Forking Appropriations: Informing New Designs Through Analysis of Sub-Populations

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Abstract
End users will often appropriate technologies, finding patterns of use beyond the originally designed intentions. Recent developments in researchers' abilities to conduct large-scale in-situ studies suggest that sufficient data can now be gathered to identify *many* such appropriations in an application, potentially showing nuanced distinctions in usage from many distinct subgroups of users. In this position paper, we suggest a procedure where data from large-scale deployments is studied, sub-populations identified and new systems are made to further explore the user activities being observed. This would advance beyond standard iterative design practice by using real-world usage patterns to fork system design or initial ideas, rather than merely evolving one breed.

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Research in the Large, Design, App Stores

Introduction
At the heart of HCI research is the design of future technologies [4]. By trying to understand the world and studying how new technologies are used, researchers try to learn the values and purposes of these systems, and how new variants could be designed. While designers may create systems and services with specific use-cases in mind, it is only through real use and appropriation that they are truly understood, with

unintended aspects of the system perhaps being adopted to a large extent. Therefore it is only through observations and analysis of usage in naturalistic settings that the true nature of a system or service can be learned.

HCI researchers acknowledge that this phenomenon of appropriation is not something which designers should shy away from or try to 'fix', but is something that should be embraced. For example, Dix writes about why we should design *for* appropriations [3] and sets out design guidelines for systems that support appropriation. Similarly Barkhuus and Polichar study how smartphones in general are appropriated, because of their openness and configurability [1].

So far, little focus has been given to these appropriations beyond merely observation. This position paper discusses theories and practices by which patterns of appropriation might be identified, perhaps among different sub-populations of users, and how the study of these patters might generate several new system ideas and inform future designs.

Appropriation 'in the wild'

In order to discover cases of appropriation, researchers stress the importance of studying systems in-situ [11]. Lab-based evaluations may aid in the uncovering of usability issues, but it is use of technology in everyday settings and real-world contexts that best foster the emergence of new or unintended forms of usage.

There are many different ways in which apps have been studied in-situ, or 'in the wild'. One method is to deploy a system to local participants who will use it for a period of time. The use is observed using ethnographic methods and the participants are interviewed afterwards. An alternative is to conduct large-scale deployments where the system is deployed to a large set of users through available distribution channels such as app stores or web sites [2]. Studies of apps conducted in such a way have been shown to attract hundreds of thousands of downloads [7], with mobile software sending back log data that can be analysed to get an understanding of how people are using the system.

Such large-scale methods offer the opportunity to gather vast amounts of data from many different situations, user demographics and purposes. However, a challenge arises in understanding *why* users are behaving in certain ways. Therefore, a hybrid method have been proposed where a local trial is run together with a large scale trial in order to verify results from the large-scale trial and to get a deeper and richer understanding [9].

So far, many of these in-situ studies have focused on evaluating systems, as well as iteratively improving and 'perfecting' a system design through established software engineering and design processes. Such procedures have proven successful in learning about and improving existing products, but there has been less exploration on their potential for generating *new* ideas. While most system evaluation papers in HCI come with design guidelines, they are exclusively about guidelines for systems much like the technology being evaluated. Here we propose a way of using large-scale deployments in order to generate new ideas and potentially new application domains.

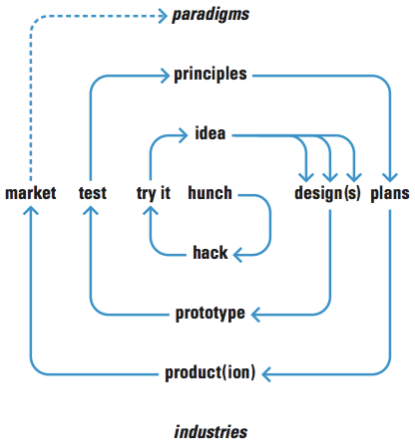

Figure 1 Verplank's spiral illustrating a process for innovation.

Ideation

One model for describing ideation and design processes is Verplank's spiral (Figure 1). This process starts with a hunch. The hunch is explored with a hack to judge its feasibility. This turns into an idea from which a set of designs is proposed. One or more prototypes are built based on these designs and are then tested. Holmquist [6] proposed adopting this model for HCI research (where typically the cycle would culminate at the stage of identifying principles).

This original model states that the spiral may then recommence with a new hunch at any stage of the process. Here, we propose methods by which the evaluation through large-scale methods can fork new ideas from which completely new systems can be built. As the evaluation or testing phase can now be done through large-scale deployments, we are able to capture data of sufficient volume and content that more than one way of using the system can be observed. Therefore the testing phase is not simply refining a prototype or evaluating one idea, but a stage of a process by which many appropriations or classifications of usage can be observed.

Previous work on the analysis of usage logs has shown promising results in identifying different usage patterns [5][8]. We aim to continue this work to explore how this can be used to identify and study different kinds of use of an application, in order to spawn these new ideas. Through the sheer number of potential users, we envision that even marginal sub-populations will show up in the analysis, which is promising for a new type of ideation and systems research.

Why sub-populations?

When studying software through large-scale methods, the typical approach has been to study how the system is used by the population of users as a whole. Usage is perhaps studied in terms of statistical numbers, summarised from the entire population's usage. In looking at data in this aggregated form, there is the risk that evaluators would lose much of the richness and diversity. Designers might identify the general use of an app – the most frequently occurring patterns of use as those they want to support, and consider the rest as edge cases or 'noise' in the statistics. Or they may attempt to make a compromise design solution that seeks to satisfy all aspects of usage but which is not perfectly tailored towards any of them.

Quantitative analysis methods might look at measures such as the frequency of feature use or 'average' use cases, trying to depict a picture of how an app is used in general. However, if the user base is composed of two very distinct subpopulations who use the system very differently, then making an aggregate picture of these two populations may create a picture of an 'average' user who is in neither camp.

Here we propose a method where we identify sub-populations of users, based on different classes of usage, and instead focus analysis on separate aggregates of these sub-populations. The intention would be to get separate analyses of each sub-group's use of the software, which together can then inform multiple re-designs of potentially multiple new products.

In terms of the diagram in Figure 1, our suggestion is that the 'test' phase incorporates classification and

clustering methods to identify subpopulations, perform analysis on each of these, and then potentially spin off several new clusters to advance new design ideas.

Forking appropriations

To illustrate how this might be achieved in practice, consider an example of a feature-rich smartphone application. The system is deployed through an app store and usage data logs from thousands of users are fed back to the researchers. These logs will show how interactions from each individual, as well as aggregated accounts from the population of users as a whole.

In addition to population-wide trends, we will be able to identify *sub*-populations of users – distinct groups of users exhibiting particular usage patterns. These patterns could include groups making use of different subsets of the application's features, using the application in different contexts, using it for different purposes, or finding value or fun using it in unintended ways.

The procedure of identifying these groups might be achieved through methods of clustering, statistical classification or machine learning. For example, Morrison et al describe a process of multidimensional data analysis to cluster groups of users [8], while Higgs et al use machine learning techniques to identify different strategies employed in an iOS game, and go on to classify each user in terms of how their performance mixes the various styles [5]. Such classifications need not be entirely quantitative; through ethnographic-style evaluation methods they might be bolstered, amended, or deeper understanding might be fostered. As the scale of this user base increases, we can imagine uncovering more and more nuanced ways that this system is being used.

Through this analysis process we would seek to identify new appropriations, and potentially new meaningful ways people come to use technology. We might identify usage patterns that are far removed from the envisioned goals of original design; far enough away that iterating or adding features to the existing app or system is inappropriate, but which suggest that they are more likely to be supported by a new product or service. Similarly, we might see features that are of obvious interest to one sub-population, but which are not heavily used by the majority of users, suggesting that the population as a whole might be better serviced by two separate apps.

We are not claiming that there is anything novel in the process of changing strategies, or pursing new ideas beyond the original intentions. We also acknowledge that this is relatively common current commercial practice, with startup companies especially exhibiting willingness for pivoting or changing the focus of their business [10]. We note however that these cases have often been serendipitous, with new ideas being 'stumbled upon', or new directions being sought out in response to a failing plan. Here we are proposing instead that the design process begins with the intention of forked appropriations in mind. We are working towards methods to specifically achieve this aim, and want to formalise the process of finding these opportunities.

Discussion and challenges

When doing iterative design processes, systems evolve, and the end result may differ substantially from

designers' initial intentions. Detecting and analysing such appropriated use has become an accepted method of system evaluation, but only considering one form of use or 'general' behaviour can fail to capture the variation of a user population. Only in identifying and separately analysing *sub*-populations can evaluators gain a true understanding of how software is being used. In this position paper, we suggest that processes can be put in place to fork system appropriations, taking advantage of large-scale deployments and statistical analysis of data to identify groups of users who make various distinct appropriations of an existing system. This may inform new multiple directions for where the design of the system should be going, but also generate new ideas. Through the work we discuss here, we hope to set out a software design methodology where we consciously look for these nuanced usages and opportunities to fork the design process.

The discussions around the model Figure 1 are not new, and neither is the potential to spin out multiple new systems from a single design loop. However, it is only in recent times that such processes become feasible. Methods for large-scale deployments and research have greatly increased the amount of data available to evaluators, and increasing computational power and the evolution of statistical modelling techniques have opened the possibility for this style of work.

This process can be seen as utilising existing deployments to ground ideas for future innovations. By its nature this process is grounded in reality, and all captured data is in-situ. An additional benefit is that researchers would know exactly *which* users from the population to target with newly designed systems for continued evaluation purposes.

We are currently engaged in working in this area, and looking to solve remaining challenges in determining the exact means by which we can statistically model and visualise our collected data to identify sub-populations, how to combine qualitative and quantitative methods to infer requirements from these groups, and how to complete the loop to feed this into the design process for new systems.

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References

[1] Barkhuus, L. and Polichar, V. E. Empowerment through seamfulness: smart phones in everyday life. *Per. Ubi. Computing, 15*(6), 629–639 (2011).

[2] Cramer, H., Rost, M., and Bentley, F. An Introduction to research in the Large. *IJMHCI, 3*(4), i-ix (2011).

[3] Dix, A. Designing for appropriation. Proc. Proceedings of the 21st British HCI Group Annual Conference on People and Computers: HCI...but not as we know it - Volume 2, 27–30 (2007).

[4] Fallman, D. (2003) Design-oriented human-computer interaction. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '03). ACM, New York, NY, USA, 225-232.

[5] Higgs, M., Morrison, A., Girolami, M., and Chalmers, M. Analysing user behaviour through dynamic population models. *Proc.CHI '13 Extended Abstracts on Human Factors in Computing Systems,* 271–276 (2013).

[6] Holmquist, L. E. (2012) Grounded Innovation: Strategies for Creating Digital Products. Morgan Kaufmann.

[7] McMillan, D., Morrison, A., Brown, O., Hall, M., and Chalmers, M. Further into the wild: running worldwide trials of mobile systems. *Proc.8th international conference on Pervasive Computing,* 210–227 (2010).

[8] Morrison, A. and Chalmers, M. SGVis: Analysis of Data from Mass Participation Ubicomp Trials. *International Journal of Mobile Human Computer Interaction (IJMHCI), 3*(4), 36–54 (2011).

[9] Morrison, A., McMillan, D., Reeves, S., Sherwood, S., and Chalmers, M. A Hybrid Mass Participation Approach to Mobile Software Trials. *Proc.ACM CHI 2012,* 1311–1320 (2012).

[10] Ries, E. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Publishing Group (2011).

[11] Rogers, Y., Connelly, K., Tedesco, L., Hazlewood, W., Kurtz, A., Hall, R. E., Hursey, J., and Toscos, T. Why it's worth the hassle: the value of in-situ studies when designing Ubicomp. *Proc.Proceedings of the 9th international conference on Ubiquitous computing,* 336–353 (2007).