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EMPLOYEE HYPERTENSION SELF-MANAGEMENT SUPPORT WITH MICROLEARNING AND SOCIAL LEARNING

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Abstract A majority of employees over the age of 40 have hypertension, impacting their health and performance. A two-week Self-Management Support (SMS) intervention was tested, with daily feedback and microlearning cycles to improve health self-management competences. On average, participants (n=8) reduced their blood pressure from 145/92 to 126/86 mmHg. User evaluation confirmed the importance of core SMS aspects: information transfer, daily monitoring, enhancing problem solving/decision making, self-treatment using a tailored action plan, coping skills and skilful coach follow-up. Several lessons are drawn on microlearning, peer coaching, health results, intrinsic motivation, and social learning, which appear useful for other health improvement initiatives.

Keywords: Hypertension, Self-Management Support, microlearning, Social learning, eHealth, employee health.

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1 Introduction

In the age group of 40-59 years old, so before employee retirement age, 55% of US citizens have hypertension (Ostchega, 2020). In many parts of the world, the numbers are worse than in the USA (Zhou, 2021). Hypertension is a leading cause of early death, which is largely preventable (Carey & Whelton, 2020). Moreover, it damages our brain and cognitive performance (Ungvari, 2021). So, we need healthier lifestyles. But how do we effectively learn new skills? How do we better our behaviours, given our busy work-life agendas? How to foster a virtual support team for ourselves?

It would help to create healthy patterns which are self-promoting: improving health competence and intrinsic motivation. For example: a person who joins a tennis club fosters both their motivation and competence. In contrast, standard care for hypertension often lacks individualized learning support and monitoring. Moreover, it has a slow feedback cycle: e.g. "Try exercising more and reducing salt, then come back in three months to check your blood pressure again." SMS (Self-Management Support) literature would advise differently: individualized learning support, regular monitoring and follow up coaching (Dineen-Griffin, 2019). Microlearning literature adds the importance of competence building (Emerson & Berge, 2018, Simons, 2015, 2020b).

The unsatisfactory results of standard care lead patients and their doctors to believe that healthy lifestyle does not help. To address this, we developed an intervention that combines coaching, blood pressure monitoring, and microlearning/training cycles to improve self-management skills and achieve rapid improvements in blood pressure.

We describe a feasibility study of a 2-weeks high impact SMS lifestyle intervention, using a daily learning- and results feedback cycle. Apart from testing feasibility and perceived effectiveness of the intervention, we qualitatively evaluate results on two research hypotheses:

Hypothesis 1: Significant blood pressure improvements can be achieved within two weeks, which are meaningful enough for participants to support health competence training and daily microlearning.

Hypothesis 2: Using high frequency microlearning in a multicomponent SMS intervention with daily coaching and feedback will foster health literacy, health competence and habit formation, besides supporting motivation and self-efficacy.

2 Theory and concepts

We use four domains of research for the design analyses of this paper. They are: Lifestyle medicine for hypertension, Self-Management Support (SMS) using ICT (Information and Communication Technology), Social learning, and Microlearning in a multichannel support mix.

Firstly, ***Lifestyle medicine*** for hypertension has a longstanding research tradition: overall (Roberts & Barnard, 2005) and regarding powerful short term effects on hypertension, inflammation and endothelial health of for example antioxidant foods (Franzini, 2012), flaxseed (Rodriguez-Leyva, 2013), beetroot and nitrates (Kapil, 2015), salt reduction (Dickinson, 2014) and healthy, low-fat food choices (Siervo, 2015), combined with exercise (Greger & Stone, 2016, Simons, 2022c). We combined this lifestyle advice to enable short term, sizable impact on hypertension.

Secondly, as discussed in more detail elsewhere (Simons, 2022a), the field of health ***Self-Management Support (SMS)*** has support process components, besides support for specific health behaviours (exercise, diet, sleep, smoking etc) and for tailoring the action plan to a participants own context and priorities (Demark-Wahnefried, 2007, Jonkman, 2016, Dineen-Griffin, 2019, Simons, 2013, 2017, 2020a, 2021). This set of SMS process components also forms the ***evaluation framework*** we used for user evaluation in section 4:

1. **Monitoring** of symptoms (regular, active self-monitoring)
2. **Information** transfer (throughout the learning process)
3. **Competence** building, including:
   a. ***Problem solving***/decision making
   b. ***Plan making***: self-treatment through use of an action plan
   c. ***Coping management***: skills for handling challenges, frustrations etc
   d. ***Resource utilization***: incl. social context or medication management

Various studies show how self-management tools and ICT (Information and Communication Technology) can help for: goal setting based on personal

preferences, ICT supported tracking and progress feedback (Kari, 2017, Lehto, 2013, Lopez, 2011, Ricciardi, 2013, Wickramasinghe, 2010). Elements like individual coaching, eTools like microlearning for health, Quantified Self (QS, Swan, 2012, 2013) progress tracking have all been shown to aid motivation and success in virtual support teams (Simons, 2015, 2016).

A third relevant field is that of ***Social learning*** (quite distinct from Social Cognitive Theory, which is a much broader framework which is largely agnostic to the detailed distinctions between types of cognition and learning from the social learning literature). Social learning, including immitation, teaching and social norm compliance, is particularly dominant in humans and it is *the* type of learning where we most strongly outperform other primates like chimpanzees and orangutans. Interestingly enough, human toddlers do not exhibit this outperformance on causal, spatial or quantitative cognition (Herrmann et al, 2007), but social learning appears to be largely a human trait. It is an efficient and preferred mode of learning throughout our lifespan, playing a large role in development of human norms, culture and knowledge acquisition (Tian, 2011, Whiten & van de Waal, 2018). Not only does this help explain why our health behaviours are usually similar to the people around us (Latkin & Knowlton, 2015), social learning can also be a major opportunity for designing health support, for example using WhatsApp groups and peer coaching (Simons, 2020b).

Microlearning concepts are highly relevant to our objectives of increasing health behaviour competence levels of participants: our fourth theory topic. Especially since our study took place in a (busy) work context, which creates a need for very efficient learning and rapid proof of effectiveness. "Business is about productivity, not learning. [..] *Inserting learning interventions into a busy employee's schedule is a real challenge*" (Emerson & Berge, 2018). Giurgiu (2017) states that microlearning should focus on only what you need to know. And that it should fulfil the human craving for instant gratification: satisfying short term goals that support long term goals. Gabrielli et al (2017) stress the "contextual" learning in a "conversation with the world and oneself". This conversation includes reflection, experimentation, and interpretation of results. Competence building is about *embedded learning*, where *doing* and *achieving results* are at least as important as learning (Emerson & Berge, 2018, Simons, 2010).

3 Method

This study aimed to develop knowledge for solving domain specific problems in the health SMS field through ***design research***, rather than design science. To achieve this, we followed the design cycle phases of Verschuren & Hartog (2005), with a focus on phases '6. evaluation' and '1. first hunch'. The 'first hunch' consists of the two research hypotheses in the introduction. For phase 6 'evaluation', we conducted a feasibility pilot to evaluate the perceived effectiveness, attractiveness, feasibility, and robustness of our multicomponent intervention. This consisted of blood pressure measurements and a ***user-based design evaluation*** on the intervention elements.

Our health SMS ***intervention*** is updated from the high intensity T2D (Type 2 Diabetes) intervention described elsewhere (Simons, 2016, 2022b). The updated format included: blood pressure-specific updates, a healthy menu App, a two-week focus on training health competence skills, and a much lower time investment, to increase efficiency and fit with busy work schedules of employees. The core components of the ***eHealth intervention*** were:

- Telephone intake & instructions for BP home measurements
- Start-, intermediate and final group sessions (face-to-face)
- Daily MS Teams eCoaching in week 1 (group- & individual coaching)
- Twice-daily BP measurements and logging email
- Feedback on group progress after 1st week
- Healthy recipe suggestions, plus a menu support App
- Portal with personalised progress and eTools for healthy lifestyle
- Content (portal and email) on health, BP, and behaviour strategies
- Specific 'PB lifestyle quick wins' to kickstart BP improvements

To enhance the effectiveness of our intervention, we applied an important lesson from the ***microlearning*** field, which is to create multiple moments daily for learning, experimentation, and reflection, in order to stimulate daily competence building cycles. (An insight which holds merit independent from several technology and tools lessons in microlearning, Simons, 2015, Gabrielli, 2017.) Participants attended group workshops on Monday, Wednesday, and Friday of week 1 (and digital group sessions on Tuesday and Thursday), plus on Friday of week 2, in addition to brief individual coach sessions per participant when needed, as a form of stepped care. Two coaches supported the group.

The intervention (and official blood pressure progress monitoring) started on Monday morning of week 1 and finished at Friday morning of week 2.

To explicate these ***coach support roles***: besides ***aiding knowledge adoption*** by participants (during the face-to-face sessions as well as individual- and Teams coaching), ***support for building competences*** is important. This includes for example reinforcing the value of health strategies of one participant, so that the others may value and adopt these strategies as well (or conversely: discourage impractical behaviours). Next, this includes providing practical tips for everyday challenges, or for health behaviours (diet, exercise, sleep, stress) that improve BP, or for practicing certain skills and routines. More illustrations of this coach support role can be found in section 4, Results, for example in Tables 1, 2, 3 and their explanatory texts.

We recruited ***university employees*** who volunteered to participate in the intervention starting in November 2021 (n=8), all of whom provided written consent for inclusion in these (anonymized) study results. Most of them (n=7) had participated in a more general employee health support program (Simons, 2017) somewhere in the 11 years before. Participants were required to commit to making lifestyle changes and participating in the various coaching and support formats, plus having hypertension stage 1 or 2, with systolic pressure between 130 – 179 or diastolic pressure between 80 – 119. Participants were asked to measure their blood pressure twice a day, starting three or four days before the start of the intervention (using a 'wash in' period), logging the results in their dashboard via our email prompts. One participant had slightly lower blood pressure at the start than expected, with 'heightened' levels in 5 of the 8 and 'hypertensive' levels in 3 of the 8 measurement moments before the start, according to AHA norms (Whelton & Cary, 2017, Carey & Whelton, 2020). The other participants all had hypertensive values before the intervention start.

After the two-week intervention, we conducted ***user evaluations*** to collect feedback. Since the goal was to create health competences during the two weeks that would also have longer-lasting value, we collected survey-based individual feedback on intervention attractiveness and perceived usefulness of the intervention's components at ***10-week follow-up***, the results of which are reported below. Overall, our method illustrates the relevance of design research in creating and evaluating effective interventions in the health SMS field, and

the potential of microlearning and eHealth interventions to support health competence development.

4 Results

There are two key findings that confirm ***Hypothesis 1*** (which suggests that significant blood pressure improvements can be achieved within two weeks, and that these improvements are meaningful enough to support health competence training and daily microlearning). Firstly, Figure 1 demonstrates that the average blood pressure of participants improved from 145/92 mmHg at the start of the intervention to 126/86 mmHg on Friday morning, which was eleven days later. This represents an improvement of 7% in diastolic pressure and 13% in systolic pressure. It is important to note that one participant discontinued medication after the first week of the intervention following consultation with her physician: without this medication reduction the improvements would have been larger. The overall improvement trend was visible ***across all participants***, including the one who was not consistently hypertensive at the start, which indicates that the results are relatively robust. Regarding systolic pressure, individual improvements ranged from 3 to 39 mm Hg. For diastolic pressure, individual results ranged from -3 to 27 mmHg. Generally, participants with higher blood pressure at start showed larger improvements in the course of these 11 days. Additionally, it is worth noting that although the small sample size means that this cannot be statistically verified, the general research finding that larger lifestyle improvements lead to larger health improvements (Greger & Stone, 2016) was also visible as a trend in this group.

Secondly, during the group sessions, most participants made explicit remarks about the direct effects that they noticed between their health behaviors and their blood pressure. For example, they discussed the impact of working late, poor sleep, various dietary choices, exercise benefits, and explicit relaxation versus continued workday stress on their blood pressure levels. As a result, there was a double effect regarding meaningful feedback from blood pressure monitoring: participants gained individual lessons learned from their own experiences, but they also shared their experiences in the group, which helped to educate and motivate all participants, when they themselves did not have improvements on a given day. This group sharing and discussion was an important aspect of the intervention, one the one hand because it fostered a

sense of community and support among participants, on the other hand since it fosters social learning: based on the examples and experiences of others, participants are aided in adopting and learning new behaviours.

Overall, these findings provide support for Hypothesis 1 and suggest that the health SMS intervention was effective in achieving significant blood pressure improvements in 11 days time.

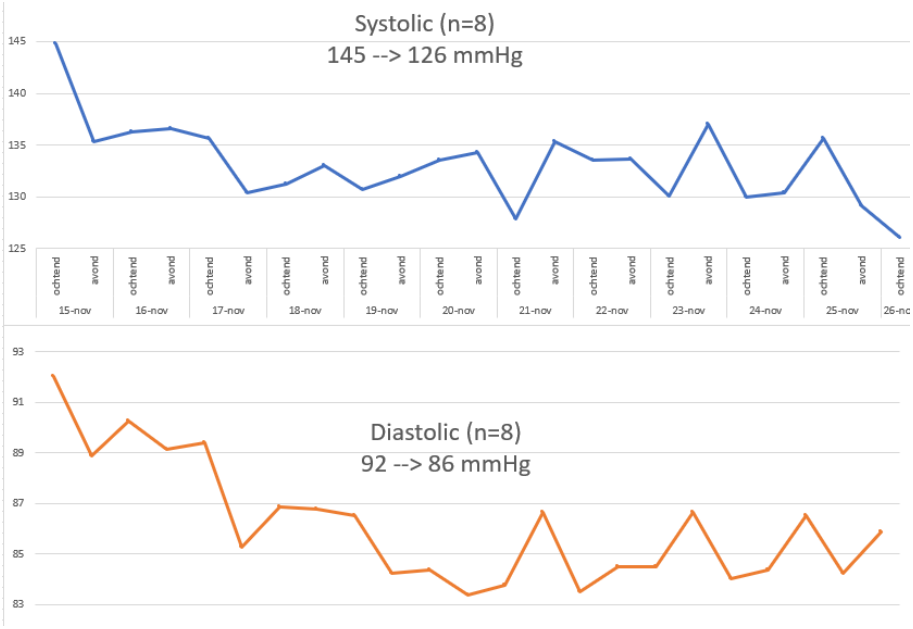

Figure 1: Average blood pressure improvement (n=8)

User evaluation confirmed ***Hypothesis 2*** (which suggests that a microlearning approach in a multicomponent SMS intervention with daily coaching and feedback will foster health literacy, health competence and habit formation, besides supporting motivation and self-efficacy). We collected user feedback based on a survey and based on user group feedback sessions in week 2 and week 10.

Table 1 shows user evaluations at week 10 on the perceived usefulness of the intervention components for supporting healthier behaviours. We clustered the components according to the SMS process framework, even though some components support more than one SMS process, which we discuss below Table 1. Scores were provided on a 7-point Likert scale, from 'totally disagree'

to 'totally agree', in answer to the question which components helped in adopting healthier behaviours.

Table 1: Components that stimulated healthier behaviours (7-point (dis)agree, n=7/8[1])

Monitoring:	**Avg Score**
1. Mail triggers for blood pressure logging	4.9
2. Daily management	5.4
3. Gaining more blood pressure control	6.3
Information transfer:	
4. Start workshop	6.4
5. Healthy menu suggestions in the food App	4.4
6. Health and blood pressure information in portal	5.4
7. More understanding of blood pressure & health	6.1
Competence building:	
8. Follow-up workshops	6.3
9. Individual tips and answers to my questions from the coaches	6.6
10. Doing this as a group	6.4
11. Tips in dealing with challenges	6.0

Table 1 starts with an overview of the perceived benefits of the *Monitoring* aspects. The results show that the main advantage gained by participants was the improvement in controlling their blood pressure, as indicated by item 3. This finding is corroborated by user explanations, presented in Table 3.

In terms of the *Information transfer* component, Table 1 highlights that the start workshop (item 4) and the enhanced understanding of blood pressure and health (item 7) were the most valued aspects by the participants. These two intervention components not only involved the transmission of information, but also focused on developing competences related to effective planning and prioritization of lifestyle choices. The aim was to identify those choices that would yield the best combination of short-term efficacy and long-term feasibility for each participant.

[1] One participant had outlier scores (since she was absent from several of the group sessions, due to illness plus family logistics). Table 1 shows the average scores of the other 7. (Score 4=neutral) Her scores were resp.: 6; 6; 6/3; 3; 4; 5/3; 6; 3; 3. For n=8, the avg scores were resp.: 5.0; 5.5; 6.3/6.0; 4.3; 5.3; 6.0/5.9; 6.5; 6.0; 5.6.

The third process element, *Competence building*, was valued most by the participants for the development of sustainable self-management skills and behaviours. This is particularly relevant given the multiple challenges that daily life poses to healthy behaviours, as listed in Table 2. All four competence-building components (items 8 to 11) received high ratings, with an average score of at least 6 out of 7, indicating that participants highly valued support for the development of their competences.

Table 2: Challenges to adopting healthy behaviours (user group inputs)

Challenges:
1. Dealing with social events (and pressures towards unhealthy foods/drinks).
2. Involving family members, who are often attached to old patterns. Family dinner food dilemma's/choices which they may not follow.
3. How to stay on course? (What helped us: tips & tricks, peer support group, putting things in perspective.)
4. The first week's effects are easy; achieving the same degree of progress (and thus motivation) the second week is harder.

In Table 2 we provided key challenges that participants mentioned in adopting healthier behaviour patterns. These inputs were given during the user group evaluation sessions in response to the question: 'Which things did you find challenging in adopting healthy behaviours?' In Table 3 we list participant group inputs (by the end of week 2 and week 10) on the question: 'What helped you to achieve healthy behaviours?'

Table 3: What helped to achieve healthy behaviours (user group inputs)

What helped:
1. **Rapid feedback** from twice daily monitoring: see direct effects from behaviours.
2. Achieving **results** and enhancing **self-efficacy**: confirming you are on the right track. And the belief you can do this. Week 10: The power of experiencing that it really works. And confirmation that you can do this.
3. **'Quick results'-tips** (like using flax seed, beet juice and daily physical activity): to kick-start rapid results.
4. **Education**: which behaviours give the **largest results**.
5. **Practical tips for every-day choices and practicing new behaviour patterns**

(diet, exercise, sleep, alcohol, stress etc), including clever strategies and products in the supermarket. Week 10: All those practical tips to make things easier: for example healthy pizza base and toppings we can find in the supermarket.
6. **High quality coaches and coach sessions** (individual and group) **to increase mastery and health competences**: for questions, practical tips, deeper knowledge, reducing noise/confusion.
7. Helps to be in a **group with peer support**: for inspiration, peer coaching, practical tips and commitment/motivation, stimulating and teaching each other.
8. Education & peer coaching on **coping**: how to deal with various challenges (involving/coping with family and social context; low-salt or low-cheese; fast & healthy meals; time and tips for exercise and moderate level physical activity.)
9. Week 10: Building **healthy 'new normal' patterns**: Easily replaced breakfast and lunch with healthier options. Or: Many 'heart-healthy' foods are now standard stock in our cooking. Or: Gotten used to new tastes (e.g. no cravings for sugar or salt). Or: Step counter as a tool for triggering regular activity. Or: Seeing the effects of stress on hypertension: impetus for better stress management habits.
10. Week 10: Power of **repetition and follow up**: some 'familiar health advice and resources' much more intensively internalized and used, in the past 10 weeks.

Overall, these findings provide support for Hypothesis 2 and suggest that the multicomponent SMS intervention fostered health literacy, health competences and habit formation, as well as that it enhanced motivation, inspiration and helped participants gaining a sense of control and effectiveness.

In addition, participant feedback highlighted the importance of not only monitoring and information, but also the diversity and complexity in developing and practicing the ***wide range of competences involved*** in making multiple daily 'blood-pressure-healthy' behaviour choices. Participants gave examples that illustrate the types of support and competence building of the SMS framework: decisions/problems solving, plan making, coping management and resource utilization. As elaborated in the discussion section below, daily competence growth of participants was enhanced by the whole range of the intervention components.

During the conclusion of week 10, our questionnaire included three satisfaction queries that had a range of 1 to 10. The respondents were asked to look back and provide feedback on the support they received (score: 8.6), their progress in health behaviour after two weeks (score: 7.7), and an evaluation of their

remaining health behaviours after 10 weeks (score: 7.4). It was interesting to note that ***two aspects of their feedback stood out and went beyond what is normally observed in the SMS literature:***

Firstly, the respondents recognized the significant ***added value*** of the ***group process*** for learning new behaviours, meaning ***Social learning***. They explicitly cited not only motivational aspects, but also the daily peer coaching, inspiration, and practical tips that they received from their peers. Group inputs and peer experiences were seen as effective support for new behaviours and tactics, required for achieving their (often quite significant) health ambitions and for dealing with various challenges in for example their social environment or practical limitations for healthy behaviour during the day.

Secondly, the respondents were ***amazed and inspired by the significant blood pressure improvement that can be achieved within a short period of time***, specifically within 11 days. One of the respondents even expressed how this experience has instilled in them a strong belief in what else they could achieve in improving their blood pressure in the following weeks: "I built up a strong belief in what else I could achieve after those first two weeks".

5 Discussion and contribution

This feasibility study, despite its valuable contributions, is subject to a few ***limitations*** that warrant attention. Firstly, the small sample size (n=8) necessitated the use of qualitative measures to confirm the two hypotheses, which do not allow for a robust quantitative analysis. However, it is worth noting that the qualitative results provide valuable insights into the feasibility and effectiveness of the intervention.

Secondly, the participants in this study were not homogenous, and not all of them used all the support components, which could have impacted the results. However, the fact that all participants showed improvement in their blood pressure trends (see section 4, Results) suggests that the intervention is potentially robust and effective.

Thirdly, the study tested multiple intervention components together, without using control groups, which makes it difficult to draw definitive conclusions about the effectiveness and added value of the support components used in the

intervention. Instead, the interpretations of effectiveness and added value are of an (inter-)subjective nature and should be taken as tentative.

Despite these limitations, the feasibility study provides important insights into the potential benefits of the intervention, particularly in terms of its ability to improve blood pressure trends in a heterogeneous group of participants. The study also highlights the importance of catering to individual needs and preferences of participants by designing some flexibility/responsiveness into interventions to achieve optimal results.

Furthermore, the limitations of this feasibility study provide opportunities for further research to explore the effectiveness and added value of the intervention using a larger sample size. In effect, follow up papers (Simons, 2023, 2024) compare similarities and differences across three different case studies, in different employer settings. These analyses confirm most findings on robustness and effectiveness from this paper. At the same time, they highlight several challenges, arising from different contextual- and intervention characteristics. For example, for one group (case C in those papers) it was decided for practical reasons (time constraints, travel distances, work schedules) that less intensive coach support would be given, with more reliance on mail based content support and self-management. In practice, this approach does suite one type of participant (those with high self-management skill levels), but not the majority. The cross-case analyses showed that for most partipants, (cognitive) knowledge and motivation are not enough: extra support for practicing competences is needed.

So, creating enough time and attention for participants to be able to invest in new health competences remains an important challenge to intervention effectiveness, as well as selecting participants with enough desire and ability to use social learning and daily feedback cycles for rapid BP competence building.

5.1 Implications and lessons for theory

Despite the small scale and limitations of this study, it has made valuable contributions to the current understanding of Self-Management Support (SMS) theory. First, the qualitative inputs received from participants provide insight into benefits of *focusing on rapid, positive health results* (including disease reversal) rather than just managing symptoms, medication, and disease progression. This

approach not only improves motivation and overall health but also builds health literacy and competence, as highlighted by one participant: *"I now understand better how blood pressure improvement also represents healthier arteries and health overall."* She gained a better appreciation how blood pressure improvements correlate with overall health.

Second, the study highlights the importance of experiential learning and competence building (*doing and experimenting*), as opposed to just cognitive learning. The challenge faced by the participants in this study was to find sufficient time and focus to experiment and practice with the learned skills, which is a common struggle for many individuals with busy lifestyles. While the microlearning approach utilized in this study was concise and effective in helping participants focus on their learning, three participants reported that they were unable to implement all of the lessons learned. This highlights the need for a strong focus on practicing and experimenting with small, regular tasks. These are crucial for learning and building competence, but at the same time challenging to implement in participants' busy lives.

The findings of this study also align with the literature on *microlearning*, which stresses the importance of designing efficient and effective learning methods that can fit into the busy lives of employees with severe time constraints. This suggests that a strong focus on experimenting and practicing with small tasks can be more effective than relying solely on cognitive learning in patient-doctor conversations.

Third, to help build competence, some longer, 'deep dive' training formats were suggested: *"It is hard to implement all the useful tips. For example, a supermarket safari for showing healthy choices would help my shopping choices further."*

Fourth, in addition to the contributions to self-management support theory mentioned previously, this study sheds light on the potential benefits of *group and social learning* beyond just motivational and affective aspects (Molka-Danielsen, 2009, Simons, 2018, 2019, 2020b). While SMS and microlearning theory often focus on managing an individual's learning process, the power of social learning observed in this study can enhance competence building through the sharing of results and experiences among participants. This is consistent with *Social learning theory*, which emphasizes the importance of seeing, discussing,

and reflecting on the experiences of others (Herrmann et al, 2007, Whiten & van de Waal, 2018).

Furthermore, this *social learning approach may be particularly beneficial in the busy lives of modern employees*. There are two main reasons for this. Firstly, observing the success of others may have a greater emotional and learning impact compared to simply hearing about it through individual learning experiences. This emotional connection can be a powerful motivator for learning and behavior change. Secondly, learning from the experiences of others can be *time-efficient*, as it allows individuals to gain knowledge and insights without having to directly experiment with everything themselves: *"By doing this together, I get much further. I learn a lot from the others' examples, suggestions and discussions."*

Fifth, this positive group support effect may be about more than just competence building. It may also be about having a (virtual) support team: in the moments of learning, but also with a more 'virtual' presence: *'tomorrow I will see them again and will have to tell my coaches and the others how I fared.'* It builds extra commitment, provides extra inspiration, and most importantly: it combines with mentally preparing for (daily or difficult) situations which one expects to occur. Making 'plans to ensure that I will do better in situation XYZ today' fits behaviour literature (Schwarzer, 2008) but should maybe also be connected to the social aspects to understand the powerful peer group effects: not just 'doing better' but also 'looking better, in their eyes' (Khan, 2017).

Overall, this study provides valuable insights into the potential benefits of group support for competence building and learning through the lens of *Social learning theory*. This approach challenges the traditional focus on individual learning processes in SMS and microlearning theory and highlights the importance of group learning and sharing experiences in modern workplaces where time is often limited.

5.2 Practical and technology implications

It is important to acknowledge the ***pivotal role that technology played*** in the success of this intervention. Indeed, technology was integral to many of its components, far beyond what was envisioned a decade ago in the eHealth/mHealth opportunity outlook (Simons & Hampe, 2010). With affordable and reliable blood pressure consumer electronics, daily home

monitoring became a feasible aspect of the intervention. Our mail/web-based coaching portal facilitated real-time progress tracking by both participants and coaches. The use of MS Teams meetings allowed for daily high-quality group and individual coaching without travel- or time-related constraints. Additionally, the content database on the portal provided participants with multiple lessons on blood pressure and healthy lifestyle. Although not utilized, the healthy menu App even included a direct order/delivery option for ingredients to participants' homes. Overall, the success of the intervention was largely dependent on the technologies and tools used to deliver its multiple competence-building lessons each day. Still, what is most important for practice, and which was also confirmed in the user evaluations: the ease of use and perceived usefulness are much more important than the number of tools. Especially within the busy work-life contexts of these employees: *'If it is not really clear and simple, I don't get around to trying it.*'

On the practical side, achieving clearly measurable blood pressure improvements daily, was a large benefit: for increasing motivation, and for wanting to learn more. Participants were positively surprised by all the empowering knowledge from research, showing how that large and rapid hypertension improvements can be achieved, using several well-directed steps (Simons, 2022c).

On a second note, they showed enthusiastic uptake of suggested 'quick win' behaviours (like using flax seeds, or beet juice, or a 5-minute walk every hour). In their feedback they were quite positive on how inspiring it is to learn about such rapid improvement options.

A third benefit for increasing learning intensity, is the relatively short intervention frame of two weeks. Participant willingness to experiment and 'go the extra mile' increases when a commitment is asked of only two weeks. And then motivation for the new, healthier behaviours becomes more intrinsic even within these two weeks, driven by results, feeling better and awareness that their health and vascular system are improving rapidly.

5.3 Conclusion

This intervention demonstrated high levels of attractiveness and feasibility for the participants. Moreover, it effectively resulted in significant improvements in

blood pressure within a short period of 11 days, with the average systolic pressure dropping from 145 to 126 mmHg. The intervention provided a wide range of tailored information transfer, monitoring, coaching, and competence building options within the framework of Self-Management Support (SMS). Additionally, it highlighted the added value of (a) group based social learning, which proved beneficial for participants in terms of motivation, inspiration, and practical tips; (b) boosting self-efficacy through the use of "quick-win options" and achieving rapid and noticeable health results within a few days; (c) multiple technology-enabled health competence building lessons each day, which helped participants to focus and learn more efficiently. These findings suggest that these options hold significant promise for future health Self-Management Support innovations, providing employees and patients with more comprehensive and personalized care.

References

Carey, R. M., & Whelton, P. K. (2020). Evidence for the universal blood pressure goal of< 130/80 mm Hg is strong: controversies in hypertension-pro side of the argument. *Hypertension*, *76*(5), 1384-1390.

Demark-Wahnefried, W., Clipp, E., Lipkus, I., Lobach, D. et al. (2007). Main Outcomes of the FRESH START Trial: A Sequentially Tailored, Diet and Exercise Mailed Print Intervention Among Breast and Prostate Cancer Survivors. *J Clin Oncol, 25*(19), pp. 2709-2718.

Dickinson, K. M., Clifton, P. M., Burrell, L. M., Barrett, P. H. R., & Keogh, J. B. (2014). Postprandial effects of a high salt meal on serum sodium, arterial stiffness, markers of nitric oxide production and markers of endothelial function. *Atherosclerosis*, *232*(1), 211-216.

Dineen-Griffin, S., Garcia-Cardenas, V., Williams, K., & Benrimoj, S. I. (2019). Helping patients help themselves: a systematic review of self-management support strategies in primary health care practice. *PloS one*, *14*(8), e0220116.

Emerson, L. C., & Berge, Z. L. (2018). Microlearning: Knowledge management applications and competency-based training in the workplace. *Knowledge Management & E-Learning*, 10 (2), pp.125-132.

Franzini, L., Ardigo, D., Valtuena, S., Pellegrini, N., Del Rio, D., Bianchi, M. A., ... & Zavaroni, I. (2012). Food selection based on high total antioxidant capacity improves endothelial function in a low cardiovascular risk population. *Nutrition, Metabolism and Cardiovascular Diseases*, *22*(1), 50-57.

Jonkman, N. H., Schuurmans, M. J., Jaarsma, T., Shortridge-Baggett, L. M., Hoes, A. W., & Trappenburg, J. C. (2016). Self-management interventions: proposal and validation of a new operational definition. *Journal of clinical epidemiology*, *80*, 34-42.

Gabrielli, S., Kimani, S., & Catarci, T. (2017). The design of microlearning experiences: A research agenda (on microlearning). Manuscript accessed 2-2-2022, from: http://ir.jkuat.ac.ke/handle/123456789/3157 .

Giurgiu, L. (2017). Microlearning an evolving elearning trend. *Scientific Bulletin*, *22*(1), 18-23.

Greger, M., & Stone, G. (2016). *How not to die: discover the foods scientifically proven to prevent and reverse disease*. Pan Macmillan.

Herrmann, E., Call, J., Hernández-Lloreda, M. V., Hare, B., & Tomasello, M. (2007). Humans have evolved specialized skills of social cognition: The cultural intelligence hypothesis. *Science*, *317*(5843), 1360-1366.

Kapil, V., Khambata, R. S., Robertson, A., Caulfield, M. J., & Ahluwalia, A. (2015). Dietary nitrate provides sustained blood pressure lowering in hypertensive patients: a randomized, phase 2, double-blind, placebo-controlled study. Hypertension, 65(2), 320-327.

Kari, T., Koivunen, S., Frank, L., Makkonen, M., & Moilanen, P. (2017). The expected and perceived well-being effects of short-term self-tracking technology use. *International Journal of Networking and Virtual Organisations*, *17*(4), 354-370.

Khan, M. L. (2017). Social media engagement: What motivates user participation and consumption on YouTube?. *Computers in human behavior*, *66*, 236-247.

Latkin, C. A., & Knowlton, A. R. (2015). Social network assessments and interventions for health behavior change: a critical review. *Behavioral Medicine*, *41*(3), 90-97.

Lehto, T., Oinas-Kukkonen, H., Pätiälä, T., & Saarelma, O. (2013). Virtual health coaching for consumers: a persuasive systems design perspective. *International Journal of Networking and Virtual Organisations 4*, *13*(1), 24-41.

Lopez, G., Shuzo, M., & Yamada, I. (2011). New healthcare society supported by wearable sensors and information mapping-based services. *International Journal of Networking and Virtual Organisations*, *9*(3), 233-247.

Molka-Danielsen, J., Carter, B. W., & Creelman, A. (2009). Empathy in virtual learning environments. *International journal of Networking and Virtual Organisations*, *6*(2), 123-139.

Ostchega, Y., Fryar, C. D., Nwankwo, T., & Nguyen, D. T. (2020). Hypertension prevalence among adults aged 18 and over: United States, 2017–2018, NCHS, National Health and Nutrition Examination Survey, 2017–2018: https://stacks.cdc.gov/view/cdc/87559.

Ricciardi, F., Rossignoli, C., & De Marco, M. (2013). Participatory networks for place safety and livability: organisational success factors. *International Journal of Networking and Virtual Organisations 4*, *13* (1), 42-65.

Roberts, C. K., & Barnard, R. J. (2005). Effects of exercise and diet on chronic disease. *Journal of applied physiology*, *98*(1), 3-30.

Rodriguez-Leyva, D., Weighell, W., Edel, A. L., LaVallee, R., Dibrov, E., Pinneker, R., ... & Pierce, G. N. (2013). Potent antihypertensive action of dietary flaxseed in hypertensive patients. *Hypertension*, *62*(6), 1081-1089.

Siervo, M., Lara, J., Chowdhury, S., Ashor, A., Oggioni, C., & Mathers, J. C. (2015). Effects of the Dietary Approach to Stop Hypertension (DASH) diet on cardiovascular risk factors: a systematic review and meta-analysis. *British Journal of Nutrition*, *113*(1), 1-15.

Schwarzer, R. (2008). Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied psychology*, *57*(1), 1-29.

Simons, L. P. A., & Hampe, J. F. (2010). Service Experience Design for Healthy Living Support; Comparing an In-House with an eHealth Solution. The *23rd Bled eConference*, pp. 423-440. Accessed 2010 from www.bledconference.org

Simons LPA, Hampe JF, Guldemond NA. (2013). Designing Healthy Living Support: Mobile applications added to hybrid (e)Coach Solution. *Health and Technology*. 3 (1) pp.85-95. DOI 10.1007/s12553-013-0052-9

Simons LPA, Hampe JF, Guldemond NA. (2014). ICT supported healthy lifestyle interventions: Design Lessons. *Electronic Markets*. 24 pp. 179-192. DOI 10.1007/s12525-014-0157-7.

Simons LPA, Foerster F., Bruck PA, Motiwalla L & Jonker CM. (2015). Microlearning mApp Raises Health Competence: Hybrid Service Design. *Health and Technology*, 5 pp 35-43.

Simons, L. P., Pijl, H., Verhoef, J., Lamb, H. J. et al (2016). Intensive Lifestyle (e) Support to Reverse Diabetes-2. In *Bled eConference* (p. 24), accessed Dec 20, 2016 www.bledconference.org.

Simons LPA, Hafkamp MPJ, Bodegom D, Dumaij A, Jonker CM. (2017). Improving Employee Health; Lessons from an RCT. *Int. J. Networking and Virtual Organisations*, Vol. 17, No. 4, pp.341–353. DOI https://doi.org/10.1504/IJNVO.2017.088485

Simons, LPA, Heuvel, AC van den, Jonker CM. (2018). eHealth WhatsApp Group for Social Support; Preliminary Results, pp. 225-237, *presented at the 31st Bled eConference*. Bled, Slovenia, Proceedings retrieval from www.bledconference.org. ISBN-13: 978-961-286-170-4, DOI: https://doi.org/10.18690/978-961-286-170-4

Simons, LPA., van den Heuvel, W. A., & Jonker, C. M. (2019). WhatsApp Peer Coaching Lessons for eHealth. In *Handbook of Research on Optimizing Healthcare Management Techniques* (pp. 16-32). IGI Global, ISBN 9781799813712.

Simons, LPA, (2020a). Health 2050: Bioinformatics for Rapid Self-Repair; A Design Analysis for Future Quantified Self, pp. 247-261, *33rd Bled eConference*. June 28-29, Bled, Slovenia, Proceedings retrieval from www.bledconference.org. ISBN-13: 978-961-286-362-3, DOI: https://doi.org/10.18690/978-961-286-362-3.17.

Simons, LPA, Heuvel, AC van den, Jonker CM. (2020b). eHealth WhatsApp for social support: design lessons. *International Journal of Networking and Virtual Organisations*, *23*(2), 112-127. DOI https://doi.org/10.1504/IJNVO.2020.108857.

Simons, LPA, Neerincx MA, Jonker CM (2021). Health Literature Hybrid AI for Health Improvement; A Design Analysis for Diabetes & Hypertension, pp. 184-197, *34th Bled eConference*. June 27-30, Bled, Slovenia, Proceedings retrieval from www.bledconference.org. ISBN-13: 978-961-286-385-9, DOI: https://doi.org/10.18690/978-961-286-385-9 .

Simons, LPA, Gerritsen, B, Wielaard, B, Neerincx MA (2022a). Health Self-Management Support with Microlearning to Improve Hypertension, pp. 511-524, *35th Bled eConference*. June 26-29, Bled, Slovenia, Proceedings retrieval from www.bledconference.org. ISBN-13: 978-961-286-616-7, DOI: 10.18690/um/fov.4.2022

Simons, LPA, Pijl M, Verhoef J, Lamb HJ, van Ommen B, Gerritsen B, Bizino MB, Snel M, Feenstra R, Jonker CM. (2022b). e-Health Diabetes; 50 Weeks Evaluation. *Int. J. Biomedical Engineering and Technology*, *38*(1), 81-98.

Simons, LPA, Neerincx MA, Jonker CM (2022c). Is Google Making us Smart? Health Self-Management for High Performance Employees & Organisations, *International Journal of Networking and Virtual Organisations,* Vol 27, No 3, pp.200-216. DOI: 10.1504/IJNVO.2022.10053605

Simons, LPA, Gerritsen, B, Wielaard, B, Neerincx MA (2023). Hypertension Self-Management Success in 2 weeks; 3 Pilot Studies, pp.19-34, *36th Bled eConference*. June 25-28, Bled, Slovenia, Proceedings retrieval www.bledconference.org. ISBN-13: 978-961-286-751-5, DOI: 10.18690/um.feri.6.2023

Simons, LPA, Gerritsen, B, Wielaard, B, Neerincx MA (2024, under review). Hypertension Self-Management Success in 2 weeks; 3 Pilot Studies. *International Journal of Networking and Virtual Organisations*, (submitted).

Swan, M. (2012). Health 2050: The realization of personalized medicine through crowdsourcing, the quantified self, and the participatory biocitizen. *Journal of personalized medicine*, *2*(3), 93-118.

Swan, M. (2013). The quantified self: Fundamental disruption in big data science and biological discovery. *Big data*, *1*(2), 85-99.

Tian, S. W., Yu, A. Y., Vogel, D., & Kwok, R. C. W. (2011). The impact of online social networking on learning: a social integration perspective. *International Journal of Networking and Virtual Organisations*, *8*(3-4), 264-280.

Ungvari, Z., Toth, P., Tarantini, S., Prodan, C. I., Sorond, F., Merkely, B., & Csiszar, A. (2021). Hypertension-induced cognitive impairment: from pathophysiology to public health. *Nature Reviews Nephrology*, *17*(10), 639-654.

Verschuren, P., & Hartog, R. (2005). Evaluation in Design-Oriented Research. *Quality and Quantity,* 39, pp. 733-762.

Whelton, P. K., & Carey, R. M. (2017). The 2017 clinical practice guideline for high blood pressure. *Jama*, *318*(21), 2073-2074.

Wickramasinghe, N., & Goldberg, S. (2010). Transforming online communities into support environments for chronic disease management through cell phones and social networks. *International journal of Networking and Virtual Organisations*, *7*(6), 581-591.

Whiten, A., & van de Waal, E. (2018). The pervasive role of social learning in primate lifetime development. *Behavioral Ecology and Sociobiology*, *72 (80)*, 1-16.

Zhou, B., Perel, P., Mensah, G. A., & Ezzati, M. (2021). Global epidemiology, health burden and effective interventions for elevated blood pressure and hypertension. *Nature Reviews Cardiology*, *18*(11), 785-802.