An Activity Theory Approach to Intuitiveness: From Artefact to Process

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Abstract. Intuition is a widely employed term when describing or evaluating user interfaces in an HCI context. It is used in by most people in their daily life, regardless of technology use; it is applied by users in various socio-technical contexts; it is even utilized by developers themselves. While Susanne Bødker and others brought activity theory into the HCI discourse, in much of the literature, *intuition* has largely remained within the cognitive science discourse. In an activity theoretical approach, this paper attempts to connect intuitiveness to activity and pointing out the changing perception of the concept of intuitiveness in relation to skill levels; changing from being connected primarily to artifacts at an unskilled level, to being linked exclusively to tasks and processes at expert level.

Keywords: Intuitive use · User interfaces · Activity theory · Experience

1 Introduction

This paper discusses an activity theoretical approach to intuitive use in user interfaces, an approach based on a human activity perspective rather than the cognitive science perspective we have seen in much of the previous literature within the HCI discourse [1–3]. The paper contributes to the field by specifically link this much-utilized term to *human practice*, placing it within the current activity theoretical HCI–discourse [4–12].

The paper presents and discusses some of the related literature, starting with a brief introduction to activity theory, which in its asymmetry focuses on the range of human activities in a human-computer relationship rather than the computer artefact, followed by a description of flow and breakdowns as aspects of intuitiveness. Based on the literature the paper discusses how an absence of breakdowns, and a maintained sense of flow are both connected to human activity, and as such inflicts upon the user's perceived intuitiveness in an activity theoretical approach.

Among non-HCI practitioners, there exists a kind of vague understanding of the concept of intuitiveness [13], and what it means when talking about people's intuitive understanding of, and approach to technology, i.e. human-computer interactivity through a user interface. This term is, according to the literature, one of the most common ones when describing user interfaces, especially among non-practitioners and otherwise colloquially [3, 13]. This is not so strange in times where human agency is increasingly dependent on being able to interact with computers through various types of user interfaces.

M. Kurosu (Ed.): Human-Computer Interaction, Part I, HCII 2015, LNCS 9169, pp. 3–13, 2015.
DOI: 10.1007/978-3-319-20901-2_1

2 Literature

First a brief introduction to the parts of activity theory relevant to this paper will be presented, followed by a description of the relationship between flow and intuitiveness in a user-interface context.

2.1 Activity Theory

Activity theory «focuses on practice, which obviates the need to distinguish 'applied' from 'pure' science—understanding everyday practice in the real world is the very objective of scientific practice. […] The object of activity theory is to understand the unity of consciousness and activity» [12].

Activity-theoretical HCI, mainly conceptualized by Bødker [8], Kuutti [10], Bannon [4], Grudin [14], Kaptelinin [15] and Nardi [12], and others, distances itself from the traditional cognitive science perspective on HCI. Instead, it is focusing on an analysis (and design) in a specific work/activity practice in a multi-user setting. This also includes user participation in the development process, and addresses *actual use* as a part of the design and development phase, in addition to seeing the importance of an interface artefact as a mediator for human action.

In i.e. Kuutti [10] and Engeström [16] we see that human activity, being contextual or social or both, has a certain direction and is mediated by artefacts, or tools. E.g. Kaptelinin and Nardi describe these artefacts as mediated affordances [17] (Fig. 1).

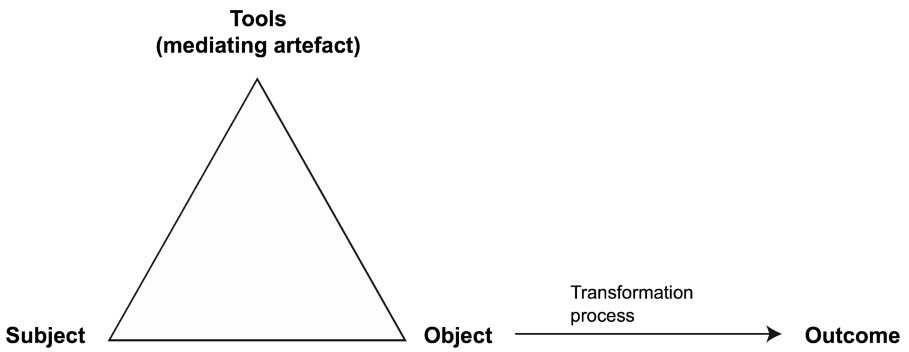

Fig. 1. The structure of activity [10]

Kuuti focuses on the structure of activity. "An activity is a form of doing directed to an object, and activities are distinguished from each other according to their objects. Transforming the object into an outcome motivates the existence of an activity. An object can be a material thing, but it can also be less tangible" [10]. Engeström [18] states that the unit of analysis when studying human-mediated activity, is the community of actors/subjects who shares the goal of the activity.

These are key elements in the discussion about the activity theoretical structure, since the theory's ability to absorb various aspects or strengthening of human agency is formalized through this conceptual framework that must be made strong enough to encompass both humans and technology within the same conceptual models [15].

Also, Kaptelinin et al. argues that activity theory in itself is "built upon the concept of mediation", which makes it particularly suitable for HCI "exploration" [19], meaning it is especially suitable as an analytical tool in a human-artefact interaction context since this relation is, by definition, always mediated.

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The perspective in this paper is that the character of abstraction through mediation should provide for an intuitive understanding of the possible features of activity.

Contradictions. Human activities are part in an overall interacting context, where related activities might change the conditions in such a way that users, during a working process, may experience problems that may cause downtime or a stop in ongoing activities. A case of 'misaligned' activities resembles what are labeled as *contradictions* within Activity Theory, i.e. events that manifest themselves as complications, mismatches, breakdowns, and so on. Misalignment could be represented by e.g. not sufficiently trained users or inadequate design of interfaces that fail to support the processes of skilled workers intuitive use. Activity Theory regards contradictions as options for learning [20].

2.2 Intuitiveness and Flow

Intuitive is an often used term when describing human-technology relations; be it either regular software, information systems, web-based systems that have some socio-technological connection or relevance or tangible user interfaces. There are situations in daily life, where we often employ this term as 'quick and easy understanding', or 'immediate apprehension or cognition'. In everyday life, then, *intuition* is encompassed by the sense of 'just knowing' without a rationale or previous experience, like some non-rational gut feeling; something along the lines of the definition found in i.e. Merriam-Webster,[1] where the meaning of the term intuition is described as:

- «a natural ability or power that makes it possible to know something without any proof or evidence
- a feeling that guides a person to act a certain way without fully understanding why
- something that is known or understood without proof or evidence»

which may be perceived as somewhat contradictory of what researchers in the field possibly would recognize as intuitive. This is not necessarily perceived as a problem

[1] http://www.merriam-webster.com/dictionary/intuition. Accessed October 17, 2014.

among ordinary people in their daily life; it might, however, be regarded as rather imprecise for the practitioners within the HCI community.

The scientific literature on intuitiveness is somewhat limited within the HCI discourse, not unlikely because of its vagueness and rather loose definition [13, 21].

Raskin [3] explains the term "intuitive interface" as normal human "intuition" would be enough to use a technological appliance. He claims that interfaces being perceived as intuitive will depend on whether a person recognizes the user interface elements as familiar. He does, however, state that it is the experience that leads to something being recognized as an opportunity to act, which is the basis for an intuitive approach to activity [3]. This is also concurred in more recent research, by e.g. Blackler et al., who, in focusing on intuitive use, state that "using familiar labels and icons and possibly positions for buttons helps people to use a product quickly and intuitively the first time they encounter it" [22].

In much of the literature that do describe intuitive interfaces, the term is, to a great extent, linked to people's cognitive understanding in a setting of human-technology relations. [1, 23–27]. Also, In 'Subconscious and Conscious Systems of Cognition', Norman goes further and relates an intuitive approach to problem-solving to the subconscious [28].

In addition, much of the literature that discusses the term, do so from an approach comprising physicality, embodiment or tangible user interfaces, while some researchers claim that intuition is a matter of experience [3, 29–31].

Leaning on Raskin's and Blackler's notion of sameness and familiarity, which are grounded on experience, we turn to Dreyfus and Dreyfus' Skill Acquisition framework. According to Dreyfus and Dreyfus, the *novice* user is identified by a strict following of rules and regulations, with a rather rudimentary situational perception, and without the capability to relate to situational adjustments. The *competent* user is able to handle tension and complexity, and is capable of evaluating actions as part of or appropriate within a larger context while adhering to a set of standards or routines regarding processes. The *expert* practitioner, no longer relies on regulations and guidelines, and maintains an intuitive approach to work processes based on experience and tacit knowledge, only employing an analytic approach in extraordinary or problematic situations.

Dreyfus and Dreyfus' framework was developed as an argumentative element in the discussions of the limits of artificial intelligence. It was not constructed as a general learning model as such. However, since this framework was based on "the dynamic processes of human skill acquisition" [30], we recognize its benefits to our argument of activity-based comprehension of what constitutes intuitive use of user interface elements. Therefore, we argue that their skill development matrix, in itself, can be made to use in describing the various degrees of intuitive use of user interfaces.

Blackler et al. [29] argue that an understanding of technology must also include recognition of similar technology. They claim that the knowledge and experience that a person acquires through using a different technology could be the basis for intuitive interaction in a similar context. They claim that recollection or recognition takes priority over expertise, i.e. an ordinary user who remembers a similar task will be capable of working in a way that resembles intuitive task solution in the similar way as an expert user would. Their three principles of familiarity that developers can rely on the work of creating user-interface that are intuitive to use:

1. Use familiar symbols/words in expected positions for functions that are the same or similar features that the users already know.
2. Metaphors for something that is already known should be linked to new functionality in the process of creating familiarity with something that is unknown.
3. Knowledge and metaphorical content and meaning should be coherent in all parts of an interface.

This is described by Israel et al. [21], who also emphasize mental efficiency by leaning on Mohs' discussion of mental focus on problem solving. Here we can see how attention shifts from the 'interface' by non-intuitive use to be 'task oriented' by intuitive use (Mohs in [21]).

Naumann et al. also focus on intuitive use rather than the UIs themselves should be intuitive [32]. In addition to discussing whether, or possibly how, intuitive use relates to the visual part of the user interface design, which is outside the scope of this paper, also intuitive use that is contextually related to tangible user interfaces is discussed.

Flow. In order to say something about breakdowns, or rather the importance of the *absence* of breakdowns, we ought first, perhaps, to say something about the concept of flow. According to Mihaly Csikszentmihalyi, flow is to be in a state of focused motivation, by being completely focused on a task in such a way that the ability and the task at hand is completely aligned, and that the work process feels natural and unobstructed, not unlike what we might consider as the intuitive acts of skilled workers. According Csikszentmihalyi, a user will, through a state of flow, be able to experience the absence of concern for losing the control or overview of how a task should be solved [33].

Csikszentmihalyi et al. [34] state that flow theory propose three conditions for achieving a state of flow:

- One must engage in an activity contains a *clear set of goals*, that adds direction and purpose for the activity.
- There must be a good balance between perceived challenges and perceived skill.
- Flow is dependent on clear and immediate feedback in order for the individual to adjust work processes to maintain the sense of flow.

Following the second condition, we argue that such a state of flow is also often associated with the joy of mastery. Csikszentmihalyi [34] states:

> «As people master challenges in an activity, they develop greater levels of skill, and the activity ceases to be as involving as before. In order to continue experiencing flow, they must identify and engage progressively more complex challenges. […] A flow activity not only provides a set of challenges or opportunities for action but it typically also provides a system of graded challenges, able to accommodate a person's continued and deepening enjoyment as skills grow.»

3 Discussion

In this section, a discussion of how contradictions, and a maintained sense of flow are related to human activity, and as such inflicts upon the user's perceived intuitiveness in an activity theoretical approach.

Intuition based on experience and skills resembles what Csikszentmihalyi describes as a state of flow. Since the experience of flow occurs when something perceived as possible actions corresponds with the person's perception of abilities, we might say that the senses of both intuition and flow stem from the perception of knowledge and experiences.

According to Csikszentmihalyi, a user will, through a state of flow be able to experience the absence of concern for losing control or overview of a task [33]. By linking this to tasks solved via user interface, we will be able to get a perception that it is through the prerequisites for a state of flow that we might see intuitive actions undertaken by a skilled user via a screen based interface tool.

By grounding the sense of experience on recollection, we might regard experience as a partly cognitive quality. However, Dreyfus and Dreyfus [30] claim that intuition comes from «[…]deep situational involvement and recognition of similarity» and not «wild guessing nor supernatural inspiration…]». Recognition of similarity requires previously acquired skills, to such an extent that it coincides with the descriptions of a proficient or, preferably, an expert user.

The choice of including Dreyfus and Dreyfus is due to their Skill Acquisition framework, revealing the attributes of the five Skill levels, from 'novice' to 'expertise' [30]. In Table 1, we see the possible requirements of a user-interface that is to support work processes initiated by users in a similar setting, but on different skill levels.

Table 1. The five stages of skill acquisition framework by Dreyfus and Dreyfus [30].

Skill level	Components	Perspective	Decision	Commitment
1. Novice	Context-free	None	Analytical	Detached
2. Advanced beginner	Context-free and situational	None	Analytical	Detached
3. Competent	Context-free and situational	Chosen	Analytical	Detached under-standing and deciding. Involved in outcome
4. Proficient	Context-free and situational	Experienced	Analytical	Involved under-standing. Detached deciding
5. Expert	Context-free and situational	Experienced	Intuitive	Involved

In this table 'totally dependent' is used to explain that users on this level are dependent, as in 'can not do without', on affordances in the user-interface. A user on this level would, probably, encounter more contradictions than a more experienced one. 'Occasionally' is employed to explain that users on this level have reached a certain degree of expertise and competence to a level at which they only occasionally will need the help of a mediated affordance in the user-interface, and by that experience less contradictions and possibly a state of flow and a sense of intuitiveness in working through the interface.

By adding a column for the varying need of mediated affordances to Dreyfus and Dreyfus' matrix of skill levels [30], Table 2 shows how a novice user must rely almost solely on mediated affordances provided by the user-interface. Observing the expert- or super-users revealed that they just occasionally lean on affordances in the user-interface in order to maintain a fluent task-flow. Also, the notion of a balancing 'agent' is needed when looking at the often experienced tension between interface design and the 'real world' work tasks in user-interface design as this is formulated by e.g. Gaver [35]. On those grounds it is possible to discuss user-interface requirements meeting the users' skill levels, recognizing the need for a collection of mediated affordances which support the need for work task support through the mediated affordances in the interface, while supporting the need for work task efficiency that will occur when users move downwards the skill level matrix by Dreyfus and Dreyfus.

Table 2. The UI-mediated affordances linked to the five stages of skill acquisition framework by Dreyfus and Dreyfus.

Human activity			Artefact
Skill level	Decision	Commitment	Relying on UI affordances
1. Novice	Analytical	Detached	Totally dependent
2. Advanced beginner	Analytical	Detached	Dependent
3. Competent	Analytical	Detached under-standing and deciding. Involved in outcome	Some to occasionally
4. Proficient	Analytical	Involved under-standing. Detached deciding	Occasionally
5. Expert	Intuitive	Involved	Occasionally to never

A central aspect of user interface elements is *use*. If an affordance represents an instruction for use, it must also be an element in facilitating intuitive use of user interfaces. This must be situated in a goal directed, human activity centered, vocational context. This is also supported by Bødker, who states, «The user interface cannot be seen independently of the goal or object, or of the other conditions of the use activity» [8]. This supports our argument of task or activity based understanding of what constitutes intuitive use of user interface elements.

A screen based user interface can, then, be regarded as a framework for mediation; a mediated whole, in which to situate functional elements and the adhering affordances that might linked to them in order to give the user the possibility, or sense, of immediate action pointing towards immediacy as the activity theoretical approach to intuitiveness in user interfaces.

Just as our world evolves, the terms we use to describe it, should evolve equally. In the networked and digital modernity that most of us live in, screen based user-interfaces are ubiquitous. By regarding all interfaces, analogue and physical as well as digital, as

some kind of mediating tool through which people might perform work or communicative activity, interfaces have become a natural and obvious part of both our private and professional life.

Much research work within the HCI field in later years has placed the so-called second wave HCI firmly within the activity theoretical tradition, while the much-used term of intuition has somewhat remained within the cognitive science discourse.

This paper's perspective supports an understanding of intuitiveness in user interfaces should be derived from human activity – of what a user tries to achieve – referring to the 'object' dependency on the structure of an activity system [10, 18] (Kuutti 1991). We will never really gain general access to a user's or a group of users', mental model (s), but their tools and objectives are accessible. One person's cognitive abilities and processes might be different from another while the same two persons might perform the same task, and through the same UI. In addition, actions and goals could be quantifiable and as such offer possibilities for establishing a framework for measuring intuitiveness with some degree of precision (Fig. 2).

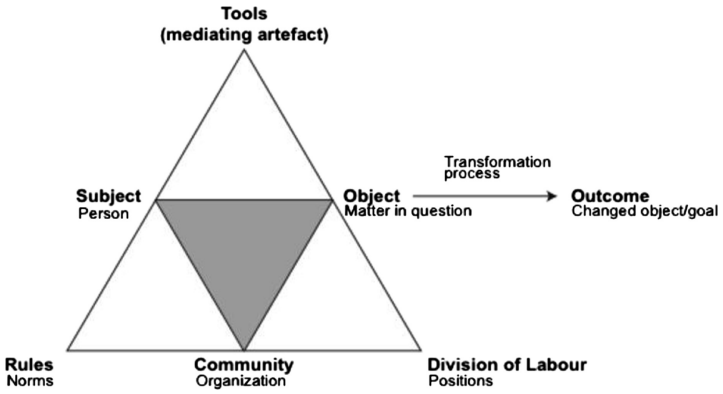

Fig. 2. The structure of an activity system. Based on Engeström [18]

We argue that intuitiveness is a contextual and dynamic term that should be related to human practice, and the additional aspects of the task at hand, i.e. 'Object' in the activity system, and the transformation process that follows it. Then, the character of intuitiveness would be a matter of evolvement, from affordance dependency to experiential tacit processing.

While opting to maintain the second argument in this paper, I also lean on e.g. Kaptelinin and Nardi [17], in grounding the argument that also screen representations like buttons, sliders, metaphors or abstractions of real world objects, represent affordances as well. A button affords clicking. A slider affords sliding. Even as elements on a screen, mediated as they are, they afford goal directed activity - actions. They are what Kaptelinin and Nardi, and others coin as mediated affordances [17]. This is also supported by McGrenere and Ho, who claim that a screen element that affords acting upon is "an affordance that is built into the software" [36]. This is in line with what Bærentsen and Trettvik [7] describe as "operational affordances", i.e. affordances that imply which activities can be undertaken with the tools that are available.

By observing intuitiveness through the lens of activity theory, that shifted the focus of analysis from technology to user activity, this will support our claim that intuitiveness, through skill acquisition, will change in nature, from being tied to the cognitive understanding of familiar artefacts among new and untrained workers to being connected to the action-oriented process and task flow among skilled workers and super-users. In short, we see this as the transition from the inexperienced user's dependence of *intuitiveness of things* to the skilled immediate action by experts; from familiarity with objects to familiarity with process.

4 Concluding Remarks

In this paper we have situated the attempts to understand intuitive use in user interfaces within an activity theoretical discourse, by linking the notion of familiarity and flow to:

1. *Experience* as previously acquired skills and habitual practice, and further describing the transition of the character of intuitiveness from, a beginners point of view, being dependent on
2. *Affordances,* as mediated artifacts in the user-interface that, in addition to facilitate actions, also clearly explain *how* the user-interface artifacts are to be used or operated, resembling the notion of a, per-element, user guide as an inherent or 'inscribed' part of the user-interface, and by acquiring skills and expertise through the gaining of expertise skill to familiarity of
3. *Activity*, as a transforming action, with the use of tools, towards an object to achieve a certain result, leaning on Kuuti who argues that "The tool is at the same time both enabling and limiting: it empowers the subject in the transformation process with the historically collected experience and skill 'crystalised' to it, but it also restricts the interaction to be from the perspective of that particular tool or instrument; other potential features of an object remain invisible to the subject…" following the Skill acquirement matrix by Dreyfus and Dreyfus.

4.1 Limitations

This conceptual paper is presented as a literary discussion and serves as a starting point for a wider discussion on activity theoretical intuitiveness in user interfaces, and how this might be interconnected to agile participatory design.

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