tice and how it changes their perspective of and relation to the environment. A diversity of artifacts has been created within a playful context, including a periscope (Rogers et al., 2005), an ambient horn (Price and Rogers, 2004) and the drift table (Gaver et al., 2004) — all of which are unusual, sometimes bizarre and often strange. Gaver et al. (2003) have also argued that ambiguity can be a desirable property in interaction design; making people stop and wonder about the artifact design, and to think more generally about the role technology plays in their lives. The theoretical underpinning of these forays into more "creative HCI" is that there isn't one preferred interpretation of a system but multiple (Sengers and Gaver, 2006). This way of viewing technology design draws inspiration from Science and Technology Studies (STS), which has documented the many ways that technologies are *interpretively flexible,* i.e., lend themselves to different interpretations besides those intended by their developers (e.g., Bijker, 1995). The idea of framing HCI in the context of multiple interpretations is also behind the cultural theories that have since been imported into HCI, to which we now turn.

6.3 TURN TO CULTURE

There are many questions about how we understand, think, and interpret what we see, hear and touch around us that do not lend themselves to being addressed by scientific theories of cause and effect or social theories of accountability. Many of our concerns about human nature and conduct are about interpretation, such as what did he mean by that, why did he give me that look, why did that performance appear so sublime and so on. These kinds of questions are the bread and butter of other disciplines, namely the Arts and Humanities. They are real questions that invite disciplined answers, involving another language and another conceptual scheme, such as argumentation and intersubjectivity (Scruton, 2012).

There are many theories and approaches within the Arts and Humanities that have evolved to answer questions about the human condition. Several with a background in these fields have jumped ship and joined HCI, as did the sociologists in the 1990s, seeing opportunities to interpret and explain the user experience and other aspects of HCI using their repertoire of interpretative schemes. Cultural theory is one such approach that has made some in-roads into HCI; an umbrella term for social commentary, critical analysis and a re-contextualizing of interaction design (Satchell, 2008). The different disciplines and philosophies they bring to bear include anthropology, social theory, Marxism, feminism, language theory and critical theory. Each of these can be broken down into sub-fields or phases of their development, for example, critical theory comprises film theory, literary theory, political theory and psychoanalytic theory, while feminism has been labeled as liberal, radical, multi-cultural and postmodern among others (Bardzell, 2009). New forms have also been developed to meet the needs of interaction design, namely, *interaction criticism* (Bardzell and Bardzell, 2008).

Critical Theory in a Nutshell

For the outsider, unfamiliar with the landscape of cultural studies, Critical Theory can appear as a dizzying array of perspectives and nuanced varieties. Adopting a critical stance in HCI requires being skeptical, which from a postmodernist position, involves viewing knowledge as subjective construction, being situated in the personal, the social, the conceptual and the political. When applied to user-centered design, it is viewed as the understandings, interpretations and everyday practices of the people being studied or designed for. What this means in practice, is to understand HCI from a number of different angles, such as "linguistic, ideological, gender-based, institutional, environmental" and to develop multi-faceted knowledge constructs that are, "diverse, complex, intentional, subconscious, implicit, genealogically layered, ideological, linguistic and ritually structured — all at once." (Bardzell, 2009).

This seems like an art form and skill set that takes much practice to develop and hone. Indeed, Bardzell et al. (2010) further emphasize how interaction criticism be seen as an *expert reading* of design artifacts, communicating new insights that can be of value to HCI. Part of the expertise in critical practice is knowing the body of knowledge in the design field and having a good sense of the important contributions that can be made from a critical stance. For those unfamiliar with this form of multi-layering and interpretative position, it can appear daunting and unwieldy. As with importing other theories into HCI, there is the danger that, researchers new to critical theory, will cherry pick certain concepts, resulting in them becoming overly simplified when out of context. In doing so, their interpretation — similar to the fate of affordances — may lose their original explanatory force, even to the point of trivializing a topic, and in so doing, making them vulnerable for ridicule by those from other "scientific" schools of thought.

The struggle facing those championing critical theory and, more generally, the adoption of a cultural theory approach to HCI, is what they are offering is an even more radical departure from the scientific paradigm than the Modernist theories imported into HCI. Moreover, bending the underlying principles and ethos of the cultural theory approach to match perceived needs of HCI practice, may be seen by some to be like heresy, grossly distorting its contribution from being interpretative to being other (such as prescriptive). But there is a price to pay for not adapting when decamping into an applied field; critical theorists may be regarded as a fringe activity, and at worse dismissed, by those unfamiliar with their method or style of writing. The way forward has to be to appropriate an HCI-oriented form of interpretation, which is more accessible to the HCI

community, but which still has its distinctiveness for addressing questions concerning human nature and the human condition. Bardzell (2009) has made a stab at this, proposing four kinds of mappings that critical theory and aesthetics can make to the practice of HCI: (i) informing the existing design process; (ii) resisting or innovating on the design process; (iii) developing and adapting critical theory relevant for HCI; and (iv) critiquing interaction designs that expose the consequences of design. Significantly, he argues, that such mappings are not intended to supersede or reject previous scientific methods in HCI — as many of the alternative theoretical approaches, such as situated action and ethnomethodology, argued for. This move towards more openness is an important step if it is to survive and flourish in Contemporary HCI, where there are ever more theories popping up, vying for attention.

6.4 TURN TO THE WILD

In-the-wild approaches to interaction design began appearing in the mid-2000s, although Hutchins (1995) seminal book "Cognition in the Wild" set a precedent for rethinking how to study cognitive and social phenomena in context rather than in isolation. Following this significant body of work, a number of in-the-wild studies and accounts began to appear in the HCI and Ubicomp literatures, describing how new technologies were being designed, prototyped, and implemented *in situ* (see Rogers et al., 2007). Wild approaches differ from earlier ethnographic approaches insofar as their focus is not on observing existing practices or deriving system requirements *per se* (Rogers, 2011). Instead, novel technologies are developed to augment people, places and settings; interventions installed and different ways of behaving encouraged. A key concern is to observe how people react, change and integrated these in their everyday lives.

The shift towards conducting in-the-wild studies has largely come about from a growing interest in how pervasive technologies can be designed to enhance and become part of the *everydayness* of life. Instead of the goal being to develop *solutions* that fit in with existing practices, the trend has been to experiment with new technological *possibilities* that can change and even disrupt behavior. Central to designing in-the-wild is being able to show how behavior changes over suitable periods of time of technologies being used *in situ* and in practice.

The outcomes of these in-the-wild studies have been most revealing demonstrating different findings from those arising from studies (Hornecker and Nicol, 2012; Marshall et al., 2011a; Rogers et al., 2007). In particular, in-the-wild studies show how people come to understand and appropriate technologies in their own terms and for their own situated purposes. Another difference is that in the lab participants are brought to the experiment and shown their place by a researcher or assistant and then provided with instructions as to what they have to do. There is always someone at hand to explain the purpose of the study, show how to use the system, or fix things if they don't go according to plan. This form of scaffolding is largely absent in-the-wild. The locus of control shifts from the experimenter to the participant. Hence, it becomes much harder, if not impossible, to design an in-the-wild study that can isolate specific effects. Instead, the researcher has to make

sense of data in-the-wild, where there are many factors and interdependencies at play that might be causing the observed effect.

The impact of these studies is making researchers rethink what the role of theory is for in-the-wild. The approach I advocate is to import *different* theories into interaction design that have been developed to explain behavior as it occurs in the real world; and then *re-contextualizing* how such a theory should frame research when used in-the-wild, and ultimately, constructing new *wild theories*, based on the findings from in-the-wild studies (Rogers, 2011).

The first two suggestions resonate with the challenges and approaches the other turns in contemporary HCI are proposing: bringing in alternative theories originating from the behavioral sciences and philosophy — that explain how people behave and act in the real world. One theory is *embodiment* — concerned with the social and physical context of the body in structuring cognition and how the world is experienced (this will be covered in more detail as "a turn" in its own right in the next section). Another is *ecological rationality*, which examines how people can make reasonable decisions given the constraints that they naturally and commonly face, such as limited time, information and computational abilities.

Ecological rationality. There has been a growing interest in how people make decisions when confronted with information overload, such as when shopping on the web or at a store. How easy is it to make a decision when confronted with overwhelming choice? Classical rational theories of decision-making (e.g., von Neumann and Morgenstern, 1944) posit that making a choice involves weighing up the costs and benefits of different courses of action. This is assumed to involve exhaustively processing the information and making trade-offs between features. Such strategies are very costly in computational and informational terms — not least because they require the decision-maker to find a way of comparing the different options.

In contrast, the theory of ecological rationality proposes that people tend to use simple heuristics when making decisions (Gigerenzer et al., 1999). Human minds have evolved to act quickly, making just good enough decisions. This theoretical approach proposes that the mind has adapted its limitations to match the structures of information available in the environment. Instead of trying to process all the available information in the environment and consider all possible options, people often make surprisingly good decisions using simple "fast and frugal" heuristics. These are rules of thumb that ignore most of the available information. They include recognition heuristics that largely eliminate the need for information and just make choices on the basis of what is recognized; search heuristics that look for options only until one is found that is good enough, and choice heuristics that seek as little information as possible to determine which option should be selected. Hence, we typically rely only on a few important cues. For example, in the supermarket, shoppers make snap judgments based on a paucity of information, such as buying brands they recognize, are low-priced, or have attractive packaging — seldom reading other package information. This suggests that an effective design strategy is to follow the adage less is more rather than more is more making key information about a product highly salient.

The theory provides a different way of thinking about designing information and how to make it salient when *in situ*. It goes against the grain of much current thinking in ubiquitous computing about contextual information (often based on unbounded rationality models of decision-making). Instead of providing exhaustive mobile recommenders of restaurants, places to visit, etc., for people on the move, the approach is minimalist, determining how, where and when to display salient information that can be capitalized on as part of a fast and frugal heuristic (Todd et al., 2011). This can lead to thinking about structuring the information environment in subtly different ways that can readily and even unconsciously influence people's choices and behaviors in desired directions. Furthermore, instead of trying to change people's behavior through influencing what and how they consciously think about an issue, it involves thinking about how to change the *context* in which they make their decisions, which may or may not involve conscious decision-making. This has led to quite different ways of designing displays in context in order to depict salient information. Instead of providing ever more information to enable people to compare products when making a choice, it is argued that a better strategy is to design technological interventions that provide just enough information and in the right form to facilitate good choices. One solution is to exploit new forms of augmented reality technology that enable information-frugal decision-making and which have glanceable displays that can represent key information in an easy-to-digest form.

Another idea is to develop new wild theory. But what form should it take? Instead of using theory to make a prediction and applying it to a specific problem, it is argued that a wild theory would address more broadly the interdependences between design, technology and behavior. While using this kind of coarser grain of analysis is not new — for example, socio-technical systems theories have been doing this for years — the subject of interest is, i.e., changing everyday behavior and designing *in situ*. Is so doing, a wild theory would become part of the design discourse rather than being formulated into a specific prediction or explanatory framework.

In-the-wild theory in a Nutshell

A starting point might for developing a wild theory might be a much talked about behavior that society is concerned with (e.g., energy consumption, well being, social entrepreneurship). The focus would be how to augment, facilitate or change it in ways that are desired by individuals and society. The problem-design space is couched in terms of an embodied, ecological or other new theoretical understanding of the way people behave in their everyday world and how a in-the-wild design could change this. A number of couplings between the environment, behavior and technology could be explored. Instead of looking at single cause-effects where doing X will produce Y, we could begin to explore a number of interlinked changes that we wish to implement, some through technological designs and others not. For example, a wild theory of technologically facilitated behavioral change would be concerned with

understanding the interdependencies between everyday phenomena, information salience, ubiquitous computing and ethics. Wild theory would also feed directly into the development of conceptual tools for design and research. Hence, I see wild theories as emerging from the cross-fertilization of alternative theory, findings from in-the-wild studies and contemporary social concerns.

6.5 TURN TO EMBODIMENT

The turn to embodiment has been gathering momentum in HCI, following the success of Dourish's (2001) book "Where the Action Is." It is about understanding interaction in terms of practical engagement with the social and physical environment. This is considered to be more representative of the way technology is heading in terms of how it is appropriated by people in their everyday settings and the diversity of physical ways we can now touch, manipulate and use interfaces, from tangibles to gesture-based hands free ones. It draws inspiration from a number of areas and theories, namely, Winograd and Flores's (1986) discussion of phenomenology, Suchman's (1987) notion of situated action, Gibsonian's conception of affordance, philosophical ideas from Heidegger (1996) thesis about "embodied interaction." That is a lot of ideas to bring together! Instead of trying to be a unified overarching theory, it has been suggested that it is more profitable to consider using the different aspects of embodiment to account for different behaviors (Marshall et al., 2013); for example, in describing what actions are available in a physically shared space (Robertson, 1997) and encouraging students to learn through physical manipulations or movements (Antle et al., 2009).

Embodied Interaction in a Nutshell

To adopt an embodied interaction stance means having a particular sensibility and approach to viewing technology, design and the world. An embodied interaction perspective takes account of the way human beings are embodied, where perception and action are always embodied. This allows for viewing interactions differently from viewing perception and action as separate stages. Dourish (2001) proposed embodied interaction essentially as a *stance* and *an organizing principle* that researchers and designers can adopt to help them uncover issues in the design and use of existing technologies and the design of new interactive systems. Everyday practices can be examined, analyzed and critiqued in relation to principles, claims and arguments about embodiment. The latter include "technology and practice cannot be separated from each other; they are coextensive and will coevolve," "embodied interaction turns action into meaning" and "meanings arise on multiple levels."