

The Runner's Journey: Identifying Design Opportunities for Running Motivation Technology

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ABSTRACT

Running is a popular recreational sport, yet for many amateur runners it remains challenging to turn intentions into sustainable running behavior. Although the market offers a myriad of running-related devices that aim to motivate runners, these often focus on the training itself and not on overcoming the barriers experienced prior to the run. A better understanding of these barriers to running is essential to identify design opportunities for technologies supporting amateur runners. We conducted two complementary studies among participants of a women-only running event. Combining an online survey ($N = 114$) and a journey mapping activity ($N = 13$), we investigated the influence of motivational barriers and enablers in runners' rituals. Based on our findings, we created the Runner's Journey, a visual narrative highlighting actionable design opportunities for running motivation technology. We propose five design recommendations to overcome barriers among amateur runners.

CCS CONCEPTS

• **Human-centered computing**; • **Human computer interaction**; • **HCI design and evaluation methods**; • **User studies**;

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KEYWORDS

Design opportunities, running motivation, amateur runners, customer journey, design research

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1 INTRODUCTION

Physical inactivity has become a major health concern. Consequently, the awareness and importance of striving for an active and healthy lifestyle within our society has increased [63]. This is reflected in the growing popularity of recreational sports, especially running [22]. As compared to other sports, running is characterized by its low threshold and its attractiveness for a wide range of people [25, 54]. This heterogeneity among runners is also represented in the large numbers of traditional and themed running events (e.g., ladies runs, business runs, survival runs). We however see a high drop-out rate among amateur runners [28, 64], due to running-related injuries and motivational loss [22, 28, 64]. Although many people start running, one of the main challenges remains to translate intentions into actual long-term running behavior [52]. An important factor influencing this intention-behavior gap are barriers and enablers experienced between making the intention to go running on a day-to-day basis, and the actual running itself [36, 46].

To support and motivate runners in their training, there has been a significant increase in the development of running-related devices [4, 22, 23]. Commercially developed running apps and

wearable technologies, such as sports watches and activity trackers, enable quantified data tracking (e.g., pace, distance, route or heart rate) [23]. These aim at making the training more enjoyable, through music or social elements for instance, or at increasing performance during the training [62]. In both cases, the main focus appears to be on the running training itself. Since the ability to overcome barriers influences one's adherence to exercise [36], these in-the-moment strategies might not effectively support amateur runners in overcoming motivational barriers experienced beforehand. Understanding how amateur runners experience these day-to-day barriers and enablers, and how this possibly affects their potential runs, might be valuable to identify how design and interactive technologies can better support runners beyond the run itself.

The present research investigates the influence of motivational barriers and enablers in runners' rituals prior to, during and after running. We sampled amateur runners of a women-only event, known for its low-threshold and non-competitive character [64]. Based on the results of two complementary studies - a survey ($N = 114$) and a journey mapping activity ($N = 13$) - we contribute the following: (i) insights into the influence of motivational barriers and enablers in runners' rituals (ii) five design recommendations, supported by a visual narrative of the Runner's Journey. The Runner's Journey highlights actionable design opportunities prior to, during and after a running session that caters to overcoming barriers among amateur runners.

2 RELATED WORK

In this related work section, we review prior literature in two areas: barriers and facilitators to exercise and running-related interventions.

2.1 Barriers and Enablers to Exercise

Barriers and enablers to exercise, play a significant role in one's adherence to exercise [40]. These factors have been investigated in previous studies, mostly in the domains of preventive health, sports, and psychology [20, 21, 40, 44]. Key factors identified as hindering exercise are unfavorable weather conditions, lack of confidence or self-efficacy, lack of social support (e.g., cancellation of sports partner) or having other demands [40, 42, 44]. Enabling factors found in empirical studies are maintaining an exercising routine, self-commitment, anticipating positive feelings and social support [40, 42, 44]. Both barriers and facilitators are often further categorized into internal and external factors. External factors are characterized as environmental and 'out of one's control' (e.g., weather, lack of social support). In contrast, internal factors are related to the individual themselves (e.g., lack of energy, past experiences) [40]. A study by Daskapan et al. indicates that external barriers are perceived more often than internal ones [5]. How people experience and cope with these barriers and facilitators, external or internal, influence the extent to which one successfully turns positive intentions into exercise behavior [36, 46] and potentially overcomes this 'intention-behavior gap' [55]. Interindividual differences related to age or gender, yet also to existing medical conditions or personality aspects such as self-efficacy, have been identified [20, 51, 57] and studies often focus on one specific target audience only.

Although the list of factors at play to enable or hinder exercise motivation is well-documented in previous work [35, 40, 51], the outcomes of these studies form an inventory of perceived and self-reported barriers and enablers without offering actionable insights for designers about what people do to overcome these. Failing to overcome a barrier at one moment does not mean that people might fail to overcome this barrier at a different moment or in a different context. Why and when a barrier will result in skipping or engaging in a running session thus remains unclear. The contextual factors influencing barriers and enablers were investigated in a one-week diary study among young women, emphasizing the complex contextual and temporal dynamics at play [42]. The results indicate that, although more different types of barriers were perceived on days where women were unsuccessful in realizing their exercise intentions, barriers were still encountered on successful days. Further research going beyond listings of barriers and enablers to exercise, investigating how and when these factors are perceived, can help to put these barriers and enablers in perspective. Through this, concrete pain points might be highlighted, which in turn can provide actionable design opportunities to support people in turning their exercise intentions into action.

2.2 Running-Related Interventions

In the field of Human-Computer Interaction, running-related interventions to lower drop-out rates focus primarily on preventing running-related injuries by improving the running technique [11, 18, 48]. In parallel, perseverance among recreational runners is also stimulated through designs that provide performance and competition stimuli during or after a running session [49]. However, runners respond quite differently to the above strategies: some runners feel motivated [6, 30, 64], others report adverse effects [50]. Etkin et al. [9] even suggest that performance-driven interventions can undermine the enjoyment of being physically active. Although a segment of recreational runners might be encouraged by being 'faster' than others [64], several studies indicate that other types of runners are rather driven by health, social support or physical fitness [21, 23, 43, 64]. We see examples of how these drivers are successfully stimulated through design, especially social support [39, 45, 67]. In 'RUFUS', supporters were enabled to cheer for runners participating in a running event from a distance [67], thus relying on social support of friends and family. Another approach was taken in 'Jogging over a Distance' [45], where support was enabled among runners themselves through a facilitated social experience, in which runners could hear each other's heartbeat. In 'Social Fabric Fitness', real-time run-tracking information was visualized on wearable displays, to support performance awareness and in-situ motivation among runners of a running group [39]. While these examples were successful in stimulating in-situ motivation and perseverance, for the most part, technologies aimed here to facilitate social support while running. However, lack of social support is primarily encountered prior to the exercise, affecting motivation negatively [51]. How technology can help amateur runners overcome barriers perceived beforehand (such as lack of social support) and positively influence the intention-behavior gap, needs further research. In this paper, we first investigate the influence of motivational barriers on amateur female runners. We then explore the barriers and enablers in runners' rituals and provide design

recommendations to support amateur runners in translating their running goals into actions.

3 METHOD

This work presents two complementary studies with the aim to investigate the temporal and contextual dynamics of motivational barriers and enablers that runners experience prior to, during and after running. We combined a survey ($N = 114$) and a journey mapping activity ($N = 13$). This mixed-method approach is used to provide a more complete and comprehensive understanding of how amateur runners perceive motivational barriers and enablers. In the studies, we recruited participants of a women-only running event that includes three distances: 5 km, 7.5 km, and 10 km. This type of running event is known for its non-competitive and low-threshold character, thus being attractive for amateur runners [61, 64]. Despite possibly having a clear goal setting of partaking at the running event, previous studies also indicate that event-runners still encounter motivational training barriers [22, 64]. By recruiting participants in the context of a low threshold running event, we targeted a rather homogeneous group of amateur runners.

4 STUDY 1

To investigate how barriers are perceived and explore if these lead to skipping a running session or are easy to overcome, we conducted a survey among participants of a popular women-only recreational running event hosted in Eindhoven, the Netherlands. In this survey, the goal was not only to see which barriers affect amateur runners most, but to put these barriers in perspective and investigate the design space of the intention-behavior gap for this target group.

4.1 Participants

All participants received an email from the event organizers two days after the event, including a link to an online questionnaire.

In total, 114 participants completed the questionnaire, distributed across different running distances: 5 km ($n = 45$), 7.5 km ($n = 27$), 10 km ($n = 40$), with a response rate of 11.4%. The participants were diverse in age, with 21.6% of the participants aged 20-29, 24.7% aged 30-39, 34% aged 40-49, and almost 19.6% above 50 years old. The average age of the respondents was 39.8 years ($SD = 11.3$). 17.8% of the participants indicated to run less than a year. 29% of the participants indicated to run about one or two years. The other 53.3% participants indicated to run for more than three years. 47.7% of the participants indicated to run 2 times a week in preparation of the event, 31.8% of participants ran up to once a week. The remaining participants ran more than twice a week (20.6%). 69.2% of the participants indicated running as their primary or only sport. For the remaining 30.8%, running was considered as an addition to their primary sport.

4.2 Procedure and Materials

In the survey, respondents were presented with four scenarios, each describing a potential barrier to go out for a run (Figure 1): Scenario S1) running partner cancels on running training, Scenario S2) poor weather conditions prior to the planned training, Scenario S3) relaxing on the couch prior to the planned training, and Scenario S4) experienced a stressful day prior to the planned training. The scenarios are not intended to cover all possible barriers, but rather to exemplify some common cases with varying degrees of user control (e.g., no control over bad weather versus internal control in the relaxing on couch scenario), chosen based on previous research [5, 42, 64, 65].

First, participants had to indicate how often the presented scenario occurred to them (*occurrence*). This question was set as a filter question, so that participants replying “never” were not asked the 3 following questions (Figure 2). Second, respondents were asked to indicate how often each of these potential scenarios were perceived

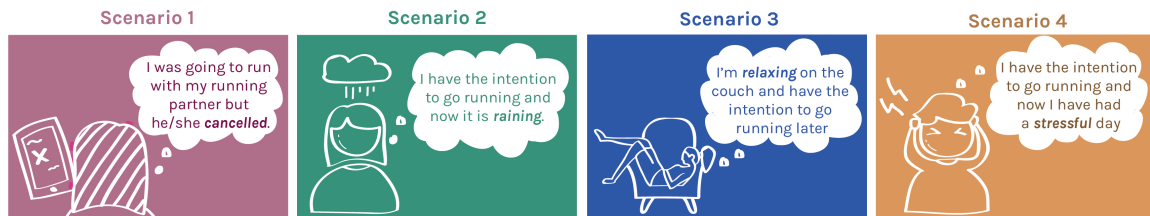


Figure 1: Four scenarios presenting possible barriers to go running

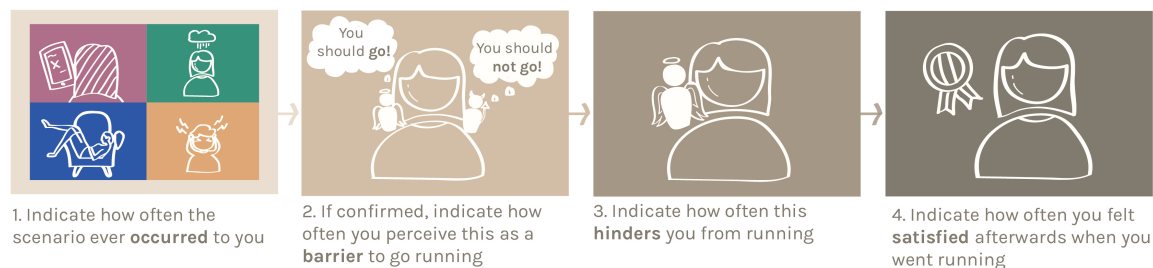


Figure 2: Flow of questions in the scenario-based survey

Table 1: Descriptive statistics of the four scenarios questions

Scenario	Question	N	Min	Max	Mean	SD
S1 Partner cancelling	Occurrence	106	1	4	1.56	0.78
	Barrier	42	1	5	1.98	0.78
	Action	42	1	5	3.50	1.17
	Satisfaction	43	1	5	4.51	0.77
S2 Bad weather	Occurrence	105	1	5	2.23	0.75
	Barrier	93	1	5	2.22	0.78
	Action	94	2	5	3.23	1.13
	Satisfaction	94	2	5	4.25	0.80
S3 Relaxing on couch	Occurrence	104	1	5	1.93	1.00
	Barrier	63	1	4	2.10	0.73
	Action	63	2	5	3.38	1.04
	Satisfaction	63	2	5	4.33	0.84
S4 Stressful day	Occurrence	103	1	5	2.56	1.14
	Barrier	83	1	5	2.20	0.97
	Action	85	1	5	3.49	1.15
	Satisfaction	85	2	5	4.39	0.77

as barriers to go running for them (*barrier*). Third, how often they still took the decision to go to their planned running session (*action*). Finally, the last question inquired about their satisfaction after running (*satisfaction*). The four questions were presented using a 5-point Likert scale format from 1 “never” to 5 “very often”, inspired by previous research on barrier frequency [13, 53].

4.3 Results

We present descriptive statistics related to the four scenarios and related variables (Table 1, Table 2).

4.3.1 Scenario Occurrence. Of the four presented scenarios, S4 Stressful day ($M = 2.56$, $SD = 1.14$) and S2 Bad weather ($M = 2.23$,

$SD = 0.75$) occurred on average the most frequently. A cancellation of a S1 Running partner, was experienced less often among the participants ($M = 1.56$, $SD = 0.78$). With 58.5% respondents replying that it never occurs, one could also assume that some of them do not have a running partner.

4.3.2 Barrier Occurrence. Most of the participants who declared experiencing the situations presented in the scenarios at least sometimes considered them as potential barriers for running. S2 Bad weather ($M = 2.22$, $SD = 0.78$), S4 Stressful day ($M = 2.20$, $SD = 0.97$) and S3 Relaxing on couch ($M = 2.10$, $SD = 0.73$) were perceived as a barrier more often than S1 Partner cancelling ($M = 1.98$, $SD = 0.78$). For all the barriers, the most common answer option was

Table 2: Distribution of answers related to the four scenarios and related variables.

Scenario	Question	Never	Sometimes	Regularly	Often	Very Often
S1 Partner cancelling	Occurrence	58.5%	31.1%	6.6%	3.8%	0%
	Barrier	21.4%	66.7%	7.1%	2.4%	2.4%
	Action	2.4%	23.8%	19.0%	31.0%	23.8%
	Satisfaction	2.3%	0%	2.3%	34.9%	60.5%
S2 Bad weather	Occurrence	9.5%	66.7%	16.2%	6.7%	1.0%
	Barrier	9.7%	68.8%	14.0%	5.4%	2.2%
	Action	0%	38.3%	16.0%	29.8%	16.0%
	Satisfaction	0%	5.3%	6.4%	46.8%	41.5%
S3 Relaxing on couch	Occurrence	38.5%	42.3%	8.7%	8.7%	1.9%
	Barrier	17.5%	60.3%	17.5%	4.8%	0.0%
	Action	0%	22.2%	36.5%	22.2%	19.0%
	Satisfaction	0%	6.3%	4.8%	38.1%	50.8%
S4 Stressful day	Occurrence	14.6%	45.6%	15.5%	17.5%	6.8%
	Barrier	19.3%	56.6%	12.0%	8.4%	3.6%
	Action	1.2%	25.9%	18.8%	30.6%	23.5%
	Satisfaction	0%	3.5%	7.1%	36.5%	52.9%

“sometimes” (ranging from 56.6% of responses for S4 to 68.8% for S2).

4.3.3 Overcoming Barriers: Transforming Intention into Action. Bi-variate correlation analyses were performed to study the relationships between the variables of each scenario. *Barrier* and *Action* were significantly and negatively correlated in all four scenarios, with the highest correlations for S2 Bad weather ($r = -.556, p < .000$) and S1 Partner cancelling ($r = -.439, p < .000$). The more frequently bad weather or a partner cancelling are perceived as a barrier, the less people tend to transform their intention into action. Correlations for S3 Relaxing on couch ($r = -.339, p < .000$) and S4 Stressful day are moderate ($r = -.268, p < .000$). More than half of the participants who declared to experience S1 Partner cancelling or S4 Stressful day as a barrier, indicated to still go for a run “often” (31.0% S1, 30.6% S4) or “very often” (23.8% S1, 23.5% S4). When experiencing S2 Bad weather as a barrier, the most common option in terms of action was to go running “sometimes” (38.3%).

4.3.4 Satisfaction. In all scenarios, the satisfaction level was higher than 4 on average. *Action* and *Satisfaction* were significantly correlated in all four scenarios, with the highest correlation for S3 Relaxing on the couch ($r = .543, p < .000$). The more frequently S3 Relaxing on the couch was considered as a barrier to go running, the more satisfied they are after they went running.

4.3.5 Socio Demographics. When studying socio-demographic variables and their relation to obstacles and doubts, we see that age is only correlated with having experienced S3 relaxing on the couch ($r = -.343, p < .000$) or a S4 Stressful day ($r = -.210, p < .000$) but not correlated to any variables related to intention or action. These results suggest that it might not be relevant to differentiate women according to their age when it comes to motivational strategies pertaining to these factors and we will not consider age as a relevant variable in this study.

4.4 Insights

Results of the first study underline that the moment prior to running is of influence on the actual running session. In the results we see moderate to high correlations between women considering the scenarios as a *Barrier* and eventually turning their positive intention into *Action*. The results of *Satisfaction*, and the high correlation with S3 Relaxing on the couch, also suggest that being able to overcome an internally induced barrier might add to the feeling of satisfaction. Overcoming external barriers might give slightly less satisfaction since these are considered to be out of one's control.

The results of the study also confirm that when someone perceives a barrier, it does not always hinder one from running. Even when considering a scenario as a barrier, there were still times when that person went for a run. A barrier should thus not be systematically considered as a blocking issue, and this calls for additional investigations on the conditions under which a barrier is blocking or might be able to overcome. On a similar note, the relatively high proportion of “sometimes” for all barriers hints at the fact that such surveys, while common in the literature, do not reflect the complexity of barriers and enablers experienced prior to exercising, and their impact on turning intentions into actions. To understand the interplay between contextual elements and factors playing a role



Figure 3: Participant visualizing her session by use of the mapping board

in the decision-making process besides the presented barriers, we combined our survey with qualitative research on runners' rituals.

5 STUDY 2

The first study suggests that when someone experiences a barrier, it does not automatically mean one will cancel the running session. How factors or contextual elements play a role in this decision-making process is still unclear and is difficult to assess in-depth with a survey. Because the investigated barriers in Study 1 were rather generic, gaining a more thorough understanding to address specific dilemmas was an essential endeavor. In Study 2, we conducted a journey mapping activity [27] to gain in-depth insights into the mechanisms behind barriers and enablers. To structure the activity, we provided participants with a journey mapping board along with 32 accompanying tokens representing daily and running-related actions on pictograms (Figure 3). By using the board, it was possible to easily compare the outcomes of the journey maps among the participants.

5.1 Participants

The mapping activity was held with 13 participants recruited during a non-performance women-only running event, distributed across different running distances: 5 km ($n = 8$), 7.5 km ($n = 2$), 10 km ($n = 3$). These participants were different participants than those who completed the survey of Study 1. The participants were diverse in age, with five (P6, P7, P9, P12, P13) between age range 20-29, five aged 30-39 (P1, P2, P3, P10, P11), and three above 40 years old (P4, P5, P8). About half of the participants did run for over a year, the others for 3 months or less (P2, P5) or between 3-6 months (P9, P13). Except for two participants (P13, P11) training less often, all women run 2 times a week in preparation of the event. Half of the participants indicated running was not their primary sport and was considered as something additional to their other sport.

5.2 Material and Procedure

The mapping board allowed participants to create a complete overview of their activities prior to, during and after a running session. We decided to first map the activity journeys to later focus



Figure 4: Example of activity mapping board of P9 reporting on her journey

on specific pain points indicated by participants. Participants placed the tokens on a timeline to sketch their activities and represent their individual running journey. The tokens varied from running-related characteristics (e.g., running individually or with a partner, wearing an activity tracker, running with music) to more general activities (e.g., showering, looking into the mirror, getting dressed, relaxing on the couch), and included the four variables presented in Study 1. Besides using the tokens, participants could add new activities with a marker. To get more insights on how these activities acted as barriers or enablers, participants were asked to elaborate on that verbally. Finally, we asked participants to draw a graph of how they felt during and after their run (“emotion timeline”) and to relate this graph to the activities presented on the action timeline. An example of a participant’s mapping board is shown (Figure 4).

During the mapping activity, the researcher acted as a moderator, using open-ended questions and inviting participants to think aloud. The journey mapping activity lasted approximately 15 minutes. Audio was recorded and transcribed and the participant’s reported journeys were captured after each session. The transcriptions of the interviews were manually coded based on a coding framework that was developed inductively, searching for overlapping patterns and similarities. Additionally, a content analysis of verbatims through the lens of emotion families was conducted by the first author using the Positive Emotional Granularity Cards [68] and Negative Emotion Typology [10]. The coding frame and the content analyses were checked by the members of the research team.

5.3 Results

We identified several patterns comparing the different phases of the run (Figure 5), and participants reported the emotions associated to their activities.

5.3.1 Planning of the Run. Results show different patterns related to the planning of running sessions. Some participants indicated having ‘fixed’ days to go running, while others were used to set the intention to go the day before: “I always prepare my clothes one day before” – P8. A third group of participants indicated to decide on the day itself: “I decide to go running in the morning. Most of the

times when I intend to go running I go immediately in the morning otherwise the chance exists I’m not going anymore” – P13 or even throughout the day: “I don’t wake up and think: I’m going to run today. The moment I decide is often throughout the day” – P11.

5.3.2 Rituals Prior to Running. An analysis of ritual elements prior to running showed similarities among the participants. Twelve participants out of 13 indicated to change their hair in a more convenient hairstyle, like a ponytail or a bun. For five of them, this was accompanied by putting on more deodorant and for a few, a moment to retouch their make-up. One of the participants apologized for these rituals: “Oh that’s so bad, I’m such a vain runner” – P11

A vast majority (12 out of 13) also indicated to take an extra look in the mirror before heading out for running. This happens often after they have changed into their running gear (clothes and shoes). One woman emphasized how she gains strength and confidence from this ritual: “I look in the mirror to gain a bit of power.” – P8

Data also shows that 11 out of 13 participants mentioned being hesitant prior to their run (varying from “sometimes” to “very often”) and that these doubts disappeared right before or while they got dressed, as illustrated by the following quotes. “The doubts disappear right before I’m getting dressed because when you are dressed, you will go” – P9, “Once I’m dressed, the doubts aren’t high anymore” – P4, “When I’m dressed is when I’m certain I will go. Before that I collect all my courage to go” – P13

From these participants, seven noted that these doubts already occur for a long period prior to the run - “I experience doubts over the entire day, until the moment I decide to get dressed” – P10. Or that they were hesitating due to the planning of the partner: “Depending on when my partner gets home to take care of the children, I’m able to go for my run.” – P11

Four other women indicated that doubts did not arise until right before the moment they got dressed and they use a personal mantra to motivate themselves and overcome these doubts: “Getting dressed is the hardest. Once I’m in my sports gear, I say to myself: Okay, I’m wearing my clothes, so I will go out the door and then I’m going to run” – P6 “I just think to myself like: I need to go. So that is what I say to myself: I just have to go” – P10

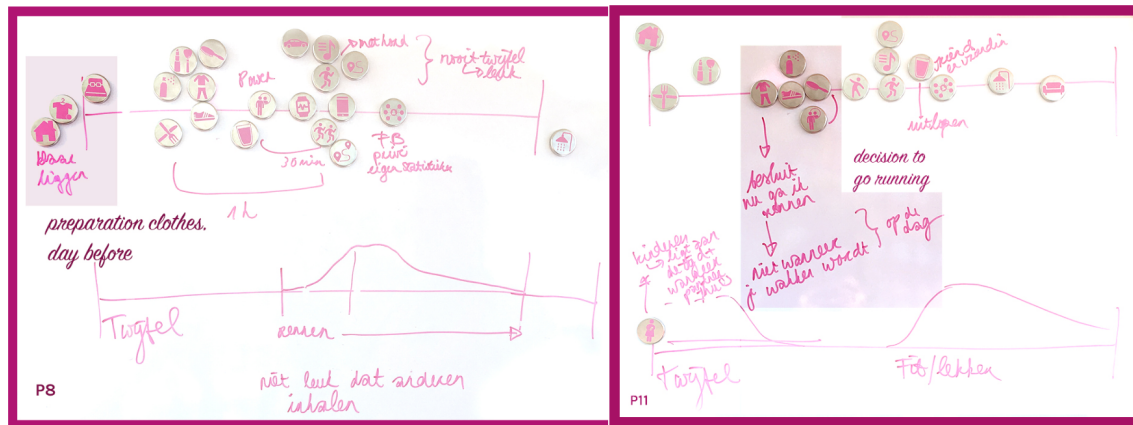


Figure 5: Running Journey of P8 and P11, highlighting the moments when they decide to go running

Only one participant indicated that she never experienced doubts beforehand because she had a special reason to participate in this running event that raised money for breast cancer: “I never hesitate to go running, because I really have a good goal. I started 12 weeks ago and one of my friends has breast cancer and when I saw this event I was like; I’m going to do this! When I couldn’t even run for one meter yet.” – P5

5.3.3 During the Running Session. The participants sketched their running session using the following elements in their journeys: planning their route, listening to music, making use of an activity tracker or phone, running individually or with a running partner, and activities such as stretching. In total, twelve participants carry their phone while running, of which seven participants also wear an activity tracker. Only one participant ran without tracking the run: “I just go running with my music and I keep track of the time and that’s it” – P11

Eight participants are running without a predetermined route, with almost all participants who indicated to run individually being in this category. Ten participants specified that they also include stretching in their session: half did it before, half did it after running. This was not related to the fact of running individually or with a partner.

Several participants reported feeling frustrated and insecure during the run itself: “When I run in a group, I don’t feel good during the run: I do my best for full 1000% but I’m always last, I try to see improvement but I really get desperate that people of 80 pass me by while I’m so tired I even get nauseous” – P8. These feelings were especially present at the start of the effort, yet turned into more positive feelings, such as feeling energetic, towards the end of the run.

5.3.4 After the Running Session. Almost all participants indicated feeling good, happy or more fit after they went for a run: “After running, I’m always proud of myself. It differs during running. Sometimes I’m like, this feels good and sometimes I’m like, what am I doing?” – P10. However, 8 out of 13 participants explicitly stressed that this rewarding feeling appears after the run only: “Afterwards I feel really good. While running not really, not in the beginning at least” –

P4, “During running I think like; why am I doing this to myself but afterwards I really feel fit” – P11 “Especially after, during the run a bit as well, but especially after the run” – P9

When asked how long this feeling lasts, one woman noted that this depends on the actions she does afterwards: “It depends how long this rewarding feeling remains, if I open up a bag of chips then it goes down again” – P10

Of the five participants who already started to feel good during the run, four indicated to run with a predetermined route. Of the eight women who started to feel good only after the run, seven women run without a predetermined route.

Only one of the participants who runs individually (out of five) indicated to feel good during the run. The other four were running with a partner, this is half of the women who were running with a partner. Seven out of 13 participants indicated to relax on the couch after their run rather than doing other activities (e.g., eating, showering). Except for one, all these women indicated to not feel good during their running session.

Further analysis of the data also shows that a majority of participants, 10 out of 13, shared their running achievements with someone (via WhatsApp, Snapchat, Strava and/or in-person with a friend or partner). This includes all the participants who run individually. The two participants who always run with a partner do not share their session with others.

5.3.5 Emotion Analysis. By using the Positive Emotional Granularity Cards [68] and Negative Emotion Typology [10], we conducted a content analysis of the results of study 2 through the lens of emotions. We present each emotion family with its related valence and definition, as well as an illustrative verbatim and the phase in which it occurs (Table 3).

6 THE RUNNER’S JOURNEY

Aggregating our findings, we created the Runner’s journey (Figure 6), a visual representation of our participants’ rituals articulating the different stages of the journey along with actions, thoughts and emotions. Journey mapping is a designerly way to communicate participants experiences and pain points, and mine these for design opportunities [60]. This approach is originally a service design

Table 3: Emotion families described with the valence, definition [10, 68], illustrative quotes and phase

Emotions	Valence	Definition	Illustrative Quote	Phase
Anticipation	+	to eagerly await an anticipated desirable event that is expected to happen	<i>Every time I notice I become fitter while running, so then I also feel fitter and then I want to pursue that – P9</i>	Planning
Doubt	-	the feeling when you have to do something, but there is more than one course of action to choose from. You don't know which option you should choose	<i>I experience doubts over the entire day, until the moment I decide to get dressed – P10</i>	Getting Ready
Courage	+	to experience mental or moral strength to persevere and withstand danger or difficulties	<i>I look in the mirror to gain a bit of power. – P8</i>	Pre-running Ritual
Confidence	+	to experience mental or moral strength to withstand or cope with the situation	<i>Once I'm in my sports gear, I say to myself; Okay, I'm wearing my clothes, so I will go out the door and then I'm going to run – P6</i>	Pre-running Ritual
Frustration	-	the feeling when you want to achieve something, but find your action blocked	<i>When I run in a group, I don't feel good during the run: I do my best for full 1000% but I'm always last, I try to see improvement but I really get desperate that people of 80 pass me by while I'm so tired I even get nauseous – P8</i>	Running
Insecurity	-	the feeling when you are uncertain about their ability to do something or to measure up to a certain standard	<i>During running I think like "why am I doing this to myself?" – P11</i>	Running
Energetic	+	to enjoy a high-spirited state of being energized or vitalized	<i>Sometimes I'm like, "this feels good!" – P10</i>	Running
Satisfaction	+	to enjoy the recent fulfillment of a need or desire	<i>Afterwards I feel really good. While running not really, not in the beginning at least – P4</i>	After Running
Pride	+	experience an enjoyable sense of self-worth or achievement	<i>After running, I'm always proud of myself – P10</i>	After Running
Relaxation	+	to enjoy the recent removal of stress or discomfort	<i>When I get home from running I really take it easy and I only take a shower 2 hours after – P8</i>	Post-running Ritual
Guilt	-	the feeling when you think you have done harm to someone. You blame yourself and cannot stop thinking about this	<i>It depends how long this rewarding feeling remains, if I open up a bag of chips then it goes down again – P10</i>	During the Day

method, used by design practitioners to synthesize the findings of user research and communicate with the team, to eventually empathize, ideate and find actionable solutions to the presented pain points [33, 60].

Previous design research related to sports and exercise mainly focuses on the exercise itself [62] and offers a limited perspective on the motivational challenges prior to or after exercising. The results of our studies suggest that a broader perspective towards running in everyday life rituals is needed, since the phases prior to and after the run influence the run itself. We thus distinguish three stages in the Runner's Journey: Before, During and After running. In this figure, we visualize the running timeline including runners' steps and actions. In Study 2, we identified positive and negative emotions [10, 68] experienced by the participants through their journey. To indicate the strength of emotions, expressed by either

the occurrences or emphasis put on a specific emotion family during the mapping activity, we visualize the emotions through curves. Illustrative quotes representing these emotions are presented in the top layer of the Runner's Journey under the label "thoughts".

Along with our multidisciplinary research team (composed of researchers and students in industrial and UX design, psychology and sport studies), we used the Runner's journey and the underlying narrative as a source of inspiration. We brainstormed on design opportunities and made first explorations of the design space, which we developed further by adopting a Research-through-Design (RtD) approach [69]. Five design concepts are used as illustrative cases in the discussion section, of which four were designed at the department of Industrial Design, Eindhoven University of Technology. Design recommendations derived from these design processes are visualized at the bottom of the Runner's Journey.

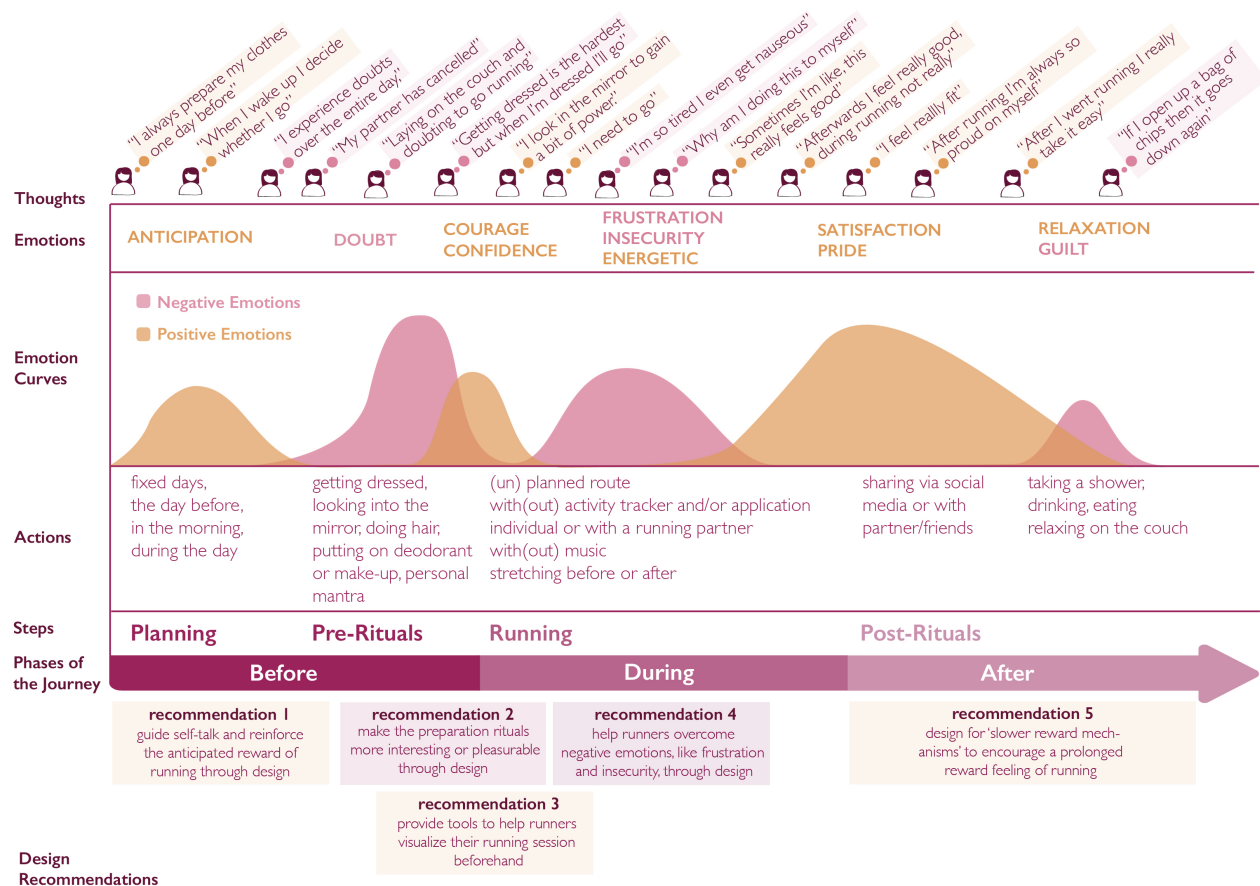


Figure 6: The Runner's Journey, a narrative visualizing turning points of emotions and actions over time

7 DISCUSSION AND DESIGN RECOMMENDATIONS

In this section, we discuss findings and recommendations supported by the Runner's Journey in light of previous work. We propose five design recommendations that make use of identified opportunities prior to, during and after a running session. These recommendations focus on supporting runners in overcoming barriers or on the reinforcement of facilitators. We exemplify them through design examples and explain how theories in design or sport psychology can help address these. These design examples are not suggested as the 'right' solutions addressing the design recommendations, yet are illustrations meant to bolster the recommendations and to inspire further ideas.

7.1 Guiding Self-Talk to Overcome Doubts prior to the Run

Going for a run is part of a goal-setting process that is sometimes initiated days in advance under the form of an intention, which is pending until someone turns it into action and goes for a run. At any moment, unexpected information such as weather reports, cancellations of co-runners or a runner's perception of their own well-being can influence this decision process [40, 42, 44, 65]. Although the

Runner's Journey shows that the planning of a running session often begins with positive anticipation feelings, this is often followed by feelings of doubt expressed under the form of self-talk. Self-talk is defined as "a dialogue in which an individual interprets feelings and perceptions, regulates and changes evaluations and convictions, and gives himself/herself instructions and reinforcement" [16]. As seen in study 2, the runner questions herself whether she should stay or should go. In sport psychology, self-talk is used for both motivational (e.g., arousal or drive) and cognitive purposes. Several exercisers indicated using self-talk in order to talk themselves into going to their workouts ("that is what I say to myself: I just have to go" - P10) and this appears as an important tool for encouraging individuals to exercise [12]. In these moments, runners counterweigh the expected benefits against the perceived barriers from running [40, 42]. An important design challenge lays in shifting this self-talk towards the anticipated benefits of running instead of the perceived barriers, as well as influencing the valence of the self-talk content from doubt to confidence. Currently, some runners do this already by using a personal mantra to motivate themselves by encouraging positive emotions (like courage, energy and confidence). The anticipated benefits of running can be amplified in self-talk through design.

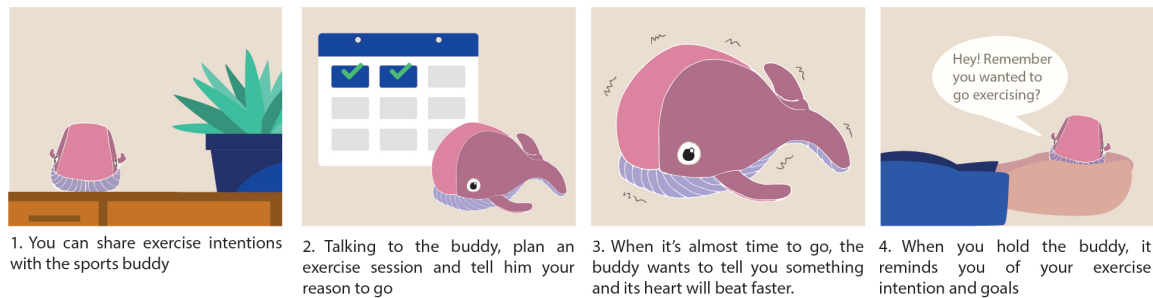


Figure 7: The sports buddy stimulates positive self-talk by reminding users of their goals and anticipated feelings of satisfaction. Design by Alynne de Haan, supervised by Daphne Menheere & Carine Lallemand

Design recommendation 1: Guide self-talk and reinforce the anticipated reward of running through design

Illustrative design concept: An interactive sports buddy starting this dialogue (Figure 7) might help shifting this self-talk to an actual one, stimulating anticipation feelings and thus contributing to outweighing enablers over barriers. To measure whether the buddy is being held, the Hexiwear prototyping tool can be used, with an integrated accelerometer, vibration motor, Bluetooth low energy and a built-in battery. Another strategy could consist of decreasing the amount of negative self-talk [17] through an interactive device supporting self-awareness and reverse listing those negative thoughts.

7.2 Supporting Running Preparation Rituals

The Runner's Journey illustrates that the doubts experienced prior to the running session have a certain time span; they do not just appear at one moment. A clear tipping point in the narrative is visible during the Pre-Rituals phase prior to the session, where after getting dressed, the likelihood of going for a run is high ("when you are dressed, you will go" - P9). This preparation phase entails the highest amount of doubts and contains different personal rituals. This offers many opportune moments for a design intervention: as emphasized through the mapping activity and in line with previous work [42], several objects are embedded into the pre-running rituals, such as the mirror ("I look in the mirror to gain a bit of power" - P8), the closet or the sports clothes ("I always prepare my clothes one day before" - P8). Lowering the threshold of doing these rituals or even making them more pleasurable to do, could in turn lower

the threshold to go running. It is possible to provoke curiosity or turn interactions like getting dressed into a game, which is a successful intention to action strategy highlighted in previous research [37]. In design, the aesthetics of friction and underlying concept of Pleasurable Troublemakers can also offer a relevant direction to support running preparation rituals. In 'Keymoment' by Laschke et al. [34], a key holder suggestively let the bicycle key fall on the ground as the car key are taken, thus disrupting the routine and offering an alternative in line with an ideal self. In the running context, the preparation phase seems to be under-explored by designers yet; although users described it as a tipping point to go running or not.

Design recommendation 2: Make the preparation rituals more interesting or pleasurable through design

Illustrative design concept: An interactive clothes hanger that persuades the user to change into their sports outfit (Figure 8). The user hangs their sports clothes on the hanger, which detects running intentions via a connection to the users' calendar. Along the day, the hanger will slowly start shrinking by connecting the arms of the hanger to servomotors. If the user takes off the clothes to go exercising, a motivational quote will appear on an integrated e-ink screen. However, whenever the sports clothes are not taken off on time, the size of the hanger will reach a point where the sports clothes fall on the ground.

7.3 Imagining the Running Session Beforehand

In the Runner's Journey, we see that runners feel energetic towards the end of the running session, usually after overcoming frustration

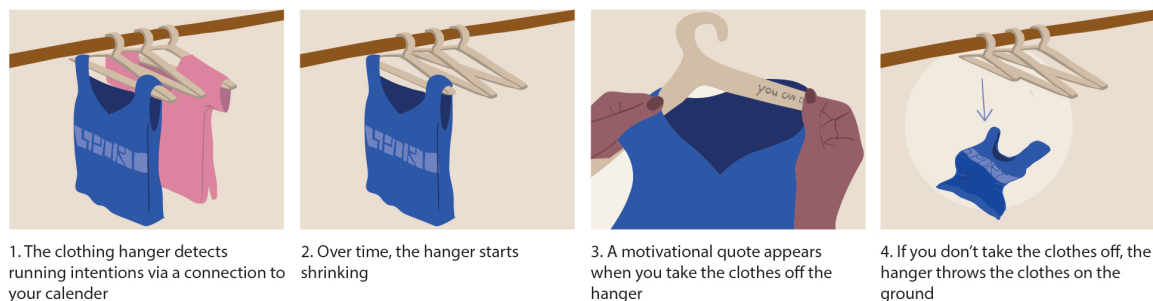


Figure 8: The interactive clothes hanger is a pleasurable troublemaker, acting during the preparation ritual. Design by Alynne de Haan, supervised by Daphne Menheere & Carine Lallemand

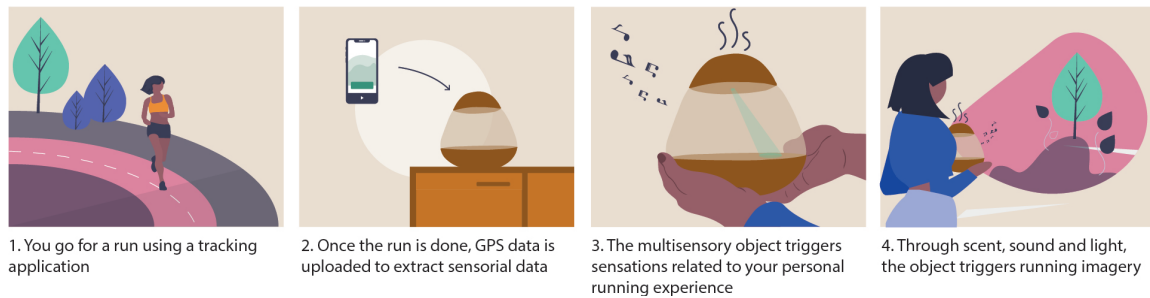


Figure 9: The multisensory running artefact triggers exercise imagery to help runners visualize their session beforehand. Design by Marleen Luijten, Floren van Barlingen & Midas Zegers, supervised by Daphne Menheere & Carine Lallemand

and insecurity. Reminding runners of this good feeling prior to the session could thus be a positive endeavor to overcome barriers. Sport psychology introduced a powerful intervention technique to stimulate this energetic feeling, called ‘exercise imagery’ [19]. Exercise imagery is originally used by athletes to enhance their performance by mentally visualizing their session beforehand. Yet it can also make a beneficial contribution to exercise participation among sedentary individuals [32]. In recreational sports, exercisers may imagine themselves participating in exercise, enjoying their workouts, and achieving their desired exercise goals upfront. Within exercise imagery, ‘energy imagery’ refers to mental images related with increased energetic feelings and stress relief [14]. To trigger imagery, different sensations like hearing (e.g., one’s footsteps on various types of soil) and seeing (e.g., the scenery of the run) may be encouraged [19]. While the cognitive aspects of exercise imagery have led to technological development, such as computer-aided imagery [47], the component related to feelings is currently underexplored in technology design, especially for recreational exercisers. Through design, the positive sensations related to running can be triggered on moments beyond the run itself, and eventually stimulate energy imagery.

Design recommendation 3: Provide tools to help runners visualize their running session beforehand

Illustrative design concept: A multisensory object that triggers sensations related to one’s personal running experience (Figure 9). In between runs, the object will play the sound of your footsteps and environment depending on the previous running route. The object will also diffuse nature-related scents (e.g. trees, mud, grass) and use light patterns to trigger running imagery.

7.4 Overcoming Negative Emotions while Running

The Runner’s Journey portrays a mixture of negative (frustration and insecurity) and positive emotions (energetic) during the running stage. Even when the runner turns their positive intentions into action, the run itself might still be considered as a burden (e.g., nauseous, too hard). This is in line with previous research indicating exercising can be considered as a short-term cost [7, 8, 56], which might adverse the enjoyment of running itself [38]. Although this challenge has been previously addressed in HCI research [1, 18, 24, 45, 66, 70], further explorations on how to leverage that critical phase of the Runner’s Journey can be pursued. Our

findings emphasized that these detractors might result in the cancellation of the training, when anticipation of negative emotions might overshadow the positive emotions experienced right before. Since people’s expectations influence new experiences, being positive can increase the likelihood of a positive experience. This so-called placebo effect has been successfully influencing exercise behavior before [2], indicating the importance of such a mind-set shift during running.

Design recommendation 4: Help runners overcome negative emotions, like frustration and insecurity, experienced while running through design

Illustrative design concept: An existing concept on the market addressing that design challenge is ‘Zombies Run!’ [70], a gamified application immersing the runner in a post-apocalyptic environment. Hearing their mission and music through headphones, the player must avoid zombies and collect goods to survive. Gamifying the running effort transforms negative emotions into positive feelings.

7.5 Prolonging Reward Feelings through Slow Reward Mechanisms

The Runner’s Journey emphasizes the high satisfaction and pride feelings runners retained from running. Whereas these feelings are strong right after the end of a session (“*after running, I’m always so proud of myself*” – P10), they quickly fade over the course of the day. An opportunity would be to make these feelings last longer, possibly carrying into the next preparation phase of a running session. This is described as a “slower reward mechanism” by Stusak et al. [58], who designed activity sculptures – 3D printed physical visualization of running data - provided feedback on the run with a delay of two days. By incorporating this delay, participants were reminded of their proud feeling again, making this feeling last longer. By realizing a “slower reward mechanism” the timeline of the running session is also stretched, making it unclear when a session ends and begins again, or maybe overlaps. This is an interesting perspective as compared to the continuous stream of data provided by current applications, being just a glance away [15]. Here, slow reward mechanisms or delayed feedback offer the possibility of anticipation and speculation of the feedback and enable to focus on the present activities [29, 59]. Shape-changing interfaces allow for this type of delayed feedback mechanism thanks to their dynamic, tangible and long-term interaction opportunities [3].

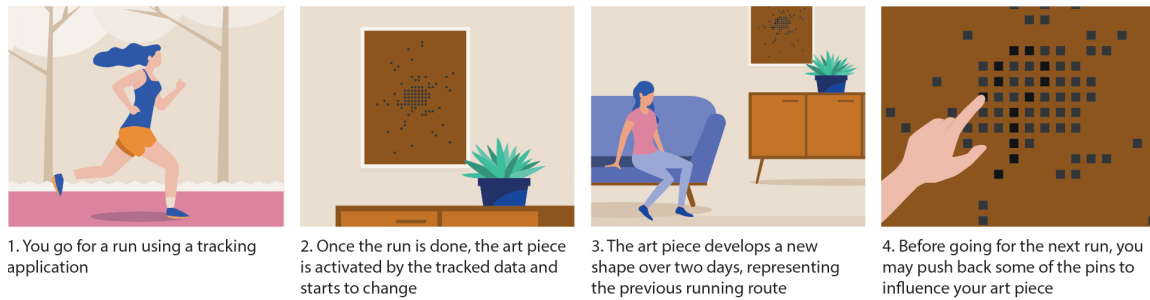


Figure 10: The shape-changing art piece includes a slow reward mechanism, providing exercising feedback over the course of two days. Design by Mads Birkebæk & Evianne van Hartingsveldt, supervised by Daphne Menheere & Carine Lallemand

Design recommendation 5: Design for ‘slower reward mechanisms’ to encourage a prolonged reward feeling of running

Illustrative design concept: An art piece, including a shape-changing interface, visualizing previous running routes over two days (Figure 10). Connected to the user’s fitness activity platform, the art piece changes shape, creating a data physicalization pattern related to the last running route. To change shape, a linear actuator motor is controlled by two stepper motors, pushing out the individual pins. By visualizing the stacked routes, runners are encouraged to adjust their art piece by going to further runs, perhaps taking other paths.

Eventually, the Runner’s Journey is a cyclic process, where rewarding feelings after the run and anticipation feelings prior to the next run connect. In the long term, the positive consequences of exercising further reinforce the motivation to run and reduce the influence of barriers: “Every time I notice I become fitter while running, so then I also feel fitter and then I want to pursue that” – P9.

7.6 Additional Insights

Further insights can be derived from the Runner’s journey, which are not emphasized in our recommendations. This is the case for social support as an enabler, visible in the post-running rituals of sharing achievements on social network, as well as the barrier provoked by the cancellation of a running partner. Social aspects are already covered quite well in running technology, especially in smartphone apps and social networks. They could be further explored when it comes to the design of tangible running devices, as illustrated by the Grace bracelet of Menheere et al. [41], which enables to share exercise intentions with friends who in turn send encouraging non-textual signals. Away from text messages or supportive emojis, this design exploration using tangible interactions modalities also stresses the importance of the aesthetics of interaction (e.g., design for gracefulness) as a motivator and call for further research in this area.

Relying on family support, TickTockRun by Knaving and Wóznia [31] provides a screen-based data visual of tracked running and daily activities to stimulate discussions within a household. The success and wide adoption of activity tracking technology, as observed in Study 2 and aligned with current market studies, should be regarded as an opportunity for designers. User-generated data can be used as a valuable input: the interactive devices we design will thus easily be aware of users’ behaviors, their progress or the

disruption of their running routine. This awareness can be used to provide tailored feedback and encouragement at the opportune time, as illustrated through our examples of the shape-changing art piece using data physicalization or the multisensorial artefact that triggers exercise imagery, both being based on data extracted from the running platform account of the users.

8 LIMITATIONS

Our studies entail some limitations. As part of our sampling strategy, we selected participants in a women-only running event. Yet these runners might not be representative of all runners experiencing motivational loss: first by presumably representing only one gender identity on the gender spectrum, second because they had a clear goal setting to participate in a running event and achieved their objective. Our participants nevertheless experienced barriers prior to their running sessions, which sometimes hindered them from going for their run. If these barriers are experienced within this group of runners, we can assume an even stronger experience of barriers and doubts among runners without clear goal setting strategies. Relying solely on retrospective self-reported data is another limitation of the present studies, which do not inform on participants’ actual running adherence. Although the Runner’s Journey was based on the two presented studies, the first study was limited in insights, but acted as a preliminary step to gain a more thorough understanding and address specific dilemmas in the second study. Through the design explorations and concepts which we developed and prototyped, we intend to investigate the topic in-situ to further understand how contextual factors influence barriers and facilitators, and to which extent these prevent amateur runners from turning their intentions into actions.

9 CONCLUSION

In the present paper, we combined an online survey and a journey mapping activity to investigate the influence of motivational barriers and enablers in amateur runners’ rituals. Based on our findings, we created the Runner’s Journey, a visual narrative highlighting actionable design opportunities for running motivation technology. We propose five design recommendations for the design of technology aimed at overcoming barriers among amateur runners and illustrate how these can lead to interesting design concepts. Although the market offers a myriad of running-related devices that aim to motivate runners during the run, the needs are high to

support amateur runners prior to exercising. The goal is to support exercising motivation and to reduce unhealthy sedentary behaviors, thereby complementing existing families of interventions to increase physical activity [26] with more specific and tailored individual design interventions. We encourage the HCI and design community to use our insights to develop and test new interactive devices to achieve these objectives.

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