Meaning, Motive and Reconfiguration: Could Activity Theory provide Design Directions for Personal Fitness Technology?

RICHARD C. GOMER

Electronics and Computer Science, University of Southampton, UK, r.gomer@soton.ac.uk

M.C. SCHRAEFEL

Electronics and Computer Science, University of Southampton, UK, mc@ecs.soton.ac.uk

Keywords: activity theory, fitness, health, wellbeing

ABSTRACT

This paper reflects on how Activity Theory might be applied to suggest new design directions for technology that aims to support and promote personal health objectives like fitness or weight loss. We draw on interviews with people who have established fitness practices (running or cycling) and those who use devices like the Fitbit in order to understand how Activity Theory concepts can help to explain aspects of their practice. We draw on existing work in Activity Theory to suggest two new frames. First, an action-meaning frame that encourages us to consider the meaningful motives behind an activity, and to situate in-the-moment instrumental motivation within that meaningful context, Second, a cultural-historical frame that encourages us to consider the historicity of personal healthful activity – where our activities came from – and the possible future activities that current activities could be reconfigured into. We suggest possible design approaches – such as designing in support of the 'activity formation process' itself, as promising avenues for future research.

INTRODUCTION

The challenge of intervening in people's lives to promote healthful outcomes is one that brings together many sticky issues of motivation, intent, bounded-rationality and conflict between what we seek "in the moment" - comfort, ice cream - and what we seek as results - leanness, good health, a healthy work-life balance. Design approaches are often grounded in 'behavioural' approaches like gamification, which leverage intrinsic motivation or simplify practices so that they can be easily understood and adopted. However, healthful activities are also full of meaning, and are usually undertaken in pursuit of conscious goals. In our work, we've been exploring how ideas from Activity Theory might inform future attempts to support personal healthful activity.

We note, in particular, the important distinction between the meaningful motives of an activity and the instrumental motivation that's required to sustain them in the moment, and the importance of supporting the continuous reformulation of activities in response to constraints and contradictions. To support our ideas, we draw on interviews with people who have established running and cycling practices, and with the users of personal wearable devices such as the Fitbit.

Activity Theory (AT)

Activity Theory, applied and popularized within HCI by the work of Bonnie Nardi (Nardi, 1996) and latterly Viktor Kaptelinin (Kaptelinin & Nardi, 2009) builds on a body of work with roots in the early 20th century work of Lev Vygotsky and later development by Alexei Leont'ev in the '70s. There is something of a divergence between the HCI-oriented work of Nardi & Kaptelinin and the development of AT in other disciplines, notably that of Yrjö Engeström (e.g. (Engeström, Punamäki-Gitai, & Miettinen, 1999)) as applied to the study of organizations. Here, we primarily adopt the theory as developed within HCI, but also draw some inspiration from other disciplines where it's helpful to do so.

A full description of Activity Theory and its many complexities is beyond the scope of this note, but a quick overview (or refresher) might be helpful. Activity Theory is concerned with the description of how human behaviors - individual and collective - is composed of Activities. It is conceptually broad, and attempts to describe everything from the abstract needs or motives that stand behind an activity, the actions that involved in doing the activity, and the atomic operations that those actions are made up of. Perhaps the most central concept in activity theory is the identification of the Object of activity. The Object - or 'objectified motive' as Kaptelinin describes it - shapes and excites human activity by encapsulating needs or motives (like obtaining food) into something that we might loosely recognize as a plan or strategy (like hunting deer or going grocery shopping). Notably, the Object of an activity may motivate and shape the behavior of many individuals (like fashioning spears to hunt deer, stalking the deer, and cooking the deer; or forming a company, constructing a superstore, stacking shelves, and purchasing groceries).

Within HCI, much attention has been given to the role of tools within activity systems. Kaptelinin and Nardi (Kaptelinin & Nardi, 2009) use Activity Theory to re-ground one of HCI's core ideas, that of affordance (Norman, 1999), into a 'mediated action' perspective that considers the three-way interaction "between the person, mediational means and environment."

Activity Theory has also, primarily outside of HCI, been applied to explain learning processes. Joachim Lompscher describes how learning can be achieved through an "activity formation strategy," observing that "*learning activity differs from other kinds of activity in that it aims, above all, at psychic transformations of the subject [learner] itself*" (Lompscher, 1999). Lompscher's framing makes clear that activities are themselves the result of earlier activities, and also draws attention to the fact that new activity stems from the 'psychic transformation' of the subject through the development of knowledge and skills.

The idea that Activity stems from human skills and beliefs that exist 'in mind' is a core characteristic of Activity Theory. Activity is purposeful and exists not just as physical actions, but also within the 'Internal Plane of Action' where potential courses of action are evaluated, and their outcomes predicted. Essentially, people can explain their activity in terms of their motives, actions and environment. We possess a narrative that describes our beliefs about how activities influence objects (including ourselves) and we use our beliefs, knowledge and skills to make sense of, reflect upon, and alter our activities. Although we'd caution against trying to draw sweeping distinctions between bodies of theory, it's reasonably fair to say that whereas a behavioral attempt to explain a fitness practice might ask

whether a gamification feature can motivate someone to walk farther, Activity Theory might ask what motivates someone to purchase a device or walk at all.

Applying Activity Theory to healthful activity is not without precedent. Jones et al (Jones, Edwards, & Viotto Filho, 2016) use it to reflect on sports coaching; and Cronje and van Staden (Cronje & van Staden, 2020) apply AT's concept of mediation to understand the role of fitness devices within personal fitness activities and identify tensions within the identified activity systems.

COMPARING PRACTICES OF RUNNERS, CYCLISTS AND FITBIT USERS

To support the ideas advanced in this note, we draw on a series of semi-structured interviews that investigated the experiences of two diverse groups of people: Those who have an established physical practice such as running or cycling; and people who are currently using a device such as a Fitbit. Our aim was to understand more about the similarities and differences of activities that seem to be grounded in the use of a device, and those that aren't.

Informed by formative interviews with half a dozen adults from a range of backgrounds who identified primarily either as "device users" (Fitbit, jawbone, fuel) or "people with a fitness practice" (like running, cycling, walking rowing, weight lifting) we conducted interviews with people that had ether an established running or cycling practice (the R/C group), or who regularly used a fitness wearable such as a Fitbit (the F group).

Interviews with the R/C group covered five main areas. These areas were not typically conducted in order, as conversations took different courses and different aspects came up in conversation in different orders; although we always started with area 1: (1) Aspects of life that are important to the participant; broadly framed; (2) plans relating to the participants' physical practice; (3) how the participant measured and reflected on their practice; (4) resources, such as social support, equipment or locations that are important; (5) reasons for engaging in the activity (initially and at currently), and whether the activity serves any other purposes.

In the case of the F group, the interviews covered four main areas. Again, the order varied between interviews based on the course that the conversation took; but we always began with area 1: (1) The device that's used, and any past device use; (2) The activity (or activities) that the device was used as part of. To encourage participants to think about their practice broadly, we asked them about ways in which their activity is (or would be) different when not using their device; (3) reasons for starting physical activity, and any ways in which they felt their device was helpful with respect to those reasons; (4) What the device measures, and how (if at all) those measurements are used; which measurements the participant pays most attention to. Whether there are ways of reflecting on progress other than the device itself.

We recruited participants from open calls posted to social networks and email invitations to mailing lists that reached across multiple organizations. We also deliberately invited participants we knew had health practices either because they talked about their Fitbit or their wearing them was obvious, or whom we knew went to the gym, ran, cycled and so on. In total, we completed 15 30-90 minute interviews. These interviews were recorded and thematically analysed.

P#	Main Activity	Gender	P#	Device	Gender
R1	Running	m	F1	Fitbit Charge	f
R2	Triathlon	m	F2	Fitbit Charge HR	f
R3	Running	m	F3	Fitbit Charge HR	f
C4	Cycling	m	F4	Fitbit Charge	m
C5	Cycling	m	F5	Fitbit Blaze	f
C6	Cycling	m	F6	Fitbit Charge	f
C7	Cycling	m	F7	Fitbit Charge HR	f
			F8	Fitbit Charge HR	f

Table 1: Participant Information

Health Motives

All participants, across groups, were motivated to engage with their activities for a variety of reasons, but all but one participant shared a common motivator for engaging in a fitness activity: concern for their health. Health was often the first reason for participants to engage in a fitness practice. For most of these participants, this was expressed as a desire to lose weight. C7, who stopped exercising following an injury, was motivated to "take it more seriously" again when he noticed that he was "getting out of shape" and "feeling heavy and lethargic". R1 described how he had "reached a point where I couldn't go on," from a combination of stress, health concerns, being overweight and poor quality interpersonal relationships.

Two Fitbit participants (F5, F6) specifically mentioned obesity and diabetes as health problems that regular walking would help them to avoid. F5 explained that "*getting ten thousand steps means I won't get fat, get diabetes and die.*" F8 had a more acute medical motivation, and was using the Fitbit to encourage walking as part of her recovery from a hip replacement.

However, health was not the initial motivation for all participants and nor did all participants cite the health benefits of the activity as being particularly important to them. One participant (C1) expressed that although they did feel that cycling (and swimming) had a fitness benefit, that was primarily only important as fitness was necessary to do those activities. For this participant, fitness was merely an enabler for these activities that provided enjoyment: *"The only reason I want to be fit is so that I can do these things, so it's not really a priority for me that it does keep me fit it just means that I can ride my bike quite well."*

Side Effects and Experiences

Some participants explained how they'd discovered new experiences and the positive 'side effects' of starting a new physical practice. For instance, participants mentioned that time spent running or cycling had a beneficial effect on the level of stress and anxiety that they felt. One runner expressed that running provided time to reflect on work and helped him to do his job better; others mentioned the physiological basis for feeling better, referring to the effects of endorphins released during exercise. No participants cited these psycho-physiological effects as reasons that they

started their practice and none suggested that they anticipated these effects. However, for at least one participant (R1) knowing that running would provide time for reflection and confidence that it would be effective at eliciting a general feeling of wellness appeared to be very important qualities of the practice.

For others, time spent with a family member was perceived as valuable in itself, or because it was seen as promoting a healthy practice in that person. For instance, C4 and C5 hoped that towing their respective children in trailers behind their bikes would encourage their children to adopt cycling later in life.

R1 expressed that running, climbing and training in the gym gave him a chance to mix with people he would not typically encounter during his job, as well as providing an opportunity to spend time with colleagues who were also interested in these activities, saying that *"another benefit, that surprised me, was I gained a wider circle of friends. So socially it has been really beneficial."*

Environment & Surroundings

The physical context for an activity was raised by both groups, but in different ways. Participants in the R/C group were typically more concerned with the qualitative effects of the environment – for instance the experience of being in a place or the effect of the weather. Fitbit participants typically referred to the environment in terms of affordance towards specific goals, usually the availability of stairs to climb.

For C4 and C5, being outside in "inspirational" or "beautiful" countryside was a positive aspect of the activity. Both these participants mentioned that living in areas with nice countryside was a positive thing that made a difference to their cycling experience. C7 talked about how races provide an opportunity to visit places, often foreign countries. For him these trips provided an opportunity to appreciate "different aspects" of both cycling and the place itself. He recalled feeling emotional when imagining the "hell on earth" of WWI when cycling through Flanders in Belgium and visiting a war cemetery.

C5 and C6 mentioned how the weather impacted their experience of cycling, and how they could prepare for environmental conditions by, for instance, taking adequate water in hot weather.

F5 explained that she had found new routes between work and home that included additional steps and incorporate steps that helped contribute to her targets by affording opportunities to incorporate more exercise into her commute, and F2 referred to the stairs in her place of work that were convenient for increasing the number of flights she'd climbed.

Everyday Context: Synergies & Antagonism

All participants told us about how their fitness practices interacted with other activities in their daily lives. This interaction was manifest in two ways: (1) getting a 'double benefit' from one action and (2) the opposite: having conflict between two seemingly competing activities

A synergistic benefit was noted when riding a bike to get to work for cyclists, or walking to work " *to get steps*" for Fitbit users. These actions enabled two needs to be realized: engaging with an activity for their health, and getting to work. Participant C4 explained that time spent commuting by bike was not "wasted" in the same way that time spent in a car or bus would be: cycling in fact provided value to him in multiple ways, both as a means of getting from A to B but also promoting health and sustainability and modeling good practices for his children. Interestingly, sometimes these fitness activities begin not as a health activity but as a functional activity: one participant C5 started cycling because it was "*a pragmatic way to get around*" when his wife was using the car.

Sometimes instead of multiplying benefits, fitness activities are presented by the participants as antagonists, in conflict with other values. R1 reported that his growing ability to go for longer runs meant that he was away from his family more on weekends – the time not at work when he felt he should be with his family. He suggested that his family were making sacrifices to support his health activity. R1 and C5 resolved those antagonistic demands by "*negotiating*" time for their activity with members of their family.

While the runners and cyclists often reported how they created these synergies or had to address antagonist activities, we more often saw the Fitbit participants defeated by antagonistic interactions that, to us, were sometime surprising. Like the cyclists and runners, Fitbit participants stack activities into synergies, often using their devices to record activity opportunistically. In the case of F1, the device was used to record steps taken while walking to work. This synergistic strategy, however, was interrupted by moving house; her walk was shortened and so she achieved less physical activity; she did not seek out new opportunities to replace these 'lost' steps. In fact, it was common for Fitbit users to embrace "more" steps or more stairs as and when available, but in at least two cases those practices has been disrupted when circumstances – and the availability of stairs - changed.

Phases of Activity

Some participants thought of their practice in terms of 'phases'. For instance, C3, a participant who raced regularly, referred to a "fitness phase" when a heart rate monitor would be added to his tool use. R2's idea of phases was also apparent: *"At the moment, it [using the technology to create a log] is quite infrequent. Most of the time I do use my Garmin [a running wrist computer] to log, but because I'm not really training for anything, and am slightly injured, I'm just not bothering at the moment. I would definitely use the log for a race or a functional threshold session."* C6 mentioned a "fitness phase" where fitness goals such as waking heart rate were important measures. Devices were typically used more deliberately when preparation for a particular event became important.

F3, who had been using a Fitbit at that point for 3 months, also shared that she was not particularly engaged in her Fitbit practice, but expected that to change over time and that she anticipated she would begin to use measures such as sleep more pro-actively, rather than just observing them. She explained that work pressures were preventing action to tackle observed problems in sleep and exercise, and that thus she was currently in "*damage control mode*".

'In the Moment' Motivation

A frequent subject of discussion among the Fitbit participants was how the device itself provided "motivation" to engage in fitness activity. For instance, their progress towards their step goal, and the knowledge that the device would turn (as F3 put it) *"smiley and green"* spurred them to engage in the activity 'in the moment'.

F5 found the social competition feature motivating, as she was motivated to "beat" her friends and family. Similarly, F7 was a member of a Facebook group that encouraged teams of Fitbit users to compete against one another, which she found motivated her to achieve more steps or active minutes.

There is a difference between this source of motivation and the ultimate goal behind the use of the Fitbit. F7 had not obtained the Fitbit in order to be able to compete with people on Facebook, but the motivation that the competition provides is nonetheless important, in an instrumental sense, to achieving her ultimate health and fitness goals by stimulating her engagement with the fitness activity.

On the other hand, despite using tools like Strava that feature persuasive elements like leader boards and achievements, the more experienced participants did not seem to rely on that external motivation. C6 was the only one of the runners and cyclists that mentioned a specific motivational technique, saying: "*when I'm on my bike, I am*

happy, I'm frustrated that I don't do it more … I need to find strategies to actually do it." C6's technique was to hold himself to account by blogging in advance about his intent to cycle.

DISCUSSION

Our research supports the view that healthful activity is a rich purposeful activity, composed of many actions, instantiated in response to needs, and constrained by external factors. In that sense, applying Activity Theory seems a fruitful approach. Some tension remains, though. Those familiar with Activity Theory will have noted that it is typically concerned with purposeful conscious activity, whereas much research in fitness devices is informed by a more behaviorist approach, concerned with issues of intrinsic motivation and habit formation. On the face of it, those subconscious factors do seem to be different in kind to where AT is usually applied, and perhaps they do constitute something of a theoretic curve-ball. We are interested in resolving that apparent tension, and in understanding how Activity Theory and behavioral approaches might be combined to explain the different aspects of our human experiences.

To inform our own work, we have described two "Frames" to draw attention to particular aspects of Activity systems that we think deserve more attention from designers, and we're using to to re-situate the role and function of devices within healthful activity system development. First, the Action-Meaning Frame – which foregrounds the extent to which individual actions relate back to the meaningful motive of an activity system – and Second, the Cultural-Historical Frame – which focuses on the ways in which activities in the present relate both to the activities that preceded them and the possible activities that might follow from them in the future.

The Action-Meaning Frame

Our own research, and other prior work, suggests that the meaningful motives behind an activity can become occluded or disconnected from the actions that people engage in. For instance, some device users report that steps are "wasted" if they're not recorded in a step counter (Fritz, Huang, Murphy, & Zimmermann, 2014) - the Object of reaching ten thousand steps occludes the original fitness motive. Conversely, we've also seen how new meanings can be incorporated into an Activity and how they re-shape it over time; recall how R1's activity had changed from a health-improving activity to one dominated by socialization and personal achievement. The Action-Meaning Frame encourages us to consider how the meaningful motives behind the activity shape and inform the activity and the actions within it, and to design to make those links stronger and more appreciable – with the ultimate goal of helping a user to discard the supporting technology altogether.

We distinguish those meaningful motives from motivation, and we consider how the motives that shape an activity can change between different 'phases' of an activity.

Motive vs Motivation

The accounts provided by participants indicate a subtle distinction between motives – the things that shape and motivate their fitness Activities in a deliberative sense – and motivation – the desire to engage in the activity "in the moment" which is foregrounded through techniques such as gamification.

F7 illustrates this distinction; her fitness activity is oriented towards a weight-loss motive, tightly bound to health and body image motives. Nonetheless, she suggested that having the Fitbit was *"massively motivating, and keeps me stepping"* because of the step goal and social competition features. It is quite possible that motives such as socialisation and competition could become additional motives in their own right, much as they did for R1, but there is also a strong

sense that the motivation the Fitbit provides is in some sense 'instrumental'; that is to say that the motivation provided by those features is valuable in so far as it helps F7 to maintain her practice regularly in service of more abstract, deliberative, motives like health and weight-loss.

C6's use of a blog to publicise his training intentions and to hold himself to account seems to perform a similar function. The posts create a sort of personal contract, enforced in part by the sense that his readers will judge him if he does not keep to his stated plans, and so provide motivation to carry those plans out. The possibility of being called out is deliberately contrived by him, and exists only in response to his other more fundamental motives like fitness.

This is not, on the face of it, quite the same as a distinction between intrinsic and extrinsic motivation. Motives like health are not external to F7, and have not been imposed by some other actor; but becoming healthier is a long-term activity: it happens slowly, it is hard to measure (especially as the ultimate goal is often to avoid developing a health condition), and the pay-off may be far in the future. A health motive may provide little intrinsic motivation, despite being the ultimate need to which the Activity is oriented; and conversely, reaching a step target for the day may have little long-term relevance to the semantics of the activity, but it provides the impetus necessary to engage in an otherwise potentially tedious activity like walking.

At its best, instrumental motivation enables us to engage in meaningful Activity even when it's painful; but at its worst, it occludes the meaningful motives that stand behind the Activity. The "wasted steps" of our own participants and the similar effect noted by Fritz et al (Fritz et al., 2014) are wasted only in respect of the instrumental motivation they they could not be transformed into; but the time spent pacing around a room or up and down the stairs is at least an opportunity cost, time which could be spent engaged in actions that could more meaningfully and effectively connect to the motives that led somebody to purchase their device in the first place.

Phases

One interesting area to consider within this frame are the different phases of activity that some participants mentioned. These different phases seem to correspond correspond to distinct Objects of Activity, and a reconfiguration of many aspects of the Activity's structure and focus, and a change in the relative balance between different motives.

A common example from the runners and cyclists of a change in the Object of Activity is the distinction between a "training" phase – in preparation for a race – and a "leisure" phase. These phases lead to marked changes in both the information that the participants sought, and the outcomes that they envisaged: In the run up to a competition, runners and cyclists seek external expertise (from coaches in the case of R1 and R2) and often make greater use of technology to help them gauge their improvement and performance – even though, in the case of R2, they found that technology could detract from the overall enjoyment of running. We heard about a shift from enjoyment and socialization, to (in a race phase) aspects such as performance and competition – in fact, several participants valued races precisely because they provide a controlled and repeatable measure of performance, and an exciting environment that encourages them to push themselves harder and to perform better.

We observe that the set of motivations behind these activities do not appear to change; only the relative extent to which different motives shape the Object of activity. It would not be fair to suggest that socialization, stress-relief or enjoyment were not important to participants during a race phase, just relatively less influential on the form and focus of the Activity.

In our own work, we're exploring how to make the links between motive and action more explicit and to prompt reflection on how actions - like moving or sleeping - relate to people's motives and values – like quality of family life

or personal achievement. We hope that building a stronger sense of how a healthful practice relates to things that are important to people will allow them to build a more reflective, resilient and dynamic healthful activity.

The Cultural-Historical Frame

We're also drawn to considering where Activities come from, and the processes through which they change; again taking a lead from Engeström's work which foregrounds the historicity of activity systems. None of the activities engaged in by people we've spoken to is entirely novel; each instantiates or builds upon collectively-defined activity systems: whether it's commuting to work, taking part in a race, or satisfying (day-after-day) the embedded 10k step Object of a pedometer. There is a cultural-historical element to Activity, even those that we frame as personal or individual. The Objects of activity that are engineered into motivational devices are a hi-tech example; but public health messaging like the UK's "five a day" also present top-down goals and actions that are intended to shape our personal Activities, encouraging us to adopt particular activities in order to improve our health.

Our aim as designers is often to package functionality, knowledge, skills or practice in a way that helps others to engage with them; but we should be cognizant of the inflexibility in how current devices present and instantiate. activities for their users and ask how we might take a step back to facilitate not just a particular action, or serve-up a specific Object of Activity, but facilitate the continual process of collectively reformulating our Activity in response to changing environmental constraints, our Activities' internal contradictions, and our shifting needs and motives.

Rather than hiding the historical source of our Activity, petrifying an activity into a package that combines Object, actions and measurement, might we use technology to render our healthful activity systems more visible and tangible? Or could we serve up sub-components of an Activity system in a way that they can be mixed and remixed; like the Meccano of personal wellbeing? Perhaps helping people to visualize and think about their own motives, possible Objects of activity that link to those motives, mechanisms for building instrumental motivation, and ways of working around the constraints that are inevitably encountered.

Forming and Re-Forming the Object of Activity

We're particularly keen to explore the ways that technology use shapes and forms the Object of activity itself. Fitbit participants often seemed to construct their activity in response to the measures provided by the device, in contrast to the Runners and Cyclists (and to some extent F2) who integrated technology into their practice in support of particular goals or phases. From an AT perspective, the Fitbit seems to provide a pre-packaged Object of Activity; strongly suggesting stair climbing and walking in answer to people's health and fitness motives. This contrasts with other available technology, such as Cancer Research UK's "Active App" that can be used in preparation for participation in their fund-raising races, and which therefore embodies more of a 'racing for charity' Object.

The fact that the Fitbit (and other tech) seems to suggest a particular Object so strongly begs broader question s for design: How do users identify an Object of Activity in answer to their motives? How can we design to facilitate that process? And, can facilitating that process make a person more resilient to contextual changes or challenges? There could be a design opportunity to deliberately review and alter wellbeing-oriented Objects, not only in terms of degree (like setting step goals) but also deliberately suggesting phases of activity, identified based on a more nuanced understanding of the user's motives; something that is largely missing from current generation devices, which provide affordances for weight loss, stamina building and post-operative recovery, but which lack real support for a more dynamic "activity formation strategy" (Lompscher, 1999).

Engeström's work on Activity Theory places particular emphasis on the contradictions within activities, and how processes such as "visibilization" (Engeström, 1999) can expose those contradictions and lead to reconfiguration of the object and motive of activity . We observe unaddressed contradictions in our research, and Fritz et al (Fritz et al., 2014) provide a detailed account of contradictions that emerge in the device-centric practices of other users. The extent to which the Object provided by a Fitbit device is fixed and inflexible presents a barrier to the reconfiguration of the corresponding fitness activity.

We propose that the Objects of fitness activity themselves – rather than being packaged into a device - need to be insourced in order that they can be flexibly transformed and reconfigured as the personal Activity develops. Our initial suggestion is that insourcing an Object means, at least, understanding how and why it relates to the motives behind the activity, and the actions that are required to pursue it successfully. For instance, insourcing an Object like "take part in a race" might involve learning that races provide an opportunity to measure performance, gain a sense of personal achievement, and to improve health and fitness through the training that leads up to the race day itself.

And we want to explore how technology can mediate between current, past and future activities, and help people to actively re-configure their activity in response to the constraints and contradictions that emerge. For instance, can we deliver targeted information that helps people to find new actions when it's too cold to exercise outdoors, or to find ways to include movement in their daily routine when they're working from home and don't have to commute?

CONCLUSIONS

Activity Theory provides a rich conceptual account of purposeful human work, which we have found useful for modeling healthful activities as described to us by research participants. Our own work is being guided by two 'Frames' – derived from Activity Theory – that we think show promise for re-conceptualizing how we think about the role of technology in healthful behavior.

First, we're keen to explore how technology can preserve and reinforce the links between the meaningful motives of an activity – like self esteem, achievement, enjoyment or health – with the actions and instrumental motivation "in the moment". Second, we want to design to support the continuous reconfiguration of activity, recognizing that activity systems do not exist in temporal isolation but are the result of the activities that came before them and that they will – must – be reconfigured as their internal contradictions or external constraints are made visible.

In both cases, there are opportunities for individuals to insource more of their activity and for technology to support exploration and learning, rather than just operationalizing aspects of measurement or goal-setting; to facilitate the Activity formation and re-formation process rather than packaging an Activity that has been pre-formed during design.

REFERENCES

Cronje, J., & van Staden, D. L. (2020). How fitness devices use their people : A mediated relationship between artefacts and tools within an Activity system . In *Proc eedings of the International Conference on Innovation and Management*. Tokyo, Japan.

Engeström, Y. (1999). Expansive Visibilization of Work: An Activity-Theoretical Perspective. *Computer Supported Cooperative Work*, *8*(1–2), 63–93. https://doi.org/10.1023/A:1008648532192

Engeström, Y., Punamäki-Gitai, R.-L., & Miettinen, R. (Eds.). (1999). *Perspectives on Activity Theory*. Cambridge University Press.

Fritz, T., Huang, E. M., Murphy, G. C., & Zimmermann, T. (2014). Persuasive technology in the real world. In *Proceedings of the 32nd annual ACM conference on Human factors in computing systems - CHI '14* (pp. 487–496). New York, New York, USA: ACM Press. https://doi.org/10.1145/2556288.2557383

Jones, R. L., Edwards, C., & Viotto Filho, I. A. T. (2016). Activity theory, complexity and sports coaching: an epistemology for a discipline. *Sport, Education and Society*, *21*(2), 200–216. https://doi.org/10.1080/13573322.2014.895713

Kaptelinin, V., & Nardi, B. A. (2009). *Acting with Technology: Activity Theory and Interaction Design*. The MIT Press. Retrieved from https://www.amazon.com/Acting-Technology-Activity-Theory-Interaction-ebook/dp/B002RDDI0W?SubscriptionId=0JYN1NVW651KCA56C102&tag=techkie-20&linkCode=xm2&camp=2025&creative=165953&creativeASIN=B002RDDI0W

Lompscher, J. (1999). Activity formation as an alternative strategy of instruction. In *Perspectives on Activity Theory* (pp. 264–279). Cambridge University Press.

Nardi, B. A. (1996). Activity Theory and Human-Computer Interaction. In B. A. Nardi (Ed.), *Context and consciousness: Activity theory and human-computer interaction* (pp. 7–16). Cambridge, MA: MIT Press.

Norman, D. A. (1999). Affordance, conventions, and design. *Interactions*, *6*(3), 38–43. https://doi.org/10.1145/301153.301168