







# Notifying Users: Customisation Preferences for Notifications in Health and Well-being Applications

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**Abstract.** In mobile technologies for health and well-being (mHealth), push notifications are a widely used tool to implement persuasive strategies. However, little research has been carried out to investigate the impact of notifications in such technologies and users' attitudes towards them. In this study, we address this gap by exploring the role of notifications and their customisation in the context of mobile applications that promote social and mental well-being. Based on observational data collected from 152 participants, we investigate users' attitudes and preferences towards notifications. Moreover, we explore how users' attitudes towards notifications differ along demographic dimensions. Our findings show that customisation of notifications is a desired feature that can be used to improve the persuasive aspect of mHealth applications.

Implications derived from our study can provide guidance for researchers and practitioners alike when designing app notifications to create better motivating, meaningful, and persuasive experiences.

## 1 Introduction

Mobile technology solutions for health and well-being (mHealth) often implement persuasive strategies in their design to keep the users engaged and motivated, and induce behaviour change efforts [31]. These strategies are integrated into the various interface elements of the respective applications and include diverse approaches, such as personalisation, self-monitoring, commitment, and reminders.

With the ubiquity of smartphones, push notifications present a convenient and commonly utilised vehicle for implementing such strategies, as they can help engage users in everyday contexts, evoke immediate action through reminders, motivators and nudges, and support sustained behaviour change and habit formation.

Despite a large amount of research on behaviour change strategies in persuasive technology, little is known about the role notifications play in such systems, how users perceive them, or how they should best be delivered.

In the persuasive technology domain, notifications have primarily been explored in terms of content personalisation and delivery optimisation [17, 26],

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while information on attitudes, customisation preferences and best design practices are limited. In these areas, insights mostly come from research that tends to be either general or about specific domains, such as marketing and advertisement [41]. Arguably, these insights do not necessarily transfer to solutions that aim to increase users' health and well-being, as they are guided by different purposes and motivations.

In this study, we aim to address the mentioned gap by exploring the role of notifications and their customisation by mapping the insights to support healthy activities and well-being support. To achieve this, we have formulated four research questions.

*RQ1: What are users' attitudes and practices regarding notifications?*

*RQ2: What are users' attitudes and practices regarding notifications in health and well-being apps?*

*RQ3: Which customisation features do users deem most useful?*

*RQ4: To what extent do the aforementioned attitudes and practices differ between user groups?*

The contributions of this paper are threefold. First, this work will contribute to persuasive research by examining the role of notifications in mHealth applications and how different user groups respond to them. Second, our study will provide insights into the users' attitudes toward notifications. We will examine how users' attitudes impact the perceived usefulness of notifications and the role of customisation in increasing their acceptance. Third, the results of this work will inform the discussion on future designs of notifications for mHealth and persuasive technologies.

## 2 Related Work

### 2.1 Push Notifications

Estimates of the average number of push notifications that smartphone users encounter range within a few dozen per day [1,6]. However, the number significantly varies between users, as they interact with different apps, use different settings, and exhibit different interaction patterns.

Notifications also vary in their purpose and content. While some notifications might only passively provide the user with certain information, others intend to elicit a response, commonly by encouraging the user to engage with the sending application. The user's reaction to the notification depends on various factors, ranging from contextual considerations, such as timing and location, to the user's relationship and attitudes towards the sender or source application [27,39].

Attitudes towards push notifications are often negative, as they can be regarded as annoying or distracting, especially when triggered too often and in inopportune situations [10,16,26,42]. In general, notifications are perceived

to be most useful and elicit the most frequent and fastest responses if they pertain to communication with real people (e.g., from messaging apps) [27, 33, 39]. The perceived usefulness of some notifications is also what offsets some of the negative attitudes in general, as users do not wish to miss important information [9].

Regarding setting preferences, research has shown that, in most cases, users tend to accept default options, or if they don't, they usually do not implement further changes once they have been initially set [33, 40]. It should be noted, however, that this does not necessarily entail satisfaction with the settings, as users might not wish to put in the effort needed to find the optimal solution [39].

To provide the best experience and outcomes for the users, guidelines for designing notifications suggest that they should provide explanations on their nature, as well as customisation features, such as opt-out and opt-in options and preference settings [39].

## 2.2 Notifications in Applications for Health and Well-Being

In the context of applications for health and well-being, several works have illustrated how notifications can positively impact users' adherence and commitment to the intervention programs [2, 12, 15].

Whether notifications could be intended for any purpose that aims to bring the users' attention to the solution, a comprehensive review of persuasive strategies in mHealth applications primarily identified their role in delivering reminders, for example, to exercise, meditate, or track food, drink, and medicine intake [31]. Reminders help keep the users engaged [2], which is particularly important in regard to the formation of habits, as for most behaviour change interventions, sustained engagement is required for positive outcomes.

In the field of persuasive technology, notifications are also often utilised as a vector for delivering motivational messages. This topic is of particular interest in the research of personalising persuasive strategies and represents a valuable effort, as motivation is an essential prerequisite for change in behaviour [8, 29].

Another stream of research in the field regards optimizing the delivery of notifications, be it in terms of timing, frequency, or context [27, 28]. Such research aims to automatize the detection of opportune situations for engagement and personalise the interaction patterns to best fit individual users. This too, is an important cause, as sub-optimal notification strategies can lead to dismissal and disengagement.

## 2.3 The Role of Customisation

The role of customisation (user-controlled adaptation) in persuasive technologies has been a topic of the research field since its inception [18, 19, 24, 25, 34], often proposed as a way to increase the persuasive aims of the system [21–23]. At the same time, customisation is said to offer a more ethical alternative to inferred personalisation (system-controlled adaptation), which may be burdened by ethical considerations, such as privacy and the facilitation of biases [30, 36, 37].

The common argument for implementing customisation features in designing applications states that enabling the user more agency over system parameters will allow them to better tailor the experience to their needs. Additionally, it has been proposed that in the context of motivational technology, customisation can bring about secondary benefits, as it imbues the user with a sense of personal agency, autonomy, and self-determination [35]. Such theoretical benefits considered, empirical inquiries have not been as supportive and showed that enabling elaborate customisation options might only benefit a specific type of user - namely those that already possess a high need for autonomy [4]. Indeed, excessive customisation might even be regarded as inconveniencing, as it requires additional engagement and effort from the users [25], going against the common design principle of simplicity.

This was found to be especially relevant in the design of technologies for mental health, where users might struggle with low cognitive and motivational capacity [43]. For such users, greater automatic input might be desired from the system, however, the promotion of engagement should not be neglected. Regardless of the users' mental state, the relationship between user autonomy and the amount of burden should be at the forefront of designers' considerations when implementing customisation options.

When it comes to specific customisation features, studies in the domain of persuasive technology for health and wellness have primarily explored their role in intervention programs, for example, through planning physical activity, setting goals, and tracking progress [38, 43]. Other domains include the customisation of aesthetic characteristics, such as the setting of theme and sound, or in a specific case where persuasive messages were delivered through an animated character, the avatar's appearance [20].

**Customising Notifications.** To our knowledge, no study on applications for health and well-being has explicitly explored the role of customisation in regard to push notifications. While some studies utilise applications with such features [2, 28], for example, for setting the timing or frequency of notifications, they are not the primary focus of evaluation and minimal information is provided concerning their contribution to performance metrics or about users' attitudes and preferences.

Nevertheless, the limited observations from the existing literature suggest that such features might be desired [29]. The option to set the time range of notifications can, for example, help users limit their use only to opportune times (e.g., when they are not at work) while setting the desired number can limit unnecessary disturbances. Such features might also be beneficial concerning habituation, as users might only find notifications practical when they first interact with the application, but not after they have become accustomed to it [28]. Furthermore, if the notifications regard different types of content or senders, the user might only wish to opt-in for some but not others.

### 3 Methods

To answer our research questions, we set out to survey a diverse population of users on their attitudes and practices concerning notifications, specifically in regard to notifications in health and well-being applications. The survey and analysis methods are described in detail in the following sections.

#### 3.1 Materials

To understand participants' attitudes towards notifications and their customisation aspects, we designed a questionnaire partially inspired by the existing literature [27, 43]. The survey had three main sections concerning attitudes and practices regarding (i) notifications in general, (ii) notifications in applications for health and well-being, and (iii) customisation settings for notifications. For the third section, we designed six mockups visualising different customisation options and participants received questions on their attitudes towards the different options. Additionally, participants were requested to complete the affinity for technology interaction (ATI) scale [11] and provide demographic information. The complete questionnaire, dataset, and analysis results are available in a GitHub repository for public access<sup>1</sup>.

#### 3.2 Sample

The participants were recruited using the Bilendi platform [3] (Bilendi Technology S.A.R.L., Paris, France). Bilendi is an online crowdsourcing service specialising in market research. The platform was chosen due to its focus on users residing in European countries and its high ethical and quality standards. The subjects received compensation for their participation.

The sample was constructed to reflect the general population by being gender-balanced and equally sampling from three age groups (<25, 25–60, >60). The final sample contained 152 respondents (77 male, 73 female, one non-binary, and one not specified) with an average age of 42 ( $SD = 20.9$ ). Fifty-eight respondents had vocational, 52 had upper secondary, 37 had a university, and 5 had compulsory primary education.

#### 3.3 Data Processing and Analysis

The data were processed and analysed using R 4.1.2 [32]. For descriptive analysis, response frequencies were calculated for the individual items. For the assessment of participants' preferences regarding the customisation options, cumulative link models were computed using the *ordinal* package [7]. Separate models were defined for each questionnaire item about the customisation options (i.e., three models). The models were specified with the respective preference item (i.e., five categories from 'strongly disagree' to 'strongly agree') as a response

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<sup>1</sup> <https://github.com/DanielePretolesi>.

variable, the customisation options (i.e., options a to f) as a categorical fixed effect and subject as a random effect.

To assess relationships between response variables and demographic dimensions, two groups for gender (female, male) three groups for age (<25, 25–60, >60), and three groups for technological affinity (low, mid, high) were considered. Participants that identified as non-binary or did not specify their gender were excluded from demographic analysis due to insufficient sample size in these groups. For inferential assessment of group differences, cumulative link models were computed for ordinal response variables and  $\chi^2$  tests for outcomes on a nominal scale.  $p$ -values were adjusted for all analyses using Holm's method [14].

For open-ended questions, responses were analysed by inductively creating groupings of the answers inspired by thematic analysis [5].

## 4 Results

In this section, we present the results of our analysis. Due to limited space in the publication format, we report our findings in a condensed form. More detailed results including comprehensive descriptive statistics and regression coefficients are available in the repository referenced above.

### 4.1 Attitude Towards Notifications

Regarding general attitudes toward notification, 42.8% of respondents find notifications useful, 41.5% disruptive, while 28.3% reported feeling neutral towards them.

When asked whether they feel in control of the number and type of notifications they receive, 50% reported feeling in control, while 20.3% did not. The rest (29.6%) were neutral toward the matter.

Regarding the type of applications that participants deem the most useful to receive notifications from, Messaging (45.4%), News (37.5%), and Social Networks (32.9%) are considered the most useful. Concerning applications for health and well-being, 19.1% of respondents considered them a useful source of notifications.

When asked whether they manage notifications on their smartphones, the majority of the respondents answered that they do (61.2%), while the rest do not (25.7%), do not know how to do it (4.6%), or are not aware of the possibility (8.6%).

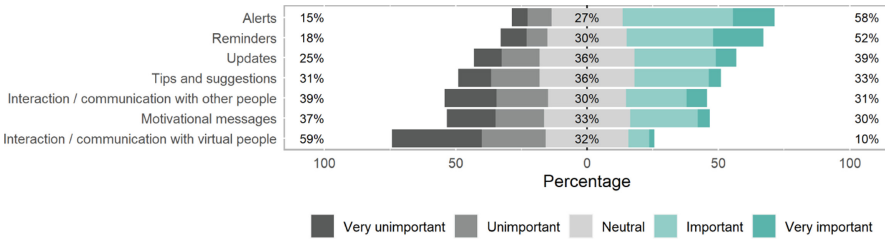
When asked what the most useful aspects of notifications are, most respondents considered the ability to receive important news and information at a glance to be the most valuable. Regarding the disruptiveness of notifications, the respondents mostly cited advertisements, non-relevant notifications, and high frequency as the primary sources of annoyance. Lastly, we asked participants how notifications could be made less disruptive. Reducing the number of notifications sent, increasing control over notifications settings, and importance filtering were identified as the most important aspects to improve notification acceptance.

### 4.2 Attitude Towards Notifications in Apps for Health and Well-Being

Approximately a third (35%) of the participants reported using applications for health and well-being. Among those, physical activity and fitness were most common (79.2%), followed by nutrition (47.2%), health assessment and healthcare (24.5%), and emotional and mental health (11.3%). Out of the 53 participants who reported regularly using such applications, 34 reported receiving notifications, with all but one finding them useful. According to these respondents, they find notifications useful to stay informed (51.5%) followed by getting motivated (48.5%), and keeping engaged with the application (48%). Only 12.1% finds them useful to stay connected with other people.

When respondents were asked for feedback about the optimum notification frequency in such applications, 39.5% responded with less than once a week, followed by one per day (27%), and once a week (23%). Should the frequency be too high, respondents mostly agreed (selected “agree” or “highly agree” on a 5-point Likert scale) that they would ignore the notifications (66.5%), followed by disabling them in the settings (63.1%) and deleting the app (33%).

Finally, we asked the participants about their preferences regarding notification types, with reminders and alerts being the most favoured. The rest of the distribution of the preferences is available in Fig. 1.

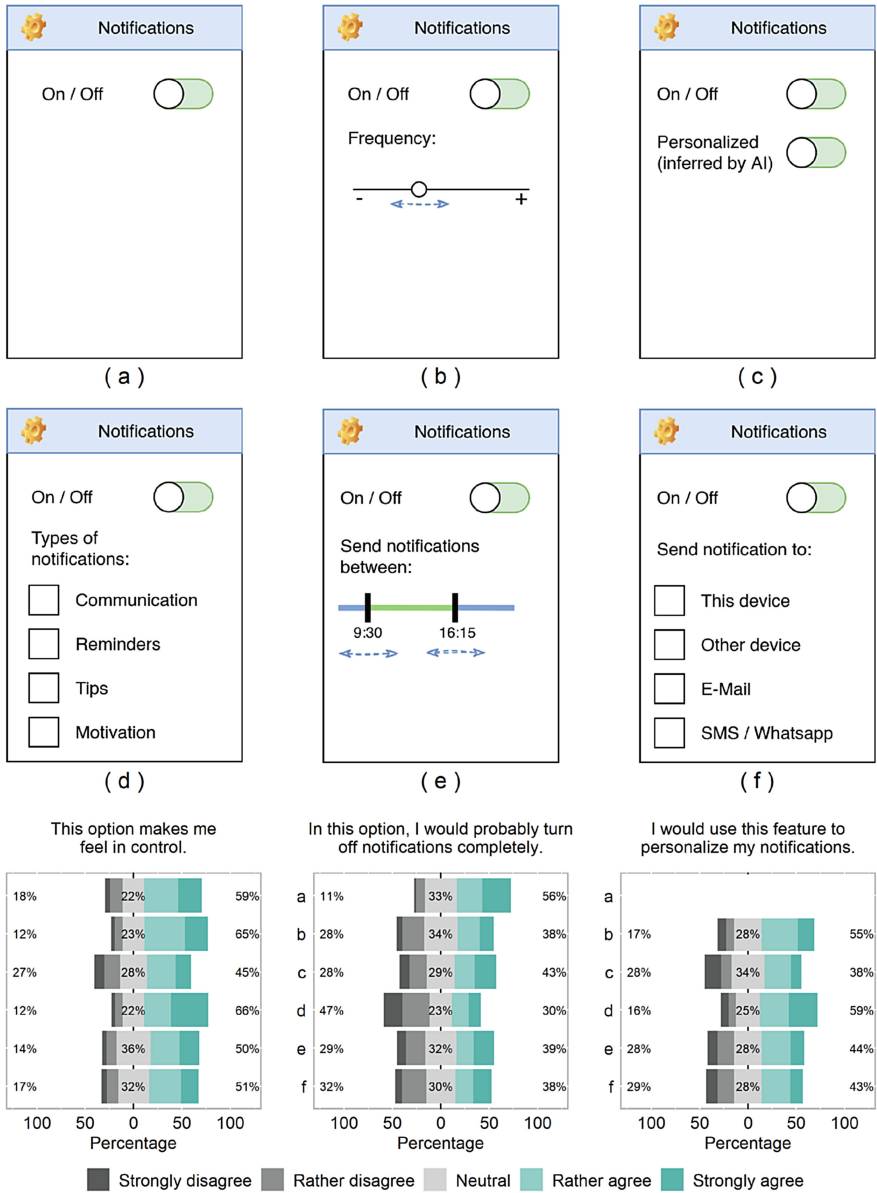


**Fig. 1.** Answer distributions for the question “In terms of apps for health and well-being, how important do you find the following types of notifications?”.

### 4.3 Customisation Preferences

Regarding customisation preferences, most participants (81.6%) think it is important to be able to adjust the number of notifications they receive and to determine when they should receive them (60.5%). Similarly, most respondents (79%) deem it very important to set what type of notifications they receive.

Regarding mock-ups showing different customisation options, their presentation and ratings of agreement with related questionnaire items for evaluation are available in Fig. 2. It can be observed that option *d* received most favourable ratings across all items. There, 65.5% of respondents agreed that the features gives them a sense of control, 59.2% answered that they would it to tailor notifications to their needs, and only 30% reported that they would turn off notifications completely when presented with the option.



**Fig. 2.** The customisation options presented in the survey and the respondents' attitudes towards them.



#### 4.4 Group Differences

We conducted further analysis by breaking down the answers according to different user groups, namely by age (<25, 25–60, >60), gender (male and female), and technological affinity (low, mid, high). For more details on methods used for analysis refer to Sect. 3.3.

**Age.** Regarding the usefulness and disruptiveness of notifications, a significant age difference with  $p < 0.001$  for both conditions was identified with young participants having more positive sentiments. A significant age difference ( $p < 0.001$ ) was also observed regarding the option to delete the application if it was sending too many notifications, where younger participants, compared to old ones, were less likely to agree with the statement. Finding it important to customise the type of notifications was found to be higher with young respondents compared to the other two groups ( $p < 0.05$ ). This corresponded to the observation in customisation preferences for option *d* (Fig. 2d), where young respondents reported a higher sense of control ( $p < 0.05$ ) and a higher likelihood of using the option ( $p < 0.01$ ). Additionally, we found significant differences among the age groups regarding the application types for which notifications are considered most useful, with young participants considering notifications from Messaging ( $p < 0.001$ ) and Social Networks ( $p < 0.01$ ) apps more useful compared to other age groups. Lastly, the analysis revealed a significant difference ( $p < 0.001$ ) showing that young users tend to manage notifications on their smartphones more actively in comparison to the other groups.

**Gender.** A gender difference was identified concerning the importance to customise the type of notifications received ( $p < 0.01$ ), with females considering it more important to customise the type of notifications compared to males.

**Technology Affinity.** Concerning technology affinity, the high affinity group was observed to report a higher sense of control over the number of notifications received, compared to the mid- and low-affinity groups ( $p < 0.05$ ).

## 5 Discussion

Our results on notification attitudes and preferences in applications for health and well-being offer valuable insights, some new and some expected based on previous knowledge. As such, our findings can be used to support the development of the research field and inform further application design. This is particularly important for the persuasive technology community, as such applications are a popular subject in the field and commonly use notifications as vectors to implement persuasive strategies. However, in the research context, notification strategies are often implemented naively of user preferences and tested in experimental conditions which might not necessarily translate to everyday use.

In the following, we summarise our findings according to the research questions and conclude by describing their key implications.

### 5.1 RQ1: What Are Users' Attitudes and Practices Regarding Notifications?

Overall, our results align with the attitudes towards notifications already known in the literature, showing that users view push notifications as useful but disruptive while revealing significant variability in attitudes. As expected, notifications are deemed the most useful when they come from messaging apps, followed by news and social media. Most respondents use notification settings, whereas the feedback received in the open-ended question suggested that having options to control notifications is generally desired.

### 5.2 RQ2: What Are Users' Attitudes and Practices Regarding Notifications in Health and Well-Being Apps?

About a third of the respondents answered that they use applications for health and well-being, with physical activity and fitness apps being the most common. These respondents overwhelmingly perceived notifications from these apps as useful, primarily for keeping themselves informed, motivated and engaged.

We further asked the respondents about their preferences in an arbitrary health and well-being application. Regarding notification content, reminders and alarms were rated as the most valuable features, whereas motivational messages and notifications regarding social interaction, particularly with virtual people, were deemed relatively unimportant. This offers practical information for the research field, as motivational messaging and virtual coaching are often utilised as strategies to support behaviour change. However, in terms of general acceptance, our results question their employment should they use notifications to engage end users.

Furthermore, concerning the optimum notification frequency, most respondents preferred once per week or less and about a third favoured once per day. Only a handful of respondents would like multiple notifications per day. This is an important observation, as the mHealth apps used in the academic community often utilise strategies where persuasive notifications are sent multiple times per day [17, 28]. This is a notable discrepancy, as it points out that the solutions proposed by researchers are not necessarily in line with user needs and preferences in everyday context. However, as previous research suggests, more frequent notifications may not necessarily deter users from engagement [27, 28], while our results imply that the most likely reaction to too many notifications would be disabling them in the settings, rather than disengaging by deleting the app.

### 5.3 RQ3: Which Customisation Features Do Users Deem Most Useful?

Respondents considered all the suggested components for customising notifications important, primarily frequency, followed by type, timing and source. This further suggests that there was a high desire among respondents for comprehensive customisation options, which was additionally informed by ratings of

our proposed mock-ups. Although the differences between the mock-ups were minimal, Option *d* (Fig. 2d), which, in addition to an on-/off- button, offered an opt-in/out menu of notification types, was most favourably rated by the respondents. This was apparent by both the low rating of the likelihood of entirely switching off notifications and high ratings of feelings of control and supposed use. These results further strengthen the previous findings on the importance of customisation [34,36] while contributing novel insights to the customisation of notification which could positively benefit the effectiveness of persuasive strategies in mHealth applications.

#### 5.4 RQ4: To What Extent Do the Aforementioned Attitudes and Practices Differ Between User Groups?

Most prominent results could be observed concerning age, where older respondents (>60) were more likely to find notifications less useful and more disruptive. They were also less likely to use notification settings and more likely to delete the application if they felt the number of notifications was overwhelming. The optimum notification frequency for health and well-being apps was also observed to be decreasing with age.

Some trends could also be observed in gender differences, particularly in the types of apps from which notifications are deemed most practical (e.g., messaging and social media for women and news and finance for men). While the ratings for apps for health and well-being did not differ, there was some discrepancy in the optimum frequency of notifications, with women leaning towards more frequent options. Lastly, our results show that, compared to men, women consider it more important to customise the type of notifications.

Finally, we observed some trends regarding technology affinity. Respondents who scored higher on the ATI metrics were more likely to find notifications useful. This corresponds to the observations that they were more likely to use notification management settings and felt more in control of the type and number of notifications they received.

#### 5.5 Implications for Health and Well-Being App Design

Overall, our results identify several aspects that previous research has not considered to improve the design of applications for health and well-being. Based on our findings, we derived five design implications:

1. Notification customisation is a desired feature and should be present in mHealth apps that utilize them in their persuasive strategies.
2. Easy access to customisation options should be provided to allow selecting which type of notifications one will receive.
3. Notifications should not be sent with a high frequency by default (preferably between one notification per day and less than one per week depending on target group and context).
4. Alerts and reminders should be prioritized over other notification types.

5. Notifications should be designed keeping in mind the differences in user groups, particularly in regard to age.

We hope that these design implications will provide more useful information for designing effective apps that rely on notifications to implement their persuasive strategies.

## 6 Limitations

The primary limitation of the study is that it was conducted as a survey and regarded notification use in an unspecified mHealth app. Therefore, the answers were collected devoid of real-life contexts and situations that shape users' perceptions and behaviours, limiting the generalisability of the findings.

Second, the survey was conducted only in Germany, which restricts the extrapolation of its findings outside its borders. While similar patterns could likely be observed in surrounding and other WEIRD countries [13], they are likely not as applicable to other cultural contexts.

## 7 Conclusion

In this work, we sought to survey user preferences and attitudes towards push notifications in general, with a more particular focus on applications for health and well-being. Our results are in line with previous research, while they also contribute novel insights particular to the design of mHealth applications. We observed that the customisation of notifications is a desired feature, which was only assumed or alluded to in previous research. We further investigated which aspects of potential customisation features are most preferable and concluded that users most desire control over notification type and frequency. Additionally, we identified significant differences in user groups, mostly related to age, which should be used to inform the design of future behaviour change approaches in mHealth applications.

Future research should further explore notifications usages in the wild by recording participants' sentiments towards notifications and different customisation approaches. Additionally, the customisation features proposed in this work should be implemented and tested to validate the current findings.

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