Goals for Goal Setting: A Scoping Review on Personal Informatics

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ABSTRACT

Research has extensively explored how personal informatics tools can support people's health goal setting practices. To understand the current state and reflect on the future of goal setting in personal informatics, we report the results of a scoping review of 51 papers that use and provide design implications for implementing goal setting. Our review highlights six implications for using goal setting in personal informatics tools (clarity, transparency, flexibility, framing and reframing, personalization, and reflection). We find that goal setting is becoming increasingly complex as the number of goals and their characteristics increase. We discuss these insights and point towards the importance of supporting self-efficacy during goal setting, showing adaptive goal evolution over time, reducing burden during goal setting, and framing goals to understand the complexity of health goals and support a holistic view on goal setting.

CCS CONCEPTS

• **Human-centered computing** → Human computer interaction (HCI); Interaction design;

KEYWORDS

Goal Setting, Personal Informatics, Self-Tracking, Personal Tracking, Scoping Review, Health, Wellbeing

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1 INTRODUCTION

Goal setting serves as a means for individuals to attain specific objectives, typically within a designated timeframe [59]. It can be a powerful technique in health management [26] that clarifies necessary steps to improve, especially in supporting individuals' decisions that affect behavior [16]. Motivations for goal setting can vary: goals may be related to individuals' physical needs (e.g., being physically healthy) or personal values (e.g., aspiring good education) [58].

Goal setting has been widely used in the design of personal informatics (PI) tools for health and wellbeing management [23]. Physical activity trackers, for instance, typically use daily walking goals (e.g., 10,000 steps) to support and motivate people in their physical fitness [16, 23, 29]. Research on tracking has also undergone notable developments in how to best support people in the process of setting, measuring, and tracking goals [82]. These efforts resulted in expanding our understanding of goal evolution from being only quantifiable (e.g., having a calorie count goal) to depending on people's qualitative goals (e.g., participating in family activities) and eudemonic values (e.g., being healthy) [71]. Employing PI tools to set solely quantified goals was challenged as not all goals can be quantifiable, and some can yield over-digitalization of human behavior [88]. Relatedly, the current state of PI tools prompts the inquiry into why PI-set goals remain rigid and unchanging (e.g., walking 10,000 steps per day), despite being able to increasingly track different types of data about people's behaviors [89]. Such inflexibilities and lack of support for goal evolution can lead to the adoption of goals which are misaligned with people's abilities and personal interests [36, 67].

Therefore, an overview of how PI tools can support people in their goal setting practices for health and wellbeing opens new directions for the future of health goal setting in PI literature. There are a few existing reviews on personal informatics. Epstein et al. [23] reviewed how the field's contributions has changed over time, Feng et al. [27] reviewed how literature on PI has used PI tools for health and wellbeing promotion, while the review of Jin et al. [41] report the drivers and outcomes of fitness tracking. Other reviews related to PI and self-tracking cover menstruation tracking [20], data sensemaking in self tracking [18] and the effectiveness of self-tracking technology in health behavior change [99].

Meanwhile, other review studies have investigated the role and impact of goal setting for health and wellbeing. Examples include investigating how goal setting works in clinical rehabilitation as an outcome measure for goal attainment [40] or as a strategy for dietary and physical activity behavior change [86]. More recent studies strive to understand general concepts of goals and goal setting in healthcare [74], goal setting in physical activity promotion [91], and chronic disease management [92].

While all these studies have contributed to a better understanding of different advances in personal informatics literature, and the effects of goal setting, less is known about how to best design and employ goal setting within PI tools. Such a resource can help HCI

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researchers identify new avenues for research and contribute to the development of more effective approaches to support goal setting.

As a result, in this paper, we aim to tackle: (1) What goal setting characteristics and strategies have been used in literature on health and wellbeing in personal informatics? and (2) What does current literature recommend about using goal setting in personal informatics for managing health and wellbeing? We carried out a scoping review to address these questions. Our search identified and analyzed 51 articles, resulting in six key goal setting implications with personal informatics and four directions for further application of goal setting in PI. Through these, we contribute to the field by creating a novel information source to support goal setting that fits people's complex relationships with PI tools. We describe the steps taken to extract relevant data from the published work. The results section presents our findings, and by reflecting on those findings, we provide opportunities for future research about goal setting in PI.

2 METHODOLOGY

To carry out our review, we first identified the keywords, search engines, and article selection criteria. We then extracted data from the resources that address our research questions. We analyzed relevant publications by following a similar approach used in PI and self-tracking related reviews [18, 23, 41]. In the following lines, we elaborate on our methodology.

2.1 Keywords and Information Sources

Our database search indexed publications published before 1 January 2022. We identified four databases: ACM Digital Library, Scopus, IEEE Explore, and Web of Science. These databases were selected as they index many prominent digital health and human-computer interaction venues where personal informatics articles are typically published. These databases were also used by other reviews on personal informatics, such as [23, 43]. Our search phrase comprised of three main keywords: "personal informatics", "goal setting" or "goal setting theory", and "health or wellbeing". As there is a variety of terminology used for personal informatics, synonymous words such as "wearable", "self-tracking", "quantified self" and "persuasive technology" were also used as search terms.

2.2 Selection Criteria

We identified 499 articles in our initial search (Figure 1 summarizes the initial selection process). We systematically filtered the articles through several selection criteria. We started by identifying and removing duplicates (n=75), non-archivable (n=47, extended abstracts, workshop articles, forum articles, adjunct articles, posters, newsletters, lecture notes, and study protocols), and review papers (n=24, scoping or systematic reviews). Review papers were discarded as we wanted to focus on original empirical work which presented a novel technology that used goal setting or studied goal setting with commercial tools. None of the 24 reviews analyzed how goal setting had been used in personal informatics research, nor identified considerations for using goal setting. Our work therefore differs from the focus of those reviews.

We then screened the titles and abstracts of the remaining 353 papers. If their titles included the keywords "goals" or "goal setting" and the abstracts indicated that the paper studied or developed a tool that used goal setting, the paper was included in our final full paper screening. However, PI tools often use multiple techniques besides goal setting (e.g., feedback; self-monitoring), which might lead it to not be a focus in a paper's abstract and title. Therefore, we skimmed through the full text of the remaining papers to see if the use of goal setting was further referred to in their methodology, results, or discussion sections. If so, the paper was also included in our final full paper screening.

A total of 166 articles were screened for eligibility. In this stage, we screened the results, discussion, and conclusion sections of papers and extracted information on design implications and recommendations regarding the use of goal setting with personal informatics tools. We considered an implication or recommendation to be any statement that informed the reader how to use goal setting within the design of personal informatics tools. For example:

> "These findings suggest that app designers might want to provide users with information (e.g., how much effort is needed to achieve a goal, personal activity performance) to contribute to more autonomous decisions and foster goal attainment. Furthermore, designers should suggest adaptable goals to each individual's ability level." [95 p.9]

We did not consider an implication or recommendation to be a general statement or finding without clear suggestions for the reader. For example:

> "Another exciting aspect that stood from our findings is the positive reception of a personalized weekly step goal. Participants felt more inclined to accept a weekly step goal increase since this increment was tailored to their previous week's performance." [95 p.9]

We added articles to our final corpus if they provided at least one implication or recommendation. Our final corpus consisted of 51 papers.

2.3 Data Extraction and Analysis

The leading author extracted information from each paper based on the following three categories: (1) article characteristics, (2) goal setting characteristics, and (3) design implications and recommendations for future work. First, information on a paper's study characteristics were extracted, including population samples, type of study carried out (interview, survey, deployment of tool), length of study, and tool(s) and data used for setting goals. Second, we extracted information on the goal sources and how goals were used in each paper, namely the types of goals that were set (quantitative and/or qualitative). Goal sources clarify the role of the people in setting a goal. Goals can be self-set (i.e., people set their own goals), assigned (i.e., goals are assigned to people, without their input), participatory (i.e., goals are designed both by the person as well as the app and/or other experts), guided (i.e., people choose from a list of goal suggestions) and group-set (i.e., goals are designed by - and for a group of people) [86].

Finally, we conducted a thematic analysis of the design implications and recommendations reported in our corpus. We started by transferring relevant information into spreadsheets. Subsequently,

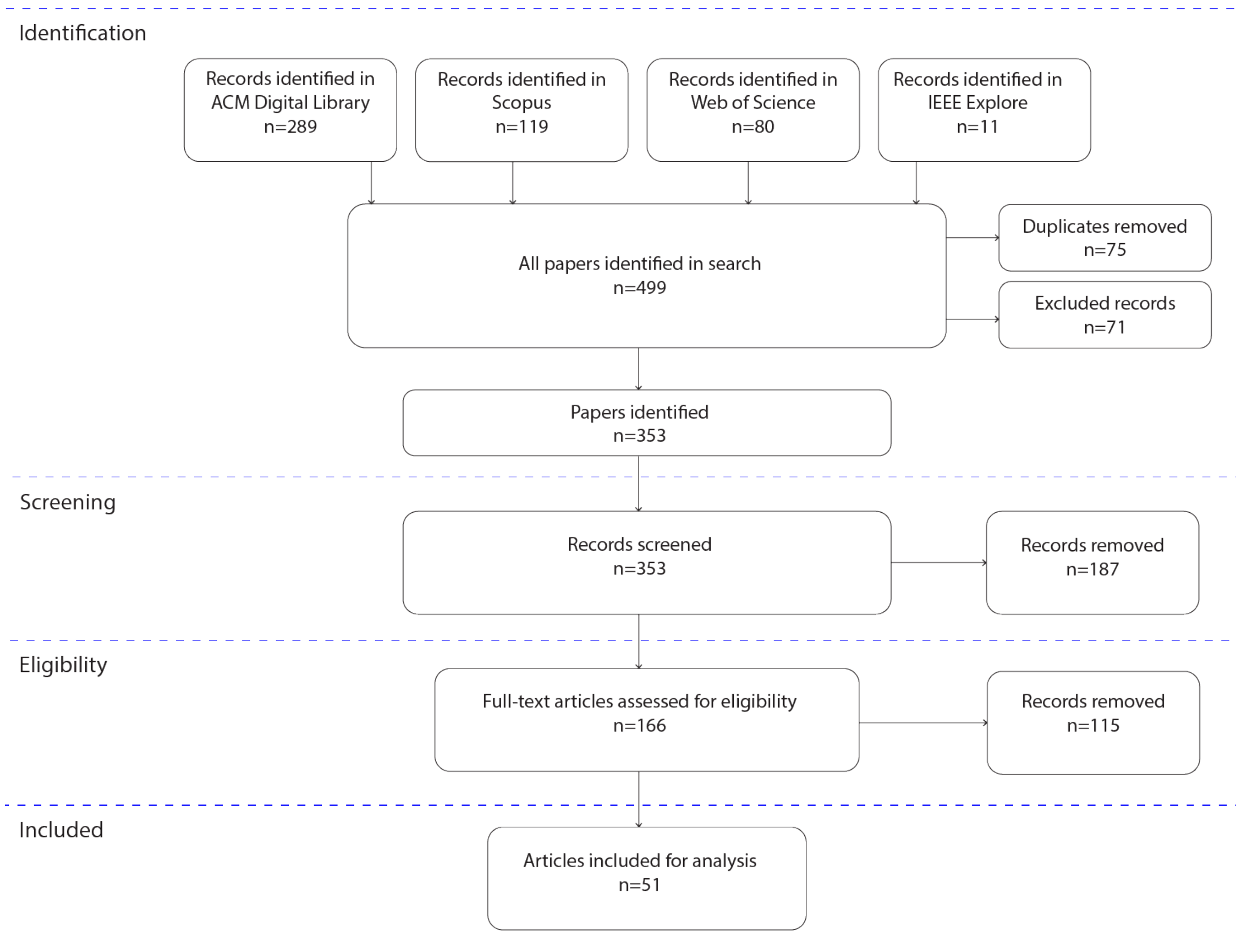

Figure 1: PRISMA Flow Chart of our Article Selection Process

we familiarized ourselves with this information, looking for patterns in our dataset [9]. The first author inductively generated initial codes [10], assuming the role of main coder and interpreter of data (as suggested in [8]). Iterative rounds of discussion and adjustments were performed between the first three authors to resolve disagreements in the final codes and create consensus among the coders until all design implications were coded. Following this, all authors conceptualized the themes [10]. During this phase, when necessary, the papers were revisited to ensure the conceptualized themes reflected the design implications and recommendations brought forward in the papers. Following this process, we arrived at six distinct themes, which we discuss in the following sections.

2.4 Limitations

We are aware of recent relevant publications which were not included in our corpus due to our search ending in the beginning of January 2022. Given the fast-paced publication culture in our field and the growing number of publications on personal informatics, digital health, and goal setting, we recognize how our work may miss new directions for goal setting from more recent work. We also recognize how our keywords may have excluded earlier work, particularly from before 2010, likely because the term "personal informatics" had not yet been defined. We integrate a few omitted publications into our discussion.

Further, our analysis focuses on how goal setting has been used by PI work in the domain of health. PI work, however, covers a larger number of domains, such as sustainability and personal finances. A broader coverage of domains may have highlighted different ways in which goal setting has been used and provide different directions for using goal setting when designing PI tools.

3 FINDINGS

This section will first provide an overview of our corpus, including how goal setting was used in each paper. We then present the design

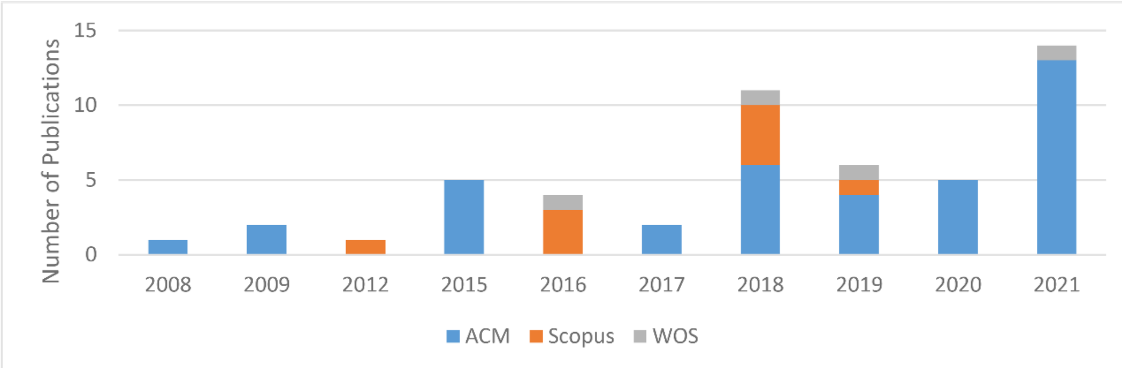

Figure 2: Publications on goal setting and personal informatics over time

implications identified across our corpus. All reviewed papers are listed in the appendix.

3.1 Overview of the Corpus

The studies in our corpus were published over a 14-year period (2008-2021), with most papers (n=36) being published after 2017 (as can be seen in Figure 2). Goals were studied across various health and wellbeing behaviors, such as physical activity and exercise (n=37), nutrition (n=12), sleep (n=9), weight (n=9), mental health (n=6) and migraines (n=1) (see Table 1 and the appendix for the full article list). Many papers combined multiple behaviors when using goal setting (n=13), such as steps and sleep for setting goals [38]. Two articles did not identify the behaviors used for goal setting, with one specifically choosing not to set goals [44] and another analyzing publicly available posts of the sale of PI tools [15].

Several papers (n=24) developed and deployed a novel research prototype that used goal setting (see Table 1). Driven by theoretical concern, these papers often evaluated the efficacy of novel prototypes and implementations of goal setting through field testing. For instance, Kim and colleagues [46] designed a data-driven medical consultation interface, *DataMD*, to explore how to support participatorily set goals between clinicians and patients for one month. Other papers (n=15) studied people's real-life practices and everyday uses of goal setting while using commercial tools, including wearables (e.g., Fitbit, Jawbone, Microsoft Band) or existing mobile applications (e.g., the MisFit app). The focus of these papers was often not the evaluation of novel goal setting implementations but rather on using the goal setting implementations offered by commercial tools to support health management. For instance, Lee et al. [53] explored how a walking goal set on a Fitbit could motivate physical activity over a 2 week period. In addition, other studies (n=11) used surveys and/or interviews to study people's practices with commercial tools or through storyboards and prototypes of a PI tool. One study conducted an analysis of public data through posts of people selling their PI tools.

Most of the 39 papers that deployed a prototype (n=24) or studied people's real-life goal setting practices with a commercial tool (n=15) lasted up to one month (59%, 23). Only two studies lasted more than 6 months, and the median study length was 1 month (IQR = 0.7 – 2.8). Study sizes typically aligned with HCI standards [12], with field deployments ranging from 1 to 8067 participants (the corresponding articles can be found in Table 1), with a median size of 32 participants (IQR = 21 - 62).

3.2 Goal Setting Characteristics and Techniques

We then analyzed how each paper had implemented goals (see Table 2 for resulting analysis). We found that most papers (n=29) used only quantitative goals which could be input and tracked by PI tools (e.g., a 10,000 daily step goal). An additional 16 papers combined quantitative and qualitative goals. Two papers only used qualitative goals and four papers did not describe what type of goals were being used.

Next, we analyzed people's roles in choosing a goal. Most papers (n=20) assigned goals to people, without their input. Examples included having healthcare providers, PI tools, or researchers assigning walking goals to people. Several studies also had people self-setting their own goals (n=19). The remaining papers set goals participatorily (n=10) or guided (n=14), with PI owners and another parties (i.e., the PI tool, healthcare provider, or researchers). Thirteen articles combined or compared multiple goal sources, such as Barbarin et al. [7], in which the participants self-set a weight goal and the system assigned a caloric budget or Lee et al. [51] where different types of goal setting strategies are studied. Because there are sometimes multiple goals in one study, it results in multiple and overlapping characteristics (e.g., having a quantitative self-set goal and a quantitative assigned goal).

3.3 Design Implications for Goal Setting

Design implications were extracted from the papers, resulting in six main implications for goal setting: (1) clarity of goals, (2) transparency of goals, (3) flexibility within goal setting, (4) the framing and reframing of goals, (5) personalization of goals, and (6) reflection on goal setting (see Table 3). For each of these design implications, we also identify *opportunities* for implementing the design implications and *benefits to people* (i.e., the resulting effect of implementing the goal setting opportunities which was derived from our corpus), which are listed in Tables 4 to 9

Table 1: Study characteristics of our corpus

Main Category	Sub-Category	# of Articles	References
Types of behaviors tracked for goal setting	Physical activity and exercise	37	[2–4, 13, 17, 33–35, 37, 38, 42, 46, 47, 49, 53–55, 57, 60, 68–73, 76–79, 83, 84, 93–95, 97, 101, 102]
	Nutrition	12	[3, 7, 24, 46, 49, 55, 60, 61, 67, 68, 78, 101]
	Sleep	9	[3, 19, 38, 46, 49, 51, 72, 76, 78]
	Weight	9	[3, 7, 55, 57, 60, 61, 72, 78, 101]
	Mental health	6	[3, 45, 48, 49, 52, 100]
	Migraines	1	[85]
	Not clear / did not track behavior	2	[15, 44]
Type of study conducted	Developed and deployed a novel research prototype	24	[2–4, 17, 24, 33, 34, 38, 42, 44, 45, 48, 49, 52, 55, 67–69, 73, 84, 95, 100–102]
	Studied practices and everyday uses of commercial tools	15	[7, 13, 19, 35, 37, 46, 47, 51, 53, 54, 57, 70, 79, 83, 93]
	Conducted survey and/or interviews without deployment of tool	11	[14, 60, 61, 71, 72, 76–78, 85, 94, 97]
	Analysis of publicly available data	1	[15]
Number of participants	Not reported	1	[15]
	1-10	3	[2, 33, 94]
	11-20	12	[3, 4, 14, 35, 38, 44, 60, 61, 78, 79, 85, 101]
	21-30	9	[7, 17, 37, 51, 52, 67–70]
	31-40	8	[19, 45–47, 49, 72, 76, 84]
	41-50	3	[57, 83, 95]
	51-60	1	[42]
	61-70	4	[24, 48, 53, 102]
	71-80	1	[54]
	81-90	1	[100]
	91-100	0	-
	101-200	3	[13, 71, 93]
	201-300	3	[34, 77, 97]
	301-400	1	[73]
	401-500	0	-
	8000+	1	[55]

Table 2: Goal setting characteristics and strategies identified

Main Category	Sub-Category	# of Articles	References
Types of Goals	Quantitative (only)	29	[7, 13, 17, 33–35, 37, 38, 42, 45, 46, 48, 53, 54, 57, 60, 69, 70, 72, 73, 77–79, 83, 84, 93, 95, 97, 102]
	Qualitative (only)	2	[24, 33]
	Both qualitative & quantitative	16	[2–4, 19, 47, 49, 51, 55, 67, 68, 71, 76, 85, 94, 100, 101]
	Not clear	4	[14, 15, 44, 61]
Goal Source	Self-Set	19	[3, 4, 7, 17, 33–35, 48, 49, 51, 53, 55, 60, 70, 78, 83, 84, 93, 100]
	Assigned	20	[4, 7, 13, 19, 24, 33, 34, 38, 42, 47, 53, 60, 67, 73, 77–79, 97, 100, 102]
	Participatorily set	10	[2, 37, 46, 47, 54, 68, 69, 76, 93, 101]
	Guided	14	[45, 51, 52, 55, 57, 60, 67, 68, 70, 78, 85, 93, 95, 100]
	Not clear or not described	7	[14, 15, 44, 61, 71, 72, 94]

Table 3: Six goal setting design implications for personal informatics

Implication	Definition	References
Goal Clarity	Making goal choices unambiguous	[19, 46, 47, 60, 61, 67, 85, 95]
Goal Transparency	Making goal sources visible	[19, 71, 85, 97, 100]
Goal Flexibility	Setting goal boundaries while allowing choices	[3, 4, 33, 34, 38, 42, 45–47, 67, 68, 70, 100]
Framing and Reframing of Goals	Aligning goals to people's interests, identities, and evolving realities	[3, 7, 14, 15, 19, 24, 42, 44, 47, 60, 67, 72, 76, 77, 85, 94, 101]
Goal Personalization	Adapting and adjusting goals based on internal and external factors	[3, 4, 19, 24, 33–35, 45, 49, 52, 57, 67, 68, 70, 78, 79, 95, 97, 100]
Reflection and Self-learning	Thinking about and learning from goals	[4, 24, 38, 44, 46, 47, 53, 67, 71, 79, 83–85]

3.3.1 Make Goals Clear. Several studies highlighted the importance of goal clarity (see Table 4). PI tools should make goals clear to understand and implement in order to prevent goal misinterpretation and misalignment with people's actual interests [19, 46, 47, 67, 85]. Without goal clarity, people may not follow the goal as intended (e.g., eat double the recommended amount of food) or choose to not follow the goal because they do not understand it [67]. Goal clarity helps people make decisions and take action towards their goals. To achieve goal clarity, several authors have suggested tailoring how goals are phrased [19, 46, 47], such as describing goals with text [46, 60] and visuals [47, 67] instead of only describing them through numbers and data. PI tools can provide opportunities to communicate with experts or communities about specific goals, such as by providing video tutorials or introducing professional coaches [61]. Likewise, goals should be contextualized. For instance, in the case of nutrition goals [67], it might be difficult for an individual to understand if a PI tool suggests "Eating 40 grams of complex carbs". Because one may not know (1) what complex carbs are, (2) if there are differences in different types of carbs, and (3) how much 40 grams is. Instead, PI tool should contextualize goals by suggesting individuals to "Eat a cup of oatmeal", which clarifies the amount ("a cup") and the type of carbs ("oatmeal"). This way of goal clarification should be followed when providing a new more difficult goal [85].

Multiple authors have highlighted the importance of goal clarity during the setting and negotiation of goals. People often discuss and set goals in collaboration with others (e.g., medical providers and fitness trainers). Solutions such as conversational agents (e.g., Alexa) can be used to facilitate the negotiation of goals and make sure the understanding of goals is aligned for all parties involved in its negotiation [67]. PI tools could allow people to annotate and highlight data with questions or events to support the negotiation and clarity of what goals will be set [85].

To achieve goal clarity, PI tools should begin with scaffolding people's knowledge and adjusting goals to ensure it is understandable. As people gain knowledge, goals may become more complex [67] and evolve more holistic goals [61]. This can be done by scaffolding knowledge that can help people learn more about their goals [67, 85] and tracked health issues (e.g., migraines) [85].

3.3.2 Make Goal Suggestions Transparent. Transparency in goal setting makes the foundation of goal recommendations explicit to people (e.g., who is giving this goal recommendation? On what basis is this goal given?) (see Table 5). It requires explaining the reasoning behind goals suggested by PI tools [19, 71, 97] and has been considered essential when supporting goal practices [19, 71, 85, 97, 100]. It can also highlight when PI can best support people in reaching their goals [85]. For example, when tracking migraines, PI tools could make people aware of when the PI is most helpful (e.g., setting realistic tracking goals) and when the individuals should consult a healthcare provider (e.g., diagnosing or discussing symptoms) [85]. Providing transparency in how or why a goal is fitted for individuals can foster their self-efficacy [19], commitment [97], trustworthiness towards goal suggestions [97, 100], and help them identify the important metrics to pursue the goals [71].

Transparency can be achieved by showing people the source data used for suggestions [71, 100] and details on why a goal has been suggested. For example, in the study of Daskalova et al. [19], people were given details on why their PI tool was suggesting adopting similar sleeping goals to other cohorts. People found these details important to see as people with parallel daily life restrictions were still able make behavior changes to enhance their sleep cycle [19]. In a similar way, disclosing any algorithms used by PI tools can foster trust towards goal suggestions [97]. For instance, people expect explanations of how PI tools translate self-set qualitative goals (e.g., to lose weight) to quantitative goals suggested by trackers (e.g., walk 12,000-steps a day) [71]. These explanations should be provided in a way that is understandable and clearly show how the explanations relate to people's PI data [97]. In addition, information

Table 4: Opportunities for making goals clear

Opportunities	Benefit to People	References
- Use tailored goal phrasing (e.g., by using conversational agents or visual aids) Provide relevant information (e.g., goal difficulty) for pursuing goal	- Clarify what the goal entails and how to pursue it	[19, 46, 47, 60, 67, 85, 95]
- Start with simple goal phrasing and guide people before making the goal complex	- Increase knowledge about goals and tracked health	[61, 67, 85]

Table 5: Opportunities for making goal suggestions transparent

Opportunities	Benefit to People	References
- Explain logic used by PI tool for setting a goal	- Foster self-efficacy and motivation towards goals	[19, 71, 85, 97, 100]
- Explain how data is collected	- Knowledge of metrics the goal is developed upon	[71]
- Make foundation of goal recommendation explicit to people	- Foster trust in the goal recommendations	[19, 71, 97, 100]
- Explain how or why the goal is fitted for the person	- Understand where PI tool is best able to provide expertise towards goal setting	[19, 97, 100]

about how the health technology uses and processes health data is necessary and can increase trustworthiness of the PI tool [97, 100]. However, there should be a balance between providing necessary information and not burdening people [97].

3.3.3 Support Goal Flexibility. Goal flexibility is the ability to make adjustments in goals in ways that support people's goal pursuit [3, 35] (see Table 6). People often change goals as their needs, understandings and abilities change [33, 37, 45, 100]. PI tools can support people in negotiating and adjusting goals by highlighting opportunities for changes (e.g., supporting goal negotiations as people's availability to pursue a goal changes [67, 68, 78]), having a secondary goal to fall back to [4, 70], setting goal margins (i.e., offering a margin that is 'good enough' to count as still achieving a goal [42]), and supporting the pursuit of multiple, concurrent goals [100].

PI tools that support multiple goals can help people pair strenuous goals with more manageable ones which they can fallback to, making challenging goals seem less daunting and encourage trying new things [42, 70]. Flexibility in goal setting gives independence to people, "human-like qualities" to the PI tool, and ownership of the goal to the individuals [46, 68]. It encourages people in articulating desires related to the assigned goals [46] and fosters compassion in PI tool [38, 42], similar to a coach considering the context when adjusting a goal [42]. This way, flexibility in goal setting can lead to less stress and guilt for the individuals [38, 42] and more engagement, motivation, and self-efficacy towards goals [34, 38, 42].

While flexibility is important, goals should be challenging [33, 45, 68]. For example, offering too much flexibility in a phone lock out mechanism to reduce excessive phone usage would be ineffective if people are able to use their phone for entertainment purposes, rather than if they need it for traveling to a new place [45]. Mitchell et al. [68] indicated people are likely to choose easier goals with chatbots rather than human coaches, therefore PI tools should take specific steps when goal setting to stimulate challenging goals. Kim et al. [47] have further suggested using the data produced by PI tools to mediate conversations between people and professionals (e.g., healthcare providers, trainers) to ensure that goals are kept challenging.

3.3.4 Support Framing and Reframing of Goals. Framing and reframing is about aligning goals to people's interests, identities, and everyday realities (see Table 7). Framing goals to better account for people's realities can inspire and motivate people towards pursuing goals [7, 47, 60]. For example, stroke survivors are motivated by the aspirational goal of being able to go home from the hospital [47]. In such cases, goals should be framed differently than as part of extrinsic motivations (e.g., "losing weight to be thin") but instead, should express how people's overall wellbeing impacts their life (e.g., "meeting the weight requirement to go horseback riding with family") [7].

Different directions have been suggested for how PI tools can support the framing and reframing of goals. Frequently mentioned is the framing between people's short-term and longer-term goals [3, 7, 42, 47, 60, 67, 71, 85, 101]. PI tools should break down longer-term and aspirational goals into shorter term actionable goals that can be tracked [47, 85]. Contrastingly, connecting daily goal achievement to long-term goal progress helps motivate people and can lead to making decisions that positively affect goal outcomes [7, 42, 47, 67]. For example, diabetes management tools could highlight how a shorter-term goal of "decreasing carbs to 2 carb choices" is connected to managing blood glucose levels and better overall health [67]. In addition, goals can be framed to be more related to holistic health [60], such as by looking beyond just step count and describing the benefits of keeping physically active throughout the day.

Table 6: Opportunities for supporting goal flexibility

Opportunities	Benefit to People	References
- Support microplanning and negotiation of goals	- Autonomy regarding the planning and challenge of goals	[3, 33, 42, 45–47, 67, 68, 100]
- Provide different goal choices or secondary & simultaneous goals	- Ability to adjust goals to fit changing abilities and routines	[4, 34, 38, 47, 67, 70, 100]
- Provide options to fit and personalize the goal to themselves	- Ownership of goals - Independence in adjusting goals	[34, 38, 42]

Table 7: Opportunities for framing and reframing goals

Opportunities	Benefit to People	References
- Frame goals in ways people can relate to goals and their cultural context	- Make goals meaningful - Aligns goals to habits and behaviors of the contextual society	[3, 7, 14, 19, 24, 44, 47, 60, 72, 77, 94]
- Connect multiple goals through goal framing (e.g., breaking them down into short quality of life improvements)	- Make decisions that positively affect goal outcomes	[3, 7, 42, 47, 60, 67, 71, 85, 101]
- Support goal framing for goal prioritization	- Evaluate, evolve, and align goals based on current needs and preferences	[3, 15, 47, 76, 85, 101]

Goals should also be framed to fit people's cultural context. For example, Ahtinen and colleague's study [3] highlight cultural preferences for goal setting. In their study, Finnish participants favored measurable goals while Indian participants viewed goals in holistic terms and felt that measurable goals would cause them stress. PI tools should avoid cultural biases by allowing having flexible goal preferences, such as deciding how and when to focus on tracking metrics [72]. Social aspects of individualist and collectivist cultures can also influence how a goal can be framed [19, 77]. Relatedly, goals can be framed in a competitive sense between people for individualist societies and in a collaborative way for people to achieve a goal together for collectivist societies [77]. In addition, cultural factors may affect planning of goals. Some cultures prefer rigid goals and others prefer flexible and changing plans [3]. In addition, goals may not follow a clear linear path and have milestones of specific importance to individuals [14]. PI tools should enable people to capture their tracking process and take into account realities that can affect goals, such as in financial, socioeconomic, and racial differences [14].

By facilitating framing and reframing of goals, PI tools are more likely to support people in evaluating and prioritizing goals as goals evolve and change over time [15, 47, 76, 85, 101]. For example, if a person is changing medication, this can be a moment to switch to a learning goal to understand how this medication change affects their health [85]. When goals are participially set, PI tools can assist the different parties to be aware of what goals are most important [101]. Prioritization can aid in discussion and decision making around goal setting, by categorizing, for example, life-related goals (e.g., "going to Disneyland") and care plan related goal (e.g., "removing the ng tube"), reducing the burden of excessive data and information [101]. A number of approaches have been used to support and encourage goals that adapt to people's evolving needs [52], such as through self-experimentation [76], self-reflection [44, 76], and more open-ended tracking [44].

3.3.5 Support Goal Personalization. Goal personalization is about making the goals fit to people's daily lives, capabilities, and preferences. PI literature has suggested supporting goal personalization around internal factors, external factors, and integration of factors (see Table 8).

Internal factors refer to occurrences that are internal to people and place constraints on goals, such as motivation, ability, and efforts towards a goal. Goal personalization here refers to goal adjustments related to people's progress, motivation and ability to achieve goals [4, 13, 34, 38, 42, 45, 47, 69, 71, 78, 83, 85, 95]. PI can adjust the difficulty of the goal (i.e., making it less or more challenging) and fit it to people's current abilities [13, 34, 45, 47, 68, 71, 83]. For example, a baseline measurement of physical activity can be used to set prescribed goals [83]. Medical conditions can impact people's ability to achieve their goal and it is essential to consider how these conditions can change and affect goal achievability [37, 38, 47, 100]. For instance, arthritis can cause previously realistic walking goals to become unrealistic [37, 38]. Hence, PI tool should support goal negotiation and alignment with one's current reality [37].

External factors refer to occurrences that are typically out of people's control and can place constraints on goals [3, 19, 35, 45, 49, 57, 67, 70, 78, 95, 100]. For instance, people's living environment or the weather conditions can affect people's choices, motivation, and prospects to reach a goal [3, 100]. PI tools should allow people to annotate or adjust goals based on external constraints to make goals more achievable [19, 24, 33, 67, 78, 95]. While overlooking external constraints can undermine people's progress towards their goals and negatively affect their goal motivation [100]. Considering planned activities can provide opportunities for suggesting new

Table 8: Opportunities for personalizing goals

Factor	Opportunities	Benefit to People	References
Internal	- Adjust goal based on progress towards goals, level of motivation and self-efficacy	- Fit people's current abilities Improve goal achievement rates	[4, 13, 34, 38, 42, 45, 47, 68, 69, 71, 78, 83, 85, 95]
	- Consider how symptoms can change and affect goal achievability	- Grasp the achievability of symptom-related goals	[37, 38, 47, 100]
External	- Consider constraints in daily routines or habits of people - Make goals appropriate for different situations	- Perceive the goal more realistic to follow - Reassure attainability of the goal	[3, 4, 19, 24, 33–35, 45, 45, 49, 52, 57, 67, 70, 78, 79, 95, 97, 100]
Integration	- Combine multiple internal & external factors	- Tailored goals to people's lives	[4]

goals, such as in using a holiday weekend to increase one's walking distance goal [34]. Further, integrating out of routine circumstances, such as eating at a restaurant instead of eating at home [67], reassures attainability of a person's goal and makes goals appropriate for different situations [33, 34, 45, 67, 97].

One possibility for goal personalization is combining internal and external factors to create goal suggestions that balance multiple aspects from people's lives. For example, Alqahtani et al. [4] recommended using contextual factors, goal progress, and individual's self-efficacy in goal setting and showing the individuals the relations between different factors to foster self-reflection and behavior change.

3.3.6 Support Reflection and Self-learning. A key motivation for using PI tools is to reflect and learn about one's behaviors. Reflection is critical during the setting and pursuit of goals as it can increase people's self-efficacy [84], motivation and commitment towards their goals [4, 47, 83] (see Table 9). Our review showed that PI tools should support periodic reflection. Periodic reflection can be useful to create realistic expectations towards goals and identify opportunities for goal adjustment [4]. Reflection can make people more aware of their long-term and short-term goals, as well as their relation [53, 71]. We found three main suggested ways in which PI tools could support reflection: demonstrating relationships in one's data [4, 67], contextualizing past data [67, 84, 85], and through self-experimentation [38, 46, 79].

Demonstrating relationships between people's goal progress, and internal and external factors fosters reflection on goal achievement and leads to thinking about goals effectively [4]. For example, showing a person with low self-efficacy, how their physical activity increases while exploring a new city can lead to identifying opportunities for physical activity and adjusting their goals in new contexts [4]. Reflecting on the relationships between contextual activity and goal achievement helps people better understand their perceived and actual behavior when setting goals.

Contextualizing and enhancing past data with people's thoughts and emotions can strengthen self-efficacy and help set appropriate goals [84]. For example, PI tools can prompt reflection on a previously achieved goal and ask about key aspects of the achievement, such as their process towards the goal [84]. Such reflection can ultimately lead people to moments of learning, which can clarify which goals one should set [84]. Alternatively, sharing stories of others who have similar characteristics as the person using the PI tool, can help prompt reflection and improve self-efficacy [84]. Receiving feedback about goals from experts, such as clinicians, helps people be conscious of the impact of their actions and behavior [67, 85]. For example, Mitchell et al. found people wanted more feedback on how well they achieved their nutrition goal when logging their meals [67].

Further, self-experimentation with PI tools can support people during the setting of goals [38, 79]. People may already have hypothesis about the relationship between different behaviors (e.g., their arthritis and level of physical activity) [38]. PI tools could support those people in setting goals and identifying which tools and data would be necessary to test those hypotheses and personalized goals [46].

4 DISCUSSION

The aim of this review was to create an overview of how goal setting has been used within personal informatics literature and extract design implications for its use in PI tools. We will revisit our research questions and reflect and discuss how our findings inform the design of future personal informatics tools. Tackling these questions also highlighted opportunities for further research on goal setting.

4.1 Goal Setting use within Personal Informatics Literature

First, our findings suggest a need for longer studies. Over half of the papers that deployed prototypes or commercial tools to study goal setting were short in duration, lasting no longer than one month (n=23). Additionally, the remaining survey or interview studies were often conducted over a few single sessions. While these studies shed important insights on the effects and uses of goals in the short term, they miss nuances on how people's goals evolve and change, as people's understanding, needs and life circumstances change. We suggest that future work conducts longer studies on goal use, as they may lead to insights on how to design PI tools that support people in their goal setting practices over time.

Second, our results suggest a need for studies that explore how tracking goals can be designed based on people's motivations. Niess

Table 9: Opportunities for supporting reflection and self-learning during goal setting

Opportunities	Benefit to People	References
- Support reflection during goal setting - Guide self-reflection (e.g., focusing on specific past events)	- Enhance self-efficacy during goal setting - Gain knowledge about behavior	[4, 24, 47, 53, 71, 83, 84]
- Support daily reflection / envisioning goal attainment for aspirational or long-term goals	- Be realistic about expectations towards goals	[4, 47, 83]
- Demonstrate relationships between goal progress and other factors (3.3.4) - Show relationships between qualitative and quantitative goals	- Clearer understanding of progress towards goal - Higher goal engagement	[4, 67, 71]
- Support self-experimentation	- Customize goals for specific behavior	[38, 46, 79, 85]
- Empower people through reflection, inform about tracked behavior	- Deepen perception of long-term and short-term goals	[53, 71]

and Woźniak [71] found that people's goals are built around internal, eudemonic needs (e.g. wanting to feel good in one's body) and qualitative goals (e.g., wanting to do well in a sports team), and that trackers should help people translate those goals into quantitative goals that can be used by trackers (e.g., walking 12k steps per day). We found these translations to be overlooked in most studies. People were often asked to set quantitative goals; however, few papers derived these goals from people's motivations. We agree with Niess and Woźniak [71] that personal tracking tools should help people in reflecting on their qualitative goals and use them as a starting point to set goals. Incorporating qualitative and quantitative goals is in line with theory on goal setting [1, 71] and in our corpus, papers discussed implementing more holistic approaches to goal setting [3, 7, 44], such as focusing on overall health rather than just weight-loss [7, 44].

We also found a diverse focus on different population samples, such as different cultures [3, 72, 77], socio-economic backgrounds [84], age groups [76], transgender communities [14], and people managing specific medical conditions [37, 38, 46, 47, 67, 85] (e.g., diabetes [67], stroke rehabilitation [47], or arthritis [37]), and health behaviors (e.g., physical [55, 93, 97] or mental [52, 85, 100]). Research is continuing to strive for understanding how strategies used by PI, such as goal setting, should be adapted and personalized for different groups of people [14, 72, 98]. We see recent studies continuing to become more specific, aware, and inclusive to the needs and challenges people face using personal informatics, such as children with ADHD [6] and Black American communities [64]. Understanding and personalizing goals for different types of people is important to prevent PI tools from becoming exclusive and inaccessible tools.

4.2 Complexity of Goal Setting with Personal Informatics

In addressing our second research question, we identified six design implications for incorporating goal setting in the design of PI tools (i.e., *clarity*, *transparency*, *flexibility*, *personalization*, *framing and reframing*, and *reflection*). We found these implications to be strongly interconnected. For example, we found *goal clarity* to be associated to the *framing of goals* and *goal flexibility*. When framing goals, people seek to understand connections between, for instance, their short-term goals choices and long-term goals. This can result in more clarity on goal choices. Further, flexibility is a means for goal personalization, but to make decisions, flexible choices should be clear to people.

It is important to note that when setting goals, individuals would benefit from understanding the relationship between their short-term goal choices (e.g., to aim for an easier or more difficult goal) and their goal progress and achievement. If this information is not clear, goal framing and goal flexibility may result in negative outcomes. For example, setting a challenging short-term goal on a day when the person does not have necessary time to achieve it, may result in stress and fail the long-term goal, leading to negative associations with more challenging goals [90]. Contrastingly, always choosing easier short-term goals may delay long-term goal achievement. Through clarifying these connections and decisions, PI tools can lead people to reflect on their goals and enable them to better personalize them. In this way, people can reflect and learn about their goals and whether the goals are worth pursuing.

The connections we identified between different goal setting design implications illustrate the complexity of goal setting and require designers and researchers to think about how they can better support interactions between PI tools, people, and possible other goal collaborators (e.g., healthcare providers). When developing goal setting strategies, researchers and designers should also consider the relationship between the goal setting implications we discussed in this paper, as supporting one will affect another.

4.3 Future Directions for Goal Setting with Personal Informatics

Our analysis yielded four directions for better application of goal setting in the future of PI tools. We discuss these future directions in the following section.

4.3.1 Fostering self-efficacy during goal setting. Goal setting can often lower people's self-efficacy [31] and failing to achieve PI goals can lead to feelings of shame [66]. One way PI tools can improve self-efficacy is by demonstrating the way people in similar situations address and pursue their goals [19, 80]. Incorporating empathy, by recognizing and acknowledging the effort of attempting to accomplish a goal [96], into PI tools can boost people's self-efficacy [39]. Fostering PI's empathy ability can be achieved through flexibility in goal setting. When people are given flexibility in goal setting through secondary or margin-based goals, their feelings like guilt and shame can be reduced as they feel that their attempts towards their goal are recognized [4, 37, 42, 70]. PI tools could further explore this area by looking at other ways of counting for goal achievement. For example, counting the time of doing the physical activity or attempting to do a goal can be one way of accomplishing a goal.

Long-term goals are often multi-faceted and can be challenging to specify yet are often most meaningful and motivational to people [71]. Therefore, goals should be clearly broken down into smaller goals and connected goals through framing to make people feel their long-term goals are achievable. Flexibility in goal setting can be a way that PI tools give people the opportunity to adjust their goal without judgment or shame. This capacity to adjust goals is of particular importance as it empowers individuals to make daily decisions with regards to the level of goals they wish to pursue. This may involve aiming for challenging goals on certain days or opting for less challenging ones when faced with demanding circumstances. Therefore, it is important for PI tools to provide necessary support and guidance in determining the appropriate level of goals and to help people build confidence in achieving their goal in the long term.

4.3.2 Showing the adaptive and evolving process of goal setting. People's goals change and evolve as they go through changes and transitions throughout their lives [28]. As a result, the goal setting process becomes a dynamic interaction between people and the PI tool, in which both parties continuously learn and adapt to one another. These findings are in line with recent PI models such as Epstein et al.'s *Lived Model of Personal Informatics* [25], Niess and Woźniak's *Tracker Goal Evolution Model* [71], and Agapie et al.'s *Longitudinal Goal Setting Model* [1], which have found people to reflect, on their own or collaboratively with others, as they develop and adjust goals. To further this evolving and adapting process of goal setting, we propose that the initial stage of goal setting can be facilitated through self-reflection, self-experimentation, and goal scaffolding (as suggested in [85]). The role of PI tools in this initial stage can be to present people with goal options and choices. However, it may still be overwhelming to make conscious decisions to set a goal, which may also lead to people choosing the default goal, such as goals the most readily available and "the easiest" option. The default goal may not necessarily align people's priorities or interest, leading to goal failure due to lack of commitment or ill-fitting goals. This, in turn, may result in negative feelings for people towards goals and goal setting. We know that reviewing and revising goals have high correlations with usefulness of PI tools [5]. Hence, it is crucial for PI tools to emphasize the dynamic and adaptive nature of goals.

To incorporate evolving and adaptive processes in goal setting, PI tools should identify different moments of reflection for short-term and long-term goals. Understanding people's overall long-term goal is important and PI tool should facilitate reflection and the breakdown of goal into smaller, manageable, and short-term goals [1, 71].

4.3.3 Reducing burden during goal setting. A number of studies raised warnings towards overburdening people during the process of goal setting [85, 97]. Goal setting with PI tools typically involves the collection of a significant amount of behavior data. However, accumulating too much data can result in fatigue and overwhelm people. We argue that a surplus of goals and resulting data can result in negative outcomes, where too many goals can overwhelm and push people away from goal setting altogether. Instead, we recommend that PI tools are designed in a way where people first identify relevant goals and then are guided towards relevant data and tool setups tailored to their goals (as suggested in [85]).

We also envision PI tools using playful strategies for supporting goal setting [24, 34]. Goals are often perceived as serious and not fun [13, 42, 54, 57, 73, 79, 102]. Some PI tools already incorporate alternative, fun strategies for goal setting, such as gamification [81] and storytelling [84]. However, in these incorporations people are typically guided to a specific outcome [11, 32]. Playful design comes from an intrinsic value to have fun or enjoy, does not have a specific end goal [11, 62]. We believe goal setting with PI tools can incorporate both values, where people have overall health and wellbeing goals and incorporate hedonic and intrinsic values of play. We encountered one goal setting activity where goals became gamified in a playful way, by having goals formed into abstract food challenges (e.g., "eat something green today") [24]. This made the goal exploratory, while also focusing on improving nutrition. We envision future work continuing to explore how playful design frameworks, such as PLEX [62], can be incorporated into goal setting to make pursuing a goal a fun activity that supports hedonic values [25].

Another way to avoid burden in goal setting is while supporting self-reflection, to prevent rumination. In comparison to self-reflection, during rumination, people constantly think about reasons and results in negative feelings and actions [87]. This can lead to goal discrepancy and failure [63]. Eikey argues that individuals may not be always engage in insightful self-reflection, but rather go into cycles of rumination when exploring their PI data, and eventually abandon self-tracking [21]. Moreover, constantly asking people to reflect on their goals might negatively affect their engagement with goals. For example, Lee et al. [53] found that even though setting PI-supported reflective goals increases people's commitment to their physical activity goals, people find those reflectively set goals difficult to achieve, less enjoyable to meet, and were less motivated toward their goals [53]. We argue that constantly overthinking about goal failures, instead of engaging with them, might result in emotional burden for those whom the use of PI tools can be very beneficial. Therefore, goal setting during appropriate moments and framed in supportive ways is necessary to encourage and motivate people through their goal setting rather than making them ruminate, feel stressed or anxious about goals.

4.3.4 Furthering goal framing with personal informatics. Framing concerns how people make choices and decisions [50, 56, 65], especially how they pursue their goals. We found that the way people's goals are framed can affect the way people make decisions regarding these goals [3, 7, 42, 47, 67, 71, 85]. Recently, Agapie et al. [1]

described The Longitudinal Goal-Setting Model where therapists collaborate with patients to identify, simplify, and adjust goals. Accordingly, people often pursue multiple, interconnected goals in parallel, while pursuing one single goal may impact the ability to achieve another goal. PI tools could help people better understand how their decisions impact different goals by connecting short term goals to long term goals [3, 7, 42, 47, 67, 71, 85]. Reflecting on how short-term goals (e.g., achieving a daily step count goal) contribute to long term goals (e.g., losing weight) can motivate and keep people engaged towards their goals [3, 7, 42, 47, 71, 83]. In addition, reflecting on multiple goals can help people prioritize goals and consider which goals will be most worth aiming for as not all goals can be worked towards congruently. On the other hand, as discussed above, excessive reflection on goals might yield rumination. To avoid that, we suggest that PI tools should prompt reflection during opportunistic moments, such as when people's life circumstances change, and goals are likely to no longer fit one's current circumstances.

We think PI tools can also support goal framing through the lens of Goal-Framing Theory [56]. Accordingly, three goal frames play a role in people's goal decisions about what to choose and how to act: (1) hedonic frames improve the way one feels in a particular situation (e.g., "The weather is looking sunny this month! Set a bigger daily walking goal this month to make you feel happy."); (2) gain frames consider and improve one's resources (e.g., "Increasing your walking goal this month will help reduce your chance of heart disease"), and (3) normative frames make one thinks what is appropriate to do according to social norms (e.g., "Setting a 30 minute daily walking goal will make you fit in the healthy population"). This way PI tools can support the process of framing and reframing goals by also showing how the presence (e.g., if you do an action) or absence (e.g., if you do not do an action) of a behavior relate to the goals (e.g., you will get/lose the chance of the benefits of pursuing the goal) [50].

In addition to these three main goal frames, a fourth one, moral goal frame, can also be activated to frame goals based on societal values [75]. We think moral framing could foster goal setting by provoking people to think beyond their personal goal choices and consider broader implications of their goals. For example, PI tools can assist people's physical activity choices by making them aware of how cycling to work with a co-worker, rather than carpooling, contributes to reducing the carbon-footprint and improving the health of both individuals. This way of guiding goal setting is also aligned with what Fleck and Fitzpatrick describe as the reflection on social and ethical impacts of one's choices [30]. We think different levels of reflection can be applied into framing personal informatics health goals by considering how one's personal health goals are affected by others in their context and vice versa [22]. Using both higher levels of reflection and moral framing into PI tools can better support people by tying in broader impacts of their health goals, such as with sustainability or social and familial environment. Helping people reflect on the broader impacts and effects that they might have with their goals further supports motivation towards goal achievement.

5 CONCLUSIONS AND FUTURE WORK

This paper analyzes how HCI literature has used goal setting in personal informatics and provides implications for using goal setting for health and wellbeing. We found six design implications for goal setting with PI tools, which were often interconnected and affected one another (*clarity*, *transparency*, *flexibility*, *framing and reframing*, *personalization*, and *reflection*). From these implications, we highlight future directions for support goal setting. We see the future of personal informatics as an opportunity to curate how data is given to people to support them in setting goals. Future research should focus on how PI tools can support self-efficacy during goal setting. We illustrated a gap in research in examining how to support people's evolving, long-term goals. With the increasing amount of complexity in goal setting, it is important to consider how to not burden people when using PI tools for goal setting. Future research should also look into how PI tools can compare framing activities in health goals to see how this can support people in creating realistic and meaningful goals.

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APPENDIX

Table 10: Article corpus

Ref	Article authors & year	Behavior data collected (for goal setting)	Goal source	Number of participants	Type data used for setting goals (quantitative, qualitative, or both)
[2]	Aggarwal et al., 2020	Physical activity	Participatorily set by patient & physiotherapist	4	Quantitative & qualitative
[3]	Ahtinen et al., 2008	Physical activity / Sleep / Mental health / Nutrition / Weight management	Self-set through PI tool	16	Quantitative & qualitative
[4]	Alqahtani et al., 2020	Physical activity	Self-set through PI tool and PI tool assigns a goal based on this goal	14	Quantitative & qualitative
[7]	Barbarin et al., 2018	Weight management / Nutrition	Self-set through PI tool and PI tool assigns a goal based on this goal	22	Quantitative
[13]	Chokshi et al., 2018	Physical activity	Assigned by PI tool	103	Quantitative
[14]	Chuanromanee & Metoyer, 2021	Gender transition health	N/A	18	N/A
[15]	Clawson et al., 2015	N/A	N/A	N/A	N/A
[17]	Consolvo et al., 2009	Physical activity	Self-set through PI tool	28	Quantitative
[19]	Daskalova et al., 2018	Sleep	Assigned by PI tool	39	Quantitative & qualitative
[24]	Epstein et al., 2016	Dietary	Assigned by PI tool	61	Qualitative
[33]	Geurts et al., 2019	Physical activity	Self-set through PI tool and PI tool assigns a goal based on this goal	7	Quantitative
[34]	Gouveia et al., 2015	Physical activity	Self-set through PI tool	256	Quantitative
[35]	Gouveia et al., 2018	Physical activity	Self-set through PI tool and PI tool assigns a goal based on this goal	12	Quantitative
[37]	Gupta et al., 2020	Physical activity	Participatorily set by physiotherapist & patient	27	Quantitative
[38]	Gupta et al., 2018	Physical activity / Sleep	Assigned by clinician	11	Quantitative
[42]	Jung et al., 2021	Physical activity	Assigned by PI tool	54	Quantitative
[44]	Khan & Maes, 2021	N/A	N/A	15	N/A
[45]	Kim et al., 2019a	Mental health	Guided by PI tool	36	Quantitative
[46]	Kim et al., 2017	Physical activity / Nutrition / Sleep	Participatorily set by doctor & patient	36	Quantitative
[47]	Kim et al., 2019b	Physical activity	Assigned by therapist	32	Quantitative & qualitative
[48]	Ko et al., 2015	Mental health	Self-set through PI tool	62	Quantitative
[49]	Kocielnik et al., 2018	Physical activity / Nutrition / Mental health / Sleep	Self-set through PI tool	33	Quantitative & qualitative
[51]	Lee et al., 2017	Sleep	Self-set and guided through a worksheet	27	Quantitative & qualitative
[52]	Lee & Hong, 2018	Mental Health	Guided through a workshop	23	Qualitative
[53]	Lee et al., 2015	Physical activity	Self-set through PI tool and assigned by PI tool	62	Quantitative
[54]	Lee et al., 2019	Physical activity	Participatorily set by the person, counselor, & workbook	79	Quantitative

[55]	Lieffers et al., 2016	Physical activity / Nutrition / Weight management	Self-set through PI tool and guided by PI tool	8067	Quantitative & qualitative
[57]	Liu & Willoughby, 2018	Physical activity / Weight management	Guided by PI tool	50	Quantitative
[60]	Lu et al., 2021	Physical activity / Nutrition / Weight management	Self-set through PI tool, assigned and guided by PI tool	18	Quantitative
[61]	Lu et al., 2021	Nutrition / Weight management	N/A	18	N/A
[67]	Mitchell et al., 2021	Nutrition	Assigned and guided by PI tool	23	Quantitative & qualitative
[68]	Mitchell et al., 2021	Physical activity / Nutrition	Participatorily set by PI tool or health coach and guided by PI tool	23	Quantitative & qualitative
[69]	Mohan et al., 2020	Physical activity	Participatorily set by PI tool & the person	21	Quantitative
[70]	Munson & Consolvo, 2012	Physical activity	Self-set through PI tool and guided by PI tool	23	Quantitative
[71]	Niess & Woźniak, 2018	Physical activity	N/A	190	Quantitative & qualitative
[72]	Niess et al., 2021	Physical activity / Weight management / Sleep	N/A	37	Quantitative
[73]	Norman et al., 2016	Physical activity	Assigned by researchers	320	Quantitative
[76]	Oygür et al., 2021	Physical activity / Sleep	Participatorily set by the parent & child	37	Quantitative & qualitative
[77]	Oyibo & Vassileva, 2019	Physical activity	Assigned by PI tool	256	Quantitative
[78]	Peng et al., 2021	Physical activity / Nutrition / Weight management / Sleep	Self-set through PI tool, assigned by PI tool, and guided by PI tool	20	Quantitative
[79]	Phatak et al., 2018	Physical activity	Assigned by PI tool	20	Quantitative
[83]	Saini & Lacroix, 2009	Physical activity	Self-set through PI tool	48	Quantitative
[84]	Saksono et al., 2021	Physical activity	Self-set through PI tool	32	Quantitative
[85]	Schroeder et al., 2019	Migraine	Guided by PI tool	19	Quantitative & qualitative
[93]	Takahashi et al., 2016	Physical activity	Self-set, participatorily set by study coordinator, and guided by booklet	130	Quantitative
[94]	Tholander & Nylander, 2015	Physical activity	N/A	10	Quantitative & qualitative
[95]	Villalobos-Zúñiga et al., 2021	Physical activity	Guided by PI tool	49	Quantitative
[97]	Woźniak et al., 2020	Physical activity	Assigned by PI tool	219	Quantitative
[100]	Zhang et al., 2021	Mental health	Self-set through PI tool, assigned by PI tool, and guided by PI tool	90	Quantitative & qualitative
[101]	Zhao et al., 2021	Physical activity / Nutrition / Weight management	Participatorily set by the clinician, caregiver, and child patient	17	Quantitative & qualitative
[102]	Zhou et al., 2018	Physical activity	Assigned by PI tool	64	Quantitative