encompassing terms prominent in sociology at the time, such as institutions, organizations, states and nations, replacing them with a more realistic and smaller set of associations for describing the very nature of societies, that encompasses both human individual actors and non-human, non individual entities. The latter draws on concepts from semiotics and computer science to investigate the relationship between designers and users, who are viewed as interlocutors in a communication process that takes place through the interface of words, graphics, and behavior.

5.7 ACTIVITY THEORY

Activity Theory (AT) is a product of Soviet Psychology that explained human behavior in terms of our practical activity with the world. It originated as part of the attempt to produce a Marxist Psychology, an enterprise usually associated with Vygotsky (e.g., 1962) and later Leontiev (e.g., 1978, 1989). In the last 30 years, versions of AT have become popular elsewhere, particularly in Scandinavia, Germany and now in the U.S. and UK. The newer "versions" of AT have been popular in research investigating "applied" problems, particularly those to do with work, technology and education.

Its conceptual framework was assumed to have much to offer to HCI, in terms of providing a means of analyzing actions and interactions with artifacts within a historical and cultural context (Bannon and Bødker, 1991; Bødker, 1989; Kuutti, 1996; Nardi, 1996). It first appeared in HCI in the late 1980s when Susanne Bødker (1989) applied it to the design of user interfaces for newspaper production. It was then brought to mainstream attention through her collaboration with Liam Bannon (Bannon and Bødker, 1991) where they showed how it could be used to analyze actions and interactions with artifacts within historical and cultural contexts. They argued that this kind of conceptual analysis could be used to inform the design of technologies that better suited workers in their work environments. Since their pioneering work, numerous edited volumes, case studies, PhD dissertations, and special journal issues have been published showing how AT can be adapted and applied to a diversity of areas, particularly the analysis of work, technology and education.

Besides Bødker and Bannon's seminal work, a number of researchers have promulgated its merits and value for HCI, notably, Yjro Engestrøm, Kari Kuutti, Olav Bertelsen, Wendy MacKay, David Redmiles and Jakob Bardram. But perhaps the most ardent and longstanding proponents are Bonnie Nardi and Victor Kaptelinin. Since the mid 1990s, they have tirelessly promoted the AT approach, arguing that it has much to offer HCI researchers and practitioners, especially compared with other cognitive and social approaches that have been imported into the field (Nardi and Kaptelinin, 2012). They claim it provides "the rigor and dedication of the scientific method of traditional cognitive science with the much needed attention to social and contextual factors necessary to HCI studies" (Kaptelinin and Nardi, 1997). Part of their mission has been to provide a broad framework for describing the structure, development and context of computer-supported activities that is easily usable by practitioners. This has included giving tutorials, workshops and an Activity checklist for identifying the most important factors influencing the use of computer technologies in a particular setting (Kaptelinin et al., 1999). Besides Nardi and Kaptelinin's reworking of AT for an HCI audience, several of the other AT researchers have elaborated and adapted Leontiev's (1978) original

framework with applied goals in mind. Notable, is the highly cited work of Kuutti's (1996) extension of the hierarchical framework to show how information technology can be used to support different kinds of activities at different levels, and Nardi's (1996) adapted framework showing how it can be of value for examining data and eliciting new sets of design concerns. Nardi recast data from a field study that she had carried out earlier to compare the benefits of task-specific versus generic application software for making slides (Nardi and Johnson, 1994). In doing this exercise second time round, but with the added benefit of the conceptual framework of activity theory at hand, she found she was able to make more sense of her data. In particular, she cites how it enabled her to ask a more appropriate set of questions that allowed her subsequently to come up with an alternative set of recommendations about software architectures for the application of slide-making.

Activity Theory in a Nutshell

Activity Theory explains cultural practices (e.g., work, school) in the developmental, cultural and historical context in which they occur, by describing them in terms of "activities." The backbone of the theory is presented as a hierarchical model of activity that frames consciousness at different levels. These are operations, actions and activities. A number of principles are also proposed.

Focusing the analysis around the concept of an activity can help to identify tensions between the different elements of the system. An example of where it was used to show these was MacKay et al.'s (2000) study of users working with a new software tool that identified 19 shifts in attention between different parts of the tool interface and the task at hand. Some users spent so much time engaged in these shifts that they lost track of their original task. Using the theory helped the evaluators to focus on relevant incidents.

There are two key models: (i) an activity model and (ii) the mediating role of artifacts.

(i) The "classic" individual model (Figure 5.1)

At the bottom level of the model are operations, routinized behaviors that require little conscious attention, e.g., rapid typing. At an intermediate level are actions that are characterized by conscious planning, e.g., producing an index. The top level is the activity, and that provides a minimum meaningful context for understanding the individual actions, e.g., writing a chapter. There may be many different operations capable of fulfilling an action, and many actions capable of serving the same activity.

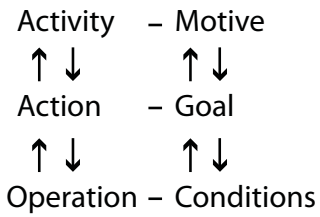

Figure 5.1: The original activity theory model.

Activities can be identified on the basis of the motives that elicit them, actions on the basis of conscious goals that guide them, and operations by the conditions necessary to attain the goals. However, there is an intimate and fluid link between levels. Actions can become operations as they become more automatic and operations can become actions when an operation encounters an obstacle, thus requiring conscious planning. Similarly, there is no strict demarcation between action and activity. If the motive changes then an activity can become an action. It is also important to realize that activities are not self-contained. Activities relate to others while actions may be part of different activities, and so on.

(ii) Mediating role of Artifacts

Artifacts can be physical, such as a book or a stone, or they can be abstract, such as a system of symbols or a set of rules. Physical artifacts have physical properties that cause humans to respond to them as direct objects to be acted upon. They also embody a set of social practices, their design reflecting a history of particular use. Leontiev (1981) describes the process of learning what these inherent properties are as one of appropriation, signifying the active nature of the learning that is needed. The kind of learning involved is one of identifying and participating in the activity appropriate to the artifact.

Consider an infant learning to feed with a spoon. Leontiev (1981) observes that, at first, the infant carries the spoon to its mouth as though it were handling any other object, not considering the need to hold it horizontal. Over time, with adult guidance, the spoon is shaped in the way it is because of the social practice — the activity — of feeding and, in turn, the infant's task is to learn that relationship — to discover what practice(s) the object embodies. By contrast a spoon dropped into the cage of a mouse, say, will

only ever have the status of just another physical object — no different from that of a stone.

The idea of abstract artifacts follows from the idea of mediation, i.e., a fundamental characteristic of human development is the change from a direct mode of acting on the world to one that is mediated by something else. In AT, the artifacts involved in an activity mediate between the elements of it. The social context of an activity is also considered central. Even when seemingly working alone, an individual is still engaged in activities that are given meaning by a wider set of practices.

Engestrøm's (1990) extension of Activity Theory, known as "developmental work research" has also been influential in CSCW. His framework was designed to include other concepts (e.g., contradictions, community, rules and division of labor) that were pertinent to work contexts and which could provide conceptual leverage for exploring these. He widened the focus from the individual triangle of a single activity (subject, activity, and object) to include supra-individual concepts — tools, rules, community, and division of labor. By tools is meant the artifacts, signs, and means that mediate the subject and object; by community is meant those who share the same object; by rules is meant a set of agreed conventions and policies covering what it means to be a member of that community (set by laws, parents, managers, boards, etc.); and by division of labor is meant the primary means of classifying the labor in a workplace, e.g., manager, engineer, receptionist.

The extended versions allow consideration of networks of interrelated activities — forming an activity system. It has been used to analyze a range of work settings — usually where there is a problem with existing or newly implemented technology — providing both macro and micro level accounts. Several others have adopted Engestrøm's approach and have used the model to identify a range of problems and tensions in various settings. Some have taken this variant and adapted it further to suit their needs. These include Halloran et al.'s (2002) Activity Space framework for analyzing collaborative learning, Spasser's (2002) "realist" approach for analyzing the design and use of digital libraries and Collins et al.'s (2002) model employed to help identify user requirements for customer support engineers. One of the putative benefits from having a more extensive framework with a set of conceptual foci is how they structure and scaffold the researcher/designer in their analysis:

"We found that activity system tensions provide rich insights into system dynamics and opportunities for the evolution of the system." (Collins et al. op cit, p58).

The extended analytic frameworks have proven attractive because they offer a "rhetorical force of naming" (Halverson, 2002, p247), providing a set of terms that the analyst can use to match to instances in their data and, in so doing, systematically identify problems. However, it still relies largely on the analyst's interpretative skills and orientation as to what course to take through the data and how to relate this to which concepts of the framework. In some ways this is redolent of the problem discussed earlier concerning the application of cognitive modeling approaches to real

world problems. There is little guidance (since it essentially is a subjective judgment) to determine the different kinds of activities — a lot depends on understanding the context in which they occur.

It is argued, therefore, that to achieve a level of competence in understanding and applying the various AT frameworks still requires considerable learning and experience (Rogers, 2008b). Hence, while, variants of the activity system model can be applied more readily, they are most useful for those who have developed them and understand activity theory in its historic context. When given to others not familiar with the original theory, their utility is arguably less and can even be problematic. For example, the basic abstractions of the model, like object and subject, were found to be difficult to follow, and easily confused with everyday uses of the terms when used by design and engineering teams (who were initially unfamiliar with them) to discuss user requirements (Collins et al., 2002).

AT does not provide a clear methodological prescription for the description or analysis of behavior as a set of procedures to be followed. Identifying elements in the framework is highly dependent on individual interpretation. One of the biggest problems with doing an AT analysis is working out when something should be described as a top-level activity and when something is better described as a lower-level action. For example, completing a software project is considered to be a top-level activity, while programming a module as an action. However, equally, programming a module could be viewed as an activity — if that was the object of the subject (person).

González (2006) tried to overcome this problem of distinguishing between levels by introducing a new intermediate concept to sit between an action and an activity and which describes "how tasks are aggregated and thematically connected on higher level units of work" (p53). He called this new level as one of engagements, which "thematically connect chains of actions towards the achievement of a purpose" (p9). Five types of engagements were outlined as specific units of work: requests, projects, problems, events and recurrents (p156). His idea behind analyzing actions/activities as types of work practices — rather than trying to decide whether to label them as actions or activities — is appealing since it can reveal more about what actually happens in the workplace. As part of the extended form of analysis, he suggested that the various actions that take place be viewed in relation to their higher-level purpose, such as a group manager composing an email and then sending it out to his team to motivate them. The emphasis is also on the way actions relate to other actions, rather than on how actions are performed through operations. The role of communication is also stressed in terms of how workers justify their motives and choice of which action/activity to follow at a given time.

Potentially, the outcome of performing this additional level of analysis is a richer interpretation of the field study data, and arguably a better understanding of how work gets accomplished on a moment-to-moment, what-to-do-next basis within the wider context of the purpose of the work. It switches the focus of the analysis from agonizing about the level at which to label something to examining the types of working spheres/engagements people have and pursue in terms of their temporal patterns, priorities and interdependencies with the work of others. It also enables a better linkage between the detailed ethnographic data collected in field studies and the conceptual labels of the framework.

What impact has Activity Theory had in HCI?

AT has been very popular, especially among Ph.D. students, as an explanatory framework. It has been used to couch and ground qualitative data in a variety of contexts. Numerous tensions and contradictions have been identified in workplace settings leading to the identification of specific needs for new technological tools. Its value has been in providing a structured framework that breaks down into a set of conceptual tools that can then be mapped onto features of complex, real-world contexts. In so doing, problems and opportunities for new interventions can be elicited. It has been popularized in Scandinavia, UK and the U.S.

5.8 GROUNDED THEORY

Grounded theory is not a theory *per se* but an approach that aims to help researchers develop theory from the systematic analysis and interpretation of empirical data, i.e., the theory derived is grounded in the data. Similar to AT, it has been a very popular choice amongst researchers wanting to make sense of the qualitative data they have collected, such as ethnographic video. The approach was originally developed by Glaser and Strauss (1967) and has been adopted and adapted by several researchers for different situations. Glaser and Strauss also individually (and with others) developed the theory in slightly different ways. Glaser (1992) documented the way the variants differ.

Grounded Theory in a Nutshell

The aim of grounded theory is to develop a theory that fits a set of collected data. In a nutshell, it is "a set of well-developed concepts related through statements of relationship, which together constitute an integrated framework that can be used to explain or predict phenomena" (Strauss and Corbin, 1998). To develop a "grounded" theory requires the researcher iteratively switching between data collection and data analysis. Initially, data is collected and analyzed to identify categories, then that analysis leads to the need for further data collection, which is analyzed, and more data is collected. Hence, data gathering is driven by the emerging theory and finishes when no further insights are gained from the alternating.

The goal of the grounded theory approach is to identify and define the properties and dimensions of relevant categories and then to use these as the basis for constructing a theory. There are essentially three kinds of coding: