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# Reflections on 5 Years of Personal Informatics: Rising Concerns and Emerging Directions

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**Abstract**

The real world use and design of personal informatics has been increasingly explored in HCI research in the last five years. However, personal informatics research is still a young multidisciplinary area of concern facing unrecognised methodological differences and offering unarticulated design challenges. In this review, we analyse how personal informatics has been approached so far using the Grounded Theory Literature Review method. We identify a (1) psychologically, (2) phenomenologically, and (3) humanistically informed stream and provide guidance on the design of future personal informatics systems by mapping out rising concerns and emerging research directions.

**Author Keywords**

Personal informatics; lived informatics; self-tracking; activity tracking; quantified self.

**ACM Classification Keywords**

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

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## **Introduction**

In the last five years, there has been a notable increase of both wearable self-tracking devices on the consumer market and related research endeavours in HCI. Li et al. coined the term 'personal informatics' in 2010 to describe systems that support people in reflecting on personal data in order to encourage self-knowledge and behaviour change [14]. From then on, researchers have examined use and non-use [8, 12], derived models and frameworks [5, 13], and explored the design space of wearable self-tracking tools in many ways [11, 17]. However, personal informatics research is an emerging area of interest lacking an overarching framing as well as bearing unexplored potential. Based on an analysis of prior research, we provide guidance to further research endeavours and the design of future personal informatics tools.

## **Methodology**

This review draws on the method of a Grounded Theory Literature Review [22] as a guiding strategy for data analysis. In the search and select stage, the ACM digital library was searched using the keyword "personal informatics" over the years 2010-2015 which resulted in 90 contributions. User, deployment, and theory guided studies addressing the use of personal informatics were included, whereas concept and hardware focused papers were excluded. Seminal cited papers published via other libraries were also included which led to a data corpus of 42 works. In this study we will focus on 20 selected papers. During the analysis stage, the data analysis software NVivo was used. Papers were imported and a source classification with attributes, such as context, user target group, methodology, and tracking type, was applied to each paper. Descriptions of tracking practices, key learnings,

and design implications were iteratively coded and constantly compared.

## **Developing three streams**

Based on the data analysis, we identify and characterise three streams of research – psychological, phenomenological, and humanistic.

### *Psychological stream*

The psychologically grounded stream is typically informed by behaviour change strategies and psychological theories, presents frameworks that provide guidance on how to design more effective and efficient personal informatics systems, and has reflection and self-knowledge as central concepts.

Key work in this stream includes that of, Li and colleagues [13], who introduce a stage-based model of self-tracking that is composed of "five psychological stages" [16], namely preparation, collection, integration, reflection, and action. Epstein et al. [5] extended the stage-based model by proposing a lived informatics model that considers the process of selecting and deciding to track as well as introducing two practices, namely, tracking and action, as an ongoing process of collecting, integrating, and reflecting. The lived informatics model, furthermore, addresses people lapsing and resuming tracking.

In order to gain an understanding of the users' need for self-reflection, Li et al. [14] identified that people ask questions concerning their current status and history of tracked activities, program-level goals, discrepancies, dependencies, and factors influencing behaviour. Additionally, they highlight two phases of reflection: discovery and maintenance, which are related to the

posed questions. In contrast to Li et al.'s empirical based approach, Baumer [1] engages with theoretical models of reflection and introduces a conceptual approach consisting of three dimensions: (1) Breakdown refers to situations when people's attention is awoken by striking and doubtful phenomena; (2) Inquiry portrays how people develop, test, and revisit certain phenomena; and (3) Transformation exemplifies a change of fundamental assumptions and behaviour.

*Phenomenological stream:*

The phenomenologically grounded stream seeks to understand how wearable self-tracking technologies are used and experienced in practice. Here, the focus shifts from the effectiveness and efficiency of technologies to the context of use and the complexity around the system's use. Research studies highlight the manifold ways in which personal informatics is embedded in our lives and aim to address the interactional, emotional, and social dimensions of tracking practices.

The use and non-use of self-tracking can be described along human, tracking device, and tracking application related determinants that are interconnected in practice. The human related determinants include individual factors such as a varied motivation and readiness to change, which affect the adoption and the ways self-tracking tools are used [7]. According to Rooksby et al. [20] there are five overlapping self-tracking styles: (1) During directive tracking people are often pursuing a specific goal such as losing weight; (2) Documentary tracking reveals that people do not only track to change their behaviour but also out of personal interest and curiosity; (3) Diagnostic tracking aims to uncover links between different phenomena such as medication and diet; (4) Collecting rewards refers to

people's will to compete and receive remuneration; and (5) in Fetishised Tracking people are primarily interested in the appeal and functionality of wearable technologies per se.

On the one hand, people keep using self-tracking devices because they develop routines, perceive the device as beneficial and engaging – often because of reaching personal goals – and hope that the gathered data might become valuable in the future [12]. Furthermore, a few people track different activities over time and even engage in self-tracking over many years [6]. On the other hand, recent studies suggest that people face difficulties in activity tracking and approximately one third of self-tracking devices are abandoned within 6-12 months. For example, even expert users tend to track too many activities at the same time which leads to "tracking fatigue," overlook triggers and contextual information which obstructs meaningful insights, as well as show a lack of rigor resulting in questionable results [2].

Tracking device related determinants of use and non-use typically include form and functionality. For example, people are often disappointed that tracking devices are not capable of accurately tracking non step-based activities [8]. Moreover, users have been shown to stop using activity tracking technologies because they are not able to identify themselves with the devices' aesthetics, or because of discomfort on the wrist or unmanageable maintenance because of short battery life [8, 12]. Application related determinants typically affect the user experience of self-tracking apps and platforms. Users reported that self-tracking apps were not usable and the represented data non-actionable and useless [12]. Furthermore, a lack of

competition and opportunities to interact with friends, who used different applications or devices made by other manufacturers, resulted in disengagement [3, 8].

All in all, individual and contextual factors, such as motivation, expectations, expertise, tracked activities and choice of tracker, as well as personal living conditions and changes in life, together influence the use of personal informatics. Notably, abandonment results not necessarily from failure: Some people who abandon personal informatics technologies successfully used their device to achieve their goals, and others wish to upgrade to newer models, and a few people lapse and resume self-tracking over time because of shifting priorities in life [3, 12, 20].

#### *Humanistic Stream*

The humanistically informed stream draws on concepts and perspectives that are grounded in research fields such as digital humanities, media studies, and sociology. This stream tends to take a reflective and critical point of view on technology-centric personal informatics research, reflects on its development by taking a look at past and present trends, and draws a broader picture by situating fundamental notions such as the self, society, and culture in the context of contemporary tracking technologies.

Since the rise of humanity, a few people have been interested in tracking the manifold facets of life, measuring the body, and obtaining self-knowledge. For example, the Roman philosopher Seneca recorded what he dreamed and Benjamin Franklin's autobiography reveals his endeavours to track 13 virtues, such as moderation and cleanliness, to achieve self-improvement [9]. In the 16th century, DaVinci explored

the design space of how to measure people's steps and walked distances mechanically [21]. Decades later, Hatano introduced a wearable pedometer called manpo-kei which with the goal of encouraging people to achieve a 10000 daily step count [ibid].

In their analytical comparison of one of the most effective self-monitoring tools - the traditional weight scale - and wearable self-tracking devices, Crawford et al. [4] illustrate how the geographical location and the perceived meaning of the weight scale has changed over the last hundred years. Similar to early advertisements for weight scales, contemporary commercials convey the impression that self-measurement "becomes the substitute for diet and exercise, transforming the body through a daily interaction with data about the body" [ibid]. In contrast to weight scales (and pedometers), Crawford et al. argue, that there is a lack of control and transparency since wearable monitoring tools transfer tracked data to service providers, returning only a small portion of the normalised and economically valuable data back to the user. Lupton [16] introduces, in this vein, the term *self-tracking cultures* in order to highlight that self-tracking is not only an individual but also a social practice which is carried out and endowed with meaning in a particular context. This perspective involves amongst other phenomena the "reinvention of the self and body" as well as social inequalities when external actors, such health institutions and workplaces, become part of the *self-tracking cultures*.

#### **Informing future research**

In the following, we propose an interdisciplinary and situated approach for future research endeavours suggesting that we need to: (1) broaden and deepen

the research context of personal informatics; (2) enrich and sharpen methodological tools; and (3) translate interdisciplinary knowledge and insights.

#### *Rewriting context*

Prior HCI research has paid much attention to the development of innovative prototypes and an understanding of the use of personal informatics systems. However, the explored context tends to underrepresent fundamental historical, social and cultural trajectories of the self-tracking phenomenon.

The limited historical account of self-tracking illustrates that contemporary personal informatics research could benefit from using the concept of 'history' as an analytical framework to reveal the present nature and inspire the future of self-tracking. Since consumers are increasingly recording health metrics [10], we could, similarly, take a closer look at the history and mundane use of artefacts, such as thermometers, glucose meters, and blood pressure monitors, in order to inform the design of future of self-tracking applications.

A humanistic perspective, furthermore, deepens the personal informatics research context by shedding light on individuals' self-awareness and consciousness. Lupton, for example, focuses attention on how individuals re-understand their own bodies and develop data dependencies through the interplay with their data images [16]. An angle such as this entails further opportunities for explorative design studies on people's reflective work with their data corpuses and, moreover, how personal informatics can affect peoples' attitudes, emotional experience, and personhood not only in intended but also unintended ways.

Finally, the humanistically grounded stream extends the personal informatics research space by conceptualising self-tracking as a socially and culturally situated phenomenon that goes beyond the individual to wider social dimensions [4, 16]. This holistic view on self-tracking highlights an insufficiently examined design space which includes not only the individual consumer but also collaborations with different actors and organisations, such as work places, educational environments, medical institutions, research facilities, and health insurance companies. Action research based studies could enable us to address, for example, how wearable self-tracking technologies mediate the interaction with different actors, challenge the traditional model of the patient-doctor relationship, and raise questions regarding data ownership and privacy.

#### *Sharpening analysis*

On the one side, previous personal informatics research has mainly drawn on explorative interview studies and questionnaires in order to uncover amongst others people's motivation and individual self-tracking practices. On the other, there are deployment studies of prototypes that have typically focused on the evaluation of a specific range of functionality. These typically applied methods are not a weakness as such. However, the predominant interview studies have rarely covered the contextual and immediate experience and most deployment studies have rarely addressed the effectiveness of the designed applications over the long term. Exceptions are, for example, Patel and O'Kane who conducted a situated study in a gym [19] as well as Gouveia et al. who ran a ten month study of the activity tracking app Habito [7].

Gaining a deeper understanding of the real world use bears several challenges since self-trackers are often mobile, active, and take advantage of different wearable devices, mobile applications, and online platforms across time and space. Instead of focusing only on retrospective or interactional data, further studies could draw on, both, rich qualitative accounts and situated application metadata, which are together suitable to coherently uncover peoples' experiences before, during, and after the use of self-tracking technologies. Ethnographically informed approaches and experience sampling methods are suitable to reveal the immediate and emotional experience of self-tracking from the people's point of view. Additionally, self-prototyped trackers, open activity tracking devices, and context-sensitive frameworks are capable of uncovering contextual information regarding the intensity and location of people's many-sided interactions within different information ecologies. Together, ethnographically informed methods and sensing techniques could help us not only to better understand people's explorative and reflective work but also its significance over the short- and long-term.

#### *Translating knowledge*

The three streams of personal informatics illustrate in how many ways self-tracking applications are embedded in peoples' everyday life, affecting their personhood, personal goals, social networks, and even public institutions and organisations. The resulting complexity around the systems' use cannot be reduced to a single research discipline or domain. Notable technological advances in machine learning, artificial intelligence, and neural networks indeed promise to be capable of grasping peoples' context and, moreover, contributing to more meaningful engagements in near

future [18]. However, sustainable and disruptive innovations in hard-and software alone are not sufficient to leverage personal informatics. Instead, this review lays the ground for interdisciplinary and translational studies to bridge the gaps between the psychologically, phenomenologically, and humanistically grounded streams and, moreover, provide greater depth to the understanding of personal informatics.

Translational research could enable us, for example, to inform the design of communicational interactions [15] by not only modelling personal digital coaches but also by exploring how different coaching strategies and styles from sport science - such as autocratic, democratic, social support, positive feedback, instruction, and training - are applied and perceived in practice. Psychological methodologies could, moreover, provide help in investigating key concepts such 'the self' and self-awareness, as well as guidance to the development and measurement of the three dimensions of reflections, which are breakdown, exploration, and transformation, when evaluating the significance of wearable self-tracking devices in the wild.

#### **Conclusion**

Drawing on a Grounded Theory Literature Review, we present unarticulated methodological differences by characterising psychologically, phenomenologically, and humanistically informed streams of personal informatics research. Our review suggests that we need to consider the underrepresented social and cultural dimensions of personal informatics, combine situated methods and sensing techniques, as well as translate interdisciplinary knowledge in order to leverage the understanding and design of personal informatics.

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