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## EXAMINING THE POTENTIAL OF A BREATH PACER AS AN ADJUVANT IN COGNITIVE BEHAVIORAL THERAPY: CASE STUDIES IN DIGITAL HEALTH FOR MENTAL WELL-BEING

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### Abstract

Increasing mental health issues worldwide call for effective interventions. Breathing therapy, particularly slow-paced exercises, is gaining recognition for enhancing mental well-being. Integrating these exercises with cognitive behavioral therapy (CBT) appears effective for stress and anxiety management. Technological solutions for home therapy have emerged, improving patient engagement. This study assesses a tactile breath pacer as a CBT adjunct for various mental health conditions.

Six participants with conditions including autism, depression, burnout, bipolar disorder, insomnia, and anorexia engaged in therapy using the moonbird breath pacer for a month, with regular email check-ins.

The breath pacer's integration into CBT showed positive outcomes. Participants found it user-friendly, adapting it into their daily routines. Customized usage patterns promoted relaxation, emotion regulation, and improved sleep, with many extending use for sleep enhancement.

This study demonstrates the benefits of technology in therapy, specifically for emotion regulation, relaxation and sleep. It supports blended care, combining in-person and remote therapy elements, with personalization encouraging active client engagement.

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Incorporating a breath pacer into CBT shows promise for mental well-being. Technology-enhanced exercises complement traditional therapy, offering personalized treatment and client empowerment. The study emphasizes the potential of technology-assisted mental health care in advancing personalized therapeutic methods.

**Abbreviations:** CBT = Cognitive Behavioral Therapy.

**Keywords:** cognitive behavioral therapy, breath pacer, breathing exercises, case study, digital health, mental health.

The prevalence of mental health issues is increasing globally, affecting diverse individuals across age groups (World Health Organization, 2021). The World Health Organization stated that approximately 450 million individuals worldwide are currently living with mental or neurological disorders, encompassing conditions like anxiety disorders, depression, bipolar disorder, and eating disorders (WHO, 2021). These disorders not only inflict individual suffering but also exert substantial societal consequences, leading to impaired functioning, diminished quality of life, and heightened physical health risks (Connell et al., 2012). Consequently, addressing mental health has become paramount, with therapeutic interventions forming the cornerstone of efforts to mitigate these issues (American Psychological Association, 2023).

Breathing therapy, a technique involving conscious control of breathing patterns, has garnered recognition as an effective therapeutic approach (Brown et al., 2013). Slow-paced breathing, characterized by controlled inhalations and exhalations at a frequency lower than the resting pace (4-10 breaths per minute), has demonstrated significant positive effects on mental well-being (Lehrer, 2018; Homma & Masaoka, 2008; Jerath et al., 2015). This technique fosters relaxation and overall emotional equilibrium, in contrast to uncontrolled breathing linked to anxiety and stress (Scharpe, 2021). Studies underscore the potential of slow breathing exercises in ameliorating stress, anxiety, insomnia, and depression (Homma & Masaoka, 2008; Jerath et al., 2015; Prinsloo et al., 2011; Yu & Song, 2010; Hopper et al., 2019).

Cognitive Behavioral Therapy (CBT) represents a well-established therapeutic approach for addressing mental health conditions (David et al., 2018). CBT centers on identifying and transforming negative thought patterns and behaviors, yielding positive and adaptive changes (Hofmann et al., 2012). Research has hinted at the efficacy of combining CBT with breathing exercises to enhance sleep quality and heart rate variability in patients with major depression (Chien et al., 2015).

The demand for accessible and at-home therapeutic options has surged in recent years, fostering innovative interventions to facilitate safe and effective treatments (Brown et al., 2013; Cho & Lee, 2019). These interventions harness

technology to empower clients to initiate and sustain therapy independently within the comfort of their homes. These digital care approaches aim to circumvent the constraints of traditional in-office therapy, including cost and lengthy waiting lists (Saad et al., 2021). Digital tools, such as smartwatches, apps, breath pacers, and audio guides, have arisen to support breathing therapy through auditory, visual, or tactile cues (Honinx et al., 2023). External guidance via devices augments the accessibility and efficacy of breathing exercises, more so than self-guided practices (Scharpe et al., 2021).

The moonbird (Moonbird BV), a portable breath pacer, is designed to facilitate relaxation, stress reduction, and improved sleep quality (Vermeulen et al., 2022). By delivering gentle tactile guidance, the moonbird synchronizes users' breathing rhythm at a slow pace. Recent research demonstrates the feasibility, user acceptance, and positive impact of the moonbird on sleep quality (Vermeulen et al., 2022). Tactile feedback proves particularly valuable for individuals who feel disconnected from their bodies and surroundings (Gallace & Spence, 2010; Della Longa et al., 2022). Incorporating touch in breathing exercises reduces cognitive load and enhances somatic experiences and motor learning (Della Longa et al., 2022; Yu et al., 2015).

The moonbird device might add a tangible therapeutic dimension beyond conventional digital CBT interventions. While digital CBT has proven effective, introducing a tactile tool introduces a haptic element that enhances engagement and offers a novel sensory experience. Moreover, these tools can liberate individuals from the confines of computers or laptops, enabling therapeutic engagement in various settings. This fusion of technology and tactile interaction marks a progressive stride toward comprehensive and adaptable therapeutic support for individuals seeking enhanced mental well-being (Steffen et al., 2021).

Nevertheless, a comprehensive understanding of device utilization, user experiences, and overall effectiveness in therapeutic settings remains limited. This study investigates the integration of the moonbird breath pacer as a therapeutic adjuvant, employing six case studies to offer real-life insights into participants' experiences while considering various therapy-specific and contextual factors. By identifying potential challenges and benefits, these case studies inform future implementation strategies and the design of larger-scale follow-up studies.

Ultimately, this study endeavors to advance therapeutic practices by showcasing the potential of technology-assisted at-home breathing therapy as a complement to standard therapy sessions for individuals with mental health disorders. It also explores the potential benefits of a physical breath pacer as a therapeutic tool that can empower patients to actively participate in their therapeutic journey, optimize patient outcomes, and cultivate a positive therapeutic experience.

## **Methodology**

### *Setting and recruitment*

The study was conducted at Faresa, an evidence-based psychological center based in Belgium with profound expertise in CBT. Faresa offers comprehensive services for individuals and companies seeking to address mental well-being, focusing on both preventive measures and curative purposes. Their team specializes in diagnostics, coaching, and psychotherapy.

A total of six participants (five women and one man, between 24 and 54 years) took part in this qualitative research study. The responsible clinical psychologist and CBT therapist screened all clients who were receiving therapy at the time. She selected participants based on their interest in the study, treatment demand and her assessment of moonbird's added value for their treatment. This resulted in a heterogenous group of individuals with various mental health conditions, including autism, depression, burnout, bipolar disorder, sleeping problems, and anorexia. This diverse range of disorders provided valuable insights into the respective symptoms and contributed to the overall potency of the study. To ensure anonymity, patient identities have been fictionalized.

### *Materials*

For this study, the digital therapeutic device Moonbird (Moonbird BV) was employed. Moonbird is a portable, handheld device designed to facilitate calming breathing exercises by expanding and contracting at a slow rhythmic pace, allowing users to synchronize their breathing patterns with its movement. Through this synchronized interaction, the device guides individuals in engaging in calming breathing exercises, primarily aimed at alleviating stress, anxiety, and sleep problems.

The tactile breath pacer is equipped with a photoplethysmography (PPG) sensor, through which it measures heart rate (HR) and connects wirelessly to an accompanying mobile app via Bluetooth Low Energy (BLE). The mobile app provides real-time biofeedback on HR, heart rate variability (HRV), and heart coherence.

Various other features and options are available on the app. Based on the heart rate measured, the ideal breathing rhythm can be calculated. Additionally, users can choose from default exercises with adjustable duration, which can be downloaded onto the breath pacer for standalone use. Alternatively, they can enter individual breathing exercises or educational journeys based on CBT. These journeys consist of audio guides with multiple episodes focusing on themes like stress management, improved sleep, and anxiety reduction.

Pre- and post-exercise check-ins are integrated into the app, serving a dual purpose in this study: empowering users to gain insights into their emotional and

physical states before and after each breathing exercise, while also providing the therapist with valuable information to evaluate the sessions. By capturing the user's self-reported experiences, the check-ins create a comprehensive overview of how the breathing exercises impact their mental and physical states.

Throughout the exercises, the app provides biofeedback to monitor heart rate and HRV, as well as to indicate whether the breathing is occurring coherently, meaning that the heart rate and breathing rate are in sync.

### *Procedure*

The standard face-to-face therapy at Faresa is based on evidence-based treatment protocols from Cognitive Behavior Therapy (CBT or CBT). CBT aims to bring about behavioral change through cognitive and behavioral interventions tailored to the client. Behavior, thinking and feeling are central to this approach.

Following an initial introduction to moonbird during the therapy session, participants were provided with the device for at home use. The therapist demonstrated the device, while the client was able to follow using an own device. They downloaded and explored the app together, i.e. all the features were shown (e.g. statistics) and different types of exercises were tested. After that, clients were given the opportunity to try out for themselves which exercise appealed to them.

Moonbird recommends a minimum usage period of one month, as noticeable physical effects typically emerge within 3-4 weeks (Lin et al., 2023). The frequency and duration of usage were determined in consultation with the therapist, and tailored to each participant's unique requirements and progress. Some participants used the device multiple times daily, while others utilized it once a day or on an as-needed basis.

Prior to each session, the therapist reviewed the completed exercises and client progress in the moonbird app. During each session, ten minutes were set aside to discuss experiences, feedback or questions regarding the moonbird device and app. It was also possible to ask questions outside the sessions, via mail. Regular check-ins and progress updates, both during the session and via bi-weekly emails, were conducted by the therapist to monitor adherence to moonbird usage and track participants' progress. This allowed for any necessary adjustments to the usage pattern and provided additional support when needed. The personalized approach ensured that the moonbird usage was optimized for each participant's specific circumstances.

### *Data collection*

Throughout the study period, the participants engaged in scheduled therapy sessions with the therapists. These sessions served as a moment for open discussions about emotions, physical sensations, and personal experiences with moonbird. The topics covered during these sessions were diverse, ranging from individual progress

and presenting concerns to the specifics of moonbird implementation and the observed effects. Both the patient and the therapist also orally shared their respective impressions regarding the use of moonbird, including feedback from the moonbird app, providing valuable insights into the therapeutic process. These impressions were written down by the therapist in a prepared template in between sessions.

## **Case description**

All names used in the case descriptions are pseudonyms (**Box 1 - Box 6**).

### **Box 1. Case 1: Autism**

#### **Patient presentation**

Marion V. is a 24-year-old woman with autism. She is hypersensitive which often makes her overstimulated. Marion exhibits black-and-white thinking patterns and struggles with compulsive thoughts. Additionally, she experiences frequent rumination, resulting in difficulty falling asleep at night. A significant challenge for Marion is emotion regulation leading to explosive expressions of anger and impacting her overall mood and stress resilience. Marion experiences problems in her private life because social contacts are difficult to build, and she doubts a lot about whether she is handling things properly. This leads to withdrawal and feelings of being overwhelmed. She expresses a need for clarity and structure, as disorientation occurred when these elements were absent.

#### **Implementation of breathing therapy**

Marion participated in a therapy program that incorporated the use of the breath pacer in several areas to optimize the therapy: to (1) reduce general stress levels, (2) redirect attention during intense emotional moments (emotion regulation), and (3) facilitate falling asleep. The guided exercises offered by the moonbird were seen as an added value because it offers support, as Marion has a great need for structure. Marion engaged with the moonbird approximately 2-3 times daily and continued the usage after one month.

### **Box 2. Case 2: Depression and burnout**

#### **Patient presentation**

Sarah B., a 54-year-old woman, sought therapy for depressive symptoms and burnout and has been in long-term therapist treatment (for 4 years). Sarah struggles to meet the demands of a job, often finding it challenging to get out of bed and structure her day. The symptoms often manifest as mood fluctuations, which she perceives as exhausting. Sarah expresses a strong desire to lead a fulfilling life, but faces difficulties in achieving this goal, resulting in significant distress.

#### **Implementation of breathing therapy**

The primary objective of adding breathing therapy for Sarah was to promote relaxation and reduce anxiety. In this context, the breath pacer served as a physical tool to enhance self-confidence and self-reliance. Adding the breathing therapy aimed to minimize ups and downs and foster a more positive and calm emotional state. Initially, it was agreed to use the moonbird once a day for one month, but the use was extended as advised by the therapist.



**Box 3. Case 3: Bipolar disorder, fear of failure, and overtiredness**

**Patient presentation**

Kobe J., a 34-year-old man, pursued treatment for bipolar disorder, fear of failure, and overtiredness. He has been in long-term treatment for 6 years. Kobe experiences mood swings, difficulty regulating stress, and trouble falling asleep when he faces a deviation from his set structure. Fluctuating sleep patterns and mood/depression also contribute to his symptoms of fatigue. Kobe heavily relies on structure and stability in his life, leading to limited engagement in social activities.

**Implementation of breathing therapy**

Kobe's therapy primarily consisted of CBT with an emphasis on psychoeducation. The breath pacer was integrated into his treatment as a physical tool to embed structure in the daily pattern, as the tactile aspect in combination with the biofeedback offered a more accessible alternative to meditation or other options for establishing structure. Initially, the device was used daily for two months. Later, Kobe decided to use it only on days when he felt the need, tailoring its application to his specific needs.

**Box 4. Case 4: Sleeping problems**

**Patient presentation**

Els V. is a 48-year-old woman who suffers from sleeping problems, specifically difficulty falling asleep and staying asleep. These issues significantly impact her mood, fatigue levels, and stress resilience. Els experiences hindrances in her personal and professional life due to persistent tiredness and difficulties with concentration.

**Implementation of breathing therapy**

The breathing device was incorporated in Els' therapy to enhance relaxation and improve sleep. The contribution of breathing therapy in this case concerned attention shifting in bed and incorporating moments of rest. Initially, Els practiced during the day, gradually transitioning to practicing before bedtime. The aim was to establish regular moments of rest throughout the day and then address relaxation therapy and attention shifting before sleep. It was agreed to use the device at least once a day for one month, primarily during the day initially and then switching to evenings. Progress updates were requested via email after two and four weeks, and the therapist regularly monitored the usage of the device. Els voluntarily continued using the breath pacer after the one-month therapy.

### **Box 5. Case 5: Burnout**

#### **Patient presentation**

Josefien L., a 26-year-old woman, has been undergoing therapy for a period of two years to address her symptoms of burnout. She is overtired from constantly exceeding her limits, leading to emotional overwhelm, physical exhaustion, and reduced mental stability. As a result, Josefien often requires rest and breaks, learning to prioritize and make choices in her weekly activities to avoid overload. This ongoing recovery process has a significant impact on her daily life.

#### **Implementation of breathing therapy**

The breath pacer was introduced to facilitate at-home self-check-ins, promote relaxation, and provide distraction. The goal for Josefien was to establish a stronger connection with her body and regularly assess her well-being. It involved creating a cocoon-like space to momentarily detach from external stimuli. The planned duration for the breath pacer usage was one month, but it was extended to slightly less than two months since the effects were not noticeable yet after 1 month and Josefien therefore wanted to use the app longer. Josefien used the device when needed, both in the morning and evening (twice a day), as well as during moments of increased nervousness.

### **Box 6. Case 6: Anorexia and stress-related symptoms**

#### **Patient presentation**

Nora S. is a 42-year-old woman with anorexia and stress-related symptoms. Nora experiences abdominal pain after eating, particularly when consuming certain foods, although no physical cause was identified. She also struggles with eating larger portions and exhibits sensitivity to stressors. Nora suffers from increased heart rhythm and feeling insecure about her body and appearance. The pressure from her environment further exacerbated her condition, making it challenging for her to make progress. Additionally, she often finds herself preoccupied with meal options and engaged in excessive rumination.

#### **Implementation of breathing therapy**

The breath pacer was integrated into Nora's therapy to alleviate evening stress and improve her ability to fall asleep faster while enhancing the quality of her sleep. The primary objective was to shift her attention from brooding thoughts to focusing on her breathing in bed, thereby facilitating easier and faster sleep initiation. The agreed duration of the device usage was one month, although Nora continued to utilize it for an extended period. She practiced with the device a few times a week in the evening and occasionally once during the day on the weekends.



## **Results**

In the following section, comprehensive findings are reported from both the patients and the therapists involved, providing a well-rounded understanding of the experiences of incorporating the moonbird device in therapy. This multi-dimensional perspective achieves a more nuanced assessment of the device's impact on the therapeutic process.

### **Case 1: Autism**

#### ***Patient findings***

Marion reported positive experiences while using the moonbird both via the checkins in the app and during the sessions. She even indicated she was looking forward to the sessions. In the short term (<1 month), she noticed an improved ability to relax and fall asleep more quickly. The breathing exercises and the accompanying voice guidance helped Marion to quiet her thoughts. Marion did not perceive any long-term effects (>1 month), the effect appeared primarily during the device's use itself. *"I found it pleasant to work with moonbird, in fact I was looking forward to it."* Her self-reported physical state was improved as Marion was able to sleep a little better. However, her self-reported mental state seemed unchanged by the use of the moonbird.

#### ***Therapist findings***

Marion was highly motivated to work with the moonbird and considered it a pleasant part of her day. In the short term, the therapist observed Marion to be calmer and emotionally more stable. Marion's breathing pattern became more coherent. A few weeks after starting to use the moonbird, therapy was discontinued at Marion's request because she felt better. However, she wished to continue practicing with the moonbird. The therapist noticed improvements in Marion's mental state, including more organized thoughts and an enhanced ability to articulate her concerns. It is important to note that these effects cannot be solely attributed to the moonbird, as Marion simultaneously received behavioral therapy. Marion was satisfied with the therapist's approach.

## **Case 2: Depression and burnout**

### *Patient findings*

Sarah experienced challenges in consistently using the moonbird. In both the short and long term, she noticed increased calmness. Initially, she did not perceive the device as immediately valuable, as she found comparable exercises on the internet that also yielded positive results. However, after using the moonbird more frequently, she recognized its effectiveness and value. Sarah relied on the device, particularly during periods of work-related stress, and observed its beneficial impact after a few days. Sarah preferred exercises with a guided voice but occasionally struggled to maintain the breathing tempo. She primarily listened to the informative audio sessions. Eventually, she decided to purchase her own device, although it remains a challenge to use the moonbird consistently.

### *Therapist findings*

Assessing the effect of the moonbird on Sarah's well-being was challenging due to her inconsistent practice. She had been struggling with behavioral change throughout therapy and experienced difficulties in taking action by herself. Although she realized that she needed to use the moonbird more in order to feel an effect, she had difficulty doing so. After two months, she started using the moonbird more frequently and her therapist noticed a calming effect. However, there were subsequent periods of reduced usage. Motivating Sarah to use the moonbird regularly posed difficulties for the therapist. *“Initially, I noticed no effect. However, after I started using the moonbird more frequently, I noticed that I became calmer. I am thinking of purchasing one myself.”*

## **Case 3: Bipolar disorder, fear of failure, and overtiredness**

### *Patient findings*

Kobe reported a positive experience while using the moonbird, particularly during the breathing exercises. He perceived limited additional value in the app. In total, Kobe utilized the moonbird approximately 10-15 times, gradually increasing the exercise duration from 6 to 15 and then 30 minutes. He also utilized the device's preprogrammed exercises, often while watching TV. Additionally, Kobe employed the moonbird before job interviews and during moments of panic or stress. *“I often used it while watching TV. But I have also used it before a job interview, and during moments of panic or stress.”*

### *Therapist findings*

During the initial phase, the breathing device was sparingly used until Kobe expressed a desire to experiment with it. Since the patient is quite rational, he took some time to figure out how he was going to implement moonbird into his structure (with/without app, when, where..). The application data revealed that engaging in exercises with the moonbird consistently improved Kobe's mood and energy levels by approximately 25% each time. Coherent breathing patterns were observed and immediate physical effects and mental impact within a few days were noted. However, due to the absence of physical therapy sessions during the intervention period (the patient only had sessions once a month or less), a comprehensive understanding of additional short-term or long-term effects is limited.

### **Case 4: Sleeping problems**

#### *Patient findings*

Els expressed satisfaction with the breathing device and found the experience enjoyable. The focus on breathing facilitated falling asleep and maintaining sleep. She felt more relaxed, experienced fewer mood swings, and demonstrated improved concentration throughout the day. Initially, Els used the moonbird during the day or in the evening as she perceived immediate use for falling asleep as too 'frenetic'. Instead, she spent some time outside, engaging in relaxation. This ritual created a pleasant moment of relaxation for her.

When she encountered difficulties falling asleep, she used the moonbird for a breathing exercise, which had a soothing effect. While it didn't cause immediate sleep, it facilitated sleep shortly afterward. Consequently, she kept the moonbird in her bedside table drawer. She made a habit of sitting outside with the moonbird each night as a preventive measure, although its effectiveness varied. Even during sleepless nights, performing exercises with the moonbird often helped her. Most importantly, it instilled confidence in her ability to manage sleep difficulties. This confidence subsequently facilitated easier sleep onset. *"Most importantly, it gives me confidence: I know that if I can't sleep, I have something that can help. And that then naturally causes me to fall asleep more easily. I feel less melancholy, but happier and more positive. I can enjoy myself again"*

In the short term, Els experiences that a moment of relaxation makes her feel calm and relaxed, leading to reduced mood swings. In the long term, Els gained better control over brooding thoughts, improved daytime restfulness, and developed increased self-confidence. Her physical state improved as she achieved better quality sleep, increased daytime energy, and a greater sense of mental and physical well-being. Mentally, her ability to focus improved, allowing her to concentrate more effectively and for extended periods. Moreover, she experienced a decrease in

feelings of melancholy and an increase in overall happiness and positivity, enabling her to once again find enjoyment in life. Els found it tedious to use the app for tracking her feelings and measuring parameters such as heart rhythm and preferred to work without it. During the exercise, her breathing rhythm slowed down, with longer inhalations and exhalations. Els conveyed her desire for an exercise that facilitated her breathing gradually slowing down.

### *Therapist findings*

After 3-4 weeks, notable improvements in Els' sleeping problems were observed. Especially given the longstanding nature of her sleeping issues, she initially held little hope for improvement. Els had previously attempted various sessions without significant success, leading to skepticism about therapy. She stated that the moonbird had proven more effective for her sleeping problems than anything she had tried before. Els took charge of setting her own breathing rhythm and used the device multiple times a day, including in the evening. Eventually, she exclusively used the device, preferring not to rely on the accompanying app. As a result, her therapist observed short-term calmness, long-term increased self-confidence, and a more positive outlook. She gained both physical and mental energy, and her hopefulness for the future was restored.

## **Case 5: Burnout**

### *Patient findings*

In the short term, the moonbird proved highly effective during intense moments, preferably without audio. Audio cues sometimes triggered Josefien, especially when problems and symptoms were discussed. *“You could see the evolution of a panicked feeling through breathing, and it's nice that you can do that yourself. The moonbird is ideal for people with panic or stress.”* Mentally, Josefien gained more confidence in her abilities as she realized the calming impact the moonbird could have. She appreciated being able to observe the progression of her breathing and regain control in moments of panic or stress. Josefien found the moonbird particularly suitable for individuals experiencing acute stress. She valued the flexibility of being able to stop the exercise whenever she desired, as well as the freedom to proceed at her own pace without external guidance. However, Josefien expressed dislike toward box breathing exercises, as they demanded more focus and endurance. Overall, Josefien found the use of the moonbird to be quite clear in its purpose.

### *Therapist findings*

The mental and physical check-ins within the app occasionally triggered Josefien. Additionally, she was unaware that the exercise duration could be adjusted. It is important for therapists to provide adequate follow-up and regularly check in with clients to address such concerns. In the short term, Josefien experienced a greater sense of calmness and increased confidence. The moonbird primarily served as a breather, with tension subsiding after practicing approximately three minutes, resulting in the exercise to be halted. Her mental state also became more stable. Ideally, a longer exercise period would be beneficial for Josefien's recovery process.

### **Case 6: Anorexia and stress-related symptoms**

#### *Patient findings*

Nora was positively surprised during the sessions, as the moonbird proved to be more effective than anticipated. However, there was a need to actively find a stimulus-free environment to ensure optimal practice. Nora noticed that the more frequently she engaged with the device, the greater her sense of calmness. She also discovered the importance of selecting appropriate moments for practice, typically when her mind was less preoccupied, and she could dedicate focused time to the exercises. Nora expressed that if she continued utilizing the moonbird for a longer duration, it could have proven beneficial to her during sleepless nights. However, during those times, she tended to prefer doing breathing exercises independently, without relying on the device, as she found that excessive focus on the device and the transition between inhaling and exhaling could be distracting. *“I was positively surprised, it worked better than expected. In the long run, I was focusing on my breathing instead of intrusive thoughts.”* In the short term, Nora experienced increased calmness and a decrease in her heart rate. In the long term, she found it helpful in redirecting her focus from brooding thoughts to concentrating on her breathing. Nora expressed a desire for an auditory cue indicating the end of an exercise, as the automatic termination of the device sometimes led to prolonged exhalation, disrupting her practice.

#### *Therapist findings*

Assessing Nora's mood and energy levels was challenging due to her inconsistent completion of check-ins. The moonbird facilitated the steps in working around eating problems, as it allowed Nora to work on physical and mental peace independently. Direct effects on her primary eating-related concerns were challenging to determine, as moonbird usage did not directly target those issues. Nevertheless, according to the therapist the device effectively promoted overall

calmness and facilitated the therapeutic process. After an initial adjustment period, marked improvements were observed after two weeks, characterized by reduced heart rate and improved breathing coherence. Nora expressed satisfaction with the therapist's approach and the efficacy of the moonbird device.

## **Discussion**

In this study, we aimed to examine the potential of integrating the moonbird device into CBT for various mental health conditions, such as autism, depression, burnout, bipolar disorder, sleeping problems, and anorexia. We explored diverse ways of incorporating the device into therapy sessions and examined its therapeutic benefits.

In all cases, the moonbird breathing device was introduced at the outset of therapy sessions and seamlessly integrated into the framework of Cognitive Behavioral Therapy (CBT). The primary objective was to investigate how guided breathing exercises, inducing physical changes, could enhance therapy and promote self-awareness, self-confidence, and self-reliance. Patients were encouraged to engage with the moonbird regularly, typically between one and three times daily or as needed, based on their unique requirements. Therapists conducted regular check-ins and provided updates during sessions and via email to monitor progress and ensure exercise adherence. Although the initial agreement was for a month of moonbird usage, some cases extended this duration to accommodate individual progress and needs. Patients enjoyed flexibility in tailoring moonbird usage frequency and timing to suit their specific needs.

The moonbird device served as a valuable tool for redirecting attention during intense emotional moments, facilitating relaxation, and improving sleep initiation and quality. It provided patients with a dedicated space for self-reflection and self-care. Interestingly, many participants extended the moonbird trial period beyond one month, often due to self-request or therapist advice. Furthermore, regardless of the initial reason for incorporating the moonbird into therapy, several participants found it particularly effective for improving their sleep, aligning with recent studies highlighting its efficacy in addressing insomnia (Vermeylen et al., 2022).

These findings bear significant implications for mental health therapy, emphasizing the potential of health technology to augment treatment experiences and outcomes. Integrating technology into therapy empowers therapists to provide individuals with additional tools for symptom management and overall well-being. The moonbird device, with its portability and accessibility, can seamlessly integrate into daily routines, allowing individuals to actively participate in their therapy journey from the comfort of their homes.



The incorporation of technology into therapy has also accelerated the adoption of blended care, a model that has gained momentum, particularly in response to the COVID-19 pandemic. Blended care combines in-person and remote elements, offering clients a flexible and accessible approach to therapy. Technology plays a pivotal role by bridging the gap between physical and virtual interactions. Therapists can leverage digital tools to craft personalized treatment plans tailored to each client's unique needs and goals.

One of the key advantages of technology integration is the ability to provide clients with tools that therapists can set and monitor, customized to address specific conditions. These tools empower clients to actively participate in their therapeutic journey, even outside the therapist's office. Clients can engage in therapeutic exercises, practice coping strategies, and monitor their progress in real-time. These digital tools often include features that enable therapists to track client activities, review performance data, and adjust treatment plans accordingly. This not only enhances client engagement but also strengthens the therapeutic alliance between therapist and client as they collaborate closely to achieve shared treatment goals.

However, while technology offers immense potential for blended care, it is essential to strike a balance between digital interventions and the personal touch of traditional therapy. Face-to-face interactions remain valuable for building rapport, establishing trust, and addressing complex emotional issues that necessitate a personalized approach. Thus, the ideal blend of in-person and remote therapy components should be determined based on individual client preferences and needs.

In summary, the integration of technology into therapy has revolutionized the delivery of mental health services, adapting to the changing landscape driven by the COVID-19 pandemic. Blended care, enabled by technology-driven tools and remote therapy options, holds promise for enhancing therapeutic outcomes, expanding access to mental health care, and empowering clients to actively engage in their healing process. As technology continues to evolve, mental health professionals will explore innovative ways to leverage its potential, prioritizing the well-being and recovery of their clients.

Moreover, the case studies underscore the importance of customization and tailoring interventions to individual preferences and needs, aligning with the principles of patient-centered care (Grover et al., 2022). Each participant in the case studies exhibited unique experiences and preferences when using the moonbird device, reinforcing the need for a personalized therapy approach. Therapists collaborate closely with their clients to understand their specific requirements and preferences, customizing breathing exercises to align with their individual goals and needs.

This collaborative approach empowers both therapists and clients during therapy, enabling active involvement in decision-making regarding therapy provision. Clients take greater ownership of their therapy journey, potentially leading to higher compliance and greater effectiveness. In this patient-centered and collaborative approach, therapists and clients work together to create a treatment

plan that resonates with the client's unique needs and lifestyle. The technology-supported breathing exercises through the moonbird device become a valuable tool in this process, offering clients autonomy and ownership over their therapeutic journey. Consequently, clients may feel more motivated and engaged, leading to a deeper commitment to therapy and ultimately improving mental health outcomes.

Recent studies have explored the integration of breathing techniques into trauma-focused CBT (TF-CBT) for patients with posttraumatic stress disorder (PTSD). These studies demonstrated the benefits of incorporating breathing techniques as complementary elements in TF-CBT, showing trends toward faster symptom reduction and improved mental quality of life (Haller et al., 2023; Rosaura Polak et al., 2015). The findings emphasize the potential advantages of implementing guided breathing exercises, such as those facilitated by the moonbird device, within CBT.

The moonbird device's flexibility aligns well with the personalized approach to therapy advocated in previous research. These findings, combined with existing research, underscore the promising role of breath pacers, like the moonbird device, as valuable tools in digital health applications for mental well-being. They reinforce the implications of our case studies and contribute to the advancement of therapeutic practices and technology-assisted interventions in mental health care.

### *Strengths and limitations*

Presenting case studies across various mental health conditions expands our understanding of the moonbird's potential impact on different individuals. The mixed methods approach, incorporating both patient and therapist perspectives, provides a comprehensive view of the effects of the breathing sessions. However, the reliance on subjective experiences and motivational data from patients may introduce potential biases and should be considered. Further comprehensive data analysis, including comparisons across different measurement moments, could enrich the understanding of patient experiences. Additionally, the absence of long-term follow-up limits the assessment of sustained effects beyond the testing period.

Despite these limitations, this study lays the groundwork for future randomized controlled trials that may include objective measures and long-term follow-up. The case studies contribute to the growing field of digital health interventions in therapy, showcasing the unique combination of breathing exercises and technology offered by the moonbird device. This research highlights the potential benefits of such devices across various mental health conditions and underscores the importance of customization and individual preferences in therapeutic interventions.

## **Conclusion**

This study demonstrates the potential and effectiveness of using the moonbird device as an adjunctive tool in Cognitive Behavioral Therapy for various mental health conditions. It offers practical examples of how technology can support breathing exercises, providing valuable guidance for therapists. The findings emphasize the importance of personalized therapy approaches that empower clients to actively engage in their healing process. The integration of the moonbird device showcases how technology can enhance treatment outcomes and improve the therapy experience. This collaborative approach between technology and personalized therapy holds promise for supporting mental well-being and advancing therapeutic practices.

## **Authors' note**

**Ethics statement:** In this feasibility study, we have complied with APA ethical standards in the treatment of our sample. The highest ethical standards were consistently upheld, following both institution's guidelines and the General Data Protection Regulation (GDPR). While the study was approached as an extension of routine clinical practice, participants were fully informed of their rights and provided written consent for both participation and data usage. Ensuring privacy, only EP (Faresa) had access to participants' identities. Pseudonyms were used in reporting to moonbird and other parties. The non-intrusive nature of the technology posed no risks, emphasizing participant autonomy, privacy, and transparency throughout. Moonbird's adherence to CE marking standards further reinforces its credibility. Although our primary aim wasn't publication, the significant outcomes and a gap in the existing research motivated us to share our insights, receiving positive feedback at the European Congress of Behavioral Therapy in Barcelona in October 2023 (EABCT 2023).

**Author Contributions:** EP, EH, SB and NJ conceptualized the study. EP performed data collection and data analysis. EP and HL wrote the original draft. EP, EH, HL, NJ, SB, and VR contributed to the article and approved the submitted version.

**Conflict of interest:** SB and EH are respectively co-founder and researcher at Moonbird B.V. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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