Persuasive Feedback for Fitness Apps: Effects of Construal Level and Communication Style

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Abstract. Persuasive technologies to support behaviour change (e.g., fitness trackers) have become increasingly popular among consumers and healthcare providers. However, studies show that such technologies often fail to offer long-term engagement and tangible health benefits. In this regards, the specific design of persuasive messages provided by the device and users' reactions to it may play a critical role. Our research explores the potential of applying theories of construal level and communication style to formulating feedback messages in self-improvement technologies. Two experiments (N = 190, N = 177) examine the influence of these two factors on goal commitment and affect-based evaluation for situations of fitness goal attainment and failure. Overall, construal level and communication style were relevant factors with independent influence. In the positive situation of goal attainment, high construal level and a friendly communication style resulted in significantly more goal commitment and positive affect than low construal level and a dominant communication style. In the negative situation of failure, results were overall less unambiguous and need to be consolidated by further research. Implications for the design of persuasive feedback are discussed.

Keywords: Persuasive feedback · Physical activity · Self-improvement

1 Introduction

An ever increasing number of people are starting to use mobile applications to improve their fitness level and well-being [22]. One essential aspect to make mobile fitness applications more meaningful and support behavioural change is appropriate feedback [2]. However, results focusing on the benefits of self-improvement technologies are inconclusive, with some presenting promising results [5], whereas others point to issues research in persuasive technology still needs to address. For instance, many fitness apps still struggle to deliver long-term health benefits [16]. Most users stop using their apps after a short usage period [13], partly due to frustration with feedback and goal setting modalities [4].

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The critical influence of the particular way the app provides feedback also becomes comprehensible when considering the role of technology as a social agent [2]. Humans have a tendency to interact with media in a social way [18]. Thus, one might conclude that technologies for self-improvement may slip into the role of an interactive coach [21,25]. In parallel to a human coach, where communication is an essential part to support behaviour change (e.g., in coaching [12]), interactive coaches may be more or less successful depending on the way they 'speak' to the user [3].

In this paper, we explore the degree of influence of the tone in which persuasive feedback is given (the communication style: friendly versus dominant) and the cognitive strategy of interpretation suggested by the formulation of the message (construal level, low/concrete versus high/abstract) impact the affective response and goal commitment of participants in a physical activity context. In short, the construal level describes how concretely or abstractly something is represented in a person's mind, which is naturally affected by the words to describe it with; e.g. walking 1000 steps each day (concrete) versus becoming a fitter person (abstract). In addition, we explore these effects for two types of feedback content; success versus failure (here: fitness goal attainment or lack thereof).

The present paper is structured as follows: The next section discusses relevant theoretical background connected to our research endeavour, including construal level theory [26] and research on communication styles of interactive tools for self-improvement [21]. The subsequent sections present two empirical studies, followed by a general discussion of our study findings and future research.

2 Background

We first introduce construal level theory [26]. Then we report on past work on communication styles of interactive technologies for self-improvement.

2.1 Construal Level Theory

Construal level theory (CLT) originates from work by Trope et al. [26]. CLT differentiates between high level construals, which are relatively abstract, and low-level construals, which are relatively concrete. The construal level has been identified as relevant for the further cognitive processing of information and a number of additional psychological variables. For instance, when a horse is construed more abstractly, i.e. as a mammal, the information regarding the species of the mammal, i.e. the horse, is omitted. Activities can also be construed in more abstract or more concrete terms. High construal level can be induced by providing the reasons for an activity; low construal by the information on how an activity is performed. This in turn means that superordinate goals should be more salient when construed more abstractly. Thus, depending on whether an object or activity is represented in a more abstract or more concrete way, we are considering or omitting certain attributes of it. Fujita et al. [10] conducted

a sequence of experiments using different manipulations to investigate the influence of construal level on self-control, showing that higher construal levels led to higher self-control. In conclusion, the authors claimed that any factor that influences the level of construal could potentially influence self-control and actions of individuals. One of such influencing factors could be a person's mood, given that a positive mood has been associated with processing visual information on a more global level than a neutral mood [11]. Along these lines, Labroo and Patrick demonstrated that being in a positive mood led to more abstract thinking and a focus on superordinate goals, whereas a negative mood shifted the focus more on subordinate goals [17]. In consequence, a positive mood may activate a more abstract construal level and subsequently support self-control. Our research may provide another step in this direction, investigating how a shift in construal level is influencing the affective and motivational experience of mobile fitness app feedback. In addition, given the central relevance of emotions for achievement and motivation [24], we also consider the so-called communication style of interactive products [21] as another potential influencing factor of peoples' affective and motivational experience in the context of goal achievement.

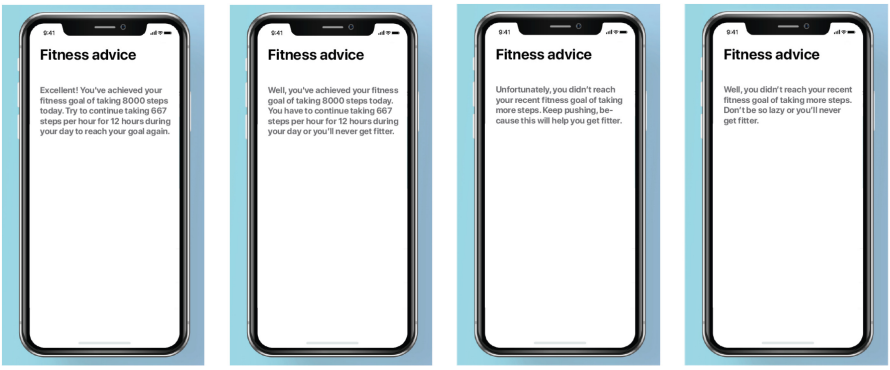
2.2 Conceptualising Communication Style of Interactive Technologies

As already argued in the 90s by Nass et al. [20], society is heading towards a time where more and more technologies turn into interactive partners or coaches [14]. Scholars found that humans act towards computers based on behavioural scripts of human-human interaction, as for example, applying social norms such as courtesy or screaming at their computer if it doesn't behave the way they wished [8,20]. Given this natural tendency of humans to engage in social interaction with technology, the deliberate design of the communication and dialogue in Human-Computer Interaction (HCI) seems of vital importance for the resulting user experience, particularly for the context of technology supporting behaviour change such as the design of fitness apps. Recent work on the border of Psychology and HCI found that users are able to perceive the communication style of interactive technologies for self-improvement and to differentiate between different styles [21]. Further, they found that different communication styles seem to be connected to different affective and emotional reactions [4,21]. Based on recent research on communication styles of self-improvement technologies [4,21], we chose two communication styles to focus and operationalise in our experiments, namely, the so-called friendly/cooperative communication style and the critical/dominant communication style. The friendly/cooperative communication style can be described as friendly, helpful and resilient. When implemented in a self-improvement technology, the feedback messages of the medium would be friendly, understanding and supportive. For example, if a user failed to reach their fitness goal, the technology might comment on this with 'Keep pushing and don't give up'. In contrast, the critical/dominant style of communication focuses on the mistakes and weaknesses of the user. Hence, the feedback would

reprimand the user and focus on their imperfections, e.g. 'You failed. You have to get a move on now'.

3 Research Goals and Contributions

The design of persuasive systems to support behavioural change is a complex endeavour. Affective and cognitive factors should be considered when designing persuasive feedback. Affective experiences have a bidirectional connection to construal level and are of relevance for achievement [24]. Previous research showcased the impact of communication style of self-improvement technologies on the behaviour change process and pointed towards a more positive reaction towards the friendly communication style. Thus, the present study investigates the effect of level of construal and communication style on affective response and goal commitment in a mobile fitness application context. The present paper is, to the best of our knowledge, the first study exploring communication style in a controlled environment and applying construal level theory in persuasive feedback.



(a) Goal attainment, friendly communication style, low construal level.

(b) Goal attainment, dominant communication style, low construal level.

(c) Failure, friendly communication style, high construal level.

(d) Failure, dominant communication style, high construal level.

Fig. 1. Examples of mockup mobile application screens presented in the survey.

4 Study 1 (Goal Attainment)

Based on previous research showing that abstract construal prompts a focus on the positive reasons underlying experiences [7,27], we hypothesise that abstract construal should lead to a more positive affective response and higher goal commitment. Furthermore, we predict that a friendly communication style should lead to a more positive affective response and higher goal commitment in a positive situation (goal attainment). Specifically, we hypothesise:

- **H1a**: High level of construal results in a significantly more positive affective response than low level of construal.
- **H1b**: Friendly communication style results in significantly more positive affective response than dominant communication style.
- **H1c**: At high level of construal, the positive effect of a friendly communication style on affective response is more pronounced than at low level of construal.
- **H2a**: High level of construal results in significantly more goal commitment than low level of construal.
- **H2b**: Friendly communication style results in significantly more goal commitment than dominant communication style.
- **H2c**: At high level of construal, the positive effect of a friendly communication style on goal commitment is more pronounced than at low level of construal.

4.1 Design and Method

Our study used a 2 (construal level: abstract vs. concrete) × 2 (communication style: friendly vs. dominant) between subjects design with four different vignettes. In vignette studies, participants are asked to see the world through the eyes of a hypothetical person in a specific scenario. As shown in previous applications, vignette studies balance the benefits of experimental research with high internal validity and the advantages of applied research with high external validity [1]. The vignette study was conducted online and the participants were randomly assigned to one of four conditions.

Participants. We recruited 190 participants (111 male, 79 female), aged 19–69, $M = 35.97$, $SD = 11.56$ using Amazon Mechanical Turk (MTurk). Given that replications studies in different areas of research using MTurk led to comparable results as the original studies [23], MTurk has become a popular means of recruitment for research in Psychology [27] and Human-Computer Interaction [6]. The recruited participants resided in the United States or the European Union. We required participants to have completed at least 1,000 HITs with a 95% acceptance rate, in line with past work in Psychology and HCI [6]. The survey took an average of 3 min 14 s to complete and the participants received $0.80 as compensation.

Procedure. In the online vignette study, users were presented with a neutral description of the situational context. They were asked to imagine that they have recently downloaded a fitness app, in order to become more active. Furthermore, they have been informed that they have used it all week and that they have recently increased their step goal to 8000 steps per day. The participants have been told that they wake up in the morning and the fitness app presents them with the following feedback, which they study carefully. Afterwards, we showed a prototype phone screen with fitness advice in one of the randomly assigned conditions, informing them that they had achieved their goal. Figure 1 shows examples of the screens.

Measures. After the survey introduction, we presented the participants with questions regarding their demographic data. We then inquired about their affective response and their goal commitment. The order of the scales has been randomised. We administered the Goal Commitment Scale [15], where the participants indicated their agreement on a Likert scale from very strongly disagree to very strongly agree. We queried the affective response of the participants based on the items used by Williams et al. [27]. The participants evaluated the extent to which the feedback of the fitness app felt 'pleasant', 'desirable', 'painful', and 'unpleasant' (latter two reverse-coded). These responses were made on 7-point scales anchored by 'not at all' and 'very'.

4.2 Results — Study 1

How do level of construal and communication style of fitness app feedback influence users' affect-based evaluations of the feedback when they achieved their goal? To answer this question, a two-way ANOVA was conducted. This analysis revealed a significant main effect of the construal level manipulation ($F(1, 186) = 4,709$, $p = .031$). Participants who were presented with the feedback in a concrete manner reported lower evaluations ($M = 16.85$, $SD = 7.26$) compared to those who were presented with the feedback in an abstract manner ($M = 19.52$, $SD = 7.12$). Thus, H1a is confirmed. There was also a statistically significant main effect of the communication style manipulation ($F(1, 186) = 55,411$, $p < .001$). Participants who were presented with the dominant communication style reported lower evaluations ($M = 14.90$, $SD = 7.03$) compared to those who were presented with the friendly communication style ($M = 21.80$, $SD = 5.75$). Thus, H1b is confirmed. There was no interaction between the construal level and the communication style factors ($p > .05$). Thus, H1c is not confirmed.

How do level of construal and communication style of fitness app feedback influence users' goal commitment when they achieved their goal? To answer this question, a two-way ANOVA was conducted. This analysis revealed a significant main effect of the construal level manipulation ($F(1, 186) = 7,589$, $p = .006$). Participants who were presented with the feedback in a concrete manner reported lower goal commitment ($M = 29.91$, $SD = 6.12$ compared to those who were presented with the feedback in an abstract manner ($M = 32.41$, $SD = 5.54$). Thus, H2a is confirmed. There was also a statistically significant main effect of the communication style manipulation ($F(1, 186) = 5,564$, $p = .019$). Participants who were presented with the dominant communication style reported lower goal commitment (M = 30.27, SD = 5.93) compared to those who were presented with the friendly communication style ($M = 32.25$, $SD = 5.82$). Thus, H2b is confirmed. There was no interaction between the construal level and the communication style factors ($p > .05$). Thus, H2c is not confirmed. Figure 2 presents the results.

5 Study 2 (Failure)

Study 2 replicates study 1 in negative situations (failure; i.e. where users failed to reach a goal and the fitness app is confronting them with an according message), in order to test the generalisability to both positive and negative situations. We expected the same effects as for study 1. Hence, the present study also investigates the effect of level of construal on affective response and goal commitment in a mobile fitness application context. Similar to study 1, we are combining this approach with an inquiry regarding the communication style of self-improvement technologies.

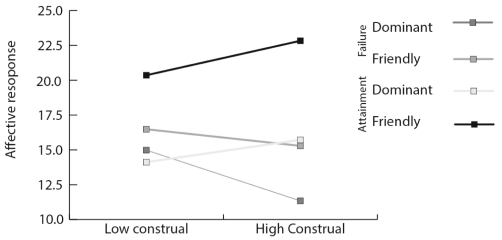
In line with our previously described assumptions, we hypothesise that abstract construal would lead to a more positive affective response and higher goal commitment. Furthermore, we predict that a friendly communication style would lead to a more positive affective response and higher goal commitment. In the present study we are exploring these assumptions in a negative situational context (failure). Specifically, we hypothesise:

- **H3a**: High level of construal results in a significantly more positive affective response than low level of construal.
- **H3b**: Friendly communication style results in significantly more positive affective response than dominant communication style.
- **H3c**: At high level of construal, the positive effect of a friendly communication style on affective response is more pronounced than at low level of construal.
- **H4a**: High level of construal results in significantly more goal commitment than low level of construal.
- **H4b**: Friendly communication style results in significantly more goal commitment than dominant communication style.
- **H4c**: At high level of construal, the positive effect of a friendly communication style on goal commitment is more pronounced than at low level of construal.

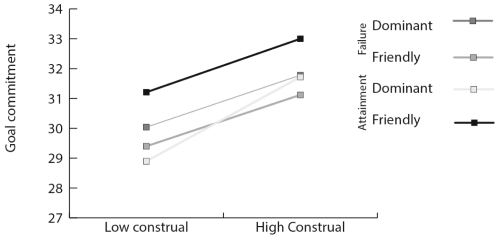
5.1 Design and Method

Again our study used a 2 (construal level: abstract vs. concrete) × 2 (communication style: friendly vs. dominant) between subjects design with four different vignettes. Similar to study one, the vignette study was conducted online and the participants were randomly assigned to one of four conditions. The procedure was similar to study 1, apart from one detail. Users were informed that they had failed to achieve their goal. Figure 1 shows examples of the screens. The measures used were similar to the measures applied in study 1.

Participants. We recruited 177 participants (104 male, 73 female), aged 20–69, $M = 33.45$, $SD = 9.35$ using Amazon Mechanical Turk (MTurk). The recruited participants resided in the United States or the European Union. We required participants to have completed at least 1,000 HITs with a 95% acceptance rate, in line with past work in Psychology and HCI [6] The survey took an average of 3 min 04s to complete and the participants received $0.80 as compensation.



(a) Average total affective response in the two experimental conditions (construal level, communication style) in both situations, i.e. goal attainment (Study 1) and failure (Study 2).



(b) Average total goal commitment in the two experimental conditions (construal level, communication style) in both situations, i.e. goal attainment (Study 1) and failure (Study 2).

Fig. 2. A visual summary of the results of the two studies.

5.2 Results — Study 2

How do level of construal and communication style of fitness app feedback influence users' affect-based evaluations of the feedback when they did not achieve their goal? To answer this question, a two-way ANOVA was conducted. This analysis revealed a significant main effect of the construal level manipulation ($F(1, 173) = 7,069$, $p = .008$). Participants who were presented with the feedback in a concrete manner reported higher evaluations ($M = 15.62$, $SD = 5.64$) compared to those who were presented with the feedback in an abstract manner ($M = 13.77$, $SD = 6.16$). Thus, H3a is not confirmed. There was also a statistically significant main effect of the communication style manipulation ($F(1, 173) = 6,401$, $p = .012$. Participants who were presented with the dominant communication style reported lower evaluations ($M = 13.63$, $SD = 6.12$) compared to those who were presented with the friendly communication style ($M = 15.81$, $SD = 5.60$). Thus, H3b is confirmed. There was no interaction between the construal level and the communication style factors ($p > .05$). Thus, H3c is not confirmed. Figure 2 presents the results. How do level of construal and communication style of fitness app feedback influence users' goal

commitment when they did not achieve their goal? To answer this question, a two-way ANOVA was conducted. This analysis revealed a significant main effect of the construal level manipulation ($F(1, 173) = 4,031$, $p = .046$). Participants who were presented with the feedback in a concrete manner reported lower goal commitment ($M = 29.77$, $SD = 5.70$) compared to those who were presented with the feedback in an abstract manner ($M = 31.37$, $SD = 5.48$). Thus, H4a is confirmed. There was no statistically significant main effect of the communication style manipulation ($F(1, 173) = 0.146$, $p > .05$. Thus, H4b is not confirmed. There was no interaction between the construal level and the communication style factors ($p > .05$). Thus, H4c is not confirmed. Figure 2 presents the results.

6 Discussion

In brief, our results show that abstract compared to concrete construal leads to a more positive affective response in the event of goal attainment, as assumed in **H1a**. A more abstract construal might shifted the focus to higher level goals (seeing the forest instead of focusing on the trees). We hypothesise that this shift in focus might enhance the positive experience of achieving a fitness goal through adding meaning to the achieved step goal. The participants perhaps perceive the situation as positive because they have not only achieved their step goal but also come a step closer to their overall goal of becoming fitter. Additionally we found that affective responses varied significantly between the two different communication styles, as assumed in **H1b**. Depending on how the message of goal attainment was communicated, participants showed different affective reactions, with the friendly communication leading to more positive affect.

Other than assumed **(H1c)**, the interaction between level of construal and communication style regarding affective response was not significant. Construal level and communication style thus seem to have separable influences on affect-based evaluations Furthermore we found that there was a significant difference between the message framed on different levels of construal regarding goal commitment in the positive situation of goal attainment. In line with **H2a**, the more abstract construal level led to higher goal commitment than the more concrete construal level. This finding may be explained through the relationship between construal level and self-control, with high construal level having a positive impact on perceived self-control [10]. In light of previous findings, linking higher self-control to higher goal commitment [19]. It thus seems plausible that high levels of construal go along with higher goal commitment. However, future research is needed to get insights into the exact relations between the three variables (construal level, self-control, goal commitment) and possible mediating effects. Furthermore, in line with **H2b**, goal commitment was affected by the used communication style in the message on goal attainment, with the friendly communication resulting in higher commitment than the dominant communication style. We assume that the friendly, supportive communication style might increase participants' perceived self-efficacy, which in turn, in line with the results from

Locke et al. [19], could have led to higher goal commitment. As also for affective response, the interaction effect between level of construal and communication style on goal commitment was not significant. Thus, other than assumed in **H2c**, the effects of construal level and communication style are merely additive.

In the negative situation of failure, our results showed a significant effect of the level of construal on the affective response. However, other than assumed in **H3a**, a lower construal level resulted in a more positive affective response. This result contradicts previous findings regarding construal level and evaluations of experiences [27]. A possible explanation can be construed in light of the studies by Eyal et al. [7]. They found that participants in a higher construal level mindset judged moral transgressions more harshly than participants in the low construal level condition, arguing that the abstract mindset might have promoted a focus on the higher level moral principles that have been violated, rather than the concrete deed. The level of construal thus affects the basis of evaluation, and negative events appear even more serious when considered on a high compared to a low level of construal, given that superordinate, moral principles have been violated. Our findings in the failure condition might be interpreted in a similar way: The superordinate goal of our participants was to become fitter, however, they failed in achieving their goal, i.e. a negative event. This failure might have appeared even more severe in the high construal level condition, which promoted a stronger focus on the superordinate goal than the low construal level condition. This might explain the less positive affective response in the high compared to the low construal level condition. As assumed in **H3b**, we found a significant effect of communication style on affective response, with the message of failure being communicated by a friendly communication style leading to a more positive affective response than the dominant communication style. Our results in the failure condition also showed a significant effect of the construal level on goal commitment.

In line with **H4a**, more abstract construal resulted in higher goal commitment. In parallel to study 1 and the positive situation of goal attainment, we hypothesise that a high construal level has a positive impact on self-control [9], which may also facilitate goal commitment. Furthermore, high level of construal may support participants to see the forest (getting fitter) instead of the trees (failure regarding the step goal today). In consequence, the high level of construal might activated a defensive orientation in action, thus showing the participant that they can still push to reach their superordinate goal and therefore leading to less negative impact on goal commitment.

This line of reasoning, however, contradicts to some extent the interpretation of the (unexpected) finding on affective response, where we speculated that failure might have appeared more severe in the high construal level condition, due to the activation of a superordinate goal and leading to a more negative affective reaction. In sum, it still requires further research to understand the exact mechanisms behind the effects of construal level and their impact on participants' experience and goal commitment in the condition of failure. Future research could utilise longitudinal, qualitative studies to further explore and validate our

findings. Other than in study 1 and the positive event of goal attainment, in the event of failure, communication style had no effect on goal commitment, leading to the rejection of **H4b**. In parallel to study 1 and the positive situation of goal attainment, in study 2 and the negative situation of failure no significant interactions between level of construal and communication style were found, either on affective response or on goal commitment.

Altogether, the differences between the findings for situations of goal attainment and failure highlight the importance of distinct studies on the effects of construal level and communication style in light of the context, namely, the self-improvement message being communicated. Depending on the message content and its valence, how the persuasive message is communicated has varying consequences for peoples' experience and commitment to a goal.

7 Conclusion

This paper investigated the effects of construal level and communication style to communicate mobile fitness application feedback to participants who have either met or not met their fitness goal. We conducted two between-subject online studies with four conditions each–four different mobile fitness app messages. It is, to the best of our knowledge, the first empirical investigation of the application of construal level theory and the communication styles of interactive technologies for self-improvement in a controlled, experimental setting. The present research broadens our understanding of the psychological effects of communication style and construal level of persuasive feedback. We have outlined the first steps of how the design of future persuasive technology feedback could apply psychological theory in meaningful ways to design for a positive, long-term experience.

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