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Designing for Coping

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Abstract

Being in the world is to flow with the currents of life, of change and contingency. We perceive what is relevant to our situation and appropriately respond to attain a more desirable state. This basic phenomenon of *coping* plays out continuously at multiple scales of our activity and has been argued as the fundamental way in which we engage with the world. Coping skilfully is to be able to perceive and act in a nuanced manner, attuned to the situation and able to act smoothly and with minimal conscious effort. If coping underpins activity, what are the implications for interaction design, which involves the design of activity? This article explores this question, showing how coping provides a novel perspective on the core phenomena of interaction design. We suggest a framework, consisting of four lenses, for situating the concerns of coping in interaction design: *malleability*, *direct manipulability*, *meta manipulability* and *social manipulability*. In our discussion we argue why coping is novel and relevant for interaction design, and how it expands upon existing perspectives on situated, resourceful action and challenges notion of rich action and coupling.

Research Highlights

This paper is intended for scholars of interaction design and human-computer interaction. It is not a practical or empirical contribution meant to provide a ready route for solving design problems. Rather, it is a set of 'glasses' providing a novel perspective on the how we engage with artifacts in our everyday activity and what this might mean for their design. The contributions are 1) introducing a specific philosophical notion which has received only marginal attention in our field; 2) a framework to ground this notion in the design of interactive artifacts; and 3) a critique of existing theory to show how coping offers new insight.

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1. Introduction

Regardless of how our years, days, hours and minutes are structured and organized, we inevitably proceed through *coping*. Despite intentions and institutions, our lives flow along as a bubbling stream, encountering and intertwining with other streams as we pursue our projects. We manage change, uncertainty and contingency by continually making nuanced corrections according to what is becoming around us. Examples of coping are smoothly chatting with a friend whilst you both sidestep slow walkers on a busy sidewalk, finding another printer when you realize the one you wanted to use is empty, and shifting and strengthening your finger grip on a glass, based on the sensation of it slipping.

The artifacts we create as interaction designers are subject to—and complicit in—the same currents of life that we cope with. Artifacts allied with our processional coping constitute and support fluid, absorbed, skilled activity. And indeed, it is typically the case that designers seek to devise something that is usable and a good fit for the intended use situation. Good design undoubtedly draws an artifact closer into alignment for a particular situation, yet it will only ever be for an idealized situation. Designers' power wanes as we come closer—temporarily, spatially, culturally and in all other aspects of context—to use in an at-hand situation. In the moment, in the flow of activity, it is people who adapt in how they interact with the world based on the contingent situation. People adapt their practices, how they relate to others and how they work with the tools and objects at their disposal. Even if an artifact has been designed from the basis of a rich understanding of its intended use situation, it is only in use that it reveals itself to be conducive or not to the flow of activity.

While the view that people act in a situated, resourceful manner is commonly held, it is less clear how the design of artifacts should be different to support this primordial phenomenon. In other words, how do we design for coping? Can we identify the characteristics of a design that supports or is determinate for coping? In this article we unpack the notion of coping, identifying its character and clear implications for design. We develop *malleability* and three expressions of *manipulability* as constructive lenses translating the abstract and profound philosophical notion to the concerns and purview of the designer.

This article is intended for scholars of interaction design and human–computer interaction. It is not a practical or empirical contribution meant to provide a ready route for solving design problems. It is oriented toward what Oulasvirta and Hornbæk characterize as a 'conceptual problem' (2016), namely, the absence of a full account of coping in the field. We provide a set of 'glasses' providing a novel perspective on the how we engage with artifacts in our everyday activity and what this might mean for their design. As such, it works like other views that a researcher or designer might take on, such Norman's 'perceived affordance' (1999). Affordance is not a fact, toolkit or set of heuristics, and its operational principles are indistinct. Notwithstanding, it has become enduring—and oft critiqued—lens in interaction design research, practice and pedagogy. Some of what is seen through our framework resembles existing orthodoxy in the research field or practice. Indeed, we believe this to be indicative of the primordial nature of coping and speaks to its power as a theory. However, that should not be mistaken as having nothing new to contribute.

The framework we propose makes specific and novel claims about the character of everyday activity and the requirements of interaction that might support this. Again, while there is similarity in part to existing strands of work they lack the totality and nuance of the view we present, and its philosophical foundation. The contributions are (i) introducing a specific philosophical notion which has received only marginal attention in our field; (ii) a framework to ground this notion in the design of interactive artifacts; and (iii) a critique of existing theory to show how coping offers new insight.

2. Coping

To its benefit, the word coping holds everyday meaning. In this article, however, we specifically use Dreyfus's philosophical understanding of coping and set aside its everyday usage. Importantly, this also excludes understandings of coping discussed in the field of psychology which do not have direct bearing on our discussion and entail rather different aims and traditions.

A PHENOMENOLOGICALLY-INFORMED VIEW

Our use of the term *coping*, drawing on Merleau-Ponty's phenomenology of perception (1965) and Dreyfus's skilful coping (2014), is specifically: 'ongoing, nuanced perception and response, striving for equilibrium'. Informed by a pragmatist reading of Heidegger and Merleau-Ponty, Dreyfus rigorously critiques 'the epistemological conception of the mind' (2014, p. 169) which holds that our engagement with the world is driven by internal cognitive or psychological states, and that there is a delineation between mind, body and world. In this view, we deliberate on our situation, deliberate on a course of action, which in turn is performed by the body in relation to the world. We see a product, reason about it, decide how to engage with it. Reasoning based on internal states and representations is, according to the epistemological account, the basis of intelligence and in a sense, how we experience artifacts as providers of meaning and sites for action.

The phenomenological perspective however, suggests that the basis for intelligence and our engagement with the world is one of embodied coping, rather than deliberation. We experience a 'grip' of our situation, a sense of balance and control. Coping is our constant striving of 'maximal grip' (Merleau-Ponty, 1965) by attunement of perception and action. While it may suit analytical purposes, it is not meant that perception and action are experienced as distinguishable or concomitant acts. Perception is not directed toward scanning the world for information, but for revealing the possibility to tighten our grip and approach equilibrium. Perception is not a stream of sense data that is interpreted but rather ongoing, embodied and active. When 'in the flow' and fluidly coping, we become 'geared in' to the situation, and do so without full awareness, as if we are pulled along by the situation itself. Dreyfus argues that coping is the basis for our most basic engagement in the world, such as moving a finger to press a touchscreen, through to the complex of activities such as playing chess.

COPING: BETTER OR WORSE

Experiencing fluid coping is for awareness of activity and its intermingled things to slip away, to be carried along with and by the situation without needing to deliberate. We might, for example, experience a mundane form of skilful coping tying our shoelaces. Complex manipulations and subtle interplay between shoes, laces, foot and fingers flows without thought, allowing us to think of other concerns. If asked 'how was it that you tied your laces?' we might struggle to account for our actions, and any account that we do give would not be the actual basis of the action but rather a post-reflective construction. When fluidly coping, we might not be aware of our body at all, despite the skilled

manner in which we perform. Similarly, artifacts that we are utilizing might seemingly disappear, integrated as extensions to our perceiving body.

Poorly coping is to be increasingly 'outside' of the activity, or not 'with' its flow. We respond poorly since we're unable to act in the manner demanded by the situation, or we're not even able to perceive what is demanded. Our grip on flowing activity is loose and erratic and we need to withdraw to consider the course of action. For example, you may be typing at a pace you have trouble coping with. Your body cannot seemingly keep up, you make mistakes, you need to look down at the keyboard and reassess the spatial relation between your body and the keys. In popular analyses following Heidegger (Ehn, 1988; Winograd and Flores, 1986), this is considered a 'breakdown', the point at which attention shifts, where the keyboard (or even our hands) becomes 'present', appearing to us as something distinctively different than when it was seemingly transparent. Coping in contrast is an ongoing phenomenon, at times going well, at times not so well. A 'break-down' can be characterized as an episode within that flow. Although breakdowns are significant both philosophically and practically, as a conceptual frame it would seem to miss much else of our everyday activity.

How is it that we gain competency and find ourselves better able to cope? According to Dreyfus, skill development is to perceive finer details of a situation and be able to perform increasingly nuanced actions. It is an expanded *perceptual* rather than *conceptual* repertoire that makes the expert. The situation and the action it demands reveals itself to us with greater clarity. Importantly, this nuanced perception and action takes place without it being necessary to reflect, it is continuously with the flow of activity. Skill broadens the range of contingency we are able to cope with. As a result, we are better able to fall into— and keep up with—the situation. There is a reduced need to withdraw to reflect and deliberate.

Although we mostly use the term 'skilful coping' to denote when coping is going well, this does not imply that the activity is ordinarily described as a developed practice. Skilful coping can also be characterized as *absorbed* or *fluid* coping. Habitual activity such as brushing one's teeth, and even casual unthinking activity such as twiddling one's hair can be considered skilful coping (Dreyfus, 1993) even though we may not value them as skills as such. It should also be noted the challenge of attaining or maintaining grip should not be equated to negative feelings like anxiety; it can at times be a source of pleasure.

3. Designing for Coping

The task for this section is to translate and extrapolate from coping as a specific philosophical concept to one that is meaningful for design. Given the significance of coping, this task is surely not resolved in this article alone. To begin with, we want to clarify why the notion of coping would seem constructive. That coping is fundamental to our being suggests that it may be broadly relevant and explains why it resonates with many other theories for people's activity and engagement with artifacts. This fact does not however make it necessarily constructive. In our view, coping is a useful concept in that it has a character. It is described as *ongoing*. It consists of *action* and *perception* which are not sequential or ordered, but *unified*. Moreover, action and perception is *nuanced*, and the agent is striving toward *equilibrium* with the situation. Unlike many philosophical concepts, coping is succinct yet clear in what it is constituted by, and thus useful for analysis. Coping is also implicated in skill development. While it is fruitful to think of in-the-moment coping, it also invites us to consider a longer time horizon, of how someone might gain understanding or mastery. Although designing for skilled use is not necessarily a key concern in all design situations, the developmental account of coping is a strength that sets it apart from other theories.

We suggest two top-level lenses for how coping relates to the design of an artifact: *malleability* and *manipulability*. These are meant as frames of reference, leading the designer to questions such as: in what way is the artifact malleable? How is malleability practically achieved now? And so on. We further distinguish manipulability as *direct*, *meta* and *social*. Together, these are four lenses for the designer, and not discrete features of a design that a user might be aware of. For example, a designer could reflect on the *meta manipulability* of an interface toolbar separate from its *direct manipulability*. These four lenses constitute our framework for designing for coping. In this section we outline the framework and following that, position it in wider discourse.

Some points of clarification. For simplicity we mostly use examples of an individual interacting with an artifact. Artifact is naively meant here as the 'object of design', the artifact, element or space under analysis or design. It could also relate to an assemblage of heterogenous device and services, such as in internet of things. Our framework is also not meant to characterize or conceptualize *interactivity* per se, like for example, the efforts of Janlert, Stolterman and colleagues (Janlert and Stolterman, 2017; Lim et al., 2007).

MALLEABILITY

Malleability of an artifact, in our use of the term, refers to the practical possibility for an agent to materially tailor an artifact so it fits their situated

requirements and with respect to their prevailing socio-material context. This might include activities like configuration, customization, dis/assembling and so forth. As an example, you might anticipate the need to calculate currency conversions before you travel and thus install an app on your phone, put its icon 'within reach' and set up the needed currencies. The *phone* is malleable in that you can install additional apps, and place shortcut icons in variously accessible locations. The *app* is malleable in that you can configure which currencies to fetch data for.

Tailoring an artifact, for the most part, is distinct from use. A phone is not used for the intention of installing and arranging app icons. Rather, people use it—according to their situation—for reading email, taking photographs and so on. And likewise, the app is not used for the intention of configuring it, people intend to use in a situation where they need to make sense of a foreign currency. Tailoring can be a focal and pleasurable practice of its own, such as crafting (Buechley and Perner-Wilson, 2012; Rosner and Ryokai, 2009), but our interest here is the routine kinds of tailoring where the purpose is to establish improved grounds for activity.

Malleability is a design-centric lens to consider the qualities and manner of materially tailoring an artifact. It is to examine the concrete opportunities the artifact furnishes, for example, through configurability, extensibility or material characteristics. Malleability as practically experienced is, however, relational. It is contingent, for example on competency, socio-material resources and so on. Varying scales of malleability can be considered as in the earlier example: a tool within an app, the app itself, the operating system, the laptop, the room, and so on. For design purposes, the locus of analytical attention is associated with the designer's remit and interest.

In a practical sense, tailoring is to inscribe or embody expectations about future activity with a degree of durability. In some expressions of malleability, an agent might delegate work to the artifact, for example, recording a sequence of actions as a macro to be executed with a single click instead of a laborious series of manual operations. Tailoring of an artifact is also in relation to other tailoring activities an agent might carry out. Through this alignment and drawing together of resources an agent seeks to improve the basis for coping according to localized needs. For example, creating an internet of things assemblage to set the lights a certain way when you arrive home.

The examples discussed thus far have concerned setting the field for activity or a situation in a general sense, rather than for a specific at-hand situation. For example, an illustrator might set up their workstation and drawing app according to how and what they draw. Depending on the qualities of malleability, this may be a relatively stable configuration since it's not readily

reconfigured. Notably, tailoring is done outside the flow of the activity it is meant to support – drawing. When it is time for drawing, the illustrator may find their ability to cope improved by having their own preset brushes at-hand, buttons on their drawing tablet set for common operations they perform and so on.

In any situation, there will be a *situational gap* between what has earlier been inscribed and manifested through tailoring and what is called for in-the-moment. Perhaps, for example, the style of illustration is such that they find it necessary to rotate the canvas much more than they usually do, requiring keyboard shortcuts that are awkward to execute, or perhaps the default brush settings is not what is needed. The gap is bridged through nuanced action, as it is only in the flow of activity that the agent is able to perceive what is demanded. The illustrator might keep their hand and fingers roughly posed ready to repeat a common keyboard shortcut. They might have to move sliders to change the brush properties, and so on. The agent might experience friction with the constraints of their own configuration, perhaps to the extent of having to break attention from the task at hand and attend to reconfiguration. Once activity is underway, the configuration achieved by way of malleability is only fortuitous to the degree of alignment with the contingent situation at hand. The tailored artifact, as in its original form, remains a relatively static embodiment of particular knowledge and expectations, and again resists the flows of contingency. Thus, in designing for coping, the malleability of an artifact is the beginning, not the end. This remains the case if tailoring happens autonomously, for example, an AI-driven internet of things system which automatically reconfigures a room according to expectations of its use. Even assuming humanlevel of intelligence on the part of the AI, there is still the question of the situational gap.

MANIPULABILITY

Manipulability we define as the ways the artifact can be worked through and with. A highly manipulable artifact is one that permits subtle, expressive use. Skillfully coping, as described earlier, is predicated on the tight and nuanced interplay between perception and action, between our body and equipmental field, pulled along by our tendency toward 'maximal grip' and higher-order motivations. An artifact with poor manipulability hampers coping because of impoverished possibility for action and impoverishment of perceivable state and result. An artifact with high manipulability reveals and allows for nuanced action and enables us to maintain a nuanced impression of its state and the result of action. The coupling of action and perception can thus become tight and continual. In the absence of manipulability, the artifact must be coped, through changes in personal or social behaviour, communication, or to the equipmental ecology—resulting in disruption (Fig. 1).

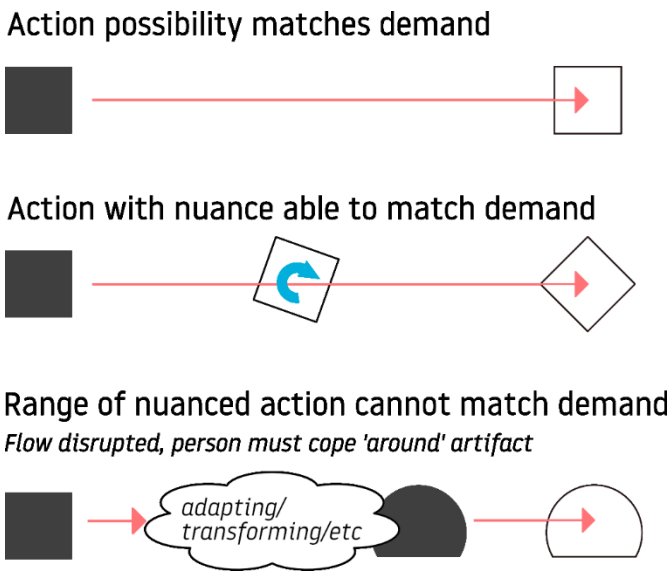

Figure 1. Scenarios of action. The first two scenarios are unproblematic, and perhaps even proceed without conscious deliberation: the person is able to act in accord to situation. In the third scenario, the person must adapt to the mismatch with what they can do with the artifact and what is demanded by the situation.

We identify three interrelated expressions of manipulability: *direct*, the richness of direct manipulation; *social*, the richness of social expression; and finally *meta*, the richness of manipulability of the artifact in order to maintain the flow of activity.

Direct

Expression of direct manipulability is in the tight coupling of action and response. Much of today's interaction design trivializes our physical abilities in the pursuit of ease of use, failing to leverage our innate ability for rich, skilled movement (as long argued, for example, by Djajadiningrat *et al.*, 2007). Consider typing in a word processor where the result of key presses is the same regardless of how you hit the keys. Contrast with playing a melody on a synthesizer where the sound can depend on how hard the key is struck, and how force is modulated whilst pressing or on release. A single, well-articulated press thus expresses many characteristics. These are embodied in the tone issuing from the instrument, providing nuanced feedback on action. Importantly, we only consider direct manipulability that the artifact is *susceptible*—and thus responds—to. While it is possible to hit a key on a keyboard with different levels of force like one would a synthesizer, it's only the synthesizer that responds in kind. As Wensveen *et al.* describe, there is 'unity' of action and response (2004).

Physically interacting with digital entities necessarily involves mediation, a translation of particular human actions through to some kind of digital

representation. To what extent then can we consider interaction 'direct'? Is using a touchscreen more direct than using a trackpad? In what manner were the early direct manipulation interfaces meaningfully direct? Directness, we suggest, is a relation of manipulability richness rather than the degree of mediation. It is a mistake to consider the physical contact point between human and device as the site of directness. The experience of directness is in equipment's ready-to-handness; when we act and feel through an artifact rendered transparent. A skilled trackpad user 'reaches' for an on-screen button through the trackpad just as a touchscreen user reaches for on-screen button with their finger.

The classic GUI button has a good a coupling of action and response. But with the view of coping, it would seem to lack nuance in its direct manipulability. It does not matter how that 'delete' toolbar button is tapped, it responds in the same way. Consider a toy alternative: perhaps a light tap moves a file to the trash can, while a heavier tap 'shreds' it so it is irrecoverable. Or perhaps as the button is pressed, it unfolds, permitting a sliding gesture that determines how the file should be deleted. This would seem congruent with recent trends for gestural interaction that allow, for example, a list to be processed by dragging list items to the left or right (Fig. 2).

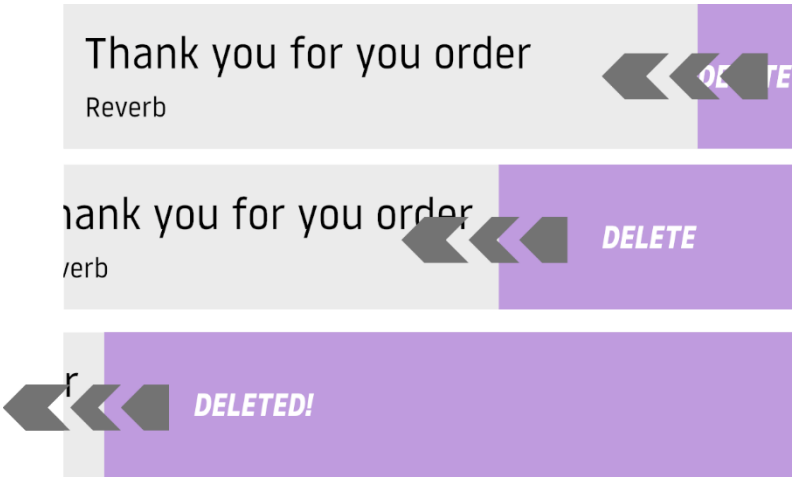

Figure 2 As an item is dragged, feedback and feedforward are provided. If the gesture goes far enough the action is performed.

Meta

Manipulability is not just a matter of degrees of freedom in the baseline use of a tool. Consider the manipulations made during activity that serve to bring objects near or push them far, reorient objects for better visibility or access, and so forth, in what Kirsch and Maglio describe as 'epistemic action' (1994).

By moving ourselves in relation to an object of relevance, or moving the object itself, we strive to sate our perceptual demands and attain maximal grip (Merleau-Ponty, 1965). In contrast to direct manipulability, meta manipulability does not necessarily perturb the artifact and elicit a change of form, function or behaviour.

Hairdressers, for example, are skilled with combs and scissors, among other implements. A competent hairdresser works quickly, running their comb through a shock of hair, holding the hair between two fingers, and then bringing their scissors into play, lopping the length of hair off. Fingers, scissors, hair and comb are all manipulated in tight unity of action. Notably, instruments are brought in and out of the focal point continually. A comb might be gripped between index finger and thumb while the other fingers work the hair. A different pair of scissors can be kept slung over the back of a hand, fingers laced through the grip, and brought in and out of action with a quick flick and reposition of the fingers. These kinds of manipulations seem to contribute more to the smooth practice of 'doing' hairdressing than the hairdressing itself. This is not, however, to claim that these manipulations are somehow outside of the activity of hairdressing. A hairdresser unable to stow away instruments with and on the hands would still be able to 'do' hairdressing. But they would be slow, stuttering between distinct acts—such as putting down a comb on a surface, cutting hair, and then picking it up later. If you were to observe such a hairdresser, you might say they not coping as well as the hairdresser next to them who is able to make fluid, integrated manipulations.

Coordinated activity can also proceed more smoothly with meta manipulations. For example, the nuance in which instruments are passed back and forth between nurse and surgeon or continually arranged on an instrument table (Svensson *et al.*, 2007). Svensson et al. describe how a nurse will make an instrument available for the surgeon with a certain orientation so that it can be smoothly seized and applied to the area of focus. Both nurse and surgeon are able to achieve this mutual coordination through intermingled, nuanced action and perception. To stress the point, consider if the nurse was blindfolded and could only hear a request for the scalpel. They could only make the scalpel available to the surgeon in a general manner because their perception of the situation is diminished. The surgeon could still take the scalpel from the nurse's hand but would likely have to make more follow-up movements of the scalpel so that it is rendered useful for the demands of the situation. In other words, the surgeon would have to cope around the nurse's lack of attunement with the situation.

'Purely digital' artifacts such as a mobile app would seem to be particularly impoverished in terms of meta manipulability. Whilst running, apps have a kind of meta manipulability provided by the operating system, in the possibility

to switch between or glance at them with gestures. Some platforms also support the possibility to position and size apps so that they run side-by-side. If implemented well, this could allow the user to smoothly bring apps in and out of view and arrangement. Meta manipulability could also be viewed in the trend of 'responsive' apps that fluidly adapt to the size of the viewport. On a computer, this allows the user even greater nuance in how different artifacts are arranged, ordered and sized on their screen. Within more complex apps we see meta manipulability in how toolboxes can be toggled, docked, resized and positioned. Keyboard shortcuts, once learned, allow users to quickly swap in and out of using different tools in the flow of the situation.

A consideration when expressing meta manipulability is whether it is nuanced and perceptible beyond the user. For a user, clicking a toolbox button to select a paint brush is precisely the same kind of interaction as selecting the eraser. The only difference is the icon. When a tool is activated (or metaphorically 'held'), the cursor moves around with the same dynamics in response to mouse or stylus movements. There's no change between tools or whether a tool is selected at all. It is only the visual feedback—such as an icon at the cursor location and depressed button in the toolbox—that gives us a sense of what we are 'holding'. The obvious contrast with physical artifacts is when you are holding a pencil its uncommon to mistakenly think you're holding scissors. There would seem to be opportunity here for greater nuance. Further, because the meta manipulability in terms of bodily movement is roughly equivalent, it is difficult for others to 'gear into' what we're up to, unless they too are looking at the screen, as we describe in the next section.

Social

Social expression supports coping because we are able to express ourselves with nuance and subtlety, and the nuance and subtlety of others' expression is available to us. Although not well-developed by Dreyfus, we suggest that the basic phenomenon of coping is also in how we relate to others. A social situation shows up to us in a particular way, calling for action. We 'gear in' to conversation and social cues just as we do with a grip on a tangible object. While people are generally skilful social copers, those who have trouble perceiving social cues or making nuanced expressions (lingual or otherwise) find it difficult to cope with social situations.

Cooperative activity is predicated on being able to attune to each other and reach an equilibrium. Mediated activity between people and through technology—perhaps over time and space—impedes or prohibits nuanced expression or perception thereof. Ethnomethodologically informed analysis of cooperative work in the field of CSCW have long identified the necessity to make one's activity available to others (Robertson, 1997, 2002; Schmidt, 2002),

and the value of language as an expressive, versatile way to cope (Bentley and Dourish, 1995). The enduring paradigms of email and text messaging and the many accounts of their creative and adhoc use in cooperative activity are indicative of the necessity for expression in conjunction with digital tools. Language and other forms of socially available expression—be it technologically mediated or otherwise—can be a respite of fluidity against artifacts obdurate to socially available manipulability.

Revisiting the case of the computer keyboard, richness and nuance typically comes about through *what* we type, not *how* we type. The intelligibility and expressivity of what we write is a matter of social construction. A person can cope by being nuanced with use of written language, and others' nuance is likewise available in their writing. Inscriptions, such as annotations, sketches, photographs and videos can be made on or with an artifact as an aid for coping at a broader scale of time and distance by virtue of their durability and transmittability. Unlike the synthesizer, we are perhaps more limited in how we can usefully analyse the social expressivity of the computer keyboard. It is only in the unity of a keyboard as part of a word processor ensemble, or the keyboard with an instant messaging client and its associated infrastructure that we might begin to examine how it supports coping.

Social expression is also implicit in *how* we do things. At the office, if a person types an angry email to their landlord, they may be purposefully nuanced in their use of language. In addition to that, the gusto with which they hit the keyboard might be expressive to their colleagues. People's activity in the world is generally available for others' perception, enabling a 'gearing in' of intersubjective understanding and cooperative activity. For an artifact to support this implicit kind of social expression, it must be usable in a performative, visible manner. In contrast to direct manipulability, this kind of expressive use does not need to relate to the actual outcome. Typing angrily at a keyboard might be visible to others in social expression (regardless of intent), but not at all in direct expression. For the keyboard and word processor, it still makes no difference in *how* the person types, it responds in the same way.

CONCLUSION

We suggest four lenses for making coping a concrete and relevant notion for design: *malleability, direct manipulability, meta manipulability* and *social manipulability*. Malleability can help an agent establish better grounds for activity through configuring and modifying artifacts. In doing so, they inscribe their localised, situated demands and expectations. However, malleability is mostly *out-of-use*, outside the flow of fluid coping. Malleability requires us to focus on the artifact itself, and forms of malleability may be out of reach in the absence of specialist skills. Expressions of manipulability, in contrast, is a

constituent part of the activity flow, wherein the artifact may become 'transparent' or seemingly part of our body. Stated differently, out-of-the-flow malleability results in durable articulations, while in-the-flow manipulability results in transitory, continually changing articulations (Fig. 3).

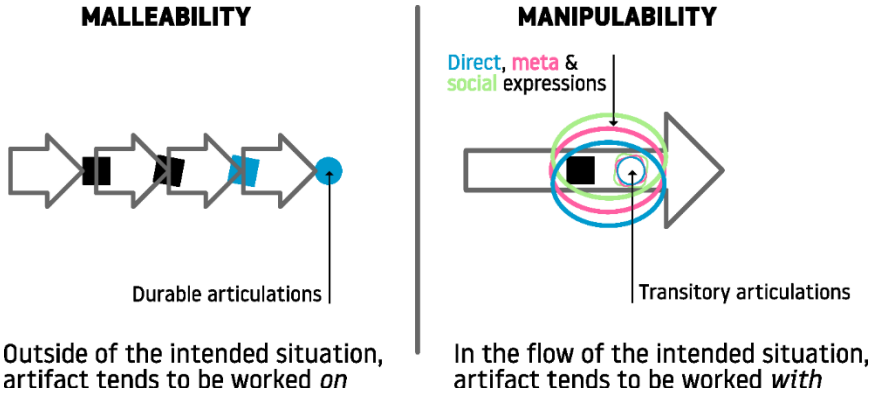

Figure 3. Differences between 'malleability' and 'manipulability'

It may well be that the malleability and manipulability draws on the artifact in the same way, or has the same bodily engagement. For example, we can move a mobile device around and rest it against surfaces. We might say that this possibility allows us to establish the grounds for activity, for example, positioning it so we can read from its screen whilst typing at a computer. In our distinction, this is not malleability of the device, because we're not materially modifying it. This possibility could however be regarded as partial support for malleability of a wider ecology that includes the device as well as computer, desk and so on. From this reference point it's not just that the device can be moved about and positioned, but also that the desk has certain possibilities and so on. As Heidegger notes, equipment depends on other equipment. The possibility for ready movement of the device might also be in service of its manipulability. For example, whilst in a collaboration scenario, being able to fluidly reorient the device so that someone else can see could be viewed as a support of meta manipulability.

As this example demonstrates, manipulability and malleability are not fixed properties of an artifact. Rather, they arise in the flow of activity with relation to a person's intent and situation (including other equipment and people), a person's skill and bodily capabilities and the designed artifact. It depends on the design situation and mandate as to how much of this relational complexity is practical and useful to engage with. The framework is a set of lenses, a way of looking *at* rather than describing formal and complete features *of*. It is possible, as we have in this text, to move fluidly in terms of scale of analysis.

4. Discussion

As a field, we've developed a breadth of theoretical perspectives and practical approaches to design artifacts such that they are useful, usable and pleasurable. In Merleau-Ponty and Dreyfus's view, coping is primordial to our being, so to some extent existing theories and methods already embody this understanding of people. Coping is aligned with key trends in HCI research, most notably postcognitivist accounts of human activity (Bødker, 1989; Suchman, 1987), embodied interaction (Dourish, 2001), tangible and rich interaction (Djajadiningrat *et al.*, 2007; Ishii and Ullmer, 1997). While coping has concordance with various theories within these movements, this should not be confused as coping not having anything new to contribute.

First, to compare at a general thematic level is to diminish the distinctive articulation, purpose and historical setting of the theories, dulling the theory in question. Since we have a precise articulation of coping and a framework that relates this to design, we likewise try to draw out similar threads from related theory, and thus demonstrate the distinctions. Second, as a theory, it would seem a measure of success if coping is both specific in what entails, yet offers broad explanatory power. In that sense, it would seem to be virtuous that coping relates well to established and emerging themes in the discourse, yet also says something distinctive. Having now uncovered this primordial foundation, we unpack it further in relation to existing work.

KEY USES OF PHENOMENOLOGY IN HCI

The significance of coping might be diminished if it is as read as a general phenomenologically-informed view of the design of interactive artifacts, like others before. Thus, we briefly survey key work that specifically draws in concepts from phenomenology to illustrate the distinctions.

Inspired by Dreyfus' critique of cognitivist artificial intelligence in the early 1970s, Winograd and Flores (1986) provide a phenomenologically informed account for language, and popularized notions of a 'breakdown' and Heidegger's tool analysis in HCI. Although Winograd and Flores make moves toward design practice, it tends to remain at a systems level of analysis and glosses the everyday practical engagement with designed artifacts.

Ehn (1988) drew on phenomenology amongst other traditions in arguing for new design practice—participatory design —that resolutely respects the skills and conditions of the people affected by the introduction of new systems. Against the period's wave of rapid computerization in government and industry, Ehn argues the political, moral and practical basis for upholding skilled labour. As a corrective, Ehn suggests new modes of design and

consideration of a 'tool perspective'. This framing invites us to design artifacts that can be wielded, gripped and worked through in a skilful manner, with direct manipulation (Shneiderman, 1983) as a key support for 'toolness'. Beyond a cursory mention—'give the user access to tools on different levels for manipulating' (p. 435) —nuance is not identified as a key element for engagement. Ehn also makes a distinction similar to our own in separating *direct* and *social* manipulability, however, *meta* manipulability is not identified.

Robertson draws on Merleau-Ponty (absent from Ehn's work) to challenge the understanding of 'awareness' in CSCW (Robertson, 1997, 2002). Subsequent work, also informed by Merleau-Ponty, explored how to design for movement in interactivity (Loke and Robertson, 2013). While this work is certainly congruent with our own efforts, it has quite a different focus and agenda.

Svanæs' work, based on Merleau-Ponty's phenomenology, is arguably the first effort to explicitly understand interactivity with phenomenology (Svanæs, 2000, 2013). The work is broad-ranging, and here we take up its two key themes: embodied perception and kinaesthetic creativity. In an analysis of reading, Svanæs identifies how embodied action sustains and constitutes what might otherwise be thought of as a merely one-way perceptual act. Thus, rather than see manipulating physical pages of a book or scrolling a browser as acts of navigation, they should be thought of as embedded in the very act of reading. The second major theme of the work is 'kinaesthetic creativity' which suggests how enactment and other lived experiences can be a creative resource for design, and has close parallels to Loke and Robertson's design methodology (2008). A core difference with our work is the point of departure: Svanæs begins from Merleau-Ponty's understanding of perception and works toward how to design for and with the lived body. We begin with Dreyfus's understanding of our primordial being (i.e. coping, which itself is derived from Merleau-Ponty) and situate that in the practical sense of everyday activity and how skill develops. Accordingly, although the views are compatible, the analysis and conclusions are entirely different.

Dourish introduces the phenomenologically informed notion of 'embodied interaction' (2001) to analyse and further the then-emerging areas of tangible and social computing. As later acknowledged (Dourish, 2013), the body and the richness of Merleau-Ponty's account is largely neglected. Despite this, 'embodied interaction' is framed as a physical affair that would seem to exclusively concern tangible interaction or social computing. In contrast, Svanæs and ourselves hold that all interaction is embodied and thus also find value in unpacking the phenomenology of mundane interaction with graphical user interfaces. The greater significance of the work would rather seem to be

its introduction of ethnomethodology to an audience beyond pockets of CSCW.

Fällman (2003) conducts a thorough phenomenology of the then-emerging domain of mobile interaction. Mobile interaction is framed as having a distinctive character and offering new potential for embodied interaction, most obviously as a consequence of being a mobile, personal device carried on the body. In the context of one design project, Fällman specifically draws on Dreyfus's notion of skilful coping, however, recasts it as the antecedent to Suchman's situated action (pp. 209–210). In this move, the primordial character of coping, and the specificity of Dreyfus and Merleau-Ponty's embodied understanding of coping is swept aside. As a result, the subsequent analysis of the case has a general ethnomethodological character and does not unpack ongoing nuanced action and perception. While Fällman's work is a fine example of working with phenomenology in a constructive and designerly manner, it does not engage with coping as we do here.

Phenomenology has long informed and inspired HCI research in both a general sense and with specific phenomenological concepts. 'Coping' however is largely alien to the field. Fällman is the singular example of engaging with coping in relation to design, and this we argue was not with the full force of the concept. The specific character of coping, that it is ongoing, nuanced and how it relates to skill has not been discussed.

SITUATED, RESOURCEFUL ACTION

The view of coping we introduce has much in common with characterizations of activity as situated, resourceful and social, such as in situated action (Suchman, 1987), distributed cognition (Hutchins, 1995), activity theory (Bødker, 1989) and embodied interaction (Dourish, 2001). While there is rough congruence amongst these theoretical perspectives and some common philosophical reference points, differences remain.

HCI's use of activity theory (c.f. Clemmensen *et al.*, 2016), like our work, emphasizes the toolness of artifacts, directedness of activity, necessity to consider the holistic ecology of practice, and in cases, shares a concern for designing for skill development. However, as Schmidt and Wagner (2002) argue, activity theory and distributed cognition (Hutchins, 1995) both maintain a cognitivist view which 'de-materializes' artifacts, viewing them as essentially interchangeable with 'psychological tools'. Coping, centred as it is on action and perception, maintains the significance of the embodied, active agent in a world of sensuous experience. Unlike activity theory, coping does not imply the relatively stable structure of well-defined goals and constituent agents and

objects that make activity theory ill-suited to analyse all kinds of activity (Bakhurst, 2009).

Given it is well-established that activity has a situated, resourceful character, how does our framework of coping contribute? The aforementioned theories have made important contributions to the field but have a different agenda to what we suggest. Situated action is a general notion, and in a sense the ethnomethodologically informed argument against cognitivist views of action. The dynamics of situated action and how the design of artifacts are allied with situated action is under-defined. The higher level of analysis of activity theory and distributed cognition favours well-defined activities over everyday being, and passes over our embodied, material engagement with artifacts. Despite numerous empirical studies that report on concerns of materiality (eg. Kirk and Sellen, 2010; Schmidt and Wagner, 2002), there is not a (re)conceptualization of situated, resourceful activity that takes bodily and material relations seriously.

Coping does not do all the work of these theories. However, it does provide a perspective that is specific in embodied action and material engagement whilst also having a clear relation to broader concerns of practice. Moreover, in the three expressions of manipulability, this view is grounded in characteristics of the designed artifact and interactive experience.

APPROPRIATION

A related topic to situated action is that of 'appropriation' (Balka and Wagner, 2006; Dourish, 2003) which here we crudely associate with articulation work (Strauss, 1985; Suchman, 1991), tailoring (Mørch, 1997) and everyday design (Wakkary and Maestri, 2008). Interestingly, in one of the few engagements with 'coping' in the literature, Turner deploys coping as a way of framing appropriation.

Appropriation concerns how artifacts are adapted by users to fit in to their existing socio-material ecology. In appropriation, this ecology necessarily changes, for example, disrupting existing practices or power structures. The configurations established through appropriation are not static, but subject to ongoing reinterpretation, negotiation and modification. Within this body of work, the practices of appropriation are broad. It might concern artifact-centric changes such as materially modifying an artifact or arranging it in environment. It might involve cultural and organizational changes, such as reinterpreting an artifact over time, or development of new practices and formalized routines. These kinds of changes might be thought of as being semi-durable. Other forms of appropriation would seem less durable and more ad-

hoc. The resourceful use of a laptop to carry a cup of coffee, for example, or jotting down a note on an at-hand scrap of paper.

Conceptually, malleability works differently to appropriation in that it is anchored in the object of design, and thus narrower and serving a different purpose. Malleability is the possibility for making material changes to the artifact itself, which in turn provisions kinds of appropriation. As described earlier, malleability is contingent on competency, available resources and so forth, but for design purposes these considerations can be bounded. Thus, rather than a general notion that agents resourcefully adapt resources in their environment to suit their needs, malleability directly concerns the designer's mandate. This is not of course to dismiss the wider and vital perspective of appropriation, but to set an additional and more specific frame of reference. It also establishes a practical distinction: malleability is only at stake if the artifact is being materially altered in a durable or semi-durable manner.

But what of the other forms of appropriation which do not involve material changes to the artifact? Some might be attributed to the *manipulability* of the artifact (Wakkary and Maestri, 2008, p. 13 make a similar conclusion). For example, the ease with which a whiteboard is appropriated and put to use in a multitude of ways (Klokmose and Bertelsen, 2013; Xiao *et al.*, 2001) would seem less about materially altering the whiteboard itself than how it can bear language and sketches (social manipulability), how we're able to move it around (meta manipulability) and the experience of using a felt-tip pen on the surface (direct manipulability). Malleability is still complicit, however. Reconfiguring a whiteboard from wall- to wheel-mounted changes its role and how we can manipulate it.

Largely removed from appropriation as it is discussed in CSCW is the notion of tailoring through 'end-user development'. This is nominally founded on two insights. Firstly, that designers can't fully anticipate or completely design for the needs of intended users, and secondly that software is a malleable medium that can be modified extensively after the design is 'done'. End-user development roughly suggests: if it is possible to design a system so that it is deeply malleable by end-users, they would be able to address their needs themselves. In that sense end-user development could be framed as an appropriation practice or an expression of malleability. As a research programme it has persisted from the dawn of personal computing (Nardi, 1993), continuing as technology evolves such as recent work with internet of things (Brich *et al.*, 2017). 'Development' here varies from writing small rules or expressions through to extended scripts or macros, written in programming syntax or depicted as a visual flow. However, because development is usually quite a different practice contra regular use, it would seem that there are only select scenarios where learning and maintaining this skill might be considered

worthwhile. For everyday engagement with technology, it seems unlikely that users should essentially become developers, or that this distinction should dissolve, as argued by Paternò (2013, p. xiii). It is, after all, the uncommon chef who fashions their own knives.

RICH ACTION

Our view of coping has been inspired by a thread of research that might loosely be clustered together as 'rich action' (Buur et al., 2004; Djajadiningrat *et al.*, 2000; Djajadiningrat *et al.*, 2007; Hummels *et al.*, 2006). Notably, the work focuses on manipulations directly in service of function and does not distinguish meta and social manipulability. Although this work has made numerous contributions, two aspects are of importance here. First, the call to design for skilled bodily interaction, and second, the view of feedback and feedforward that is advanced. We will now show how the view of coping challenges and complements this work.

Rich action advocates for skilled bodily interaction, inspired, for example, by how plant operators use their hands and tools when engaging with traditional machinery rather than the exacting button-poking required for operating a digital control panel. The suggestion is that digital controls draw more on cognitive resources than bodily ones. Because the human body is capable of skilled, nuanced movement, a design opportunity presents itself, it is argued, in designing tangible interfaces that leverage this. Suggestions include designing action with multiple 'degrees of freedom' so how an action is performed has a bearing on the outcome. What this work fails to identify however are the key characteristics of interaction that support skill. It also seemingly implies that tangibility is a prerequisite or guarantor of skill. The problem remains: what should a designer attend to if they wish to design for skill?

Coping presents a clearer view of skill development (viz. Dreyfus and Dreyfus, 1999). In this view, skill is predicated on nuance—the possibility that an agent can act and perceive in a progressively nuanced manner. This suggests two key insights missing from accounts of tangible (Ishii and Ullmer, 1997; Israel *et al.*, 2009) or rich action and skill. First, skill is not dependent on tangibility. Tangibility is but one path for providing nuance of action and perception and making interaction tangible does not necessarily provision nuance. Second, characterizing nuance as *breadth*—as in parallel degrees of freedom—overlooks the *depth* of nuance. It's not just that an agent is provisioned with freedom of expressivity, it's that they are able to act and perceive with *increasing* nuance: for nuance to seemingly unfold as they become aware of its very possibility. In practical terms, this means that interaction should be designed to support both loose, unskilled use and precise, skilled use across however many degrees of freedom that are offered—and

critically that there is correspondence of action and response within this continuum of use.

By way of a toy example, consider a rich, gestural interaction utilizing a computer vision sensor for controlling music. It might be that a rich action has a breadth of three degrees of freedom, allowing the user to make a unified gesture that expresses genre, volume and which room to play back. So far, this would largely satisfy a call for rich action. But how does the user get better at this action? How do they improve their ability to select a particular genre as part of this unified expression? It is not enough that a rich action allows the user to express a multitude of dimensions, it must allow for someone be able to develop competency in the exercising of that possibility. Coping suggests that interaction should be designed so that the user is able to perceive and perform in an increasingly nuanced manner.

Perhaps for example, there is a continuum and resemblance between novice operation, such as 'play all music', through to 'play rock music' through to a more precise articulation of 'play late 60s krautrock'. Consider as analogy the continuum and resemblance of perception and action from a novice person picking up a tennis racquet and using it to crudely hit a ball through to a skilled tennis player able to precisely modulate where the ball should land, how it should spin and its power. While this would seem a straightforward point, it is largely missed in discussions of skilled rich action and skilled use of tangible artifacts. Designing for nuance of action and perceptibility is partly based on aspects of 'coupling', such as affordances, feedforward and feedback.

COUPLING

Affordances

Norman's 'perceived affordances' (1999) is commonly understood as features of a design that suggest how it could be used. It is the designer's task to ensure the artifact furnishes the appropriate signs to support a user's understanding, and thus establish expectations for engagement. For example, a GUI button has the affordance of tapping if someone perceives it as being tappable, due to its resemblance to other things the user has learnt can be tapped. Affordance as a concept can help unpack issues with design. For example, if an element appears to you as a button but is not operable as you would expect of a button, you might be frustrated. If function is revealed through button-like operation yet you do not perceive that button-like operation is called for, you might become frustrated by trying other ways of engaging, or perhaps you are altogether oblivious the operation exists.

Norman's view is quite distinct from Gibson's original articulation (1979). For Gibson, affordances are the possibility of action an environment furnishes an agent, invariant to the needs of the agent or whether they are perceived. Thus, a mobile phone can be said to afford throwing for an agent, regardless of whether they perceive it as being something to throw or having the urge to throw it. Affordances are relational, hinging on the agent's bodily capabilities. For a new born baby, a mobile phone does not afford throwing, for example. An alternative development of affordances in HCI has been by Gaver (1991), who hewed more closely to Gibson's original and in the process articulated a clear framework for conceptualizing affordances, for example, notions of 'false affordances' and 'hidden affordances' that we allude to above.

'Affordance', for both Norman and Gibson, shares our concern with action and perception, however there are three key differences. The first is a difference of epistemology. Norman presents a cognitivist viewpoint, and as argued by Sharrock and Coulter (1998), Gibson still has cognitivism complicit in his theory of affordances, despite efforts to the contrary. Following Merleau-Ponty, coping is adamantly argued by Dreyfus to be based on a way of knowing that does not depend on mental representation or conscious deliberation. That, for example, our body is 'solicited' to act by and in our situation. It's beyond the scope of the article to discuss this point in detail, but for now it suffices to say that affordances and coping rest on two rather different positions for how we experience and engage with the world. The second difference is that affordances are characterized as having a binary quality while coping stresses nuance. For Norman either a button has the perceived affordance of tapping or it does not, or for Gibson either the tree affords climbing for you or it does not. In terms of how we experience the world, this view would seem to gloss over a great deal. For example, consider a 'rich action' button that solicits different qualities of tapping, where rhythm, force and angle play a role. How does one talk of the affordances here? If one was to describe it as 'the button affords rich tapping', does that not gloss significance in the complexity of action? And how would such a formulation be constructive in design, to design an affordance for 'rich tapping'? And in relation to Gibson, to say 'that tree affords Sally climbing' is to say nothing of the degree of exertion and risk that would distinguish this affordance to another, let alone the height at which we might consider the tree 'climbed'. Affordances would likewise seem to cover over that perception is in action itself, and that nuance develops as we learn in relation to our socio-material environment. Unlike the concept of coping, affordance lacks a developmental account. The third major difference is that affordances are not concerned with an agent's situated needs. Coping frames nuanced action and perception in relation to the agent's situation—what they are up to, what they are directed toward. This provides a useful means for

orientation and constraint for design by keeping human intentions and goals in focus.

As theory, 'affordance' has been heavily critiqued and reinterpreted, yet Norman's initial—ambiguous and flawed—framing continues to have currency in design practice. As such, it's this meaning we carry forward in our discussion in relation to feedback and feedforward.

Feedback & feedforward

While a button might be said to afford tapping, a person does not necessarily know what to expect when it is tapped. 'Feedforward' is the aspect of design that fills this gap, signifying the result of action (Wensveen *et al.*, 2004). An example might be to label the button with the text 'Print' or use an icon depicting a printer. Affordances and feedforward are often conflated together, for example, to say 'the button affords printing', but the distinction does provide greater clarity between these concerns. After all, a person might be aware that interface element is *supposed* to allow them to print (feedforward) but be unaware of *how* to activate it (affordance).

Once tapped, how does someone know what the application is up to? How does the person know whether they tapped 'properly', or after some time why nothing happens? This is the role of 'feedback', to express state or outcome, and has long been considered important for establishing a meaningful coupling of action and response (Wensveen *et al.*, 2004). For example, the visual depiction of an interface button might change while it is tapped to suggest the tap was successful, while subsequent visual indicators and the activity of the printer suggest the state of the system. Feedback in particular underwrites notions of 'direct manipulation' (Hutchins *et al.*, 1985; Shneiderman, 1983), the experience of manipulating an object 'directly' even though it is mediated.

AFFORDANCE, FEEDFORWARD *&* FEEDBACK

These three aspects of affordance, feedforward and feedback are established perspectives on how to design interaction at the fundamental level of action and perceptibility, and as such highly relevant to both the framework of coping and interaction design. We unpack these further with respect to coping. Our analysis builds in part on the early insights identified by Gaver (1991), who in contrast to Norman, noted that affordances are relational and they could be thought of as sequential and nested. With sequential affordances, we can characterize the unfolding of affordances as interaction proceeds. Nested affordances help to conceptualize different levels of analysis —for example, an app's affordance of 'sending mail' is contingent on the affordance of 'text writing', and so on. To further show the implications of coping, we identify

three qualities that tend to be overlooked and which all relate to the aspects of affordance, feedforward and feedback.

First, the aspects show up to us according to the situation itself. We attune to what is relevant for the situation, with feedback, feedforward and affordances slipping in or out of awareness. Rather than only thinking how to make these aspects palpable, the designer also needs to consider how these aspects can recede. For example, the lettering on a keyboard (feedforward) easily slips from our awareness as we fluidly cope with our keyboard. But if we need to access a seldom used key, the lettering becomes available to us. In contrast, the lettering of a GUI button arguably does not recede to the same extent since it is always present in our visual field.

Second, aspects show up to us according to our skill. Recalling that skill development is perceptual repertoire development, what constitutes feedback, feedforward or an affordance for the novice may not be so for the expert. The expert field operator, for example, may perceive that a pump is running poorly based on the sounds it produces. The novice field operator, although they might overhear the same noise, are unable to perceive its nuance, and thus the pump 'shows up' to them in a distinctly different way. This nuance is often lacking in interaction design, perhaps in part because of the dominance of using symbolic approaches to express meaning, such as icons, text and colour. The text feedback 'storage space is running low' does not permit a nuanced reading. Nuance can be expressed when these techniques are combined, for example, in a file listing colouring the file name to express if it is encrypted and overlaying a symbol if the file has been synchronized, or perhaps more promisingly, utilizing non-symbolic or non-visual means altogether. Examples techniques might be shaping-changing artifacts (Rasmussen *et al.*, 2012) or haptic sensations (Moussette and Banks, 2011).

Third, aspects are ongoing. They are not just involved when a person first meets an artifact, or after a discrete action has occurred. Rather, they are always already part of how we relate to the artifact. 'Sequential affordance' is a welcome remedy to the idea of fixed affordances but seems to imply that affordances are cleanly delimited in time and perception. If feedback, feedforward and affordances are 'coming and going' it challenges our ability to smoothly cope, since it is contingent on *ongoing* nuanced perception and action. With the view of coping, we advocate instead for the ongoing availability of these aspects. Consider the continual existence of tactile feedback when typing. Although we're not consciously aware of it, we 'gear in' to the feeling of our fingers on the keys and activating the switches, and thus able to feel when a key is not hit properly. The view of coping also suggests that feedback, feedforward and affordances be expressed in a nuanced continuum. With a sudden visual alert that 'storage space is running low', there is no

possibility to anticipate this state, to smoothly handle this contingency in the flow of activity. In contrast, consider if available storage space is expressed in an ongoing manner, 'raising' as space diminishes. As a result, space might be perceived in a more nuanced manner, and thus permitting the possibility for the user to smoothly deal with it in the context of the situation they are in. Finally, coping's understanding of the ongoing nature of feedback, feedforward and affordances is to see them as partly constituting the artifact's holistic expression of tension and solicitations for action—not as design details attached to individual features or elements.

To keep the aforementioned qualities of feedback, feedforward and affordances in mind, we suggest thinking of them as a *textural quality*[1] rather than cognitivist 'information' as they are often misconstrued (Gibson, 1979; Norman, 1999, 2008; Wensveen *et al.*, 2004). Texture is an inherent quality of material that the designer may choose to subdue or bring forth. Through technical and material means, texture can also be arbitrarily created by a designer, perhaps entirely supplanting a material's raw texture. Texture can have a richness of detail that shows up to us differently depending on the situation, and importantly, is continuously available to us across our range of bodily senses in a holistic way. That is to say, we do not experience the brick wall as being 'colour information' and 'temperature information' and so on, it is experienced in light of our situation. A bricklayer building a house will perceive the texture of brick differently than a photographer taking a photo of a brick house. With this metaphor, the designer might shed notions of objectivity, and place a greater emphasis on situatedness, subjectivity, continuity and nuance.

To demonstrate the character of these qualities, consider how feedback is discussed in a usability context (Harley, 2018) as one of the ten usability heuristics (Nielsen, 1994). The article contains useful advice for designing feedback, however the aforementioned qualities are absent. Feedback is characterized in cognitivist terms, as information which leads to informed decision making, appearing as an event subsequent to user action or system status change. Driving a car, it is suggested, is predicated on 'continuously see[ing] its speed to decide if you need to go faster or slow down'. We can apply the three qualities to interrogate this example: Do we stay watching the speedometer? Do we consciously 'decide' to go faster or slower? Is speed measurement something that we keep track of in our head? Rather, isn't it the case that the speedometer is only looked at when the situation calls for it? And as we become skilled drivers, don't we become attuned to other forms of feedback to get a more nuanced impression of speed, such as the bodily sensations and the sound of the vehicle?

[1] Meant differently here to the word's use by Robles and Wiberg (2010)

5. Conclusions

Merleau-Ponty and Dreyfus' concept of 'coping' could be read as being a general claim that people act in a situated resourceful manner, that we smoothly adapt as contingency pops up. This would render 'coping' as analogous to the non-philosophical understanding of the word. In this view, although it is antecedent to notions such as situated action or activity theory, it offers nothing new. There may be an academic interest in connecting situated action to the stronger claim of coping as the basis for being, but it would not seem to have direct significance. Coping might also be read as a part of a counter-claim to cognitivist accounts that activity is directed by plans, or that our engagement with the world hinges on mental representations. It is true that coping is not allied with classic cognitivist accounts, but such critique is not novel at this point in the field's development.

What then is the novelty of coping as a concept? It would seem at least that the general thrust of coping, sensible and relatable as it is, has been thoroughly assimilated in regions of our field. While this everyday understanding of coping is compatible with the philosophical formulation of coping, it offers little value. To be clear, the everyday meaning of coping is not the basis for this article. Rather, we specifically work with the philosophical concept of coping, put forward by Dreyfus following Merleau-Ponty. To make the philosophical concrete we make the practical—and regrettably reductionist— definition of coping as *'ongoing, nuanced perception and response, striving for equilibrium'*.

It is this meaning, which makes specific claims of the character of coping and its 'mechanics', that is novel and significant, and as we showed, set it apart from other uses of phenomenology or accounts of situated action. Hornbæk and Oulasvirta note that in HCI theory, it's usual that 'design-sensitizing constructs … [which] point toward opportunities in design … do not tell *how changes* in those conditions affect interaction' (2017, p. 5048 original emph.). In a modest measure, our framework does not suffer this fate. Coping is not just an assertion that this phenomenon exists, but it gives us the analytical acuity to identify how well coping is proceeding and possibility to locate the reasons thereof. Coping is also implicated in Dreyfus and Dreyfus' (1999) widely cited model of skill development. Namely, that as we gain competency, we are able to act and perceive with increasing discernment: the situation shows up to us differently. There is a developmental aspect of coping, a claim of how it changes with competency, and what competency may hinge on.

'Coping' is relevant for interaction design in three ways. First, it speaks directly into the essential dynamics of interactivity. Designing the manner of an artifact's susceptibility to action and how it makes itself perceptible is at the

core of notions of embodiment, coupling, rich action, feedback, feedforward and perceived affordance. Second, it also speaks into higher-order concerns such as the social context of use, for example, how designed characteristics support coordinated activity. Third, as it should be evident, to some degree human-centred design is already oriented toward designing for coping.

Even if coping is novel and relevant, how is it constructive? In principle, since people cope with all that they do, it can easily become a diffuse idea. Our approach for making coping constructive is to develop four 'lenses' with which coping can be explored in relation to design: (i) *malleability* and (ii) *direct manipulability*, (iii) *meta manipulability* and (iv) *social manipulability*. Together, they constitute a novel view of how people cope with interactive artifacts. It is not a universal conceptualization of interaction, the sort mounted by Janlert and Stolterman (2017), but rather one which seeks to explicate issues of embodied coping as a practical ongoing accomplishment. We hope others will develop other lenses or further refine those that we have suggested—it's far from a complete account of coping and interaction design. Each lens, we argue, reveals coping in a different light, foregrounding a different set of relations and practical concerns for design. For each lens, we show how the philosophical concept of coping builds upon or challenges existing notions. In its whole, the framework is significant in the cohesive weavingtogether of concerns from the embodied and instrumental manner of direct manipulability, how artifacts are flexibly integrated into flowing activity through their meta manipulability, and how artifacts and their use are part of the socially accountable order of activity—social manipulability

We do not seek to make strong claims about the practical use or effectiveness of this framework for designers. However, it might be such that the distinctions we make in the framework are treated as considerations for design. For example, how is meta manipulability experienced in relation to the artifact? And is it nuanced? Is it ongoing? Where, how and why does the character of meta manipulability change? What is it about the artifact that would seem to support or constrain its meta manipulability? Beyond the artifact, what other practices or resources would seem to support or constraint its meta manipulability? And so on. In some design situations, the designer might hold up the experience of fluid coping as an ideal to strive for. That, in use, the very thing they are designing should 'disappear' and the agent is able to perform *through* it. But how to achieve this? What does the designer need to attend to? How can people utilize the artifact with skill or mastery? Our framework of coping offers a new way of examining this.

Our contribution is to HCI theory, in identifying shortcomings in existing understandings of how people cope. Although coping has been discussed in two prior cases (Fällman, 2003; Turner, 2011), this is the first to fully unpack it

and treat it as a central concern. We develop a framework of four lenses to examine how people cope in relation to interactive artifacts, and how particular characteristics of an artifact can support or diminish coping. We demonstrate the novelty and significance of coping in how it challenges or expands upon existing theory.

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