

Dynamics, Multiplicity and Conceptual Blends in HCI

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ABSTRACT

Discussions on what makes user interfaces “natural” or “intuitive” have led researchers to apply Fauconnier and Turner’s theory of *Conceptual Blends* to explain how users rely on familiar and real-world concepts when they learn to use new digital technologies – as a blend of experiences from the “physical” and the “digital” world. This pursuit has multiple challenges of which we address four: The continuous *dynamic* development of experiences; the *multiplicity* and *complexity* involved; the distinction between “real” and “virtual” experiences, and finally applying descriptive concepts *predictively*. Based on our background in activity theoretical HCI we discuss two cases to nuance the discussion of conceptual blends and HCI. We provide an understanding of conceptual blends beyond one-to-one static blends, and immediately recognizable concepts. We focus on multiplicity, dynamics and learning, and in that we provide a more advanced methodological scaffolding of analyses of conceptual blends, hence we propose that designers need to seed blends in design.

Author Keywords

Conceptual blends, activity theory, interaction design.

ACM Classification Keywords

H.5.2. Information interfaces and presentation (e.g., HCI): User-centered design, Theory and methods.

INTRODUCTION

Recently we have seen numerous discussions on what makes user interfaces “natural” or “intuitive” [4, 21, 22] particularly in the light of the increased complexity of interaction design in the wake of ubiquitous computing, augmented reality, tangible computing, post-desktop and post-WIMP computing.

One of the prominent takes on what makes a user interface feel “natural” is when it draws on our experiences from the “physical world” or the “reality” as Jacob et al. [22] put it.

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They present Reality-Based Interaction as a framework to encompass and describe emerging interaction styles in tangible, body- and touch-based interaction on a low level in relation to our experiences in the physical world. Imaz & Benyon [4, 21] and Jetter et al. [23] have recently applied Fauconnier and Turner’s [17] theory of *Conceptual Blending* as a vehicle for explaining how users rely on familiar and real-world concepts whenever they learn to use new digital technologies. Jetter et al. [23] are particularly interested in how to create effective blends our experiences from the “physical” world with those from the “digital” world to create user interfaces that feel more “natural”. The topic of how people base their acting on familiar practices and concepts is important to us, and we find the use of Fauconnier and Turner’s [17] theory promising. Yet we find the current uses in HCI premature, too one-dimensional and struggling with the relationship between the “physical” and the “digital”. This leads us to revisit our own theoretical background in activity theoretical HCI for a richer supplement to what the literature presents.

First of all, the use of words such as “natural” or “intuitive” as adjectives for human-computer interaction has been the subject of criticism. On the background of a linguistic focus at large, Koefoed and Dalsgaard [25] point out that words are not only descriptive, but also formative and we should be careful how we use them. They problematize the use of the word “natural” as *“the terminology highlights qualities that it does not help us understand and explain adequately, obscuring important aspects at the same time.”*

Secondly, while we find the theory of Conceptual Blending a welcomed addition to the theoretical repertoire of human-computer interaction, as it can indeed help to explain why something is perceived as “natural” in the lack of a better word, the dynamics, complexity and power of the way we think and make sense of the world (including computers) is somewhat underexplored in [4, 21, 23]. Accordingly this paper sets out to pursue the background in Fauconnier and Turner. This background is strongly related to other contributions regarding speaking and acting that have been seen in the past in HCI, and with this basis we find reason to develop the notion of blended interaction towards four challenges:

- The continuous *dynamic* development of experiences.
- The *multiplicity* and *complexity* involved in how experiences are activated and combined.

- The strong distinction between “real” and “virtual” experiences.
- Applying descriptive concepts prescriptively.

In the current paper we will position this discussion to work on metaphors and HCI, we will discuss the potential of conceptual blending beyond the physical/digital ‘divide’ and add to the picture some theoretical inspiration from activity theoretical HCI.

The contributions of the paper to HCI are first of all conceptual in that we emphasize an understanding of conceptual blends beyond one-to-one static blends, and beyond immediately recognizable metaphors. We focus on multiplicity, dynamics and learning, and in that we provide the second contribution, namely a more advanced methodological scaffolding conceptual blends with focus specifically on dynamics, complexity and potential for using blends for predicting and anticipating use in design. We define multiple and dynamic in contrast to one-to-one and static. Hence, multiple blends involve more than two concepts or input spaces, and the dynamic focus allows for studying how blends change over time in line with Fauconnier & Turner’s writings.

CONCEPTUAL BLENDING

According to Fauconnier & Turner, conceptual blending forms the basis of human ingenuity. It is the ability to combine multiple conceptual spaces into one emergent one, called a blend, that shares and combines traits of the input spaces, but provides an emergent structure for reasoning and acting beyond the individual input spaces. To exemplify with a paraphrased example from Fauconnier and Turner: Given a mountain climber who climbs a mountain one day and descends down the same path the next day, conceptual blending is what we use when we compute the point on the mountain path where the mountaineer was at the same time both days. We do this by imagining two mountaineers; one ascending and one descending at the same time and then “running the blend” in our mind. Similarly conceptual blending is what allows us to reason in and about the paradoxical mixture of a computer’s file system and the metaphor of an office desktop and folder cabinet when using a desktop computer.

Again according to Fauconnier & Turner, the way we construct the meaning of the world around us, whether of ink on paper, of words spoken or of pixels on a screen, is a highly dynamic process and constantly in development through blending, deblending, compression (e.g. of time or space) and decompression of blends. The development of blends is not only individual, but happens on a cultural level as well. Fauconnier & Turner exemplify this with how it took centuries to develop the blend between numbers and a two-dimensional plane that made us capable of reasoning about complex numbers – something that is now part of a standard science education. Complex numbers have become “natural” or *entrenched*, as Fauconnier & Turner would put it. The world is perceived through layers upon layers of

blends, some of them individual, some of them made up on the fly, and some of them culturally entrenched. This means that even though we may be helped in design by choosing better or more “intuitive” or “natural” concepts to blend, this is only a very intermediate state in the way the new blend, linguistically and through our doing, blends with other concepts in new and unpredictable ways.

Writings on conceptual blending in HCI

In their current writings on blended interaction, Jetter et al. write [21]: “*Blended Interaction, a new conceptual framework that helps to explain when users perceive user interfaces as “natural” or not.*”

Fauconnier & Turner [17] work with a basic form (Figure 1). While this is but one of many pictures/ways of reasoning used by Fauconnier & Turner, it has become the main understanding applied by e.g. [4, 21, 23, 28].

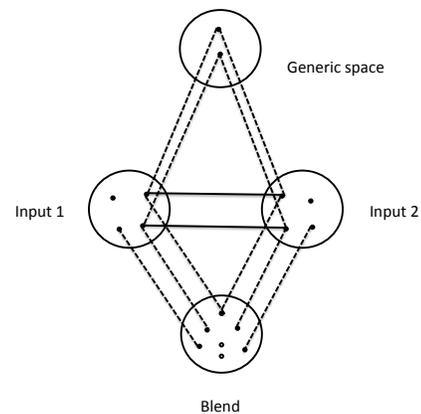


Figure 1 Fauconnier & Turner work with this basic form where a blend draws from two input spaces into one blended space, where processes of composition, completion and elaboration make the blend work for its user.

As a consequence, Imaz & Benyon [21 p. 57] are concerned primarily with blends of two input spaces: “*A blend implies four spaces: two input spaces, a generic space and the blend space*” and in this Jetter et al. address in particular blends of the virtual and the digital: “*we explain how the users’ conceptual systems use blends to tie together familiar concepts with the novel powers of digital computation.*” [23 p. 1139]

“*The virtues of physical and digital artifacts are combined in a considered manner so that desired properties of each are preserved, and a seemingly “natural” human–computer interaction (HCI) is achieved*” [23 p. 1139] illustrates how the two papers are very much addressing one set of concepts coming from a physical domain, and another coming from a virtual, hence blends being on that boundary. Jetter et al. discuss how digital blends can become “natural” when users are exposed to technology even though, to them, there are fundamental differences between the experiences from the digital world and from

the non-digital, physical and social world: *“the experiences that we make in our non-digital physical or social environment and that we integrate in our conceptual systems are usually very different from those that we make with the digital world of computation.”* [23 p. 1142]

This needs to be substantiated, and it is not obvious that it is true and possibly why it is true. If we look at their own example: *“For example, unlike real-world objects, a digital object can have a multitude of copies and instances that exist at different points in time and space. Often they are not physically contained in the devices that we use to access them, but they are located on something called a “server” or a “cloud” on the other side of the planet.”* [23 p. 1142] One may well argue that the reason for this phenomenon is that over time, the two concepts of objects have become different, and people are well able to handle both independently. A more obvious example may well be that a document in MS Word and a paper document are not at risk of being conceptually confused, because we all know, and have experienced, that they are, exactly as Jetter et al. describe: *“Frequently used blends from the digital world such as the “folder” or undo/redo have already become a part of the conceptual system of a large part of the user population and thus have become well established in their everyday world or reality. This enables designers to build new blends based on these already established blends.”*[23 p. 1147]

With this quote in mind, it is interesting that neither of the writings put any emphasis on multiplicity (rather than one-to-one blends) or the dynamics of blends in their models, despite the obvious recognition, that concepts change over time.

Jetter et al. actually state that blending is dynamic: *“This process of blending or conceptual integration (...) enables us to innovate and to create new, more complex concepts from existing concepts as input. The resulting output concept has a new emergent structure that is not available from the inputs alone. Over time this creates a vast network of conceptual integrations that connects high-level complex concepts via many intermediate steps to our most basic low-level bodily, spatial, or social experiences.”* [23 p. 1141] However, they do not expand on this dynamism in their framework.

In contrast to this, and when it comes to design, they instead focus on what we may call ‘one shot’ blends and do not discuss how this development is supported or hindered, or even continues. That multiplicity is at stake, and the development of concepts and the blending as such not random, is indicated in the following: *“The point we want to emphasize here is that interaction designers should consider using and blending the vast amount of concepts (e.g., image schemas and themes of reality) that we as humans share due to the similarities of our bodies, our early upbringing, and our sensorimotor experiences of the*

world before resorting to elaborate conscious analogies such as the desktop metaphor.” [23 p. 1145]

This quote however, opens to possible interpretations where blends mix over time, as users develop their use (of them and the end-design). This is well in line with [17] as we see further below, but appropriation/development in use is not discussed a lot by either author.

In summary, Jetter et al. are in many ways on the right track in pointing towards conceptual blends as useful means of understanding how, over time new technological concepts become entrenched in human language practices, and how this kind of understanding is useful for designers. We are, however, interested in a richer understanding of conceptual blending. This we believe has strong roots in other existing work in HCI that we consider in the following.

LOOKING BACK ON HCI

As early as the CHI conference in 1982, Frank Halasz and Tom Moran presented a critical discussion of analogies and metaphors as they were used in HCI [18]. Their example was the typewriter as a metaphor to help users start using computers. In a world where conceptual models were what was needed they point out that metaphors or analogies cannot stand alone, that they are piecemeal and inconsistent, in terms of pointing users forward regarding use: *“Although metaphors are readily interpreted by the learner, multiple metaphors don't necessarily add up to a consistent view about the system. This is what the conceptual model provides---a framework for integrating all the points made metaphorically. Since the conceptual model is synthetic, it must be built up piecemeal; and the pieces are naturally (though not exclusively) conveyed by metaphor.”* [18 p. 386] Fauconnier & Turner's [17] discussion of the desktop interface as a double-scoped blend with a number of internal (yet acceptable) inconsistencies aligns well with Halasz & Moran [18].

In another part of the HCI universe, the participatory design discussion of Scandinavia in the early 1980s [2], there was a lot of focus on the relation between specific professional languages and how they could be activated in design in order to support better use. The works of Lakoff and Johnson [26] was used extensively when Bøgh Andersen and Halskov [1, 27] worked with metaphors in design from a linguistic/semiotic angle, and discussed, e.g. the roles of spatial metaphors as used when people talk about moving information between databases. Much of this work was less related to cognitivism and modeling than that of early HCI, and more to Wittgensteinian understandings of ordinary language and language games to address the relations between language, understanding and acting. In relation to Fauconnier & Turner, these writings share the idea that it is the familiarity and everydayness of concepts and routines, the ways that concepts and practices are entrenched, that matter, rather than absolute and representational forms of naturalness. An overview of metaphorical thinking in HCI,

as well as of specific metaphors applied and reified through interface design, can be found in Blackwell [6].

Various authors have used and developed ideas of blended spaces and interaction: Mokey et al. [29] and O’Keefe et al. [31] utilize in particular ideas of physical and digital blends, Hoshi et al. [19] work towards a design-oriented approach to using conceptual blends. Hutchins [20], with his foundation in distributed cognition, focuses on material anchoring of conceptual blends, however, with little focus on the role of technology and O’Hara et al. [30] deal with praxis and the inter-subjectivity and shared development of routines. It points towards ‘occationed properties’ as something that makes objects and actions recognizable in situations, by people who share practices and language (in the Wittgensteinian sense, much closer to the work of Bøgh Andersen and Halskov [1, 27]).

ACTIVITY THEORETICAL HCI AND CONCEPTUAL BLENDS

In our own work, we have a further basis in the socio-cultural activity theory as it has been used and developed in HCI [3, 5, 7, 8, 11, 12]. It often seems that instrumentality and action through technologies have been the main element of activity theoretical HCI, yet at the same time, it is fundamental to activity theory that all activity is social, and that hence, doing and talking go hand in hand [14]. Human activity can be analyzed into a three-level hierarchy of activity, action and operation [5, 12]. Activity motivates *why* a particular set of actions, with particular material or ideal objects, is carried out. Without motive, there is no activity. With the division of work in society, activity may be poly-motivated, meaning that a particular activity may have more than one motive, coming from e.g. different areas of life. The activity theoretical tri-partition is not a means for static categorizations. Instead it provides three sets of analytical glasses, each of which focuses on an important aspect of human activity: Motivation (by asking *why?*), goal-orientation (by asking *what?*) and function (by asking *how?*).

Activity is culturally given and socially formed and language is essential for how we have access to it. Specifically, human activity is mediated by both instruments and language, in ways that can be understood as different forms of overlaid mediation: *“In recent years, it has become more and more clear, however, that the concept of mediation needs to be nuanced and extended to deal with the complex worlds of multiple mediation that surround human beings. Our observations suggest that real life mediation is heterogeneous (...); dynamic (mediators change through time); and consists of webs of mediators, either used simultaneously, connected in chains, or organized in levels, either due to different levels of automation or to different purposes of the activity. In addition, most activities involve instrumental (tools, machinery) as well as semiotic mediation (displays, conversation).”* [7 p. 374]

Bødker & Bøgh Andersen [7] propose that development of instrumental skills goes hand in hand with the formation of successive concept formation. *“Humans are compulsive interpreters”* they state and point out that learning a new application should be seen not only as a development of skills but also as a process of concept formation and stabilization of language. Through a couple of examples (e.g. their dissection of the desktop interface [17 p. 22] and a discussion of a traffic light [17 p. 246]) Fauconnier & Turner demonstrate the applicability of conceptual blending as an explanatory framework include human acting, and participating in shared practices in ways that are parallel to this. Bardram & Bertelsen [3] argue that initial familiarity is needed to trigger what Kaptelinin [24] calls the orienting basis – the early alignment between the user’s practices and concepts and the new artifact.

In the activity theoretical perspective, human beings are situated in a web of activities and ecologies of technological artifacts (cf. [12]). Human beings draw their experiences and concepts from these, e.g. when picking up new technologies or learning new practices. Bødker & Christiansen [8] talk about the space of experience and the horizon of expectation, and according to Bødker & Polli [13] we can look back on experiences in relation to expectations by studying the development of concepts in the space. Bødker & Polli seek inspiration from Bakhtin, [32 p. 54] and Bødker & Christiansen [9]: A word is first somebody else’s and then, when being picked up, first is half somebody else’s half one’s own. It becomes one’s own only when populated with one’s own intentions, one’s “accent”, when one appropriates it. Bardram & Bertelsen [3] refer to this with the concept of initial familiarity, which they argue can be constituted in interface design both through playing on simple affordances or interface metaphors.

Engeström [16] points out that change processes are not fully predictable: When a new artifact, and in this particular context, a new concept is brought into use, its use cannot be predicted, and hence, we need to understand the relationships between the future use, and part practices, language and artifacts (see also [11]). The development of human practices is in one way or another different from what the learners already are capable of, the possible future practices, or developmental potentials. Bertelsen & Bødker [5] point out that computer artifacts are not only mediating users’ relations to their objects of work, they are, at the same time, mediating the relation between designers or culture and users. Computer artifacts are social mediation and accordingly the designer leaves traces that help her be present as a more capable peer, guiding the user through the zone of proximal development (Bardram & Bertelsen [3]).

From an activity theoretical perspective, language and concepts are accordingly characterized by multiplicity, dynamics and they cannot be used in immediately prescribing future use, even though it points towards certain

potentials, at the costs of others. The entrenchment that Fauconnier & Turner talk about runs deep, culturally as well as in the learning of people.

The theory of conceptual blending is, in our opinion, highly compatible with the activity theoretical HCI, and the philosophical roots are compatible (see also a parallel discussion in [30], and in [15]). Fauconnier & Turner have a predominantly linguistic focus, as has other previous work on metaphors in HCI. Thus a practice-based background, which we see borrowing from the later Wittgenstein. However, compared to the straight-forward ‘two blends into one’ scheme (figure 1), it is essential that we consider conceptual blends in intrinsic and complex forms with emphasis on:

1. The ways in which blends develop in use, and become everyday and entrenched, both culturally and for the individual.
2. The ways that some meanings of concepts are lost in blending and deblending happens.
3. The ways in which blends serve both to provide recognizability and immediate action possibilities with new artifacts (initial familiarity) and expectation for future use.
4. The ways in which conceptual blends are also a result of contradictory elements that the human beings cannot accommodate for in straightforward manners.
5. The ways the blends are appropriated by users, and move from being somebody else’s to being ones own.
6. The complex intermixing of new blends when new artifacts are introduced and multiple existing ones.
7. The difference between blends as designers work with them, and blends as they get picked up by users, and beyond that the challenge of using blends prescriptively.
8. Despite this lack of predictability, designers may nonetheless be able to address how conceptual blends connect to user’s existing ones, and seed new practices, as we will return to.

We bring these various contributions regarding concepts and blends together in our analysis in the following section, after which we will return to discussing the prospects of a more nuanced understanding of blends and blended interaction.

TWO CASES

In the following we will present our understanding of the dynamics and multiplicity of conceptual blending in the context of HCI through two cases. One is a study of how people appropriated iPhones, and two, an experimental system to enable audience participation in an art exhibition mediated by their own personal smartphones.

We will discuss these two cases because we are able to trace concepts and blends through interviews with users

during processes where a new technology was brought into their activity. By revisiting these previous cases and papers we have mapped out which blend(s) designers intended, and which concepts ended up being activated (which blends the users made) and what challenges this actually would create for long-term use and for redesign. It is important to point out that the blends are based on post-hoc analyses of empirical and design material from two of our previous studies.

The first case is based on analyses of interviews with twelve iPhone users [9, 11] about their appropriation and use of iPhones. Five users were re-interviewed after a year. In two published papers [9, 11] we analyzed various elements of how these interviewees addressed their expectations and anticipation of the new iPhone and its use; how they talk about their exploration of the iPhone, and how they ultimately talked about a more steady (but not static) state of use. For the purpose of the current paper we have gone on to systematically map and categorize the concepts and blends.

In the second case we went through a similar process based on interview data and published material [10, 13]. The material regarded the meeting of gallery visitors with the technology in the exhibition, the initial familiarity that they experience in the exhibition, activating past practices, and the potential for a future use as they come to understand it through the visit to the gallery, something that had also been the focus in [13]. In this case we had further access to material about how the technology in question was through and designed, since it was part of a technological experiment that we did ourselves.

iPhone

It is uncontroversial to say that the iPhone changed the way we think about mobile phones. Making sense of what the iPhone (or any smartphone) is and does happens through a mega-blend that involves blends like personal computing and mobile phones; texting and instant messaging; point-and-click based interfaces and touch interaction; GPS device and internet capable computer etc. etc. etc. The list is close to inexhaustible.

When Steve Jobs presented the iPhone at his keynote in 2007 he said “*Well, today, we’re introducing three revolutionary products of this class [...] an iPod with a touch interface, a revolutionary mobile phone, and a breakthrough Internet communicator. [...] These are not three separate devices, this is one device, and we are calling it iPhone. Today, today Apple is going to reinvent the phone, and here it is.*” In the following we use this to stand in for the designer blend, even though this may be a matter of marketing as much as of design. Nonetheless, this is the blend that users largely met when they bought an iPhone at the time. We will compare this blend with the ones established by our interviewees in their appropriation of the iPhone.

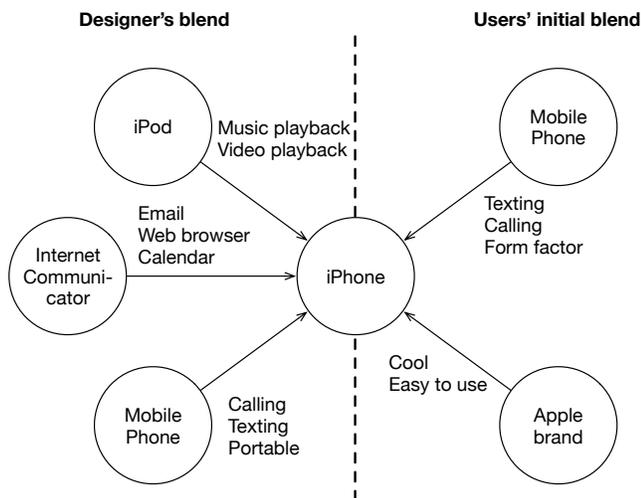


Figure 2 Illustration of the iPhone blend as Jobs presented it (left) and how it initially was perceived by our interviewees (right) The syntax is borrowed from [17]’s networks of blends, and illustrate on the left-hand side the designer concepts and on the right-hand the users. The labeled arrows indicate what was brought in from the input spaces to establish the new blend.

The main expectation of our interviewees was to get a *new cool telephone that would also support text messaging*. Some of the interviewees saw the iPhone as slightly *big*. None of them were immediately expecting to substitute e.g. their current camera or music player with the new iPhone, nor were they interested in the access to web browsing, Facebook and such. Accordingly, they saw their iPhone as something that would substitute their previous cell-phone. At the beginning many of the interviewees described that they still used e.g. a *separate calendar, camera, music player*, together with the iPhone. But that changed over time.

From the outset the interviewee’s iPhone blend(s) was quite different from the designers’ (Apple’s) iPhone blend (illustrated in figure 2). However, over time our interviewees developed their understanding of the iPhone quite significantly through exploring the app store and phone, and pursuing recommendations from media or friends. While phoning was a concern early on, as people consolidated their use, phoning took a backseat role – it was important for people to be reached through the iPhone, but they didn’t much use the iPhone for phone calls. The fundamental complaints that they made early on, like the iPhone being a *big* phone, quite literally disappeared as people started appreciating other aspects of the iPhone: *“I text and surf more than I call.”* [9].

One could say that a convergence happened over time between the designers’ iPhone blend and the users’ iPhone blend. The iPhone turned into a general-purpose computing device, where our interviewees would expect they could e.g. find an app for train and bus schedules when visiting a new city, but also occasionally receive and make calls.

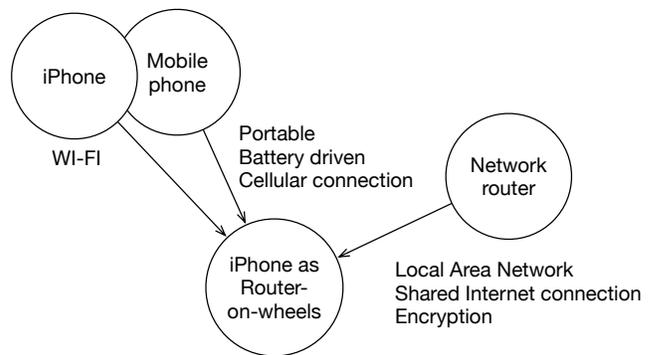


Figure 3 Illustration of the router-on-wheels blend

We also observed idiosyncratic uses and understandings as the iPhone developed: One interviewee reported how he primarily used the iPhone for reading poetry in boring classes. Another interviewee reported how his colleagues and he would use one of their iPhones as a “router-on-wheels” when car-pooling to work in the morning. One of them would simply turn on personal hotspot on his or her iPhone and everybody could use the Internet connection from their laptops (Figure 3).

The personal hotspot is documented in the iPhone manual (which is summarized directly in the personal hotspot settings pane). *“Turn on Personal Hotspot to share you iPhone’s Internet connection. Additional usage charges may apply”*. Below it is possible to set the “Wi-Fi Password”. This two-sentence manual is enough for most people, but it assumes a quite complex set of blends: Cellular connection as Internet connection, internet connection as a (potentially costly) service on top of the cellular connection, telephone as wireless access point with encrypted communication. At the same time, the group, in this case, moved this from a personal hotspot to a shared one, which is not a form of use that is conceptually seeded in the manual. Neither does it seem that such a construct has been a selling idea for the iPhone, and there is little evidence that the inspiration for the concept as such has come, packaged with the iPhones.

The use of the iPhone as a portable wireless router has also been controversial in that not all telephone carriers would allow the feature to be used, or would require an additional subscription for it to be activated. However, as it has now become culturally entrenched that a smartphone is also a portable Internet connection, such fees are becoming rare.

From an activity theoretical perspective [see e.g. 5, 12] the iPhone has influenced why we use and have a phone, what we do with a phone, and how we use it. Blends play in on all levels, e.g.: The phone as an expensive and desirable accessory (why), the phone as an Internet connection or a poetry machine (what), and the (personal) computer and multi-touch input. The latter level, the how, is the primary focus of [22], and they in fact use the iPhone as a case for their Reality-Based Interaction framework. However, our low-level operational understanding is also dynamic.

People, now, seem to expect multi-touch from a touch-interface, something that we would never expected before it was introduced. Soon we will most likely expect pressure awareness on any touch-based interface and experience breakdowns [3] when not available.

Local Area Artworks

Local Area Artworks (LAA) was a design case set up to explore the use of technology to mediate participation in art curation. In LAA, conventional curatorial descriptions of artworks were replaced by texts on digital panels collaboratively written and re-written by visitors during the exhibition, using their personal mobile devices as mediators.

From the designers perspective (this time us, figure 4 left) we had constructed a conceptual blend between Wikipedia-inspired collaborative authoring and the traditional description panels placed next to artworks, authored by curators. To emphasize this blend we limited the amount of text that could be written about an artwork to what could fit on the screen of the displays. Hence, when it filled up, people had to edit or delete what was there already. The resulting design consisted of six digital panels mounted next to six individual artworks throughout the exhibition. There, users could edit text and write new text, within the one-page format while standing in front of the specific art piece and display. To emphasize the collocated use, text was live-updated on the digital panels and other connected devices as people would edit the texts on their personal phones inspired by Google Docs. When visitors opened a browser on their phone connected to a dedicated wireless network, they were automatically redirected to our web-based system. We used WiFi proximity detection to redirect visitors' smartphone web-browsers to the editable text of an artwork in their immediate proximity.

Through observations and interviews during its month-long deployment in an art exhibition, we investigated how the system was understood and appropriated by the audience. The results are documented in [10, 13].

What we observed was that the users of LAA only partially made sense of the system as we had intended. On an operational level the blend between the physical proximity to the artwork and the content of the web-browser was established smoothly, similarly the use of the phone as a text input device was relatively unproblematic. However, *what* the system was for and *why* was not clear. The blend between Wikipedia and the interpretation panel was not established. The interviewees talked about texting, messaging, discussions, Facebook posts, a guestbook, or a whiteboard. Furthermore, they were split between seeing the panels as separate or integrated part of the artwork; hence, of identifying whether they were participating in art or art interpretation. The interviewees mainly saw the panels as means for expressing personal opinions which gave rise to *a interpretation panels and Facebook wall blend* (see figure 4 right).

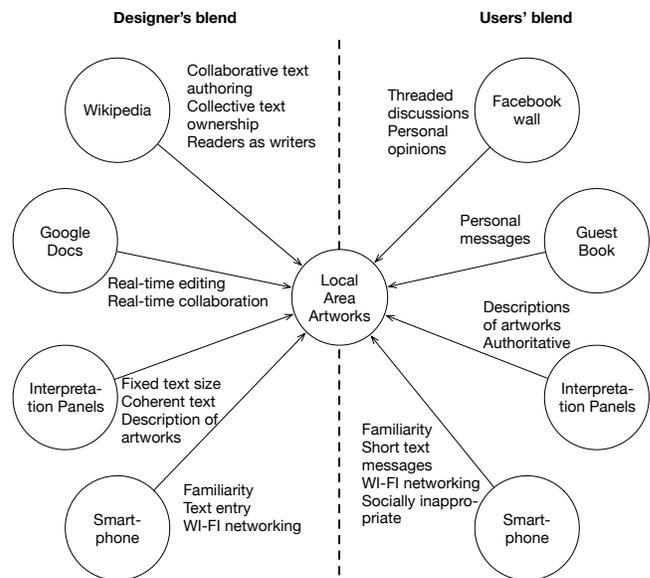


Figure 4 Depiction of the blends involved in the understanding of Local Area Artworks from the designers' perspective (left) and the users' perspective (right).

The Facebook wall is interesting in that it is itself a conceptual blend that brings a wall, but not just any sort of physical wall, into Facebook as something upon which the owner herself and other people can write messages and comments, in a time-sorted manner. The Facebook wall lends metaphorically from surfaces and graffiti, and actually only more indirectly from walls at large, which are otherwise more closely connected to separating rooms, and carrying roofs. So in a way the Facebook wall is already a multiple blend, and one that blends physical concepts rather than one physical with one virtual. The time-sorted message concept may be seen as a (mainly) virtual notion, blended into this.

The interpretation panels and the Facebook wall blend were brought into the LAA case, not because it was considered explicitly by the designers, but rather as a result of the interaction of the users with the panels, as stated by one interviewee: *"a possibility to make a comment about it (artwork), and then people who come another day, or later today could read it, that you could actually give your own point of view and someone will read it."* [13] Whereas only one interviewee talked explicitly about the Facebook wall, many other interviews in various ways talked about a (public) sequence of statements, interwoven with comments, leading to give the blend its name.

Perhaps due to the use of smartphones, it got mixed with the notion of texting, or of shorter text messages, all in all leading to 'dislike' of users with the idea that one could edit other people's contributions. This idea, in turn, was the result of the designers thinking regarding Wikipedia. However, in actual use the idea of the Wikipedia blend did not carry through to the users, and neither did the designers' metaphorical linking to the A4 page. While descriptive for

the designers, it did not prescribe the use of the LAA in any important manner, to the users.

The Facebook wall, while prohibitive to the understanding that the text could and should be edited as a whole, also played the role among art gallery visitors of pointing towards future use possibilities, exactly because it pointed to social media, allowing the interviewees to speculate about various ways of on-line sharing of discussions:

"I think it could be interesting if, when you went up to an artwork and you wrote something down on your smartphone or your iPad, but then you couldn't see what others have written before, because otherwise you keep it in the back of your head what others have written before, and so we also commented on the others comments a couple of times, but if the other comments were just hidden, until you have posted your comment, then you wouldn't be influenced at all."

"It could be a great feature, if you could take up the battle (of the discussion) on Twitter or on an online forum [...], because you have two opposing opinion of the artwork and could get into a nice discussion."

In its own way the wall may at the end of the day play a meaningful part, exactly because in an art gallery people could potentially leave comments on a wall.

The Facebook wall concept as it was used in this case, was and is a dynamic concept: It came into being in a complicated mix, and it got its own life when users talked about immediate experiences and future use possibilities, where also other social media such as Twitter played a role.

It was not the Facebook wall, but rather the curatorial 1-page text that the designers thought would provide initial familiarity. A Facebook wall-like use was nonetheless what users talked about, instead of what the designers had anticipated.

The use of the phone, and the entrenched understanding of what a (smart-)phone is used for may have played in. Text production on a phone is typically aimed at small messages or statements, and while we as designers could "deblend" text input on a phone from texting, tweeting or writing Facebook posts, our users' could not. The social understanding of a phone also played a large role. A phone is for communicating away from immediate social surroundings, hence our interviewees expressed: *"it's a bit strange to take out your smartphone actually, because normally you don't do that when you walk in an exhibition. It feels a little bit like: now I take out my phone, am I bored? (laughing)."*

Summing up the blends

We have used the two cases to draw out specific blends. In the following we discuss how they speak differently into the challenges that we identified earlier in the paper.

The virtual/physical divide

In the specific cases, the virtual/physical divide is difficult to recognize. As a matter of fact, all the concepts lend heavily from many domains, some of which had strong physical connotations, when traced backward while other less so. The phone, as we know it today, is not an added virtual layer upon a physical phone. This is even though people, e.g. when they talk about typing on the phone in the art gallery, talk about the physical phone. But already, texting is something that we do on phones today, not a conceptual add-on to phoning, as many of interviews point to in various ways. Both physical and virtual parts are deeply entrenched in each concept in the conceptual blend, to the extent that the separation seems little meaningful.

We point out that even multi-touch interaction makes little meaning as seen from the point of view of a virtual/physical divide. When we go beyond the level of "naïve physics" as described by [22], it seems that what makes the World natural to us is shared experience – with our bodies, with language and with objects of various sorts. It is less evident from our examples that it matters whether concepts and objects come from a physical sphere, or whether they are virtual. Certainly in our examples the blends can never be reduced to the 'one physical part to one virtual', that is the basic blend promoted by [21, 23]. It is more complicated as soon as we start looking.

The problem of multiplicity

Blends are not one-to-one, and blends happen on multiple levels as our examples show. Multiplicity happen in many forms: The concepts get borrowed and appropriated from many domains, some of which are meaningful to the particular use activity, while others are either brought in as e.g. analogies, by the designers, or they are sheer historical reminiscences. The activity theoretical layering of activity, action and operations points out that blends may consist of concepts helping the user deal with why, while yet others point at what or how. The Local Area Artwork example demonstrates how layers of blends are constituted across the levels of why, what and how. Similarly we see that some concepts in the blend are designed to help users recognize, or help the users actually recognizing something through initial familiarity. The curatorial 1-page text is one such example, that the designers thought would set the stage, and hence was guiding their design, while actually the users did not see the panels that way. They on the other hand introduced the Facebook wall in this capacity, leading to use becoming rather different from what the designers had anticipated.

We have pointed out that there are important ways in which parts of a blend may point ahead while others more directly come out of use, and help users recognize their current practices and understandings in the blend. Or not, as matter of fact even though the designers projected that they would. In Bakhtin's terms they stayed 'somebody else's', namely

the designers'. To paraphrase Peter Bøgh Andersen [7]: *We as humans are compulsive blenders*, and these kinds of examples show how this blending cannot be fully anticipated.

The problem of dynamics

In both the iPhone example (router-on-wheels) and regarding Facebook vs. Wikipedia, we see that blends point ahead. At the same time as users recognize the blends as something that guide their future use, the blends also change in the actual interaction, as it happens. The router-on-wheels blend was supported by the notion of the personal hotspot as documented in the iPhone manual, but the appropriation, also conceptually, did not end there. The "somebody else's" concept of Apple got turned into the group's own router-on-wheels.

The frustrations regarding the need for editing in the LAA case (which was a result of the 1-page curatorial text concept used by the designers), in the meeting with the concept of the Facebook wall as the users saw it, actually led users to speculate about the possibilities of future uses of the panels in the art gallery. Whether this reflection as such led the users to e.g. use the panels differently, we have no evidence of, since it was not studied. However, this is indeed a possibility if we consider both [17] and the previous activity theoretical ideas regarding the dynamics of blends. It is an asset rather than a problem that blends are dynamic. Some blends serve the purpose of helping people reflect and address the future, a kind of meta-blends that should be considered more, e.g. in design rather than thinking only of which two concepts from two domains could immediately be combined.

From descriptive to prescriptive

Designers' blends, as they use them in their own thinking and acting, and as they project the users will recognize them through the design, and even through manuals, differ significantly from users' blends, as we have seen in both cases. Designers are capable of deblending how one writes short texts on the phone (as typically done in texting) from producing text with the phone keyboard, but did not get picked up by users. The 1-page text and Wikipedia shared editing failed miserably in terms of prescribing use, and led to frustration among users, rather than helping them. This is not very different though, from the way both Bakhtin and Wittgenstein would see the language: Words resist, they are somebody else's and it takes appropriation to perhaps eventually pick them up. Hence, *blends cannot simply be 'given' to users as prescriptions*, they need to be considered as something that *point ahead and help seed future practices*.

In our perspective this points out that designers have a challenging and complex task ahead when they consider blends to be included in, or with new technological artifacts. Accordingly we propose a more systematic approach to working with blends in design. This approach

must look back at conceptual blends from user domains as well as from technological pasts.

MAKING BLENDS POINT AHEAD?

Throughout the above discussions we provide a deeper and more nuanced understanding, and use of blends, than the static, one-to-one use we see in the HCI writings. We are also concerned with the naturalness element that connects blends and the physical, and as we pointed out, we found the physical/virtual distinction difficult to identify in our own cases. In these cases, the physical/virtual is one of many ways in which blends get blended and deblended in design and use.

Designers' blends may differ significantly from users' blends, and as pointed out they are difficult to presume and prescribe. This does not mean that the blends that get seeded in and through the new design (also e.g. in manuals) do not matter to users. Hence, they can certainly be more or less useful seeds for the users' appropriation of the design. This is why it matters if the design can become the user's own, conceptually populated with their 'local' accents.

To be true to the blended interaction perspective, the blends introduced by the designer, *are* the means HCI has to influence use. Finding out which concepts work for this kind of blended interaction may need more, specific exploration, which can be done as part of a design process, as we see it.

Specifically we offer a checklist that will hopefully help guide designers and analysts to get a more advanced grip of specific blends where they unfold when a technology is designed and used (Table 1). For the time being this is our attempt to help designers work systematically with the complexities of multiple blends developing over time.

DISCUSSION

The theory of conceptual blending is a welcomed addition to the theoretical repertoire of human-computer interaction. In a day and age where much of the discussion seems to be about making computers go away, conceptual blending turns more towards understanding how we talk about them, and how talking about, and using go hand in hand.

In particular conceptual blending can help to revitalize discussions of metaphors in a constructive way, where inconsistencies and multiplicity between the input spaces are accepted. However, we believe that there is more to the discussion of blends than the relation between the physical and digital. As a matter of fact we believe the distinction between the physical and digital to be unproductive. Instead a layered understanding of human activity, as proposed by activity theory, can help scrutinize blends in this respect: Blends related to the low-level physical interaction with the computer would reside on the operational level (the how). However, with an activity theoretical understanding mental and conceptual operations can be operationalized as well as the physical, and these dynamics are equally central to the understanding.

1. Who articulated the blend? (designer/user)
2. Where do the concepts come from? (physical/virtual/design/use (which different domains?))
3. How does the blend relate to experience? And expectation?
4. For each concept in the blend: What meaning does it bring? What does it block? When does the concept resist the particular use? Where do the blend disconnect from its original meaning?
5. How was the blend picked up for anticipating use? How was it recognized as ‘somebody else’s’?
6. How did it support initial familiarity and get appropriated in that? Where does it resist being picked up by users?
7. How did users make it their own? What were the local ‘dialects’ and how did the blend change as use developed?
8. How did the blend point ahead in terms of future use? What sort of uses does it seed?
9. Does the blend relate to the operational level (how), the action level (what), or the activity level (why)?

Table 1: Checklist for analyzing conceptual blends.

Fauconnier & Turner’s notion of *entrenched* blends provides a compelling alternative to the words “natural” or “intuitive”. To return to Koefoed and Dalsgaard’s point that words matter [25]: asking *how* or *why* something has become natural or intuitive is meaningless, but it is perfectly reasonable to ask *how* and *why* something has become entrenched. Texting on a phone is a good example of something that has become deeply entrenched, culturally and in many of us, even though it is actually a contradiction in terms. Is it natural or intuitive? It has certainly changed the meaning of the phone, despite the fact that many of the iPhone users interviewed consistently complained that texting on the iPhone is difficult.

After having tried it, it is obvious that a systematic and consistent analysis of blends in relation to a particular technology or use activity is complicated. Even for the relatively superficial examples of the blends from the two cases it is obvious that conceptual blends quickly become very complex. While we advocate for embracing this complexity, we also *call for tools to tame this complexity*. In table 1 we have summarized a number of questions that we see fit for helping designers and analysts achieve that.

CONCLUSION

Based on our background in activity theoretical HCI we discuss conceptual blends in two cases. We provide an understanding of conceptual blends beyond one-to-one static blends, and immediately recognizable metaphors. We focus on multiplicity, dynamics and learning, and in that we

provide a more advanced methodological scaffolding of analyses of conceptual blends, hence we propose that designers need to seed blends in design, rather than they can presume certain blends, based on their own experiences. Furthermore we argue that the distinction between “physical” and “digital” is unproductive, and propose the leveled understanding of activity from Activity Theory as an alternative frame of understanding.

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