a controlled situation where they can shape the course of action.

Perception of naturalness was logically inferred to have a progressive pattern from several user stories. Once in such state, they looked for anticipated progression. For instance, when a person performs a difficult task repeatedly, it becomes effortless for him, thereby shifting his experience towards higher naturalness. Anticipated exploration begins by following set patterns. Thus, we found that the state of naturalness is not stable but it is progressive. NUX would increase if the state of naturalness gets increased to a higher level. Figure 5 summarizes the overall states of naturalness in a scale from highly natural to unnatural based on how the participants ranked their different perceptions of naturalness in the activity of gauging naturalness. For example, while performing random unfamiliar actions, a person feels uncertainty which results in a state of stress. When a person is forced to do an action, he feels performing in a constrained state and thus unnatural. In a different situation, when the person performs an action intuitively, he is able to think effortlessly resulting in comfort and peacefulness, thereby shifting towards higher naturalness.

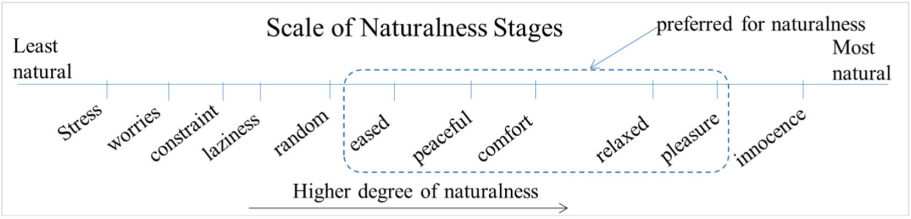

Fig. 5. Scale of naturalness stages inferred from participant inputs

4.2 Naturalness Derived from Action

Figure 6 shows the summary of how the participants ranked different actions be related to the drivers of naturalness. As evident from fig, to take the user to a higher naturalness state, the user's actions should be improved from being forced or with ignorance to that which is close to being playful, spontaneous or intuitive. We inferred that there are two different ways to use actions as drivers for naturalness i.e. 'freedom of action' and 'anticipated reaction'. The anticipation of any reaction to an action makes the experience more natural. 'Ignorance' refers to a state where the person has no clarity on occurrence or result of an action and 'Being forced' refers to a state where the person is subjected to follow a set of rules. Any reaction of product that propels user into such states is never natural.

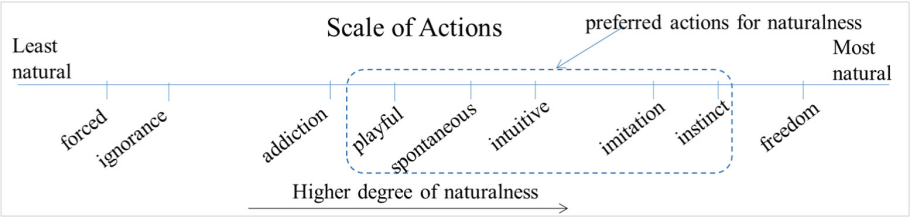

Fig. 6. Scale of action as naturalness driver inferred from participant inputs

From this, we understood that different level of actions drives different states of naturalness. Then how do we consciously enable those actions in a product? From the analysis of the participant statements, we were able to infer several ways to enable appropriate actions from which users would derive higher degrees of naturalness. Those were named as 'Action Enablers' and are as follows:

i. Digital naturalness enabled from real life actions
ii. Borrowed experiences from actions
iii. Contextual actions
iv. Learnt naturalness

Next, we describe each of these Action Enablers in detail with examples.

4.2.1 Digital Naturalness Enabled from Real Life Actions

Participants shared various instances of naturalness experiences from both physical and digital encounters. We found that there were pros and cons for both encounters that we identified as 'Incrementers' and 'Decrementers', respectively. Thus, four such 'Action Enablers' were identified as mentioned below with examples:

Physical Experience Incrementers (PEI) – e.g. muscle memory say while driving; rich sensorial immersions say for the sense of weight or temperature; or approximation of distance from a sound or facial expression.

Physical Experience Decrementers (PED) – e.g. randomness, time-taking non co-located communication through mails or letters.

Digital Experience Incrementers (DEI) – e.g. flexibility to redo any action, flexibility of customization, control over action time to act.

Digital Experience Decrementers (DED) – e.g. low trust factor due to hidden intentions and miscommunications in any software, awkwardness of using in public.

We found that people unconsciously related their natural experience of physical life into their digital encounters. Figure 7 summarizes the strategy of making use of real world naturalness drivers to reduce the effect of naturalness limiters in the virtual world. We concluded that *making use of real-world naturalness drivers to reduce the effect of naturalness limiters in the virtual world would enhance the NUX*. For example, in one of the e-books, the page turning interaction was designed very close to how one would do for turning the pages on a real book. This adds to the natural digital experience of the user. Therefore to design for natural digital experience, attempts should be made to translate the physical experience incrementers (PEI), maintain the digital experience incrementers (DEI), reduce the digital experience decrementers (DED) and avoid physical experience decrementers (PED). For e.g. software application which involves some online financial transaction that user doesn't trust, then such application may be designed with richer sensorial immersion, say haptic feedback, to make it more natural. Hence, for designing a digital product with NUX, first naturalness decrementers needs to be identified and be reduced or possibly neutralized through naturalness incrementers from physical life encounters.

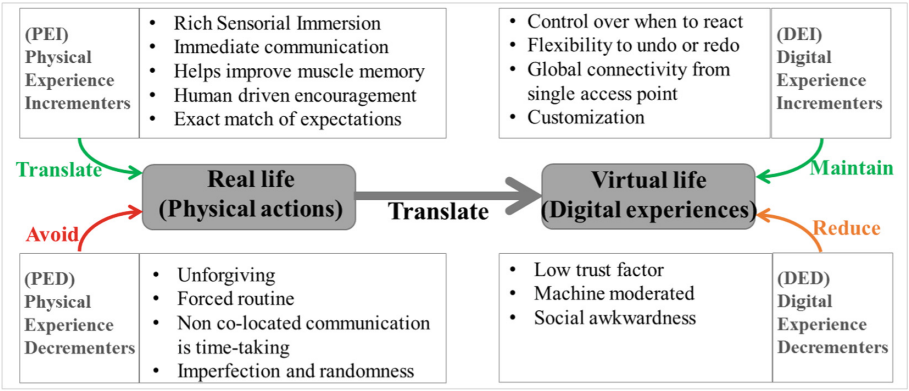

Fig. 7. Digital naturalness enabled from real life actions

4.2.2 Borrowed Experiences from Actions

There are many different skills that people develop based on their real-life experiences, such as being picture smart, detail oriented, goal oriented, efficient decision making, etc. We found that they borrowed attributes of such skills and utilized them into similar parts of other activities in digital encounters to feel natural, as illustrated in Fig. 8. For example, fiction reading hobbyists develop strong mental visualization of stories and are capable of borrowing that into the gaming experience. Similarly, detail oriented people find naturalness in fineness and depth of detailing in the digital world so they explore more and compare a lot in e-shopping. People with efficient decision-making skills tend to be efficient in following map routes, searching and online transactions. Likewise, a task oriented person will maintain proper check list and calendar to be task and time oriented. Thus we concluded that attribute or skill of one activity/habit makes a similar part of another activity natural. Therefore, *to design a new digital encounter we need to map the closely related attributes of Source Task actions to get the target task actions.* Given a target application to be designed, find out the appropriate kind of source instances according to the kind of user and map the appropriate attributes to the respective attributes of that source for NUX.

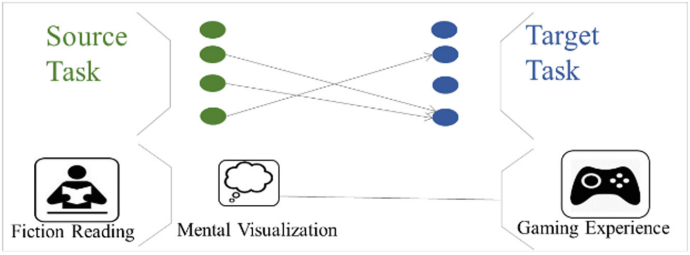

Fig. 8. Borrowed experiences from actions in earlier task enabling naturalness

4.2.3 Contextual Actions

We found that *to be natural, 'Actions' driven by 'Needs' should be in accordance with the 'Context'*. Most of the 'actions' of people are associated with one or the other 'needs'. For example, the need of social connection drives an action to associate with others through social media. Needs are fundamentally categorized according to expanded Maslow's hierarchy of needs [24]. We mapped various instances of real life actions as well as actions performed digitally, mentioned by the participants according to the fundamental needs from Maslow's hierarchy, as shown in the left portion of Fig. 9. For instance, real life action of decorating one's home, the digital action of photo editing or digital drawing, were mapped to the aesthetics need of the user. Also, we found that such digital actions were also hierarchical in nature as they mapped to the needs which were fundamentally hierarchical themselves. Moreover, from all the instances, we found that all familiar actions were considered natural only in an appropriate context; i.e. even a familiar action if not performed in suitable context, will turn out to be unnatural. For instance, two of the participants found video conferencing in a public place to be unnatural. Generically contexts could be majorly categorized into following five types:

- Time – involves periodicity, flexibility, and relativity of time
- Place – involves purpose of place, availability of resources and occasion
- Activity – involves importance and urgency of the activity
- People – involves number, relationship, culture and power-index of the people
- Self – involves age, gender, personality and state of emotion of self

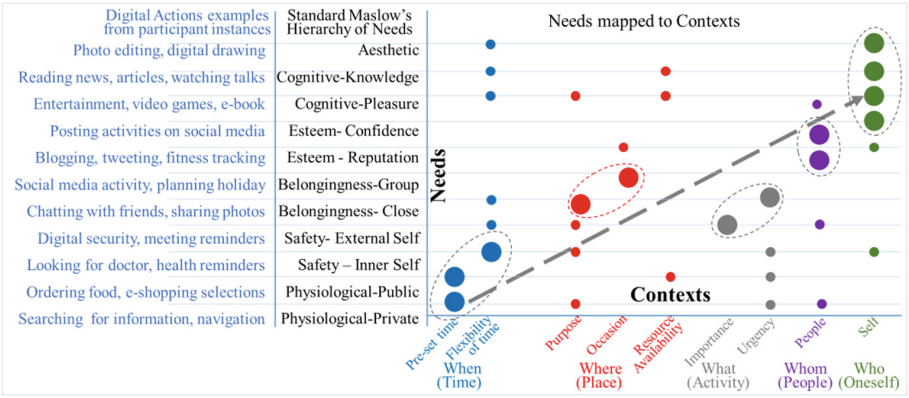

Fig. 9. Digital actions mapped to fundamental needs (left) and needs mapped to contexts (right) using the Need-Action-Context framework

We used these categories to evolve the mappings of Needs with Contexts from the various stories and instances that our participants shared during the interview session. For every instance that they shared, we asked them which Needs did it matched to and its most suitable context. Through these mapping what evolved was named as *"Need-Action-Context framework"*, which represents the relationship between different types

of needs and relevant contexts. In Fig. 9 this is shown in form of a bubble chart, wherein the size of the bubbles represents the goodness of match between the need and corresponding context. For instance, a busy senior professional who is diabetic and needs to follow a regime of medicines, food, and exercise, the naturalness of his actions to have a healthy life (Need = Safety of inner self) will depend upon the availability of time from his professional routine (appropriate Context = Flexibility of time). Thus to assist him in this need with natural digital experience would include relevant reminders on his phone which understand his timings and lifestyle correctly. Instead, a basic timely reminder would be unnatural or may be annoying to him.

In Fig. 9, the diagonal progressive line reveals that for NUX relating to the higher level of needs, the equally higher level of context would be appropriate. In other words, context should be in accordance with the need. Thus we concluded that *actions performed by the users in digital encounters should be designed by taking utmost care of appropriate context*. For designing a digital experience for a particular action first 'root need' has to be identified and then appropriate context should be derived from this framework. Only then based on the relevant context appropriate action should be designed. As per the Need-Action-Context framework, contexts of Time and Place are less crucial and therefore the system can intervene or make recommendations on them. On the other hand contexts of People and Self being more crucial, the strategy would be to understand those well and design for user's needs.

4.2.4 Learnt Naturalness

By mastering an action one becomes confident on the nature of its reaction and thus removes any possible ambiguity, thereby progresses towards Naturalness. Generally, it starts from being an intentional action as part of behavior and progresses ultimately to an unintentional habit as a part of their personality. Our participants did mention about various instances of performing conscious or unconscious actions and related them to one of the following factors:

I. Behavior – (e.g. writing strong emails, making approximations)
II. Habits – (e.g. longing to do something new, relating events)
III. Personality – (e.g. leadership, manipulation, solution orienteers, risk taking)

Each of these could be intentional as well as unintentional, the latter being more influential to naturalness. Generally there are three kinds of habit: Intellectual Habit (that deals with mental or psychological qualities of a person like applying past knowledge to new situations, building sensitivity towards few topics, etc.), Motor habit (what people perform physically like rolling a pen, shaking hands while talking, etc.) and Habit of Character (that people develop as a part of their personality over time and adopt them in any kind of situation). Therefore, as people keep repeating actions consciously or unconsciously they adopt those into their behavior which slowly gets progressed into the habit and finally becomes part of their personality. Behavior converts into habit through repetition and habit ultimately gets embedded into the personality. Now the question was which of these actions should be leveraged as naturalness enabler? In any case, there shouldn't be any external factor that should attempt to interfere or change user's habits or personality.

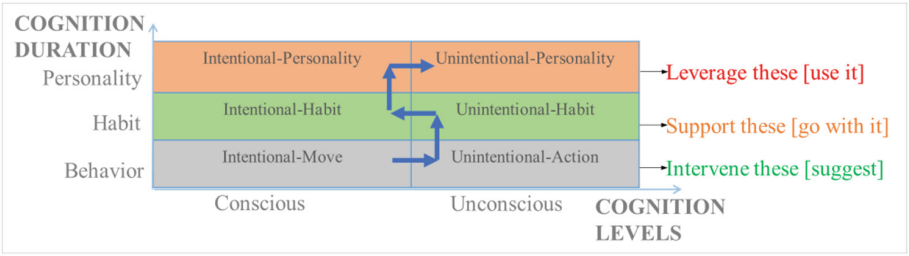

Fig. 10. Design direction to make use of user's behavior, habit, and personality

The highest level of naturalness experience in a product can be enabled through actions by leveraging or exploiting the personality of the user. For example, from the current pattern of email organization of a user who is organized personality, recommendations to apply the same pattern for files or apps could enhance his digital interaction naturalness. For the next level of impactful naturalness, user's habits should also be supported. For e.g. if a user is habituated in making particular typing mistakes, then it won't be appropriate for the system to point out each of them every time. Rather an ideal natural design would be to identify and correct them automatically and convey to the user. Figure 10 illustrates all these design strategies for making use of these kinds of actions. Also, we noted that naturalness does not get impacted if some of the users' behaviors are intervened. For instance, for people who wish to have their presence felt in community or social network, a social network application could be designed to make them feel unique. The application should enable them to make unique posts in a social network. Thus we concluded that *repetitive conscious or unconscious actions increases learnt natural behavior*. Digital system may intervene to enable user's conscious actions due to behavior but it should always support user's habit and must not attempt to change user's personality, rather leverage it.

4.3 Naturalness Derived from Cognition

As mentioned earlier, Cognition is one among the naturalness drivers. We further describe here how different levels of cognition, measured using a subjective scale, can influence different states of naturalness. From the analysis of the participant statements, we were able to infer several ways to trigger appropriate cognition effect from which users would derive higher degrees of naturalness as shown in Fig. 11. A higher level of naturalness is achieved if there is no involvement of rigorous thinking which is probably because being thoughtless is being without consideration of the consequences. From the instances shared by our participants, we could clearly observe that there was a clear preference of performing actions freely, without any constrains and without any prior thoughts. Thus we inferred that *decrease in response time and cognitive load increases naturalness.*

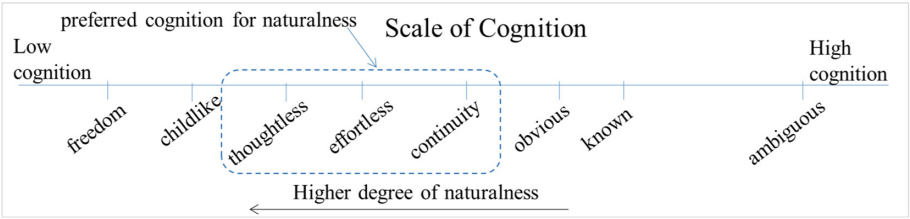

Fig. 11. Scale of cognition as naturalness driver inferred from participant inputs

Now, similar to 'naturalness derived from actions', the naturalness deriving cognition too had several enablers that a designer must design for NUX. These are named as 'Cognition Enablers' and are as follows

1. Visual cognition
2. Emotional enablers
3. Reduced effort as enabler
4. Confirmation enablers
5. Incentivizing, and
6. Avoiding Unnatural experiences

Next, we describe each of these Enablers in detail with examples.

4.3.1 Visual Cognition

From the design perspective, Naumann et al. [10] had studied the relation between aesthetic design characteristics and intuitiveness of interactive products. Visual cognition or visual perception is primarily derived from the semeiotic analysis as described earlier. It can be influenced by three factors: Color, Material, and Form.

'Color' is present everywhere and the people relate things with their colors as one of the visual aspects of naturalness. For example, change in color of a fruit from unripe to ripened state seems natural to them. Color helps to differentiate or relate something thereby enhancing NUX. One such way to assist this cognition process of the users would be the use of duotone color (two different shades of a color). Also, few colors symbolically represent some feeling; say vintage style colors rendered users with past or childhood memories. We observed that colors follow a progression from low to high or subtle to bright, similar to fruit ripening or changing the color of the sky according to the time of the day. So, the use of complementary colors showed progression and movement and naturalness as per the participants' reactions. Learned habits are represented with warm colors (yellow, orange) whereas conditioned habits are represented with cool colors (mostly blue). Generally, the natural colors perceived are *energetic, progressive* and *complementary* that enhances NUX.

'Material' is another such visual cognition aspect that affects natural UX experience. Materials are usually perceived in multiple layers which are one behind the other. The first layer acts as protective and accommodating while second acts as flexible and light. Each material combined together has its own identity as well as its cumulative identity. It is noted that all materials need to be organized in such a way that their

existence complements each other. We observed that light and flexible materials provide comfort, which in turn takes closer to naturalness. Thus natural attributes of material are *protective, flexible, light* and *accommodating*.

'Form' is that visual element which is clearly distinct in people's real and digital experiences and hence plays a crucial role in imbibing naturalness. We observed that virtual reality and augmented reality interfaces added naturalness in experience due to the 3D forms. This is because these forms add a sense of depth (like a container) which users perceived to be supportive and sturdy. Forms are perceived as spherical and bulgy, to show continuity and repetitive cycle. This repetitiveness triggers learned habits which enhance the NUX. We inferred that the perceived attributes of natural forms are *supportive, continuity, connection,* and *binding*.

4.3.2 Emotional Enablers

Emotions play a very strong role in enabling naturalness provided it is rightly leveraged through intelligent design in any digital experience. Through semiotics analysis of the photos chosen by the participants, we attempted to infer the preferred emotions. Although, as obvious, we observed that mostly positive emotions were related to naturalness, but additionally we were able to infer few more insights relating to emotions for naturalness. Like, people preferred singularity of emotions to be natural, i.e. focusing only on one state of mind took user closer to naturalness. At the same time, the emotion of being independent or being comfortable in the company of own was found to be most strongly related to naturalness. Also emotionally people were reluctant to follow any kinds of rules or constraints from whatever digital gadget they used. To be natural, people indicated that they wanted to be emotionally free from all routines.

Further, people emotionally wished to see growth or progression in any activity to be natural. It is quite natural for human beings to do something faster and better next time and all consequent times. Without apparent progression boredom sets in which was found to be highly unnatural. For instance, changing TV channel – in a new TV, a user would be contented even if it shows some delay in switching as the user is learning to do. But once the user gets used to it the delays should also get reduced accordingly, else the user does not get an emotion of progression and boredom sets in. Thus, *for being close to natural the digital experiences should be designed to focus only on one positive emotion with some progression and not multitude of emotions.*

4.3.3 Reduced Effort as Enabler

We found that 'interests' are something that people consider close to natural, only once they clear a threshold with some efforts. For instance, playing a computer game could be of interest to someone but it is not natural unless the expertise is gained. Obviously, for expertise, the user has to put in a lot of efforts and of course for that he should be motivated enough. Now the key should be to somehow reduce this effort to enhance naturalness of an interest. From the instances shared by our participants we could identify two major ways of reducing the effort – first, by rapidly increasing the familiarity with the activity of interest; and second, by streamlining the exploration involved in the process of improving skills. Further, we have identified some primary and secondary mechanisms (as described in Fig. 12) which would enable these two ways to reduce the effort as described below:

- Frequent encounters: Repeated engagements with the activity are important to increase familiarity with it. The time interval between these encounters needs to be minimized with the support of constant motivation.
- Guidance: A coach or co-learner suggesting suitable techniques to perform certain part of the activity which they learnt from their experiences. Such techniques are beneficial to avoid mistakes during practice which will further reinforce increased familiarity and reduced exploration.
- Observed experience: These are the learnings received by observing someone else doing the similar activity. These are implicit ways of gaining experiences rather than explicitly getting guidance from others.
- Borrowed familiar experience: The user tries to utilize the past experience of different activity to current activity.
- Personalized routes: Everyone has their convenient way of doing an activity and enabling the person to look for those convenient ways reduces exploration.

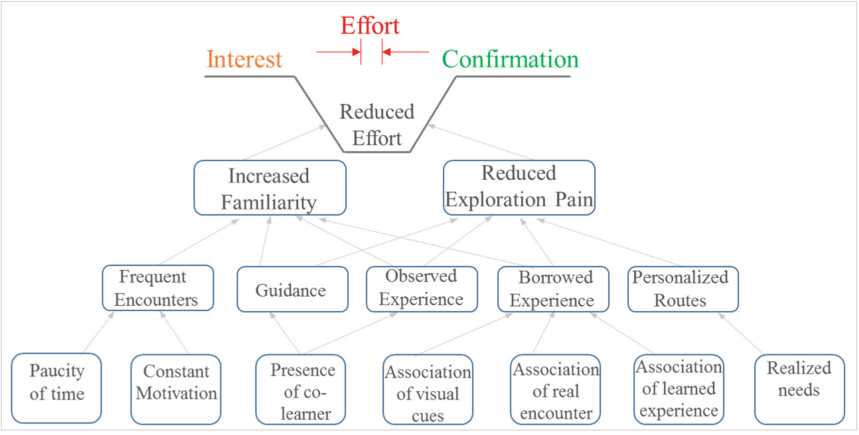

Fig. 12. Increased familiarity, reduced ambiguity, and reduced exploration enables naturalness

Thus we concluded that *increased familiarity reduced ambiguity and reduced exploration effort enables naturalness.* Below are two recommendations on design guidelines based on above inference:

- Provide 'guidance' to avoid diversions from intended path, but once sufficient expertise is achieved it should eventually disappear.
- Provide user with 'personalized route' through modified interaction flow and reorganized information based on user's identified need and goals.

4.3.4 Confirmation Enablers

In the minds of people, every activity goes through the progressive states of ignorance, difficulty, improvement, comfortable and then natural. To move from one state to other,

one needs some confirmation about their self-capability regarding that activity. It is mostly an appropriate return/response that enables the confirmation and we have termed them as 'confirmation enablers'. Through participant statements, we have identified that these confirmation enablers progress towards naturalness. Prior literature [25] has also reported the fact that, for an expert user with heavy practice, decisions become intuitive. Figure 13 shows that, at what state of the user's activity, which confirmation enabler can confirm certain activity to be natural. In Fig. 13, the circles represent different confirmation enablers, which helps progress the perception of naturalness. The size of each circle represents how common that confirmation enabler is. Vertical alignment of the circles represents the corresponding confirmation states for which that confirmation enabler would be suitable. For example, in a difficult situation of the activity, absolute achievement gives confirmation to the person and repetitive achievements will make it feel very natural in performing that activity. In other words, for a new e-shopping user who is reluctant to make an online payment due to privacy concern, some extrinsic motivation may be effective. This motivation can be derived say from his peers who had 80% times successful transactions, or by observing others while transacting.

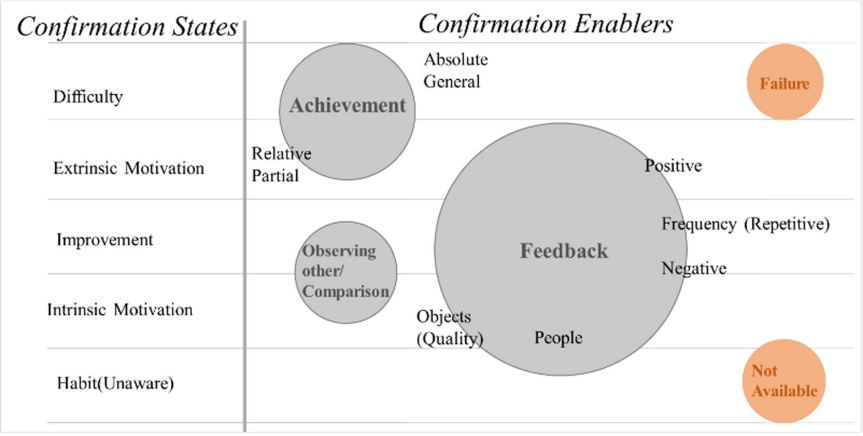

Fig. 13. Use of confirmation enabler for appropriate state initiates naturalness

Thus we concluded that *use of particular confirmation enabler for appropriate state initiates naturalness*. Natural UX for digital products should make use of appropriate confirmation enablers. The first step is to understand the particular state of action and how difficult would it be to make that action feel natural to the user. Accordingly confirmation enablers could be designed to boost the NUX.

4.3.5 Incentivizing

Incentive forces people to adapt new routines, and repetition of these routines becomes a natural habit. Actions repeated frequently and in a particular order become routine and natural habit to people. Most of these habits are from childhood, but as they grow up,

they need an incentive to adapt to new habits. These incentives are motivational to people to adapt to new habits, progress and acquire naturalness. These motivations give fun, pleasure, satisfaction and spontaneity to the user. Thus we concluded, *an appropriate incentive at an appropriate stage would be capable of changing the course of naturalness progression*.

4.3.6 Unnatural Experiences as Blockers

Similar to our findings of naturalness enablers, we also found few unnatural experiences that degraded the NUX. Our participants also shared a lot of instances which resulted in not so natural experience. We tried to infer the pattern of those instances and various factors involved in making the experiences unnatural. We found that 'Forced routines' or tasks are the ones that user does unwillingly and found them slightly unnatural. Instead, as already discussed earlier, if any task is preferred by the user, then repeating the same would improve naturalness. In addition, the act of imitation is something natural to human but repeated imitation turns the experience to unnatural. For instance, one of our participants started to maintain schedules and reminders on her phone by imitating a habit of her boss. But after few days, she started to find it unnatural as she did not find it useful to her lifestyle. With repetition of imitations, people may slowly shift to an unknown situation which they would not prefer. Other instances of unnatural experiences were found to be with unnecessary interventions in natural activities. One of the participants mentioned that the chat bots present in e-shopping sites to assist the new users are an experience had turned-off a regular visitor like her. Additionally, some extraordinary tasks above user's capabilities make the experience unnatural to the highest degree. For instance, one of our participants found the advertisements which pop up in some mobile applications prompting users to win by participating in quiz or lottery to be completely unnatural. Figure 14 summarizes these naturalness blockers. Hence, the design strategy would be to avoid the higher ones in the hierarchy i.e. extraordinary tasks and unnecessary interventions. The lower ones i.e. forced routines and repetitive imitations can be adapted to by giving users appropriate incentives and goals.

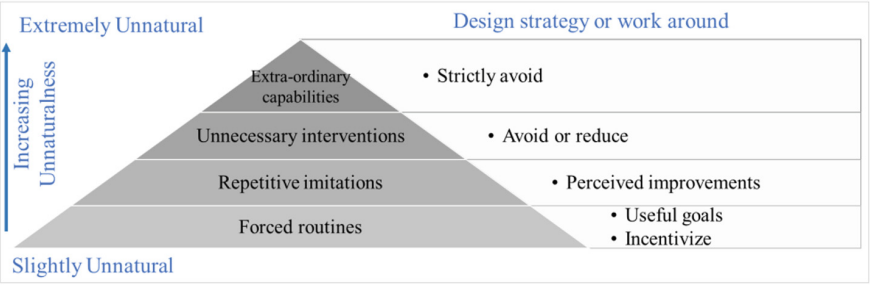

Fig. 14. Perception of unnaturalness which needs to be avoided

5 Conclusion

From this study, we were able to collate several insights on what in general users perceive as natural, what factors drive naturalness and how that can be enabled by making appropriate design choices. We applied user-centered design process with a diverse user group to explore the abstract notion of NUX. We realized that naturalness gets evoked when actions map to appropriate motor movements as well as cognition process. Through the three scales, i.e. scale of naturalness states, the scale of action and scale of cognition, we were able to subjectively define the causal dependency of the level of naturalness on the levels of actions and cognition. Also, we were able to identify various enablers for these actions and cognition which drives the experience towards being more natural. We also found that the perception of naturalness varied over time and context. We have explained the guidelines for NUX design through several examples related to design of digital software product for each. The guidelines developed in this study will enable designers to identify, evaluate and design NUX at different phases of the design process.

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