How HCI Interprets the Probes

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ABSTRACT
We trace how cultural probes have been adopted and adapted by the HCI community. The flexibility of probes has been central to their uptake, resulting in a proliferation of divergent uses and derivatives. The varying patterns of adaptation of the probes reveal important underlying issues in HCI, suggesting underacknowledged disagreements about valid interpretation and the relationship between methods and their underlying methodology. With this analysis, we aim to clarify discussions around probes, and, more importantly, around how we define and evaluate methods in HCI, especially those grounded in unfamiliar conceptions of how research should be done.

Author Keywords
Cultural probes, probes, reflective HCI

ACM Classification Keywords
I.m. Computing Methodologies: Miscellaneous

INTRODUCTION
"How can you extract user requirements from dreams?" – [19, p. 55]

Recent years have seen a burgeoning interest within HCI in aspects of everyday life that lie beyond traditional concerns with the workplace and efficiency, such as domestic and urban spaces, play and entertainment. This call for new domains of inquiry has been accompanied by an exploration of new methods for engagement. Perhaps one of the most prominent has been a series of approaches that we broadly refer to here under the umbrella term of "probes."

Probes were initially developed by a group of designers led by Bill Gaver [16,17,18,19] as part of the EU Presence Project, which explored how to better integrate older participants into the everyday life of their communities. Since project members were geographically dispersed and unable to immerse themselves in the communities for long periods of time, they developed what they called a 'cultural probe', a design-oriented way to acquire inspirational glimpses of communities targeted for design. The cultural probes provided an additional form of engagement with the participants and were personally introduced after a number of interactions with the participants had transpired.

Cultural probes are designed objects, physical packets containing open-ended, provocative and oblique tasks to support early participant engagement with the design process. As the designers put it, "these packages of maps, postcards, and other materials were designed to provoke inspirational responses from elderly people in diverse communities. Like astronomic or surgical probes, we left them behind where we had gone and waited for them to return fragmentary data over time." [17, p. 22] As data trickled in, the cultural probes inspired design responses used to foray into the design space.

HCI has always been characterized by a catholic, experimental, and eclectic approach to methods. Even with this history, though, probes present a conundrum. It is clear that the pioneers of the probes approach have used them successfully in engaging, provocative, and influential design studies. It is clear, too, that the approach has proven adaptable and portable for other researchers in support of related design agendas. At the same time, the nature of the probes approach itself remains strangely elusive. Its originators have expressed considerable concern about the ways in which it has been adopted [19], while some uses of probes have been criticized as poor substitutes for ethnographic and other methods for generating qualitative analyses of the practices of everyday life [13].

Our goal in this paper is not to analyze the problems and potentials of probes *per se*, nor to set out a critique of the ways in which the approach has been taken up in different projects, although elements of each of these must by necessity appear in passing. Rather, what we want to look at is the reason why probes have been taken up broadly, and in the ways in which they have. We take the success of probes, for good or ill, executed well or poorly, as symptomatic of deeper concerns within contemporary HCI, and attempt to diagnose the underlying condition.

So, while this paper is about probes, it is not a "methods" paper. In fact, what we will argue here is that the challenges that probes pose are epistemological ones. That is, cultural probes are not simply "another technique" for getting data

CHI 2007, April 28–May 3, 2007, San Jose, California, USA.

(indeed, far from it) but rather frame an alternative account of knowledge production in HCI design.

As authors, we come at this from different points of view and with different positions on the merits and uses of probes. Some of our concerns are pragmatic, some methodological, some pedagogical, and some conceptual. While our positions have developed in the course of the investigations leading to this paper, we have not come to a shared position. We do not find this inherently problematic. In fact, we find probes a particularly useful point of departure for important, healthy, and productive debates around method, practice, and epistemology within contemporary HCI. Accordingly, while the uptake and interpretation of probes is our primary topic here, this exploration should be read in the context of broader concerns about disciplinarity and knowledge production in HCI. In particular, we will argue that patterns of probes adoption are driven by a common desire to turn reflective, interpretive research methodologies into formal, packaged, and ideally objective methods. We argue, too, that this drive substantially misconstrues the intention, merits, and nature of validity, not only of cultural probes, but of interpretive approaches to HCI research more generally, whether drawn from design, ethnography, or beyond.

In what follows, we begin by describing the uptake of probes, examining the ways in which researchers have responded to the work of Gaver and his colleagues and adapted them for their own needs. By reflecting on these, we will explore a series of challenges raised by the probes – challenges that, as we have suggested, appear superficially to be about methods but are perhaps more accurately seen as rooted in epistemological concerns. Finally, we will step back to consider what probes and their adoption might tell us about HCI practice, and in particular, how we might move from a focus on "method" to one on "methodology."

CULTURAL PROBES AND THEIR UPTAKE

Since the initial publication of cultural probes in *interactions*, the use of probes has proliferated widely in the HCI community. Probes have been interpreted broadly. Some cases are grounded very much in the original cultural probes work [38,47], while, in other cases, 'probes' has become an umbrella term covering everything from photo diaries [12] to longitudinal user studies [41] to field trips [37]. In order to explore the uptake of cultural probes, we examined approximately 90 papers including the phrase "probe" contained or cited in the ACM Guide to Computing Literature. While not exhaustive, this is a large cross-section of relevant work, spanning a variety of contexts from the home to hospitals to urban environments, as well as user populations from children to the elderly and from a number of cultural backgrounds.

Space precludes a review of every paper in this set, but an overall sense of the wide uptake and adoption of cultural probes can be derived by examining those studies we call 'x' probes – methods inspired by probes which replace the 'cultural' of cultural probes with another topic of interest or to indicate a different style. Identity Probes [7], Urban Probes [49], Domestic Probes [20], Value Probes [58], and Empathy Probes [43] redirect their focus either to places (e.g. the home or the city) or to a desired result (e.g. the identification of values or the development of empathy between designers and users). Other 'x' probes highlight new approaches to carrying out probes (e.g. Mobile Probes [26], Digital Cultural Probes [30], or Cognitive Probes [42]), emphasizing technology as a probing artifact as well as a collection method for responses.

Perhaps the most influential 'x' probe is the Technology Probe [27,40], which has led to several modifications in its own right. Technology Probes are low-fi technology applications designed to collect information around use, explore usability issues, and ultimately provide inspiration for a new design space. The developers of the Technology Probe concept caution that this is not a form of iterative design for advancing prototypes but instead introduces a novel technology to track how users respond to and engage with it over time. It is on this point that many of the 'x' probes and other probe modifications – including those modifying Technology Probes – vary; some probe use is about moving toward a single design application or product whereas others use probes to open up new design spaces.

The 'x' probes indicate in microcosm what we have found to be true of probes uptake more generally. Under the umbrella term of probes live a remarkable diversity of practices, reflecting different ideas about what aspects of the original cultural probes are essential, alterable, or superfluous. In the remainder of this section, we will characterize the commonly taken-up attributes in probe adaptations. The categories we have developed are not mutually exclusive – many papers in our study pick up on multiple attributes – nor the only possible categorization of this broad range of work. In developing our categorization, we aimed for categories that accurately and fairly reflected common themes from many papers and provided concrete evidence in examples and citations for further analysis.

Probes as Packet

One frequently picked up attribute of cultural probes is their material form. Some papers include a pared-down version of the probes described in the original probes study, such as an open-ended series of postcards or a photo diary [e.g. 6]. Blythe et al [5], for example, adapt one aspect of cultural probes by giving their users a "three wishes" exercise: three pieces of paper with the words "I wish I had..." to be filled in when users "encountered problems that might be solved by future technological developments" (p. 658). Other researchers expand the probe packet range by developing variations of evocative tasks, such as using Indian rasas to categorize feelings [8], drawing from Gardner's theory of multiple intelligence to design probes that engage alternate forms of self expression [58], and chaining probe responses together by using matchbooks littered around the city [48].

In many instances, researchers adopt cultural probes as a kind of ready-made kit with minimal adaptation except for the directions, including in it a camera with tasks, postcards with evocative (or semi-evocative) prompts, and maps for depicting activities or relationships. This use may stem from the need for a lightweight method that quickly reveals data leading into design without the need for heavyweight analysis, such as in industry, where design cycles are quick and the focus is on results rather than theories [15,34]. Cultural probe variants appear to be "often used early on in fields where broad and rapid data is desired" [49, p. 342], sharing drivers with discount methods for usability as well as rapid ethnography [44]. The goal in these contexts is often to get something that works – and, not incidentally, can be easily narrated as working to colleagues who may relate to HCI only loosely, if at all.

Probes as Data Collection

Most of the papers in our review adopt probes as a tool for data collection. Here, probes are employed as a means of collecting information: as a type of user requirements-gathering or needs assessment, as feedback on a particular application in an iterative design cycle, or as a supplement to social science or ethnographic approaches for understanding a particular context. Amin et al. [2], for example, develop user requirements through a participatory design exercise, introducing a probe into a group exercise for exploring non-verbal messaging with mobile phones. The probe results were discussed by the group participants and ultimately turned into four attributes that resulting designs must fulfill. Kuiper-Hoyng and Beusmans [36] also use probes in combination with interviews in order to help people articulate aspects of home life that they ordinarily do not reflect on; these insights are then used to refine ideas for potential products. Gaye and Holmquist [21] implement probes to provide a baseline understanding of their users' environments and the paths they would take through the city. This information directed where subsequent user studies were conducted and provided a way to compare path changes after introducing a wearable system interface for real-time electronic music-making in the city.

Several studies use cultural probes as a supplement to, or in some cases as a replacement for, social science approaches to understanding users needs, environments, and technology use [e.g. 14,25]. Many employ probes as a means of following up on interviews and contextual inquiries or to help conduct interviews, while others use interviews to follow up on and interpret probe results [e.g. 2,4,11,15,36]. We also found social-scientific strategies such as variations of inter-rater reliability tests [25,58] used to validate interpretations of probe results. Many studies are quick to point out that design-inspired probes have different aims and techniques than ethnography, yet propose that ethnographic methods and cultural probes can be used together or that probes can be adapted for ethnographic ends [e.g. 9,23]. However, others seem to present probes as a form of discount ethnography as discussed by Dourish [13]. Overall, probes used for data collection move beyond what Mattelmäki et al. [43] refer to as "inspiring signals" toward a more "holistic understanding." The information that is collected is about either current use situation or about potential new applications and resulting interactions.

Probes as Participatory

Another aspect of probes highlighted in the literature is participation. Some studies aruge that probes are not participatory enough, critiquing the original implementation of cultural probes as leaving too much control in the designer's hands [e.g. 12,29]. Some advocate using probes in a more participatory design fashion, insisting that participants should play a role in translating probe responses to design ideas [e.g. 2,26,49].

But other studies in this group advocate probe use precisely because they "give participants a voice to interpret and explain their own practices" [56, pp. 1476-7]. The level of participation is viewed as rich in terms of results and engaging in terms of process, which is often cited as more enjoyable than traditional surveys or interviews [e.g. 58]. For some, a value of probes approaches is that they support reflection by users themselves as part of data acquisition [e.g. 36,55]. In this way, participants take responsibility for and control what information they record or share in the probes [22] and can find some privacy in the ambiguity of responses. For this reason, a number of the studies comment on the applicability of probes for sensitive settings or with populations that need a high degree of sensitivity [e.g. 9]. Probes, then, are a site at which questions of the relevance, validity, and politics of participation are articulated.

Along these same lines, since probes are often associated with a focus on emotional aspects of interaction design, the playful, engaging and creative nature of participating with probes is often cited as a motivation for using them in research. For some, the focus is on moving away from user requirements and data analysis and towards inspirational methods to inform design [e.g. 38]. The ludic and provocative nature of cultural probes and its potential to spur engagement may also be attractive; they are valued, for example, for their ability to address intimate, idiosyncratic, personal issues [e.g. 27], while their openness and experimental format may be seen as particularly suited for non-task-focused parts of user experience [e.g. 55].

Probes as Sensibility

While certainly less popular than the preceding attributes, some work picks up primarily on the provocative, ambiguous, and experimental attitude of the original cultural probes, rather than the method. Whereas many of the studies in the previous categories hold true to the methods of probes but appropriate the attitude or intention, in these studies the opposite transpires. Sometimes, the methods are modified only slightly, as in the "mediating intimacy" work of Vetere et al. [57]. Like some of the

previous studies, this study uses probes as a form of data collection, combining cultural probes with contextual interviews to develop design guidelines for technology to support intimacy. However, rather than seeking to develop objectively validated understandings of this data, the authors are clear about the necessary indeterminacy of their results: "[T]he probe data was naturally incomplete, unclear and biased. This inevitably led to subjective interpretations where the data was often discussed in terms of the researchers' own experiences of intimacy" (p. 474).

In other cases, the methods are changed more dramatically and in fact could be unrecognizable against the original cultural probe packet. In works such as the Influencing Machine [54], the Snatcher-Catcher [39], the Censor chair [1], Sashay [48], and the original technology probes [27,40], the designed application is itself thought of as a probe that forces new interaction, reflection, and reactions by users. These projects pick up on the provocative nature of the cultural probes. Some cite the original inspiration of the cultural probes, namely the Surrealists and Situationists, as a guide for their work as well. Lundberg et al. [39], for example, argue that "like the cultural probe, the Snatcher-Catcher installation [a 'smart' refrigerator that records who is taking what food] is one way to trigger feelings about privacy and integrity, and also irritate and stimulate people to give us… feedback" (p. 210). Likewise, the Influencing Machine [54] is designed to cause speculation by both designers and users about the enigmatic nature of emotion and the influence of user over machine or vice versa. In collecting participant responses to the Influencing Machine, as one would collect responses to a probe, the goal of the researchers was not to understand or make proclamations about a general user community. Instead, the designers were looking for particular stories about how different combinations of people interpreted their experiences. Like most other studies in this category, the information collected is not presented as comprehensive or analyzed into a definitive set of requirements.

Citing the Probes

Quite a few papers we reviewed cite probes as one touchstone of their argument, without this being central to their work. These papers still tell an important story, however, about the range of probe uptake and the ways in which they have been interpreted. Some of the papers in this category simply mention probes alongside other methods such as longitudinal studies, contextual inquiry, or ethnographic studies [e.g. 10,51], treating them as yet another possible method for a designer's or researcher's toolkit. Others employ the term probe broadly as a synonym for any user study or any survey, questionnaire, or interview that involves either open-ended questions or some kind of audio or visual element [e.g. 41,30]. Some papers refer to using probes in their research, but without specifying how they were used [e.g. 3,33,41]. Finally, several papers use the idea of cultural probes as a jumping off point for developing different methods [e.g. 5,32]. For example, Isbister et al.'s Sensual Evaluation Instrument [28] is not itself a cultural probe, but the authors mention probes as an important point of inspiration in developing evaluation methods that move beyond the laboratory and tap into cultural influences. Overall, these papers refer to cultural probes as a form of legitimacy for particular kinds of practices – whether these are new practices or existing practices with a new name.

WHAT'S LEFT BEHIND

Any adaptation of a method must inevitably make decisions about which aspects of the method are essential, and which aspects may be safely altered or left out for new contexts and purposes. This is particularly the case when the method is not presented as a clear-cut formula. The patterns of probe uptake embody an implicit valuation of what is essential about cultural probes.

In comparing the original probes work to its broad use in the literature, it is clear that some attributes have seen broad pick-up in more or less their original form, including the material form of the probes, their use to stimulate early design conversation with users, and the playfulness and experimental nature of the approach. Less commonly but still with some frequency, researchers have been inspired by probes' provocative sensibility.

At the same time, a number of attributes have frequently been altered from the original cultural probe work. In some cases, this adaptation is acknowledged and explored. For example, many researchers acknowledged that although cultural probes were designed for inspiration, they adapted the probes to provide information in order to give clearer guidance to the design process or to validate findings from other methods [e,g, 23, 9]. Often the drive to elicit information leads to the development of summary analysis, general themes, or requirements in a manner quite unlike the original cultural probe results [e.g. 2,36,11]. In addition, the provocative nature of probes is often acknowledged but downplayed as researchers seek to not confuse or alienate participants [e.g. 24]. The open-ended and evocative nature of the probe tasks is also often altered to provide the types of responses researchers may be looking for [e.g. 36].

But what is most striking in analyzing the probes variations is the extent to which some attributes of the original cultural probes have been broadly left behind. In the following sub-sections, we illustrate five aspects that receive little or no attention in the literature. The subsequent section will then explore the underlying tensions that may explain what aspects of cultural probes resonate with and what aspects provide challenges for the field of HCI.

Subversion of Existing Methods

The provocative nature of probes is often alluded to in the literature, but provocation is different than subversion. Cultural probes originally aimed to subvert or undermine, rather than supplement, traditional HCI methods. According to the cultural probe designers, traditional HCI

methods place researchers as experts who diagnose users' needs, or, alternatively, as servants who do the users' bidding. "Either alternative serves to hide both the researcher and the people they research: known genres, they have 'rules' allowing both sides to present themselves as they want to be seen." [18, p. 23]. In contrast, the original probes were "designed to disrupt expectations about user research and allow new possibilities to emerge" [ibid]. Drawing on experimental arts traditions such as Situationist 'games,' the implicit authority of the cultural probes themselves was deliberately subverted, in part by their ambiguous, unfamiliar, and playful nature, and in part by explicitly positioning them to participants as experiments that might fail.

The experimental and subversive nature of the original probes is often lost, however, when they are seen as a reproducible method and explained within traditional accounts of knowledge production in user-centered design. What we see, then, is the probes being adopted within the frame of existing HCI approaches, and particularly in light of a traditional conception of the relationship between users, requirements, designers, and designs.

Rich Explanation of Approach

Another omission apparent in much of the probes literature is a lack of detail in describing how probes were introduced to participants and how designers moved from probe results to eventual designs. In other words, the leap between probe and design is often left undocumented. Papers might mention probes were used to generate design insight without documenting either their implementation or interpretation [e.g. 3], skip directly from description of packet contents to the final product design or user requirements [e.g. 5,33], or discuss probes results without connecting them to resulting design [e.g. 26].

Gaver et al. sympathize with the difficulty of moving from probe results to designs: "Most of the time the relationships between Probes and proposals are...complex and difficult to trace…We freely admit that the responses they elicit are not necessarily accurate or comprehensive, and that they seldom give clear guidance to the design process" [19, p.56]. Sometimes a line may be clear, or at least a clear narrative line may be made in retrospect. Yet more often than not, this is not the case, due to the fact that cultural probes are one source of many in the design process and that by nature the probes have a high level of subjectivity.

However, despite these difficulties, the original probe work details a rich process surrounding the development of probes and the movement toward design proposals. The fact that several of these steps, as we will describe below, are not illustrated in the literature suggests they are either overlooked or not seen as important to describe. The latter case may be driven by a perception that the methods of probes have become codified and reproducible so as not to need such explanations; whereas the former case suggests that difficult-to-pin-down steps where emotion or intuition must kick in are not amenable to familiar modes of practice in HCI and therefore seem a 'black art' [59]. In either case, the result is a black-boxing of the interpretive process.

Uncertainty as an Asset

In acknowledging the difficulty of moving from probe responses to design proposals, Gaver et al. highlight this difficulty as a valuable opportunity, not a problem to be solved: "we value the mysterious and elusive qualities of the uncommented returns themselves…What is the point of deliberately confusing our volunteers and ourselves? Most fundamentally, it is to prevent ourselves from believing that we can look into their heads…[I]t is impossible to arrive at comfortable conclusions about our volunteers' lives or to stand back and regard them dispassionately. Instead, we are forced into a situation that calls for our own subjective interpretations." [19, p.55].

In contrast, many of the studies in our literature review view the uncertainty of working with the probe results as a problem to be ameliorated. They often exhibit a tendency to narrow possible meanings, and a desire to produce the one correct interpretation of the probe responses rather than acknowledging that many interpretations are possible. This approach is evident in many studies that seek to uncover the respondents' true meanings and intentions behind their probe responses: such studies thus introduce analytical rigour into their interpretative methods by including follow-up interviews [e.g. 36,43], statistical methods such as graphing or numerical analysis [e.g. 45], or cross validation of results [e.g. 58, 25].

The introduction of methods to ascertain the correct interpretation of probe results or to collect a more specific set of information in the first place by reducing the ambiguity or open-endedness of the probes reveals an epistemic clash between the kind of 'information' the original cultural probes generate and the information that is expected of probes as an integrated HCI research method. That is, these alterations may be introduced in order to make probe results more amenable to forms of analysis already familiar in HCI, a process not infrequently characterized as a shift from using probes for inspiration to using probes for information [e.g. 31,23]. Whereas the original cultural probes created a funnel that started from the narrow end with very specific stories and fragments and moved toward a broad set of interpretations and resulting design space to explore, probes for information tend to reverse the funnel and move from a broad collection of data to a small, well-defined set of requirements, themes, or insights which then are used to inform design [e.g.11, 35]

The Stance of the Designer

As alluded to previously, one often overlooked step in the original account of the probes is the process of designing the probes and proposals and the inherently subjective stance of the designer throughout this process. A substantial amount of time and attention went into the design of the

original probes so that they would be delightful but not condescending, engaging but allowing for detached responses, designed but not intimidating and personally reflective for both the participants and the designers [17]. When first introducing the cultural probes, the designers emphasized that "[t]hey are a way for us to get to know you and for you to get to know us" [17, p. 22]. As the probes become more standardized, however, this personal mark and expression of the designers is increasingly lost [e.g. 9].

Furthermore, in addition to revealing themselves through the probe packets, the designers also reveal themselves through the design proposals or speculative designs inspired by the probe results. Those designs were not intended to accurately represent the way participants currently live, think, and feel, but to project a series of speculative possibilities which would resonate in positive and negative ways with the participants. "We thought of the proposals as our turn in a conversation that had started with the probes and continued with the elders' responses. Presenting the proposals to the group implied our perceptions of themselves and their community, as well as suggesting possibilities for change" [16, p.603].

In contrast, many of the papers in the literature review appear to downplay the subjective, personal nature of probes and their interpretation in design. This is reflected in the broad genre of papers whose conclusion is a set of themes or issues said to hold for users generally [e.g. 2,11,45]. These papers shift cultural probes from a specific conversation involving particular actors to an impersonal analysis independent of both researcher and researched.

Exploration through Sketching

The model of probes as an unfolding conversation taking place through multiple stages of design leads to the final contrast with existing literature on probes, namely the ways in which probe results generate implications for design. While in the literature, probe responses often lead directly to final system design, in the original probes work there is an important intermediary step in interpretation that the researchers called exploration and sketching, in which they interpreted probe returns through a series of speculative and often impractical or undesirable designs.

These designs did not aim to specify the system that would eventually be implemented. Rather, they served to advance the conversation between designers and participants, as well as to better understand and explore issues that would come up in designing for these participants' lives. For example, some speculative designs brought out negative stereotypes, serving to sensitize the designers in future work to problematic issues such as overemphasizing security and thereby inadvertently developing an 'electronic cage.' These design responses to the probes were compiled and discussed with the elders, with the aim not of selecting an actual implementation but of "encourag[ing] the elders - and us - to imagine the world implied by our designs... We wanted them to enter this world for a while, to tell us what their everyday lives might be like, and about the successes and failures they might anticipate" [16, p. 604]. Only after this process of communication was complete did the 'actual' design of the final system begin.

DISCUSSION: UNDERLYING TENSIONS IN HCI

In identifying what is taken up and left behind in the uptake of the probes, our goal is not to present the original cultural probes as the 'one best way' to inspire design, nor to present adaptations of the method as necessarily erroneous. It is not the fact of adaptation that concerns us, but its nature. In this section, we will argue that the specific challenges in uptake that the probes have presented HCI are symptoms of deeper issues that arise for appropriators when drawing from the original probes. The probes' flexibility leads to them being in some sense a Rorschach test, revealing their uptakers' perspectives and preoccupations. We move now to identifying two major underlying tensions in HCI the probes reveal: how to handle issues around interpretation, and how to configure the relationship between methods and methodology.

Handling Interpretation

Moving from inspiration, or glimpses of particular lives as possibilities in a design space, to information that seeks to pinpoint exact requirements or needs of general communities is symptomatic of different stances on the ultimate goal of interpretation, in particular whether it should be open or closed [53]. The former approach sees interpretation as opening up a variety of possibilities.The latter sees interpretation as a process of negotiation toward one single, correct, and unambiguous understanding; the need to establish a single interpretation then leads to a proliferation of methods to support a narrowing of and verification of the potential design space. From our literature review, we have seen interpretation approached in both ways, with the original probes work favoring the former and the majority of adaptations favoring the latter. While in the original probes the designer's interests were often only hinted at and only fragmentary glimpses of user's lives were gathered, information-oriented probes variants tend to present more clear-cut, focused, and on-topic questions and tasks in order to delimit the design space and enhance the chance of finding the right answer. While this eases interpretation, it also dramatically reduces the potential for surprise and for breaking preconceptions that motivated the original probes design.

Underlying the shift from open to closed interpretation is a subtle but potent shift in the definition of interpretation from response to representation, i.e. from seeing interpretation as a researcher *responding to what was expressed by* the researched to seeing interpretation as a researcher *ascertaining facts about* the researched. When interpretation is seen as response, it is conceived of as dialogical; researchers express themselves in their research questions and instruments, participants interpret researchers' interests and intentions and respond by

expressing themselves in their responses, researchers respond by expressing their interpretations in potential design ideas, etc., without ever attempting to fix the true meaning of any particular response.

When interpretation is seen as representation, however, the goal is not to hear and respond to user's expressions, but to fix the true meaning of what users said, who they are, what they do, and what they need. When interviews, workshops, and other participatory techniques are used to ascertain the meaning of probes, this is often grounded in a perspective that the end goal is not for designers and users to engage in conversation about a variety of possibilities that may interest both of them, but for designers to acquire the correct interpretation of users' expressions to ground design [e.g. 2]. Indeed, a major focus of probes' uptake in HCI has been to use probe returns to develop objective, factual descriptions of user needs [e.g. 2,11,15,35,36,45]. While this increases the apparent generalizability of the results of probe interpretation, it reduces or eliminates the richness of probe interpretation as embedded in design. At the same time, the validity of these generalizations of a fundamentally idiosyncratic and personal method is doubtful. The use of statistical analysis of probe results, for example, demonstrates a desire to round out or complete the fragmentary nature of the probe responses, even though what results is simply a numerical interpretation of these still incomplete glimpses.

The Hermeneutic Stance

That cultural probes can be so easily mistaken for a technique to get at the single correct interpretation of user's lives is symptomatic of a deeper lack of clarity in HCI about the distinctions between positivist and hermeneutic frameworks. This confusion has bedeviled the uptake of other dialogic approaches such as ethnography and participatory design (PD) into HCI as well. Indeed, to the extent that probes offer a means of engagement between designers and groups whom CHI traditionally positions as "users," and that they explicitly attempt to focus on the practices of everyday life as topics of inquiry, probes often appear connected in researchers' minds to these other approaches that have attempted to move beyond the laboratory as the primary site for interaction between designers and those who might be affected by their activities [e.g. 52,45,50].

At the same time, cultural probes have been criticized as poor substitutes for ethnographic inquiry – "ethnography by post." [13] Certainly, the critique that probes are an inadequate substitute for ethnography or PD might be validly leveled at particular implementations or occasions of use. But at a more general level, the situation is murkier. That probes should not be used to generate data in the way in which ethnography might, for instance, seems self-evident. Probes, on the one hand, do not generate 'data' and were not intended to, while ethnography's inherently analytic stance reaches beyond simple "data gathering." PD is perhaps more usefully understood as a form of political activism, one that has, from its inception, been concerned with questions of democratic representation and challenges to coercive management.

But in terms of interpretive stance, the relationship between probes and ethnography is closer than might be imagined. The "technique" interpretation of probes suggests that they are a means by which data about everyday life might be extracted for the purpose of design, albeit without the conscious interpretive presence of an ethnographic investigator. What this misses from ethnographic investigation – and what, as Dourish [13] observes, is also frequently missing from narrow accounts of ethnographic work within design contexts – is the critical interpretive frame. Cultural probes are designed not to provide data about settings, but to spark design inspiration; similarly, ethnographic investigations are organized not to extract facts from settings but to stage encounters between cultures that may then be supporting of appropriate interpretive analysis. What cultural probes, ethnography, *and* participatory design share, fundamentally, is a recognition of the essential role played by the interpreter, which runs against common conceptions in HCI of researcher/scientist as objective observer, and which is often therefore dropped in HCI practice in favor of instrumental use for requirements gathering. This loss points to a deeper and more disturbing trend in the amalgamation of research methods into an interdisciplinary context: a disengagement between methods and their underlying methodology.

Method vs. Methodology

In one of the earliest introductions of cultural probes to the HCI community [17], the authors foreshadow and caution against the likely draw of cultural probes as an off-the-shelf method for design-based research: "We believe the cultural probes could be adopted to a wide variety of similar design projects. Just as machine-addressed letters seem more pushy than friendly, however, so might a generic approach to the probes produce materials that seem insincere, like official forms with a veneer of marketing. The real strength of the method was that we had designed and produced the materials specifically for this project, for those people, and for their environments. The probes were our personal communication to the elders, and prompted the elders to communicate personally in return" [17, p.29].

It is perhaps not surprising then, since the potential had been well anticipated, that many of the studies we reviewed appear to instantiate a probes-as-recipe approach. The outward form of the original cultural probes, namely the technique of providing a probe packet with a camera, postcards, diary, maps, and sets of instructions or questions as a base set are often enough for a researcher to cite cultural probes as the method of research [e.g. 35,52]. But in many cases, it is only the form of the probes that is adopted and the spirit producing these forms is absent. That is, in the interest of generating particular kinds of data, the

open-ended and evocative questions disappear in favor of directed questions like, “take a picture of your favorite spot in the house” or “tell us how you stay in touch with loved ones” [e.g. 24,36,52] Not only do such questions close the design space and prove likely to funnel answers into datasets, they also point to a more disturbing trend of ‘discount probes’ in which the probe is divorced from its grounding methodology, with implications for resulting designs. Sending a camera to a participant does not embody the full complexity and rigor of the methods described by the original cultural probe, and this seriously compromises the validity and usefulness of interpretative and design spaces that result from probe deployment. Furthermore, codifying the methods into a set of reproducible techniques perpetuates many of the research ‘games’ or set roles that the original probes intended to call into question.

Without the corresponding methodology or attitude in place, the method of probes often becomes either simply the physical objects such as disposable cameras or the playful approach, but both lack the epistemic grounding that make their results truly meaningful. Further, without that methodology, the ‘discount probes’ become exactly the kind of method that the original probes attempted to resist: quantitative instead of qualitative, producing data instead on producing responses, closing instead of opening the design space.

This divorce between method and methodology harkens back to our discussion of ethnography; whereas the principles of ethnography dictate a particular attitude toward research and analysis which highlights the relationship between the researcher and the researched, this attitude is often lost in HCI practice, as ‘methodology’ becomes equated with a set of data collection techniques or methods. Gaver et al. [20] recognize this situation with cultural probes in their distinction between ‘probology’ and ‘probes’, where the probological attitude of experimental, evocative, and subjective research geared toward opening rather than narrowing possibilities is undervalued or forgotten and the emphasis remains instead of the techniques of data collection. This divorce between methodology and methods suggests why many of the studies in our literature review that focused only on the methods nevertheless missed the richness of the original methods. This divorce also explains why there were very few studies identified as ‘probes as sensibility’ where the sentiment of the probes remained and the techniques were modified. Instead, the greatest trend appeared to be holding true to the formula of the probe techniques, while resisting or changing the attitude.

This adoption of techniques without acknowledging a corresponding shift in attitude is not isolated to the appropriation of cultural probes but reflects larger issues for HCI in general. For instance, the attraction to 'design-y' methods and results but discomfort with the corresponding value of uncertainty leads to an overwhelming desire for codifying a design approach into easily-reproducible methods, or research recipes. Furthermore, the very nature of HCI as an interdisciplinary field suggests that methods will be picked up from a range of disciplines and put toward a range of alternate uses. In some cases, the methods will be adopted in part, leaving critical aspects of the method behind, and in other cases the motivating concepts or attitude behind the original method become lost in translation. This suggests broader implications for HCI, and we turn to these implications next.

CONCLUSION: IMPLICATIONS FOR A REFLECTIVE HCI

We have highlighted in this paper a number of distinctions between the original cultural probes and their uptake. The original probes were presented as subverting methods, but tend to be picked up as a recipe or reproducible method. The bespoke, designed, open-ended and provocative nature of the original probes tends to be modified for more expected results. The hermeneutic nature of the original probes tends to be readjusted to a data collection approach. And, although probes could support an on-going design conversation, this is often abbreviated in practice, moving directly from data gathering to final design.

Despite the distinctions we have laid out, our goal in this paper is not to lay out the one right way to use probes. To do so would be to apply the narrow funnel of interpretation that we have been suggesting was not the strength of the original probe work. While many variations may differ in essential characteristics from Gaver et al.'s original probes, that doesn't preclude them from being interesting methods in their own right. There is nothing wrong with adapting probes for new needs and in new contexts or with being inspired by probes approaches to develop other methods. What is problematic, however, is to alter essential aspects of the probes methodology *without thinking through why and how the new variants make sense.*

At its most basic level, adaptations of the original cultural probes should be grounded in an awareness of which essential aspects of those probes are being adopted and which are not, and should justify those decisions. It is not at all unusual for probes in the literature to change cultural probe characteristics such as eliminating most or all elements of designed expression, asking focused, factual questions, engaging in statistical analysis of the fragmentary results, or summarizing the results of a cultural probe in terms of a few characteristics which are held to be true of all users. It is also not unusual for such probes to be published apparently without awareness that these *are* in fact alterations to the original cultural probes, or, when they are recognized as alterations, that those changes seriously undermine the mechanisms by which the original cultural probes can be said to work.

It is essential for the field to recognize that variant methods that draw on cultural probes but change these essential aspects *cannot rest on the common acceptance of cultural probes for their validity*. Instead, they must construct new explanations for why they work. In these cases, the new

methods are certainly a substantial contribution to HCI - though, perhaps, one that should not be labeled a 'probe.' Furthermore, it is important to articulate which probe variant is one's starting inspiration point, since the method and interpretation strategy substantially differs among cultural, technology, urban, cognitive, or other probe variants. This is important to underscore: there is not one probe method but many.

As we have argued, the questions that probes raise for HCI are epistemological, not purely questions of method. Our reading of the use of probes points to a tension between, on the one hand, the appeal of the approach in finding a new way to engage with users around topics that traditional HCI methods have frequently left unexplored, and, on the other hand, a set of epistemological constraints that are implicit in the traditional HCI toolkit. The transformation of probes as they have been incorporated into more traditional design projects highlight this tension.

In particular, the stance of the designer as embodied in the original probes work is a poor fit to the dominant engineering model of HCI [46], which gives the designer a privileged position in the knowledge production process. In this model, users are passive agents whose actions and utterances become useful only when subjected to the rationalizing scientific instrumentality of HCI engineering processes. These processes, indeed, deny the agency of both engineer and user; what is produced is an objective account of a stable world of which the engineer is an observer. What the probes set out is emphatically not a different means by which this process can proceed, or a different instrumentality; rather, they set out an alternative account of knowledge production in HCI, one that arises as a participative engagement between individuals. Irrespective of the particular merits or problems of probes themselves, what they offer is an opportunity and occasion to bring the epistemological commitments of HCI design methods into the foreground.

Clearly, we believe that an explicit reflection on epistemological concerns should be "part of the conversation" in HCI. Clearly, too, we are skeptical of the value of probes when divorced from this reflection. The value of probes may eventually turn out to be less in the forms of inquiry and procedure that they open up, but in the fundamental epistemological commitments that they challenge and represent.

ACKNOWLEDGMENTS

This work was supported in part by the National Science Foundation under awards 0133749, 0205724, 0238132, 0326105, 0527729, 0524033 and 0534445. Thanks to the AC and anonymous reviewers for very helpful suggestions.

REFERENCES

1. Aley, E., Cooper, T., Graeber, R., Kerne, A., Overby, K., and Toups, Z. O. 2005. Censor chair. In *Proc.. MULTIMEDIA '05*. NY: ACM Press, 922-929.
2. Amin, A. K., Kersten, B. T., Kulyk, O. A., Pelgrim, P. H., Wang, C. M., and Markopoulos, P. 2005. SenseMS. In Proc. *MobileHCI '05*, NY: ACM Press, 161-166.
3. Battarbee, K., Baerten, N., Hinfelaar, M., Irvine, P., Loeber, S., Munro, A., and Pederson, T. 2002. Pools and satellites. In *Proc. DIS '02*. NY: ACM Press, 237-245.
4. Battarbee, K., Soronen, A., and Mäyrä, F. 2004. Living in a zoo. In *Proc. NordiCHI '04*. NY: ACM Press, 373-376.
5. Blythe, M., Monk, A., and Park, J. 2002. Technology biographies. In *CHI '02 Extended Abstracts*. NY: ACM Press, 658-659.
6. Bødker, S., Kristensen, J. F., Nielsen, C., and Sperschneider, W. 2003. Technology for boundaries. In *Proc. GROUP '03*. NY: ACM Press, 311-320.
7. Candy, F. J. 2003. The fabric of society. In *Proc. DPPI '03*. NY: ACM Press, 28-33.
8. Chavan, A. L. and Munshi, S. 2004. Emotion in a ticket. In *CHI '04 Extended Abstracts*. NY: ACM Press, 1544-1544.
9. Crabtree, A., Hemmings, T., Rodden, T., Clarke, K., Dewsbury, G., Hughes, J., Rouncefield, M. and Sommerville, I. (2002) "Sore legs and naked bottoms". *Proc. DIRC Conference on Dependable Computing Systems*, London: The Royal Statistical Society.
10. Desmet, P. and Dijkhuis, E. 2003. A wheelchair can be fun. In *Proc. DPPI '03*. NY: ACM Press, 22-27.
11. Dey, A. K. and de Guzman, E. 2006. From awareness to connectedness. In *Proc. CHI '06*. NY: ACM Press, 899-908.
12. Dindler, C., Eriksson, E., Iversen, O. S., Lykke-Olesen, A., and Ludvigsen, M. 2005. Mission from Mars. In *Proc. IDC '05*. NY: ACM Press, 40-47.
13. Dourish, P. 2006. Implications for design. In *Proc. CHI '06*. NY: ACM Press, 541-550.
14. Fitton, D, Chevherst, K., Rouncefield, M., Dix, A. and Crabtree, A. (2004) Probing Technology with Technology Probes. Paper presented at the Equator Workshop on Record and Replay Technologies.
15. Foucault, B. 2005. Designing Technology for Growing Families. *Technology @ Intel Magazine*. http://www.intel.com/technology/magazine/research/growing-families-0805.pdf
16. Gaver, W. and Dunne, A. 1999. Projected realities. In *Proc. CHI '99*. NY: ACM Press, 600-607.
17. Gaver, B., Dunne, T., and Pacenti, E. 1999. Cultural probes. *interactions* 6, 1 (Jan. 1999), 21-29.
18. Gaver, W.W., Hooker, B., and Dunne, A. (2001). *The Presence Project*. London: Royal College of Art.
19. Gaver, W. W., Boucher, A., Pennington, S., and Walker, B. 2004. Cultural probes and the value of uncertainty. *interactions* 11, 5 (Sep. 2004), 53-56.
20. Gaver, W. W., Bowers, J., Boucher, A., Gellerson, H., Pennington, S., Schmidt, A., Steed, A., Villars, N., and Walker, B. 2004. The drift table. In *CHI '04 Extended Abstracts*. NY: ACM Press, 885-900.
21. Gaye, L. and Holmquist, L. E. 2004. In duet with everyday urban settings. In *Proc. New Interfaces For Musical Expression 2004*.

22. Hagen, P., Robertson, T., Kan, M., and Sadler, K. 2005. Emerging research methods for understanding mobile technology use. In *Proc. CHISIG Australia 2005*, 1-10.
23. Hemmings, T., Clarke, K., Crabtree, A., Rodden, T. and Rouncefield, M. (2002) Probing the Probes. In *Proc. Participatory Design 2002*, pp. 42-50.
24. Horst, W., Bunt, T., Wensveen, S., and Cherian, L. 2004. Designing probes for empathy with families. *In Proc. Dutch Directions in HCI*. NY: ACM Press, 15.
25. Howard, S. Kjeldskov, J., Skov, M.B., Garnæs, K., and Grünberger, O. 2006. Negotiating presence-in-absence. In *Proc. CHI '06*. NY: ACM Press, 909-921.
26. Hulkko, S., Mattelmäki, T., Virtanen, K., and Keinonen, T. 2004. Mobile probes. In *Proc. NordiCHI '04*. NY: ACM Press, 43-51.
27. Hutchinson, H., Mackay, W., Westerlund, B., Bederson, B. B., Druin, A., Plaisant, C., Beaudouin-Lafon, M., Conversy, S., Evans, H., Hansen, H., Roussel, N., and Eiderbäck, B. 2003. Technology probes. In *Proc. CHI '03*. NY: ACM Press, 17-24.
28. Isbister, K., Höök, K., Sharp, M., and Laaksolahti, J. 2006. The sensual evaluation instrument. In *Proc. CHI '06*. NY: ACM Press, 1163-1172.
29. Iversen, O. S., Kanstrup, A. M., and Petersen, M. G. 2004. A visit to the 'new Utopia'. In *Proc. NordiCHI '04*. NY: ACM Press, 171-179.
30. Iversen, O. S. and Nielsen, C. 2003. Using digital cultural probes in design with children. In *Proc. IDC '03*. NY: ACM Press, 154-154.
31. Jönsson, B., Svensk, A., Cuartielles, D., Malmborg, L., Schlaucher, P. . Mobility and learning environments: Engaging people in design of their everyday environments. http://www.certec.lth.se/doc/mobility1/MobilityLearningReport021215.pdf
32. Kaye, J. 'J.' 2006. I just clicked to say I love you. In *CHI '06 Extended Abstracts*. CHI '06. NY: ACM Press, 363-368.
33. Kember, S., Cheverst, K., Clarke, K., Dewsbury, G., Hemmings, T., Rodden, T., and Rouncefield, M. 2003. Designing assistive technologies for medication tegimes in care settings. *Universal Access in the Information Society,* 2 (3), 235-242.
34. Kim, J., Lee, S., and Kim, S. 2006. Understanding users in consumer electronics experience design. In *CHI '06 Extended Abstracts* . NY: ACM Press, 189-194.
35. Kriglstein, S. and Wallner, G. 2005. HOMIE. In *CHI '05 Extended Abstracts*. NY: ACM Press, 2094-2098.
36. Kuiper-Hoyng, L. L. and Beusmans, J. W. 2004. Using home networks to create atmospheres in the home. In *Proc. Dutch Directions in HCI*. NY: ACM Press, 7-10.
37. Labrune, J. and Mackay, W. 2005. Tangicam. In *Proc. IDC '05*. NY: ACM Press, 95-102.
38. Lindström, M., Ståhl, A., Höök, K., Sundström, P., Laaksolathi, J., Combetto, M., Taylor, A., and Bresin, R. 2006. Affective diary. In *CHI '06 Extended Abstracts*. NY: ACM Press, 1037-1042.
39. Lundberg, J., Ibrahim, A., Jönsson, D., Lindquist, S., and Qvarfordt, P. 2002. The snatcher catcher. In *Proc. NordiCHI '02*. NY: ACM Press, 209-212.
40. Mackay, W. E. 2004. The interactive thread. In *Proc. DIS '04*. NY: ACM Press, 103-112.
41. Maldonado, H., B. Lee, and S. Klemmer. Technology for Design Education. In *CHI '06 Extended Abstracts*, 1067-1072.
42. Mamykina, L., Mynatt, E. D., and Kaufman, D. R. 2006. Investigating health management practices of individuals with diabetes. In *Proc. CHI '06*. NY: ACM Press, 927-936.
43. Mattelmäki, T., Battarbee, K., Empathy Probes. Paper presented at *Participation and Design*, Malmö 2002.
44. Millen, D. R. 2000. Rapid ethnography. In *Proc. DIS '00*. NY: ACM Press, 280-286.
45. Murphy, J., Kjeldskov, J., Howard, S., Shanks, G., and Hartnell-Young, E. 2005. The converged appliance. In *Proc. CHISIG of Australia*, 1-10.
46. Newman, W. 1994. A preliminary analysis of the products of HCI research, using pro forma abstracts. In *Proc. CHI '94*. NY: ACM Press, 278-284.
47. Nilsson, M., Johansson, S., and Håkansson, M. 2003. Nostalgia. In *CHI '03 Extended Abstracts*. NY: ACM Press, 964-965.
48. Paulos, E. and Beckmann, C. 2006. Sashay. In *Proc. CHI '06*. NY: ACM Press, 881-884.
49. Paulos, E. and Jenkins, T. 2005. Urban probes. *In Proc. CHI '05*. NY: ACM Press, 341-350.
50. Plaisant, C., Druin, A., and Hutchinson, H. 2002. Technologies for families. In *CHI '02 Extended Abstracts*. NY: ACM Press, 938-939.
51. Rodden, T. and Benford, S. 2003. The evolution of buildings and implications for the design of ubiquitous domestic environments. In *Proc. CHI '03*. NY: ACM Press, 9-16.
52. Roibás, A. C. and Johnson, S. 2006. Unfolding the user experience in new scenarios of pervasive interactive TV. In *CHI '06 Extended Abstracts*. NY: ACM Press, 1259-1264.
53. Sengers, P., and Gaver, B. (2006). Staying open to interpretation. In *Proc. DIS '06*, NY: ACM Press, 99-108.
54. Sengers, P., Liesendahi, R., Magar, W., Seibert, C., Müller, B., Joachims, T., Geng, W., Mårtensson, P., and Höök, K. 2002. The enigmatics of affect. In *Proc. DIS '02*. NY: ACM Press, 87-98.
55. Swallow, D., Blythe, M., and Wright, P. 2005. Grounding experience. In *Proc. 2005 Conf. European Assoc. Cognitive Ergonomics*. University of Athens, 91-98.
56. Vetere, F., Davis, H., Gibbs, M.R., Francis, P. and Howard, S. 2006. A magic box for understanding intergenerational play. In *CHI '06 Extended Abstracts*. NY: ACM Press, 1475-1480.
57. Vetere, F., Gibbs, M. R., Kjeldskov, J., Howard, S., Mueller, F., Pedell, S., Mecoles, K., and Bunyan, M. 2005. Mediating intimacy. In *Proc CHI '05*. NY: ACM Press, 471-480.
58. Voida, A. and Mynatt, E. D. 2005. Conveying user values between families and designers. In *CHI '05 Extended Abstracts*. NY: ACM Press, 2013-2016.
59. Wolf, T. V., Rode, J., Sussman, J., and Kellogg, W. (2006). Dispelling "design" as the black art of CHI. *Proc. CHI 2006*, NY: ACM Press, 521-530.