myPace: An Integrative Health Platform for Supporting Weight Loss and Maintenance Behaviors

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***Abstract*—Obesity is a major health concern caused by unhealthy eating behaviors. Digital weight loss interventions have adopted mobile technology primarily in order to support self-monitoring. However, many available apps are not designed as a part of dietetic practice; therefore, a distinct gap in the research exists relating to technology that supports the patient–practitioner relationship. This paper presents myPace, which is a complete weight loss and management system that is deployed via a smartphone and a PC. It connects dietitians and patients between face-to-face consultations and extends the relationship through patients' regular progress updates and dietitians' tailored and timely advice, for sustained behavior change. The prototype was developed from research into behavior change for weight loss, which furthermore was underpinned by theory and tenets of human support models, such as the supportive accountability framework. We report on an early-phase system design goals via a formative research process, which aimed to implement theoretical principles and match practical dietetic practice. To that end, only the clinical end user's perspective was sought through a coaching think-aloud protocol on the first iteration of the prototype and interviews with dietitians. Findings show that the system has many positive design features, but which require further development in order for the system to be fully acceptable within dietetic practice and motivate patient engagement.**

***Index Terms*—Behavior change, healthcare practitioners, mobile health, supportive accountability, weight loss.**

I. Introduction

LIFESYTLE management apps form one of the largest segments of the mobile app market. They contribute to the exponential increase in digital interventions to support weight loss that range from websites that provide information to downloadable or internet-based software that help users manage their energy balance and stay motivated, to more recent weight loss apps on mobile phones. European health organizations have recognized this and have sought to better organize and manage available lifestyle apps (and broader health apps), examples being the National Health Service (NHS) Health Apps Library and the European Directory of Health Apps.

Evaluations comparing traditional and digital technology on outcomes relating to effectiveness and adherence in weight management are beginning to surface [1]. However, important questions remain, as to the range of outcomes that should be measured, the effectiveness of digital interventions, how these should be operationalized and the time frames over which they should be assessed [2]. When we consider the nature of digital weight loss interventions, it is clear that many of the available apps were not built for use as a part of medical or dietetic practice. More particularly, there is a gap relating to technology that complements and supports the patient–practitioner relationship and the ability to sustain the impact of this over time. This lacunae is perhaps surprising given the strong influence that this relationship has on patient motivation, adherence to treatment, and patient satisfaction [3].

However, intensive personal counseling is costly for mass uptake, and so new and persuasive health technologies have emerged that are mobile and convenient and specifically designed to change behavior and sustain motivation [4]. In relation to behavior change, Fogg [5] proposes the tiny habits methodology, which is meant to encourage (positive) habits to form. First, the target behavior is reduced to the smallest possible behavior, in the case of myPace a "small step" so that it can be easily achievable and encourage users with various abilities and motivation levels. Second, the new step is created to fit into a routine and a signal or reminder then functions as a trigger for the habit. Repetition of the cycle develops the habit and potentially a change of attitude to drive the individual toward continuance in weight loss behavior.

It is necessary to consider how to make this design more accessible, useful, and usable to dietitians across Europe, and additionally, to explore how the tenets of behavior change can best be translated into digital applications in general and into myPace in particular. This is vital in order to develop technology that matches and is relevant to dietetic requirements and the routine practices of the dietitian–patient consultation.

The development of myPace recognized the need to embed existing and emerging perspectives in behavior change theory but also build on existing frameworks and design methodologies for creating persuasive technologies. Most particularly, however, it sought to capture and embed the experience and benefits of the patient–practitioner relationship. To that end, human support models, such as supportive accountability provides an appropriate framework to guide the development of e- and

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m-health interventions [6], [7]. This is due to the way it supports the practitioner–patient dynamic through emphasizing behavioral strategies, such as goal and expectation setting and monitoring through a process of accountability, but also coresponsibility between patient and practitioner to motivate patient engagement. Given that weight loss interventions are traditionally a cooperative undertaking, a key imperative is to translate such new perspectives into successful weight management technologies, while addressing the practitioner's perspective and the various types of clinical practice [8].

II. Related Work

A. Overview of M-Health Interventions

In the past few years, there has been an increase in digital interventions specifically to support weight loss. These interventions can take different forms as appropriate to the patient and context and employ various techniques or strategies to facilitate the target behavior [9]: Tracking smartphone apps that enable individuals to count calories, plan meals, obtain healthy recipes, monitor calories burned, access social support, and receive advice and support from trained coaches and professionals [10]; motivation and reminders through tailored messaging [11]–[13]; buddy networks to support and motivate members during their weight loss and/or maintenance [14], [15]; integrating face to face meetings, remote monitoring medical devices, and communication technology (telephone/web/mobile) to facilitate change [16]; and providing a range of tailored, automated, and/or visual feedback in the form of nutritional breakdown of foods and support for physical activities [17]–[21].

Increasingly, commercial weight loss groups are providing e-support though "virtual" online groups. These exploit social networking functions on the web to encourage and sustain motivation and support among members. A unique approach in this area employs highly interactive 3-D virtual worlds informed by the behavior change theory to educate and encourage members to engage in more healthy lifestyles [22]. Less formally, online discussion networks to support weight loss endeavors have sprung up within groups whose primary aims are unrelated to weight loss (e.g., http://www.cpfc.org/forums/showthread.php?t=239412).

More broadly within the healthcare domain, the potential value of technology is seen in supporting routine health practice by embedding remote monitoring and communication features into mobile phone technology, enabling patients and practitioners to access health tools on the move [20], [23]–[28]. In weight loss, another fairly recent approach has been to integrate face-to-face meetings, remote monitoring medical devices, and communication technology (telephone/web/mobile) to facilitate change [29].

The stage is, thus, set for the integration of technological innovation into weight loss interventions in healthcare [13], [28], [30], [31]. However, while e-interventions show much promise and appeal, there is currently little unequivocal or systematic evidence of their effectiveness in enabling weight loss among diverse patients [32]. Important reviews are beginning to surface in this area. For example, some recent reviews have compared effectiveness, self-monitoring, and adherence between traditional and digital technology [33], while others focus on the effectiveness of mobile technology for weight loss using randomized control trials [27], [34].

Overall, evaluations have painted a mixed picture of effectiveness [12], [17], [30], [35]–[39]. Recent systematic reviews of the literature have noted the reliance on formative or early stage research in judging the effectiveness of m-health interventions [32]. The quality of evaluations also varies; some do not adequately describe the exposure, or may exclude control groups [21]. Many studies also suffer from high attrition, small sample sizes, low transferability, and skewed population distribution making it difficult to generalize the findings. Although the use of particular concepts such as self-monitoring and feedback is widespread, the behavioral focus can be quite narrow and more research is needed to determine if self-guided delivery, as opposed to provider-supervised models are effective even if a greater range of behavioral strategies are employed [40]. Critically, there is little evidence that the design of e-interventions or their evaluation are guided by underlying theory, or that there is a relationship between behavioral concepts within a theoretical framework [41]. Indeed, in their content analysis of health and fitness mobile apps, West *et al.* [20], [42] found that many available mobile interventions were quite general and not based on established theoretical principles. There is a clear consensus that more rigorous methods are needed to determine the effectiveness and efficiencies of e-interventions, and further, important questions remain as to the outcomes that should be measured and the time frames over which they should be assessed [43].

Finally, it seems that rather than simply seeking to understand whether an intervention is effective or not, e-health evaluations should seek to specify for whom the intervention might be effective for, the mechanisms whereby it becomes effective and the contexts within which it is most likely to be effective for behavior change. From a human–computer interaction and design perspective, notably Klasnja *et al*. [44] have argued that a primary goal for evaluation in design and development is to understand *use*. This is in terms of user perceptions and expectations and how the technology will fit into people's lives or working practice. This view is complemented by a behavioral science perspective, where Pagoto and Bennett [31] highlight the need for efficacy research to engage healthcare practitioners during development to fully account for the care process and practice. In order to understand the design requirements for healthcare technologies based on human support models, the current work is motivated by a need to understand how practitioners may use a connected smartphone and web app such as myPace before conducting an efficacy evaluation.

III. System Design and Architecture

A. Supportive Accountability Framework (SAF)

The myPace technology was developed out of research into the methods and strategies dietitians routinely use in their practice and, therefore, built to match practical dietetic experience. The technology was also designed to embody the key facets of the SAF [7]. The concepts advocated in this framework

overlapped, broadly, with the kinds of approaches and strategies dietitians used in their routine practice and, importantly, identified human support as a significant contributor in e-health interventions. The myPace platform, then, is practical, evidence-based, and rooted in the relevant theory. Only very recently has the focus of studies shifted to implementing human support models, such as supportive accountability, thereby extending and enhancing practitioner–patient communication in the practice areas of pharmacy [45] and psychiatry [6].

"Supportive accountability" has been proposed as a framework for modeling the ways in which human relationships can best support e-interventions. The model asserts that adding a human support element to e-health interventions will enhance user adherence. The human element is conceptualized as a sympathetic, trusted, and credible person who the user feels accountable to and who will deliver a program of support and motivation that best matches the user's specific needs. The human support element is expected to increase the user's sense of autonomy (intrinsic motivation) over time and, thus, reduce his/her reliance on the relationship to sustain the intervention. We extended this framework to consider the ways in which a human relationship (patient-practitioner) can best be embodied in technology designed to augment or enhance face to face patient care.

Within the frame of supportive accountability, human support is exemplified in a bond (called a "therapeutic alliance") between the user and the human support element (in our case, the health professional). In our application of this, the health professional is a legitimate (that is, trusted, benevolent, and credible) person whom the patient has developed a face-to-face relationship. This relationship is enhanced online as the health professional engages with (supports) the patient in his/her weight loss. For this reason, we have focused our initial efforts on understanding the health professional context and developing interventions that both dovetail with and support clinical practice.

Sustained engagement with the intervention (adherence) is achieved through varying levels of motivation, which is tailored to match each patient's motivational needs. Regardless of the level of motivation required, intrinsic or extrinsic, the practitioner's aim is to build patients' confidence and intrinsic motivation so that the patient becomes increasingly responsible for his/her weight loss. In this way, the intervention can be sustained when the support provided by the health professional is withdrawn from the system.

Sustained communication from the health provider signifies a social presence that the patients can rely on and feel accountable to. Through engagement between health professionals and patients, expectations are identified; goals are agreed and subsequently enacted and embedded by the practitioner in the use of the technology. Patients' engagement and performance are also monitored. These can be responded to between consultations using the platform and reflected on subsequent face-to-face consultations.

B. myPace Prototype

In designing myPace, we wanted to adhere to the guiding principle that the relationship between the dietitian and the client is fundamental to instituting the building blocks for sustained change. The technology is uniquely designed to complement and support the trusted health practitioner–patient relationship, which has a strong influence on patient motivation, adherence to treatment, and patient satisfaction, and the ability to sustain this relationship over time is an important function of successful weight management strategies [46]. Several elements of SAF are embodied in the myPace platform (see Fig. 1). The demo of the myPace application can be found at: https://vimeo.com/109108169.

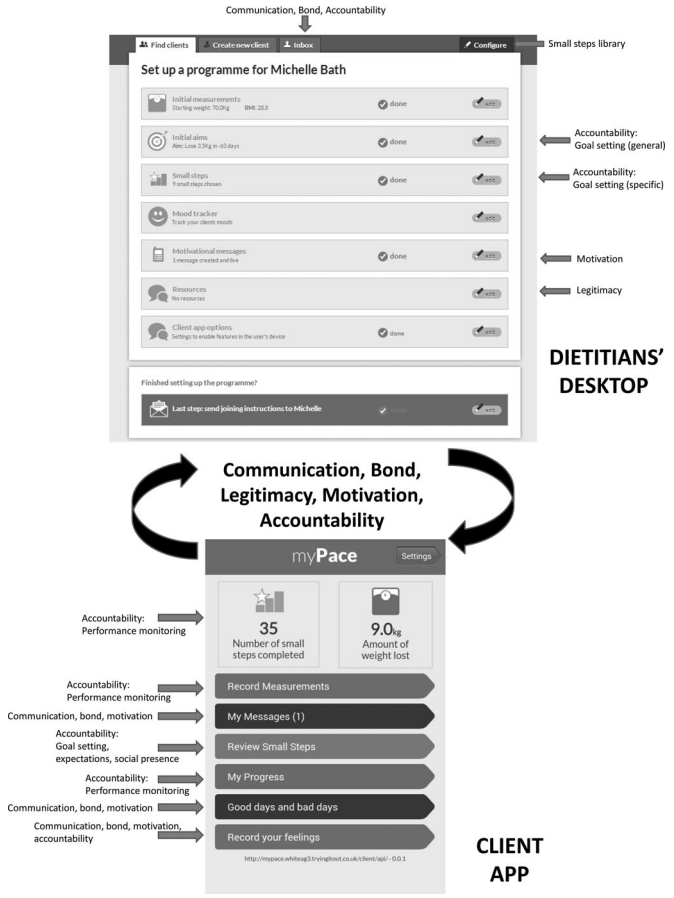

Fig. 1. Relationship between the dietitian's desktop and client app. Programme features are coded by facets relating to supportive accountability.

With respect to system design objectives, the following was used as a guide:

1) facilitating communication between the dietitian and the patient between consultations;
2) facilitating self-reflection in goal setting and supportive accountability;
3) creating understanding of the condition and commitment to change by setting small steps to monitor progress;
4) supporting motivation by achieving small steps with feedback from the dietitian.

As the technology is designed to support the face-to-face consultation, the nature of this consultation and the aims it seeks to achieve are built into the way the technology works. Elements of motivational interviewing and patient-centered care, important components of the face-to-face medical consultation, are also enabled through it.

Clear expectations such as patient-centered aims and intermediate goals (called "small steps") are decided by the patient with the dietitian in the context of the consultation. This resonates with Fogg's [5] approach to supporting "tiny habits" and designing for behavior change. This is also a normal part of dietetic practice and represents a key workflow that can combine a number of elements as described by Mohr *et al*. [47]: user defined, frequency, conditions (tune and event-based rules), and tunneling. For example, patients are reminded about these agreed intermediate goals via notifications on their phone. These reminders are automated. The form that these take can also be constructed with the patient in the consultation.

Patients can register the achievement of their suggested small steps on the same day they were notified about them. This allows their performance to be monitored over time. If desired, dietitians can respond to patients' performance between consultations using the platform by sending motivational messages or changing aspects of the intervention to match changing needs or performance. The system also monitors and tracks patients' mood and their reflections on their progress. myPace maps these layers of data alongside each other to build an overall picture of each client's performance, enabling realistic and targeted advice and action. Summary reports on performance provide an evidence base for discussion in the upcoming consultation. The program is flexible and is expected to grow and change with the patient as he/she proceeds through the treatment.

The myPace platform includes features that signal social presence (through timely and context relevant motivational messaging), enable clear communication of expectations of patient behavior (through relevant goal setting), and enables patients to monitor their performance (integrating weight changes with the information about mood and goal related achievements). The software is designed to be integrated into the face-to-face consultation and reflects much of the way that consultation is structured.

myPace is built upon strategies dietitians use in their everyday practice and incorporates relevant tenets of the behavior change theory into its functionality making it both practical and evidence-based. For clients using myPace, they can report on their progress, which is tracked over time. This helps provide dietitians and clients alike with a clearer picture of each clients' eating practices, thus enabling realistic and targeted advice and action.

C. myPace Design (Early Phase)

Given the context of therapeutic relationship-building, which the myPace app supports, the focus of the early phase of development for defining the specification was the perspective of the health professional. This approach has been fully supported by recent work arguing for the need to understand the health practitioner's perspective and clinical practice [8], [45].

In keeping with previous m-health weight management program developments, we followed a formative research process, incorporating expert and target population input [48]. Expert input involved a project team and advisory board with expertise in weight management, nutrition, dietetic practice, m-health, behavior change, and persuasive design. We conducted an extensive literature review in order to determine the relevant theory to support weight loss and the appropriate platform that would support the therapeutic relationship as shown in Fig. 1. Target population input was sought through formative feedback from dietetic practitioners through two methods: 1) a coaching think-aloud protocol [49]; and 2) semistructured interviews.

The coaching think-aloud protocol was designed as an inpractice exploratory scoping exercise of myPace, involving active intervention on the part of the moderator via a training session on the first iteration of the prototype. This was to determine acceptance issues and pinpoint system flaws at a very high level, an approach that is in keeping with similar applications [50].

Sixteen dietitians were contacted via the Freelance Dietitian Group of the British Dietetic Association and three were recruited to take part in the study. This sample size is small, but purposive and is comparable to recent work that has investigated the implications of mobile apps for clinical practice [51]. Each dietitian was set up with the myPace software and received face-to-face personal training in its use. At this training session, they were provided with further information about the software and were allowed to practice with it, while being guided by the trainer who answered any questions they had. The dietitians were also allowed to provide feedback on their first impression of the software during these sessions and use/recommend the app as they would expect to if it became a regular tool to support their everyday practice. Notes were taken during the sessions, which were later coded thematically according to design features of the app and how they relate to supportive accountability [52].

Semistructured interviews were conducted face-to-face with 20 dietitians across the U.K. to investigate dietetic practice in more depth to contribute toward efficacy and the ways that myPace may be successfully integrated, as well as to more substantially consider the tenets of SAF within the myPace platform.

Primary sources of recruitment of dietitians for the interviews were our project partners, the European Federation of the Associations of Dietitians, and the online Freelance Dietitians Network of the British Dietetic Association. Participants had to fit, at a minimum, with the following criteria: Qualified as a dietitian; currently practicing in the UK; and working in either freelance practice or in the NHS.

The interviews questioned dietitians about the nature of their practice, and the role they envision technology might play in improving their work. All participants were informed that the project team was working on technology to support dietitians in their practice. They were also told that this technology would help to connect them with their patients between consultations. Additionally, we did not reference/name aspects of the SAF directly in the interview, but themes relating to SAF emerged and were coded from the participants' responses.

Interviews were face-to-face and lasted around 45 minutes and participants were incentivized with a £20 Amazon voucher. The interviews were audio-recorded and transcribed. The data were analyzed using thematic analysis [52]. Patterns in the data were identified and coded. Connections among emerging themes

were made to develop the range and diversity of the themes. After the coding, categories were analyzed a second time for connections and areas of disparity. These processes allowed the researchers to view the data in terms of levels and dimensions of connected ideas and perspectives.

IV. Findings

A. Coaching Think-Aloud

All three dietitians responded very positively to the app when they met face-to-face with the researcher during the training session. The dietitians spoke positively and enthusiastically about the app and the ways it could be adapted to their practice. The flexibility of the system was particularly appealing to all the dietitians, and two of them mentioned that they would be able to use it to treat clients with other problems besides weight loss, such as clients who need to gain weight, clients who need to stabilize their weight, as well as clients with irritable bowel syndrome (IBS). The "Good days and Bad days" diary feature and motivational messaging features also stood out for dietitians, although they did not have access to this client data in their view, and several talked about ways in which these functions could be further developed to enhance overall dietetic care. Dietitians also provided feedback on additional features that they felt could be usefully included in later versions of the app. For example, a print function for the program to provide a record of the session as a handout to patients and the option for data to be shared across apps such as physical activity apps, food diaries, body composition, diabetes monitors, etc.

Feedback received from dietitians on design features of myPace as they relate to supportive accountability are as follows.

1) *Accountability [Goal Setting (Specific)]:* The bar chart showing the "Small steps" completed per week does not show number of steps assigned for that week for comparison. A stacked bar chart, dietitians argued, will present more valuable data enabling, for example, the depiction of steps achieved exceeding steps set.
2) *Motivation:* While it was recognized that a unique feature of myPace distinguishing it from available apps is that the client receives "Motivational Messaging," which is direct automated yet personalized notifications from the dietitian, dietitians also wanted a function that allowed them to send out a single message to all clients or clients segmented by specific characteristics.
3) *Accountability (Social Presence and Bond):* Schedule, view, and manage appointments over time; export appointments to outlook calendar or other calendar programs; existing clients can request appointments and receive reminders giving the user increased control over their treatment process and emphasizing the continued accessibility and availability of trusted human support.
4) *Communication:* The journal (see "*Good Days and Bad Days*" on the client app) takes more time to review and respond to and it would be beneficial to make it selective when setting up the patient. Freelance dietitians will decide which patients need this service and recommend it to them (potentially at a higher cost). Another potential option could be to post the thought to a blog/forum for patients using myPace. The dietitian acknowledged that this might have privacy implications and also that forums would need to be moderated, but that it would provide value.
5) *Accountability (Performance Monitoring):* Weekly weighing was introduced into myPace based on information collected from practicing dietitians in five European countries: France, Germany, Hungary, Portugal, and the United Kingdom system (a process not reported here). Feedback from a small group of hospital-based dietitians in the United Kingdom who evaluated an early mockup of the system showed that practice varies and weighing can be optional as weighing may negatively impact the motivation levels of some clients. During the coaching, think-aloud freelance dietitians stated that they might ask patients to weigh themselves daily (see "Record measurements"). Currently, dietitians cannot set up patients to measure their weight or waist circumference at intervals of less than a week. This could be made more customizable as some dietitians might find it useful for patients to measure themselves daily.

Despite this continued emphasis on the value and potential of myPace in dietetic practice, initial enthusiasm for the tool did not translate into actual uptake, use, and recommendation. There were a number of reasons for this including:

1) dietitians were freelance and working part-time meant that they had access to a smaller client base than a full-time freelance dietitian;
2) types of clients the dietitians perceived were most suited to the tool meant that only a small number of clients they did see were eligible to be recommended myPace. For example, one dietitian felt clients had to solely be weight reducers, which meant clients coming in for weight gain or dietetic advice related to specific illnesses were ineligible in their view. Another dietitian mentioned that the tool could be used with her IBS patients, but that it would take some planning to integrate this into myPace;
3) clients had to have iPhones to use the mobile app, which further reduced the number of eligible clients, and there was reluctance to recommend the web app only as the dietitians felt it might not add much value;
4) clients may already be using another weight management tool, for example MyFitnessPal.

There is the sense that this uncertainty about how the tool will work, particularly in contexts where patients have associated comorbidities to consider, leads the dietitian to err on the side of what they are comfortable and confident using, rather than something new that requires much planning. The researchers initially suggested that the dietitians used test clients (e.g., colleagues, friends) to get used to the technology to address this problem. However, it seems that this approach did not significantly increase dietitians' confidence in the use of the tool. One dietitian also felt that myPace is better suited to patients who are just starting their programme or patients that are not doing well on the programme they are on or do not have specific goals, which is to say those clients who do not practice "small steps."

Conversely, another dietitian felt happy to introduce the technology to any client who she felt might benefit from it regardless of where they are in their weight loss treatment.

B. Interviews

Dietitians made several references to tenets of supportive accountability in their responses and the potential of technology to support their practice. Enhanced communication, process accountability, and performance monitoring were referenced most often.

> *"In my perfect world, they would go in online and they would fill out their diary, their exercise diary, their goals, and then I could put comments on it on a weekly basis, in between my appointments. That would be the perfect setup for me."*
>
> (WP1007)

Increased, more structured and efficient communication with patients was considered especially valuable in sustaining the bond between the dietitian and the patient between consultations. Communication was also intricately tied to legitimacy—building trust and displaying benevolence, expertise, and immediacy in reciprocity—process accountability and performance monitoring.

> *"Well, as I said, it is em . . . it is uploading of real-time data and that is certainly, you know, it could be weight, it could be activity, it could be the food diary, tied in with mood as well . . . so that is giving you, I suppose, an indication of where someone is going over a period of time. The food diary though is, you know, by its very definition, [is not] going to be very, very accurate, whereas this . . . would give you a more accurate appraisal of where somebody is, because it is real information rather than, you know, what somebody is forgotten or thinking about or . . . "Oh, I must write the food diary," and they do it last thing at night and they forget."*
>
> (WP1015)

The software allows patients, dietitians, and any other related practitioners such as GPs, to "See the whole journey" (WP1010), and the inputs and outputs of that journey, in terms of goals and progress, but also in terms of more emotional inputs that affect action and activity.

While myPace has dedicated features for extrinsic motivation, and dietitians acknowledged this, dietitians expressed more interest in fostering patients' self-awareness through the process accountability procedures built into myPace, and by extension, progressively enabling intrinsic motivation.

> *"I think more for the patient to see a link between their mood and their eating habits and how they can prevent eating in response to their mood . . . for the patients particularly, for them to see that link, to learn then what can they do differently . . . ."*
>
> (WP1003)

Interestingly, there was no reference to adherence in the interviews. This may be because dietitians view the tool as supporting the weight loss process, but have no evidence to speculate about overall adherence outcomes of using the tool. More often, dietitians mentioned possibilities for the tool to enable change. Notably, there were fewer references to the dietitian as a person to whom the patient will be "accountable," that is, responsible to, via myPace. There was more emphasis on the software enabling better patient care and progressively supporting patient autonomy.

As well as supporting patients in their weight loss, dietitians also made several references to myPace supporting their broader workload by possibly inserting key efficiencies into the way they work. The communication and information access that myPace facilitates was perceived as something that could reduce dietitian work-load in the longer term.

> *"The problem I think is that you are duplicating information a lot of the time, which is a waste of time. So, if you have got a way to just quickly [have the] information and, you know, print it out and disperse it to everyone you need to, then it just saves you so much time, and then you can actually be more effective as a practitioner."*
>
> (WP1010)

These efficiencies, some dietitians felt, have the potential to increase their professional legitimacy. Further, performance monitoring was viewed at a patient level and also at a departmental level. For some dietitians, having access to all of this information about patient performance in one place was seen as a good way for them to evaluate their own practice.

> *". . . like your own advice, like is this easy to follow or not, as well, like, you know, if there is more things you should be telling them and what patients find most useful, I guess, which is good for our outcomes for our service as well."*
>
> (WP1010)

Departmental outcomes are formally evaluated at different intervals, particularly for commissioners, and many dietitians viewed myPace as potentially valuable in supporting them in evaluating their service.

Following on from these insights, future iterations of the design specification and prototype will involve a rigorous evaluation that will focus on predetermined outcomes of interest around the support accountability framework (such as adherence). This will also involve the consumer voice and greater contextual information on how the patient integrates the app into their everyday life and creates a positive user experience [53].

C. Summary of Findings

A central and ongoing concern for healthcare providers is how to incorporate new technology into practice. A keylesson learned from the design and development of myPace is that the adoption of new tools and associated ways of working involves integrating practitioners' existing skills and knowledge in a flexible way into technology. Technology should match existing practice and, for weight loss technology, support practitioners in enabling clients to make sustained changes. The design of new healthcare technologies should take into account the role of the therapeutic bond in achieving behavioral and clinical outcomes. To that end, SAF was of value in framing the issues relevant to sessions with clients, and providing a context for the delivery of technological support.

The study focuses on the dietitian perspective as the technology was developed to support health practice. In a context such as healthcare where access to the end user is restricted, usually mediated by the healthcare worker, designers need to

work closely with those who regularly interface with patients; therefore, extensive collaborative design is essential [54].

Furthermore, there is the issue of how health practitioners might integrate new technology into their fast-paced practice. This takes planning and is improved with experience. A technology might seamlessly match practice, and health practitioners may see significant value in it, but without guidance on effective ways to incorporate the new technology into their existing routine, take-up will likely be limited. The designer can suggest ways the technology might support practice based on evidence from their collaboration with practitioners. However, there is an important value in compiling dietitian-led evidence and recommendations for the use of the technology in practice, which may improve usage rates.

Based on findings from the coaching think-aloud, dietitians can now use their small-step libraries to configure template program for typical patient groups; configured templates are available to dietitians in the consultation. This allows dietitians to plan how they might use the system with conceptually modeled end users through the development of patient personas and profiles for example and gives them practical experience using the platform outside the consultation [55]. This process also allows dietitians to reflect on and structure their program in a clear and easily identifiable way.

V. Conclusion and Future Work

Further research will seek to explore the value of this approach in other healthcare domains that will benefit from the synergy between embedding principles of behavior change and maintaining and drawing on the relationship between the patient and the professional in keeping connected. We recognize the need within the NHS for "new models of care" in a context, where drastic efficiencies are also necessary. Though it might seem counter intuitive to develop digital technologies that extend rather than further curtail the role of the health professional, our early engagement with dietitians in both developing and evaluating the myPace app suggests that it is worth further exploring the ways in which reduced face-to-face contact can be designed so as to capture the benefits of the relationship and encouraging and enabling changed health behaviors.

References

[1] M. Carter, V. Burley, C. Nykjaer, and J. Cade, "Adherence to a smartphone application for weight loss compared to website and paper diary: Pilot randomized controlled trial," *J Med. Internet Res.*, vol. 14, p. e32, 2013.

[2] E. Breton, B. Fuemmeler, and L. Abroms, "Weight loss—There is an app for that! But does it adhere to evidence-informed practices?" *Transl. Behav. Med.*, vol. 1, pp. 523–529, 2011.

[3] B. Spring, J. Duncan, E. Janke, A. Kozak, H. McFadden, A. DeMott, A. Pictor, L. Epstein, J. Siddique, C. Pellegrini, J. Buscemi, and D. Hedeker, "Integrating technology into standard weight loss treatment: A randomized controlled trial," *JAMA Internal Med.*, vol. 173, pp. 105–111, 2013.

[4] T. Alahaivala, H. Oinas-Kukkonen, and T. Jokelainen, "Software architecture design for health BCSS: Case Onnika," in *Proc. 8th Int. Conf. Persuasive Technol.*, 2013, pp. 3–14.

[5] B. J. Fogg, "The behaviour grid: 35 ways behaviour can change," presented at the 4th Int. Conf. Persuasive Technology, Claremont, CA, USA, 2009.

[6] R. Lederman, G. Wadley, J. Gleeson, S. Bendall, and M. Alvarez-Jimenez, "Moderated online social therapy: Designing and evaluating technology for mental health," *ACM Trans. Comput.-Human Interaction*, vol. 21, 2014.

[7] D. C. Mohr, P. Cuijpers, and K. Lehman, "Supportive accountability: A model for providing human support to enhance adherence to eHealth interventions," *J. Med. Internet Res.*, vol. 13, p. e30, 2011.

[8] G. White, K. Caine, K. Connelly, R. Selove, and T. Doub, "Designing consumer health technologies for the treatment of patients with depression: A health practitioner's perspective," *Interact. J. Med. Res.*, vol. 10, p. e2, 2014.

[9] S. Chatterjee and A. Price, "Healthy living with persuasive technologies: Framework, issues, and challenges," *J. Amer. Med. Informat. Assoc.*, vol. 16, pp. 171–178, 2009.

[10] C. Tsai, G. Lee, F. Raab, G. Norman, T. Sohn, W. Griswold, and K. Patrick, "Usability and feasibility of PmEB: A mobile phone application for monitoring real time caloric balance," *Mobile Netw. Appl.*, vol. 12, pp. 173–184, 2007.

[11] I. Mazzotta, F. De Rosis, and V. Carofiglio, "Portia: A user-adapted persuasion system in the healthy eating domain," *IEEE Intell. Syst.*, vol. 22, no. 6, pp. 42–51, Nov./Dec. 2007.

[12] G. Manzoni, F. Pagnini, S. Corti, E. Molinari, and G. Castelnuovo, "Internet-based behavioral interventions for obesity: An updated systematic review," *Clin. Pract. Epidemiol. Mental Health, CP, EMH*, vol. 7, pp. 19–28, 2011.

[13] G. Rao and K. Kirley, "The future of obesity treatment: Accessible, inexpensive, and technology based?: Comment on 'integrating technology into standard weight loss treatment: A randomized controlled trial'," *Archives Internal Med.*, vol. 173, pp. 111–112, 2013.

[14] M. Rotheram-Borus, M. Tomlinson, M. Gwegwe, W. Comulada, N. Kaufman, and M. Keim, "Diabetes buddies peer support through a mobile phone buddy system," *Diabetes Edu.*, vol. 38, pp. 357–365, 2012.

[15] T. Webb, J. Joseph, L. Yardley, and S. Michie, "Using the internet to promote health behavior change: A systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy," *J. Med. Internet Res.*, vol. 12, 2010.

[16] C. Pellegrini, S. Verba, A. Otto, D. Helsel, K. Davis, and J. Jakicic, "The comparison of a technology-based system and an in-person behavioral weight loss intervention," *Obesity*, vol. 20, pp. 356–363, 2012.

[17] H. Arem and M. Irwin, "A review of web-based weight loss interventions in adults," *Obesity Rev.*, vol. 12, pp. e236–e243, 2011.

[18] B. Cugelman, M. Thelwall, and P. Dawes, "Online interventions for social marketing health behavior change campaigns: A meta-analysis of psychological architectures and adherence factors," *J. Med. Internet Res.*, vol. 13, p. e:17, 2011.

[19] G. Rao, L. Burke, and B. J. Spring, "New and emerging weight management strategies for busy ambulatory settings: A scientific statement from the american heart association endorsed by the society of behavioral medicine," *Circulation*, vol. 124, pp. 1182–1203, 2011.

[20] J. West, C. Hall, C. Hanson, M. Barnes, C. Giraud-Carrier, and J. Barrett, "There's an app for that: Content analysis of paid health and fitness apps," *J. Med. Internet Res.*, vol. 14, p. e72, 2012.

[21] J. Tang, C. Abraham, C. Greaves, and T. Yates, "Self-directed interventions to promote weight loss: A systematic review of reviews," *J. Med. Internet Res.*, vol. 16, p. e:58, 2014.

[22] J. Johnston, A. Massey, and C. DeVaneaux, "Innovation in weight loss programs: A 3-dimensional virtual-world approach," *J. Med. Internet Res.*, vol. 14, p. e120, 2012.

[23] M. Boulos, S. Wheeler, C. Tavares, and R. Jones, "How smartphones are changing the face of mobile and participatory healthcare: An overview, with example from eCAALYX," *BioMed. Eng. OnLine*, vol. 10, p. 24, 2011.

[24] D. Luxton, R. McCann, N. Bush, M. Mishkind, and G. Reger, "mHealth for mental health: Integrating smartphone technology in behavioral healthcare," *Prof. Psychology, Res. Practice*, vol. 42, pp. 505–512, 2011.

[25] J. Stephens and J. Allen, "Mobile phone interventions to increase physical activity and reduce weight: A systematic review," *J. Cardiovasc. Nursiing*, vol. 24, p. 24, 2012.

[26] A. S. M. Mosa, I. Yoo, and L. Sheets, "A systematic review of healthcare applications for smartphones," *BMC Med. Informat. Decision Making*, vol. 12, 2012.

[27] R. Bacigalupo, P. Cudd, C. Littlewood, P. Bissell, M. S. Hawley, and H. Buckley Woods, "Interventions employing mobile technology for overweight and obesity: An early systematic review of randomized controlled trials," *Obesity Rev.*, vol. 14, pp. 279–291, 2013.

[28] N. Goodwin, "The need for an integrated response to designing and adopting new technologies," in *Proc. Int. Congr. Telehealth Telecare*, 2011.

[29] C. Pellegrini, S. Verba, A. Otto, D. Helsel, K. Davis, and J. Jakicic, "The comparison of a technology-based system and an in-person behavioral weight loss intervention," *Comparative Study Randomized Controlled Trial Res. Support*, vol. 20, pp. 356–363, 2012.
[30] L. Hamel and L. Robbins, "Computer- and web-based interventions to promote healthy eating among children and adolescents: A systematic review," *J. Adv. Nursing*, vol. 69, pp. 16–30, 2013.
[31] S. Pagoto and G. Bennett, "How behavioural science can advance digital health," *Transl. Behav. Med.*, vol. 3, pp. 271–276, 2013.
[32] C. Kennedy, J. Powell, T. Payne, J. Ainsworth, A. Boyd, and I. Buchan, "Active assistance technology for health-related behavior change: An interdisciplinary review," *J. Med. Internet Res.*, vol. 14, pp. 116–135, 2012.
[33] G. Turner-McGrievy, M. Beets, J. Moore, A. Kaczynski, D. Barr-Anderson, and D. Tate, "Comparison of traditional versus mobile app self-monitoring of physical activity and dietary intake among overweight adults participating in an mHealth weight loss program," *J. Amer. Med. Assoc.*, vol. 20, pp. 513–518, 2013.
[34] L. Hebden, K. Balestracci, K. McGeechan, E. Denney-Wilson, M. Harris, A. Bauman, and M. Allman-Farinelli, "TXT2BFiT, a mobile phone-based healthy lifestyle program for preventing unhealthy weight gain in young adults: Study protocol for a randomized controlled trial," *Trials*, vol. 14, p. 75, 2013.
[35] S. Kelders, J. Van Gemert-Pijnen, A. Werkman, N. Nijland, and E. Seydel, "Effectiveness of a Web-based intervention aimed at healthy dietary and physical activity behavior: A randomized controlled trial about users and usage," *J. Med. Internet Res.*, vol. 13, 2011.
[36] B. Nguyen, K. Kornman, and L. Baur, "A review of electronic interventions for prevention and treatment of overweight and obesity in young people," *Obesity Rev.*, vol. 12, pp. e298–e314, 2011.
[37] L. Camerini and P. Schulz, "Effects of functional interactivity on patients' knowledge, empowerment, and health outcomes: An experimental model-driven evaluation of a web-based intervention," *J. Med. Internet Res.*, vol. 14, 2012.
[38] L. Morrison, L. Yardley, J. Powell, and S. Michie, "What design features are used in effective e-health interventions? A review using techniques from critical interpretive synthesis," *Telemed. E-Health*, vol. 18, pp. 137–144, 2012.
[39] L. van Genugten, P. van Empelen, B. Boon, G. Borsboom, T. Visscher, and A. Oenema, "Results from an online computer-tailored weight management intervention for overweight adults: Randomized controlled trial," *J. Med. Internet Res.*, vol. 14, 2012.
[40] S. Pagoto, K. Schneider, M. Jojic, M. DeBiasse, and D. Mann, "Evidence-based strategies in weight-loss mobile apps," *Amer. J. Preventative Med.*, vol. 45, pp. 576–582, 2013.
[41] W. Evans, L. Abroms, R. Poropatich, P. Nielsen, and J. Wallace, "Mobile health evaluation methods: The text4baby case study," *J. Health Commun.*, vol. 17, pp. 22–29, 2012.
[42] J. H. West, P. C. Hall, V. Arredondo, B. Berrett, B. Guerra, and J. Farrell, "Health behavior theories in diet apps," *J. Consumer Health Internet*, vol. 17, pp. 10–24, 2013.
[43] A. Watson, T. Bickmore, A. Cange, A. Kulshreshtha, and J. Kvedar, "An internet-based virtual coach to promote physical activity adherence in overweight adults: Randomized controlled trial," *J. Med. Internet Res.*, vol. 14, 2012.
[44] P. Klasnja, S. Consolvo, and W. Pratt, "How to evaluate technologies for health behaviour change in HCI research," presented at the *SIGCHI Conf. Human Factors Comput. Syst.*, Vancouver, BC, Canada, 2011.
[45] D. Volland, K. Korak, and T. Kowatsch, "A health information system that extends healthcare professional-patient communication," presented at the *European Conf. Informatics Syst.*, Tel Aviv, Israel, 2014.
[46] L. Francis, "The physician-patient relationship and a national health information network," *J. Law, Med. Ethics*, vol. 38, pp. 36–49, 2010.
[47] D. C. Mohr, S. M. Schueller, E. Montague, M. N. Burns, and R. Rashidi, "The behavioural intervention technology model: An integrated conceptual and technological framework for eHealth and mHealth interventions," *J. Med. Internet Res.*, vol. 16, p. e146, 2014.
[48] W. Waterlander, R. Whittaker, H. McRobbie, E. Dorey, K. Ball, R. Maddison, K. Myers Smith, D. Crawford, Y. Jiang, Y. Gu, J. Michie, and C. Ni Mhurchu, "Development of an evidence-based mHealth weight management program using a formative research process," *JMIR Mhealth Uhealth*, vol. 2, p. e18, 2014.
[49] E. L. Olmsted-Hawala, E. D. Murphy, S. Hawala, and K. T. Ashenfelter, "Think-aloud protocols: A comparison of three think-aloud protocols for use in testing data-dissemination web sites for usability," presented at the *SIGCHI Conf. Human Factors Comput. Syst.*, Atlanta, GA, USA, 2010.
[50] L. Hebden, A. Cook, H. van der Ploeg, and M. Allman-Farinelli, "Development of smartphone applications for nutrition and physical activity behaviour change," *JMIR Res. Protocols*, vol. 1, p. e9, 2012.
[51] M. Waite, C. Martin, S. Curtis, and Y. Nugrahani, "Mobile phone applications and type 1 diabetes: An approach to explore usability issues and the potential for enhanced self-management," *Diabetes Primary Care*, vol. 15, pp. 38–49, 2013.
[52] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative Res. Psychol.*, vol. 3, pp. 77–101, 2006.
[53] Y. Ayzenberg and W. Rosalind, "FEEL: A system for frequent event and electrodermal activity labeling," *IEEE J. Biomed. Health Informat.*, vol. 18, no. 1, pp. 266–277, Aug. 2013.
[54] M. Matthews, D. Doherty, D. Coyle, and J. Sharry, "Designing mobile applications to support mental health interventions," in *Handbook of Research on User Interface Design and Evaluation for Mobile Technology*, J. Lumsden, Ed. Hershey, PA, USA: IGI Information Science Reference, 2008, pp. 635–656.
[55] A. Das and D. Svanæs, "Human-centered methods in the design of an e-health solution for patients undergoing weight loss treatment," *Int. J. Med. Informat.*, vol. 82, pp. 1075–1091, 2013.

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