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Always Look on the Bright Side of Life? The Quest for an Online Cognitive Training to Prevent Adolescent Anxiety and Depression

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Summary

Always look on the bright side of life?
The quest for an online cognitive training to prevent adolescent anxiety and depression

Anxiety and depression are highly prevalent disorders, and can have enduring negative effects on social or academic functioning as well as physical and mental health. Adolescents are particularly vulnerable for the development of these disorders, which might be related to the large social-emotional and physiological changes in this period as well as imbalances in brain development. That is, emotional experiences become more intense, while the capacity to control cognitions and emotions is not yet fully developed. However, adolescents are also known for their flexibility and capacity to quickly learn and profit from interventions. Given this combination of heightened vulnerability and plasticity, adolescence seems an optimal period for prevention and early intervention of anxiety and depression. Traditional interventions have small effects, but many adolescents do not profit from them or do not seek help due to financial or logistic barriers, or fear of stigma. Also, these interventions might not be able to consistently change implicit cognitive processes that have been shown to play an important role in the etiology and maintenance of anxiety and depression.

Anxiety and depression are characterized by the tendency to selectively attend to negative information (attentional bias) and to interpret ambiguous information in a negative way (interpretation bias). Furthermore, deficits in cognitive control reduce the ability to correct such biased processing and to effectively regulate emotions. For example, the capacity to control the access and removal of emotional material to and from working memory seems impaired, which can lead to prolonged worry and negative mood. During the past decade, cognitive training paradigms have been developed, that directly target implicit cognitive processes and cognitive control, and might reduce emotional vulnerability.

The aim of the current research project was to investigate whether online cognitive training could reduce anxiety and depressive symptoms and increase emotional resilience in adolescents. If adolescents could acquire a more positive information processing style, this might make them less vulnerable to stressful experiences, and reduce the risk of developing emotional disorders. If such a cognitive training would be effective, it could be an attractive alternative to existing preventive interventions for adolescents, as it could be provided 24/7 anonymously, and at no or very low costs, thus increasing accessibility and probably reducing stigma.

We conducted one pilot study and three randomized controlled trials (RCT), to investigate effects of various types of training, aimed at either attentional bias, interpretation bias, or working memory. We used several Cognitive Bias Modification (CBM) paradigms, which had yielded promising effects on cognitive biases, emotional reactivity and symptoms of anxiety or depression in previous research, and adapted an existing working memory (WM) training

task to an emotional context. Our first studies (Chapters 3-6) focused on unselected adolescents (universal prevention), while our later studies (Chapters 7 & 8) were performed in a sample of adolescents with heightened symptoms of anxiety or depression (indicated prevention).

Chapter 2 describes the results of a study on the relationship between attentional and interpretation biases on the one hand, and anxiety and depression on the other hand, in the unselected adolescents who participated in our first RCT (n = 681). Results revealed that two different tasks assessing attentional bias and an interpretation bias task all explained unique variance in anxiety symptoms, and two of them were independently related to depressive symptoms. This points to the possibility that anxiety and depressive symptoms share underlying cognitive processes, and suggests that it is worthwhile assessing various biases simultaneously to better understand symptoms.

Chapter 3 describes a pilot study testing the effectiveness of a visual search CBM for attention (CBM-A) training, on both attentional bias assessed with our newly developed attentional bias assessment task and on anxiety symptoms. Results showed that two sessions of this visual search training strongly reduced attentional bias, and had small effects on social phobia compared to placebo training in unselected adolescents (n = 32).

In Chapters 4, 5 and 6, the results of the RCT with unselected adolescents are reported. In this study, adolescents were randomized to either a visual search or a dot-probe CBM-A training (Chapter 4), a CBM for interpretations (CBM-I) scenario training (Chapter 5), an emotional WM training (Chapter 6), or one of their corresponding placebo control trainings. Adolescents received eight sessions of online training over four weeks and completed assessments of cognitive processes before and after this training period. They also reported on symptoms of anxiety and depression and on secondary measures of emotional resilience (like self-esteem, negative thinking, test anxiety, etc.) before and after training, and at three, six, and twelve months follow-up. Parents also completed a questionnaire on their children's social-emotional and behavioral problems at these time points. The visual search CBM-A and the CBM-I training were effective in changing the targeted cognitive processes: they led to reduced attentional bias and interpretation bias respectively compared to their placebo groups. The dot-probe CBM-A and EmoWM training did not differentionaly affect cognitive processes. For all types of training, experimental and placebo groups did not differ in the extent to which anxiety and depressive symptoms reduced or emotional resilience increased. That is, improvements were observed for all groups, but the training groups did not outperform the placebo groups, except for some small trends on secondary measures. The limitations of the online nature of the training, and the drop-out during training and at follow-up assessments, precludes strong conclusions, but results suggested that cognitive training had no added value for unselected adolescents. This might be related to the low level of initial symptoms and biases in this unselected sample, which leaves little room for improvement and could also reduce motivation to actively engage in the training.

To investigate whether the two training paradigms that had an effect on cognitive biases would be more effective in reducing symptoms and increasing resilience in adolescents with heightened symptoms of anxiety or depression, two more RCTs were conducted. Here, 1988 adolescents were first screened on symptoms of anxiety and depression, and those scoring in the upper half were invited for the training studies. Again, eight online training sessions were offered

and adolescents were assessed pre- and post-training and at three and six months follow-up.

In Chapter 7, the RCT on the visual search CBM-A training in 108 selected adolescents is described. This training was not only compared to a placebo control training but also to a group who did not receive any training, to differentiate between placebo effects and effects of repeated testing or general time effects. As in our first RCT, a large reduction in attentional bias was observed from pre- to post-training in the visual search training group, but short- and long-term reductions in anxiety and depressive symptoms and increases in resilience were observed in all groups. As even the no-training control group improved to the same extent as the visual search training group, these results seem to reflect a natural decline in symptoms or effects of repeated testing.

In Chapter 8, the RCT on the scenario CBM-I training and a picture-word training in selected adolescents (n = 119) is described. The picture-word training had a special focus on positive mental imagery and was expected to be more engaging for adolescents. Although a small change in interpretation bias was observed in the scenario training group specifically, no emotional effects were found compared to a neutral control scenario training. Again, all groups improved equally in terms of symptoms and emotional resilience.

In both RCTs described in Chapter 7 and 8, we also included an extensive evaluation questionnaire. Although adolescents indicated that in general they were satisfied with the training, responses to more specific questions were quite negative. A majority would not train again or recommend the training to a friend who experiences emotional problems, and most adolescents did not enjoy the training. Also, adolescents indicated that they did not understand the purpose of the training and the majority thought they had received a placebo training. Based on these results, and the lack of emotional effects above and beyond the control conditions, we concluded that the CBM-A and CBM-I trainings as implemented in these RCTs, also did not have added value as indicated preventive interventions for selected adolescents.

However, several limitations of our studies were identified that might have affected the results. The online nature of our training programs allowed us to include large samples, but also reduced experimental control over training circumstances and compliance of participants. The lack of face-to-face instructions or reinforcement might have reduced the opportunity to profit from the training for some adolescents, and some struggled with technical issues. Also, many adolescents did not complete the intended amount of training. Furthermore, sample sizes were reduced considerably at follow-up due to high drop-out rates, and power in our first RCT was also limited by unbalanced randomization (smaller placebo groups). Finally, the strong reliance on self-report might have increased the risk of demand effects.

Given these limitations, in combination with initial promising findings and current inconsistent findings in the literature, we should not yet stop investigating the potential of cognitive training for adolescents. Based on the theoretical background of cognitive training, one would only expect effect on symptoms or resilience, if the targeted cognitive processes are successfully changed. In our studies, not all training paradigms were successful in changing cognitive processes. Furthermore, the cognitive effects that were present, were only observed on assessment tasks that closely matched the training tasks, and did not generalize to other indices of biased information processing. Therefore, developing training paradigms that are more effective

in changing relevant cognitive processes in an online training environment, affecting near and far transfer tasks, seems essential to better understand the potential for emotional change.

Potentially fruitful directions to improve training tasks lie in tailoring training to specific individual needs (e.g., personalized stimuli or performance-based difficulty levels), including longer, more, or booster training sessions, providing a better rationale for training, or developing more engaging (e.g., gamified, or more challenging) tasks. Also, the possibility of combining various types of cognitive training or adding cognitive training to other forms of psychological or pharmacological interventions should be further investigated.

If a meaningful change in cognitive processes would be obtained, the question still remains whether this would have a considerable effect on emotional resilience and anxiety and depression. That is, many factors are involved in the development of these disorders, and the relative impact of cognitive processes in adolescents is not yet fully understood. More research into the predictive value of various cognitive processes and optimal measures to assess such processes is thus also needed.

To summarize, if online training paradigms could be developed that result in robust changes in cognitive vulnerabilities, and are acceptable to adolescents, this might still be a promising approach in preventing anxiety and depression. However, based on the current results, that cognitive training groups did not outperform control groups with respect to change in emotional functioning, more experimental research is recommended before implementation could be considered.