A gamified app that helps people overcome self-limiting beliefs by promoting metacognition

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Abstract

Previous research has shown that approaching learning with a growth mindset is key for maintaining motivation and overcoming setbacks. Mindsets are systems of beliefs that people hold to be true. They influence a person's attitudes, thoughts, and emotions when they learn something new or encounter challenges. In clinical psychology, metareasoning (reflecting on one's mental processes) and meta-awareness (recognizing thoughts as mental events instead of equating them to reality) have proven effective for overcoming maladaptive thinking styles. Hence, they are potentially an effective method for overcoming self-limiting beliefs in other domains as well. However, the potential of integrating assisted metacognition into mindset interventions has not been explored yet. Here, we propose that guiding and training people on how to leverage metareasoning and meta-awareness for overcoming self-limiting beliefs can significantly enhance the effectiveness of mindset interventions. To test this hypothesis, we develop a gamified mobile application that guides and trains people to use metacognitive strategies based on Cognitive Restructuring (CR) and Acceptance Commitment Therapy (ACT) techniques. The application helps users to identify and overcome self-limiting beliefs by working with aversive emotions when they are triggered by fixed mindsets in real-life situations. Our app aims to help people sustain their motivation to learn when they face inner obstacles (e.g. anxiety, frustration, and demotivation). We expect the application to be an effective tool for helping people better understand and develop the metacognitive skills of emotion regulation and self-regulation that are needed to overcome self-limiting beliefs and develop growth mindsets.

<div align="center">**Extended summary**</div>

1. Introduction

Implicit mindsets have a powerful influence on peoples' attitudes and behaviors. A Growth mindset regarding intelligence is proven to improve academic performance, willingness to take on challenges, engagement, motivation, and resilience [1,2]. However, how exactly mindset change happens and why people often fail to truly change their mindsets is unclear. Dweck (2015) has highlighted the importance of working through fixed mindsets by recognizing them and staying in touch with them. As well as the need for accepting the thoughts and feelings that arise when fixed mindsets get triggered and working with and through them repeatedly [3].

Current mindset interventions inform people that their brains are plastic and that they can improve their capacities with the right effort [3]. Even though these interventions are helpful, the size of their effect is not very high, since receiving information is often insufficient to overcome deeply ingrained implicit beliefs such as the fixed mindset [4]. To address this problem, we augment a traditional mindset intervention with a newly developed gamified mobile application (app) that helps people learn and leverage metacognitive strategies for overcoming maladaptive mindsets.

2. A digital coach for overcoming maladaptive beliefs

Our mobile app is designed to help people overcome deeply ingrained maladaptive mindsets by supporting two fundamental metacognitive skills: meta-reasoning and meta-awareness. Meta-reasoning is the capacity to reflect on the content of one's thoughts and emotions. Meta-awareness is the capacity to recognize thoughts and emotions as mental events instead of equating them to reality. Since our training of meta-reasoning and meta-awareness supports belief revision in general, we expect that it can help people develop growth mindsets about a wide range of personal and intellectual characteristics. Our application additionally targets self-efficacy which is an "individuals' confidence in their ability to control their thoughts, feelings, and actions, and therefore influence an outcome" [1].

Figure 1.A shows our app's main screen. At the very beginning, the app asks the user to set a daily goal for practicing a skill or habit they would like to build but find challenging (e.g. exercising, learning a new language, waking up early). The user is asked to open the application each time this challenge makes them feel bad about themselves or experience aversive feelings. When this happens, the user can either use the meta-reasoning coach to

discover and work through self-limiting beliefs or use the meta-awareness coach to embrace already identified patterns.
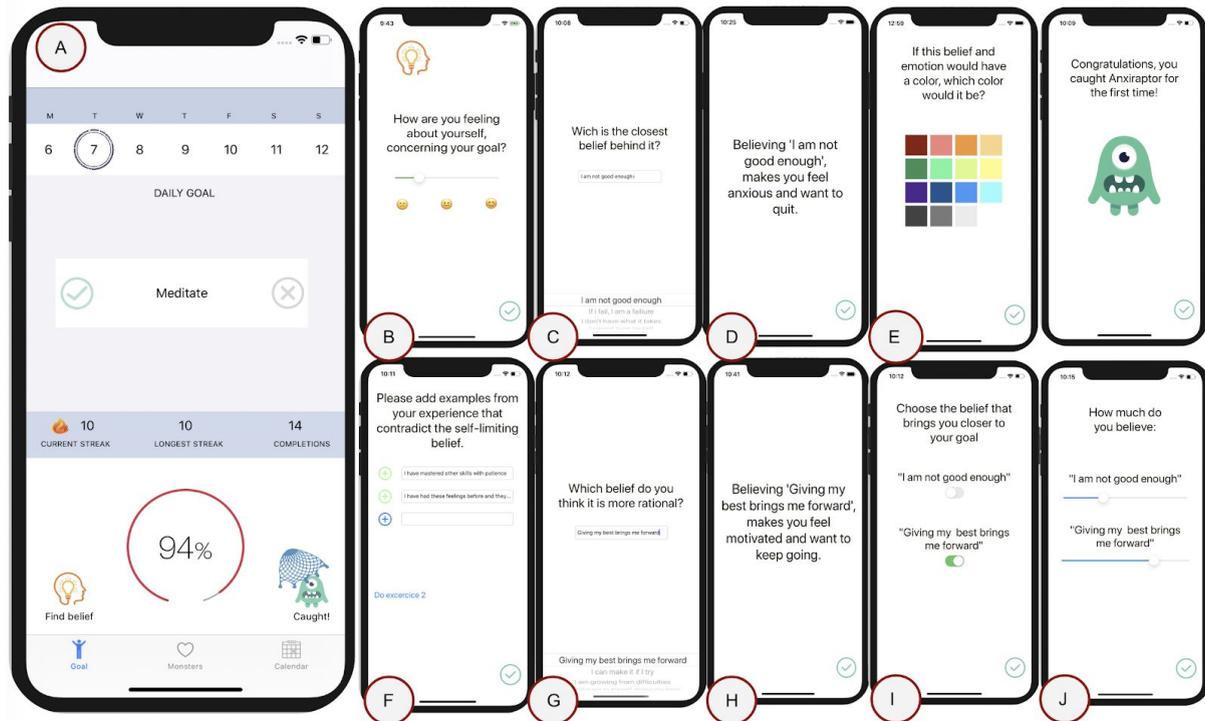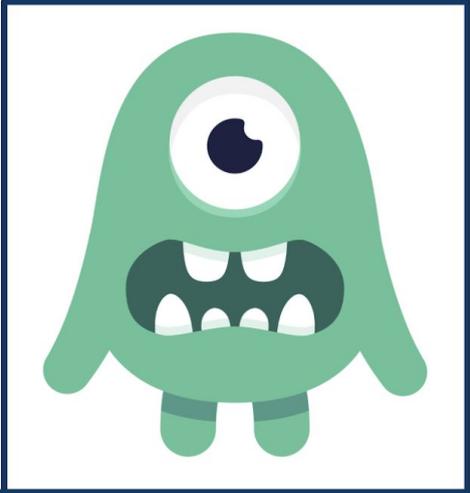

Figure 1. Exemplary interaction with the meta-reasoning coach A) The main screen. B) The app asks the user how he or she feels in regards to their goal. C) The screenshot illustrates how questions work with drop-down menus. In this step, the user answers four questions regarding their current (1) emotions (2) thoughts (3) beliefs and (4) inclinations to act. D) The app summarizes how self-limiting beliefs relate to the selected emotions and actions. E) The user creates an avatar to represent the self-limiting beliefs. F) The app asks the user to challenge the self-limiting belief with two exercises. G) Subsequently, the user considers more encouraging beliefs. I this step, the user answers questions regarding (1) alternative beliefs (2) resulting emotions and (3) inclinations to act. H) The app summarizes how the encouraging belief relates to the chosen emotions and actions. I) The user chooses which belief better aligns with their goal. J) To finish, the user enters the degree to which he or she believes in each belief.

2.1 Meta-reasoning

The meta-reasoning coach is based on the ABCD method for cognitive restructuring [5]. Figure 1B-J displays an exemplary interaction with the coach. It helps users to find self-limiting beliefs (Figure 1B-C), understand their consequences (Figure 1D), challenge those beliefs (Figure 1F), consider more empowering alternative beliefs (Figure 1G), and compare the costs and benefits of both ways of thinking (Figure 1D, H and I). The app aids the user in this process by providing multiple choices (Figure 1C and G), which are based on an online survey. Additionally, the app asks users to customize an avatar to represent the

recognized maladaptive pattern (Figure 1E). Figure 2 illustrates the resulting profile of an exemplary avatar.

Emotions: Anxiety, fear
Number of catches: 11
Irrational belief:
   1.   "I am not good enough"
If I believe this I tend to:
- Look for distractions
- Bite my nails
- Quit

Alternative belief:
   1.   "Doing my best brings me forward"
If I believe this, I tend to:
- Look for creative solutions
- Give my best
- Keep going

Anxiraptor

Examples that challenge the self-limiting belief:
1. I have mastered other skills with patience.
2. I have had these feelings before and they were not true.

To a friend, you would advise:
1. "Don't take those thoughts too seriously, breath and keep going."

Figure 2. Example of an avatar's profile. The profile of a little monster avatar contains information gathered with the meta-reasoning coach. It also displays the number of times the user noticed thinking the thoughts linked to the specific avatar (number of catches).

2.2 Meta-awareness

The meta-awareness coach is based on the Acceptance Commitment Therapy (ACT) model for coping with maladaptive mental habits [6]. We ask users to start the meta-awareness coach when they become aware of having a self-limiting belief that they have previously worked through and created an avatar for. The app then guides the user through a breathing exercise to practice accepting and observing the aversive feelings. Subsequently, the user reminds him or herself of a more encouraging alternative belief. Figure 3 shows how the meta-reasoning and meta-awareness coach work together with the avatars.
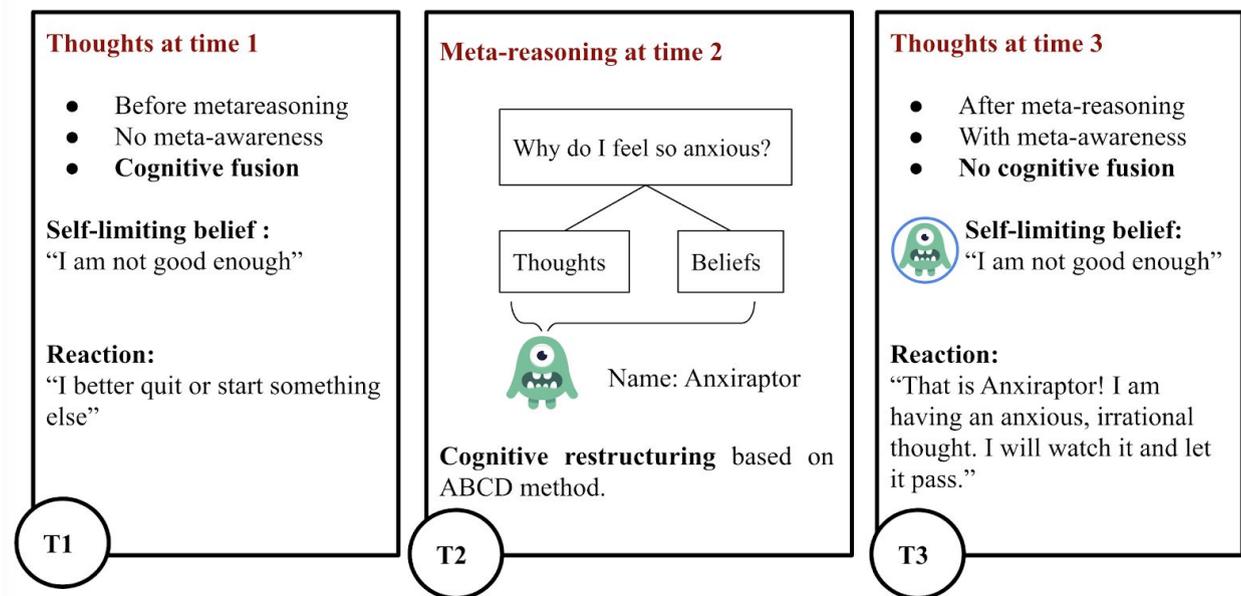
Figure 3. Meta-reasoning, meta-awareness, and avatars. T1) Cognitive fusion. The user believes he or she is not good enough and reacts out of fear. T2) Meta-reasoning. The user identifies the self-limiting belief with the help of the meta-reasoning coach and creates an avatar to represent this pattern T3) Meta-awareness. The user identifies the self-limiting belief and feelings of anxiety as "Anxiraptor", the pattern he or she already recognized in the exercises of meta-reasoning and decides not to take it seriously.

4. Evaluation

We plan to test the effectiveness of the application in a field experiment testing whether combining a short mindset intervention with our meta-reasoning and meta-awareness coach (experimental condition) is more effective than the short mindset intervention alone (control condition). The efficacy of the interventions will be measured by the reduction in self-limiting beliefs, such as the fixed mindset, and the increase in adaptive beliefs, such as the growth mindset, after the intervention compared to before the intervention. As an additional outcome measure, we will record how often participants succeed at their daily challenges.

We predict that guiding and training people on how to leverage meta-reasoning and meta-awareness for overcoming self-limiting beliefs can significantly enhance the effectiveness of mindset interventions and enable people to improve their implicit theories about their intelligence, skills, personality, and their ability to achieve their goals (i.e., self-efficacy). Furthermore, we anticipate that by training metacognition with our application,

people may improve other psychological characteristics that are beneficial for learning and goal achievement, such as their motivation to improve.

5. Conclusion

We are optimistic that this line of work will yield insights into the role that meta-reasoning and meta-awareness play for the development of growth mindsets. We hope that our gameful mobile app for coaching people to use metacognitive strategies will help them to consistently work on and overcome maladaptive thinking styles and their emotional consequences, develop growth mindsets, improve themselves, and better their lives.

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