

# THE **RELAXATION EFFECTS** & **FUTURE DESIGN DIRECTIONS** OF A NOVEL MULTI-SENSORY AND TANGIBLE DESIGN PROBE

**RELAX-CHANGE** — a drum to decrease anxiety for people with elevated anxiety in daily life.



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## **Master thesis**

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# LIST OF DEFINITIONS

**Elevated trait anxiety.** An elevated form of trait anxiety (T-Anxiety). The stable elevated tendency of a person to experience anxiety on a daily basis, across many situations. The stable tendency to perceive stressful situations as threatening and to respond to such situations with intensified state anxiety (S-Anxiety) reactions.

An individual with elevated trait anxiety has the key tendency to have excessive, uncontrollable worry about a number of life events or activities and is often accompanied by high emotional and bodily arousal.

**State anxiety.** A state of anxiety which has been triggered. In other words, a moment of increased intensity of a person's anxiety level (S-Anxiety).

**Anxiety responses.** Responses to a state of anxiety or long-term high daily anxiety levels. These include cognitive responses (excessive negative thinking), emotional responses (high emotional arousal) and bodily responses (tensed muscles, increased breathing, elevated heart rate etc.).

**Worrying.** A chain of future oriented thoughts, negatively affect-laden and quite uncontrollable, concerned with what if?-thinking.

**Rumination.** Repetitive thinking that focuses its attention on one's depressive symptoms and is concerned with loss, hopelessness and failure.

**RELAX-CHANGE.** A design probe which is a novel multi-sensory, playful, expressive and tangible drum to decrease anxiety and enhance relaxation support, that has been designed in previous work.

The name RELAX-CHANGE for this design probe has been chosen, because the probe aims to change the perspective on relaxation support for people with elevated trait anxiety.

**RELAX-CHANGE Prototype.** The design probe RELAX-CHANGE and its three underlying novel relaxation principles, is translated into a prototype with similar formgiving used in this thesis to evaluate the probe's relaxation effects and future design directions. Functioning as the main object of knowledge construction.

**Playful expression.** A free form expressing oneself in a playful manner, on a physical and emotional level.

**Playful tension-release / expressive tension-release play.** The design probe supports playful tension and release drum play (playful tension-release / expressive tension-release play). The probe supports building towards an expressive peak in drum play (tension), through multi-sensory feedback, flowing from there into relaxation (release). This is the main underlying pathway in the drum to distract from negative thinking, flow into relaxation, and release from the multiple responses to high levels of anxiety.

**Deep absorption.** The design probe supports high engagement in a distractive task (through expressive tension-release play), that is able to be tailored to the different expressive, musical and light preferences of the people within the anxiety spectrum and offers deep level of absorption.

**Multi-sensory feedback.** The multi-sensory feedback in the design probe contains a combination of light and musical feedback and triggers the multiple senses of a person with anxiety. The combined light & musical feedback supports the creation of playful tension-release; enhances the engagement in drum play and therefore the ability of the novel drum to provide deep absorption; and supports in overcoming the multi-faceted anxiety responses (cognitions, emotions, bodily tensions). Finally, there is the additional benefit that the light and musical tones create a more relaxed state in itself, aside from their supportive functions.

**Musical tension / musical tension-release.** This refers to the build up or creation of musical intensity in musical play that eventually dissolves, a.k.a. releases. Musical tension is a moment of unease in musical play and the expectation for it to be released. In the design probe, harmonic musical tension-release is implemented in the musical feedback of the drum. Making use of clashing or nice sounding combinations of harmonic musical tension tones and harmonic musical release tones existent in major and minor musical scales. With these tones, musical tension (“clashing” sound) can be created in drum play through 1) a dissonant combination of tones played after each other in play and 2) through the play of a musical tension tone over a non-tension tone (release tone) which is held on for a while. This can be released by switching in musical play to musical release tones.

**Harmonic tones.** Tones that can harmonize, in other words, blend well together or that can create dissonance, in other words create a clashing sound when combined in musical play.

**Major / minor musical scale.** A scale containing eight musical tones. The difference between major and minor scales is one essential tone, the third one in the scale. This tone gives the major scale a more bright and cheerful sound as compared to the more dark and sad sounding minor scale.

**Musical tension tones.** Harmonic tones that create a dissonant (“clashing”) sound when played together, after each other, or in combination with musical release tone out of the major or minor musical scale it is part of. These are the second, fourth, sixth and seventh tones within a major or minor musical scale.

**Musical release tones.** Harmonic tones that release a dissonant (“clashing”) sound when played after a musical tension tone. These musical tones sound nice when played singularly or in combination with other musical release tones part of the major / minor scale implemented in the drum. These are the first (base), third, fifth and eighth (octave) tones within a major or minor musical scale.

**Pentatonic scale.** A musical scale with five tones per octave (a set of 8 musical tones). Each note within the octave pairs well together and you can play them in any order to create a pleasing melody. In other words, there is no bad note or chord that can be produced. A major pentatonic scale has an absence of the 4th and 7th intervals which allows for a distinct absence of musical tension, a clashing sound, from one note to the next within the scale itself and will therefore always sound good. This scale is often used in current steel tongue drums in current music therapy practice for relaxing musical play.

**Cognitive-behavioral therapy (CBT).** One of the most effective psychotherapeutic methods for anxiety patients, superior to medication. In CBT disturbing thoughts (cognitive), negative emotional reactions (emotional) and inflexible behavior (behavioral) are identified, corrected and re-structured focusing on self-monitoring and relaxation training.

**Physical tension-release.** A process of tensing various muscles in the body and relaxing those different muscle groups afterwards. This is done in the relaxation technique 'progressive muscle relaxation (PMR)', known in the field of cognitive-behavioral therapy.

**Daily life contexts.** Settings which a person with elevated trait anxiety encounters in everyday life, during his/her typical routines and that are close to the person with anxiety. Such as home environment (livingroom, bedroom etc.), public transport or the supermarket.

**Percussion instruments.** A type of musical instrument that makes a sound when it is hit, shaken or scraped. These include for example a xylophone, hand pan, snare drum or steel tongue drum. These are more accessible than complex musical instruments such as a guitar, but still require lots of practice in timing and amount of strength used.

**First Person Perspective.** When using a first person perspective, the designer is an actor in the design context, part of the target group, designing for herself within this context, incorporating their own experiences. The designer's current and past experiences within this context allows the designer to take responsibility, find intrinsic motivation, use intuition and construct an intuitive design research framing.

**Second Person Perspective.** When employing this perspective, the designer uses inspiration- or data-oriented workshop, field or laboratory strategies to involve the users in the design process. Taking this perspective allows designers to build an empathic understanding and to construct an empirical framing of the user situation and the stakeholders' values within.

**Experience Sampling Method (ESM).** This is an intensive longer term user research method that involves participants reporting on thoughts, feelings, behaviors, and/or environment on multiple moments over time. Participants report in the moment or shortly after and this method is also referred to as the daily diary method.

**Mixed Methods Data Collection.** In this thesis, the “mixed methods” data collection around the use of the prototype involves simultaneous collection of both quantitative and qualitative data, followed by a combination and comparison of these multiple data sets. It involves the collection of complementary data on the same phenomena.

**State-Trait Anxiety Inventory (STAI).** This is a commonly used psychological self-report questionnaire to quantitatively measure a person’s trait and state anxiety level. It has 20 scaled items that assess trait anxiety and 20 scaled items to assess state anxiety.

**Video Logging.** The use of video recordings to log a person’s behavior, when the design researcher is not there. In the case of this thesis, the diary study participants logged their drum play behavior (hand and playful movements) through video recordings of their drum play sessions.

**Video Annotations.** The process of coding videos for observational and non-verbal behavioral analysis. In this thesis, a video annotation of the participant’s drum play behavior characteristics in the video recordings was done. The videos were annotated with the MAXQDA coding software.

**User Experience (UX).** UX is defined for me as experiences derived from personally encountering systems, products or services which is unique to every individual (especially within special need groups) we are designing for. Next to this, UX is focused on a particular mediator, in the case of this thesis the RELAX-CHANGE prototype, which creates, influences and shapes the user’s experiences around expressive drum play for relaxation. UX is affected by time and contextual factors and consists of UX during play (momentary), UX after play (episodic), UX before play (anticipated) and UX over time (cumulative).

**Expressive bodily drum play.** Drum play through use of expressive body movements.

**Guiding playful interaction.** Playful interaction mechanisms in the drum that provide guidance to the person with anxiety, in either expressive tension-release play, play engagement or the release of the various anxiety responses. For example, light feedback that shows which drum touch pads are recommended to touch during play.

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Dear

## 01 FOREWORD

diary,

**To everyone who suffers from anxiety on a daily basis. The onsetting thoughts, sudden high emotional rushes and muscles that are so tensed that it feels like you can barely take one extra step forward. It is so difficult to control, it controls you, it takes control of your every-day life. I feel you and I empathise. It is time, yes the time is now, to change our perspectives on anxiety reduction and relaxation support within the field of mental health, it is time to RELAX-CHANGE.**

*“So Veerle, here is a pillow. You can box on it, as hard as you want, you can let it all out. Once you feel like you are done, I want you to wait and let your breathing get back to its normal pattern by itself, naturally.”*

That is what a therapist told me a long while ago, when I was dealing with hyperventilation and extreme breathing issues on a daily basis. The breathing issues got so bad that even if I had perfect breathing patterns, I was afraid I would have a hyperventilation attack at school or that I would not be able to control my breath during the day. The fear took control of my thinking, it took control of my daily life functioning. I remember I learned lots of exercises to distract myself from thinking to control my breathing or from the physical responses such as perspiring hands. Like journaling, fingertip movements to turn attention on body parts, breathing exercises and body scans. However, “boxing into a pillow” was the only remedy that I still remember, and that actually helped effectively. It felt like the easiest and most intuitive way to flow back into a natural state of breathing, which supported me to go on with my day.

This advice stayed with me and was the very first inspiration for the design of the novel drum for relaxation, for people with elevated trait anxiety — RELAX-CHANGE. It was the very first inspiration to design research an opposing approach to all the soothing and digital relaxation tools out there. Characteristics that clearly do not work for everyone in the anxiety spectrum. In other words, it brought me to a more expressive and tangible relaxation approach as the novel pathway to relaxation support for this target group. Together with my passion for music creation and the relaxation / empowering benefits of active music engagement, I decided to create a probe that would make these benefits accessible to this target group. No musical skills needed, no more “what-if I fail playing this musical instrument?” thinking. RELAX-CHANGE is none of that, no actual musical instrument, it is a relaxation intervention. An easy, tangible, rigid and practical probe that provides an expressive and musical pathway to let go of the excessive thinking, just like boxing into a pillow, to support flowing into a natural state of relaxation on a daily basis.

So how does this master thesis position itself within my 1,5 years of design research around the designed probe RELAX-CHANGE? In M1.2 I created the probe RELAX-CHANGE. The probe supports people with elevated trait anxiety to build towards a peak of multi-sensory expressive drum play (tension) to flow into relaxation (release). The general potential of the design probe to support relaxation was emphasized through the results from two focus groups involving participants with elevated anxiety, and two psychotherapy expert interviews. RELAX-CHANGE's potential to be used at home or within therapy (van Wijlen, 2020) was explainable through the underlying psychological principles and engagement potential attributed to the design of RELAX-CHANGE in the evaluations.

However, flexibility of the multi-sensory interaction had to be improved to fit a larger variety of anxiety patients. Furthermore, the potential of the probe in a clinical mental health setting had to be researched to broaden knowledge about the potential for people with elevated anxiety (van Wijlen, 2020).

Therefore in the M2.1 project, I investigated the values, weaknesses, opportunities, and threats of the design probe to offer relaxation support in psychotherapy research and practice (van Wijlen, 2021). I did this at the psychotherapy department in Giessen, Germany in collaboration with prof.dr. Julian Rubel. Moreover, a high level version of the M1.2 RELAX-CHANGE prototype was developed. Results from 11 qualitative semi-structured interviews with clinical psychology students, clinical psychology / psychotherapy researchers and therapists were investigated (van Wijlen,2021). Results suggested that therapists and researchers are open minded regarding opportunities of technological solutions in clinical contexts and see added value for patients suffering from anxiety within the clinical contexts (van Wijlen,2021). Moreover, results suggest that especially because of the design qualities such as 'accessibility and flexibility', 'visible direct feedback', 'engagement and absorption potential' and 'playful musical approach' RELAX-CHANGE is perceived as a valuable device for the clinical context (van Wijlen,2021).

However, barriers for this target group in accessing clinical mental health and relaxation support, such as stigma (individual) / limited knowledge of general practitioners (provider) / psychotherapy waiting lists (systemic), limit this target group to benefit from existing and novel relaxation interventions in the mental healthcare contexts that are currently the norm (Collins, Westra, Dozois, & Burns, 2004). Moreover, to contribute to bridging the gap with RELAX-CHANGE between playful design (research) for relaxation, psychotherapeutic interventions, musical relaxation interventions and commercial/ practical solutions, evidence for the efficacy of the probe's novel relaxation principle is needed and future design directions need to be outlined. In order to contribute to evidence-based novel relaxation support for people with elevated trait anxiety and the creation of playful, expressive, multi-sensory and tangible design directions for novel relaxation support for this target group. All in all, to contribute to RELAX-CHANGE, changing the perspective on relaxation support within the elevated anxiety spectrum.

Therefore, in this master thesis, the relaxation / state anxiety effects of the probe in daily home contexts is researched; and the probe's future design directions are explored. To provide an overall contribution to enhancing accessible "daily" relaxation support for this target group and to making a start of evidence-based and accessible products that offer a novel pathway to relaxation for people with elevated trait anxiety to be used in daily life "mental health" contexts, where individuals first seek assistance.

Enjoy reading & Let's RELAX-CHANGE!

*Best,*

Veerle van Wijlen.

PS: May you get a little overwhelmed during the reading, try boxing into a pillow :)

## 02 ABSTRACT

We are living in a more inclusionary world, in which all kinds of people are accepted and offer a source of inspiration to others around us in society. However, people with elevated anxiety (18-35 years old) experience periods of everyday negative thinking that are difficult to control. This limits their daily functioning and ability of being “their best self in society”. Therefore this target group has a high need for effective pathways to cope with phases of negative thinking and to come to relaxation. Current literature elicits the need to bridge the gap between effective relaxation notions from music therapy, cognitive-behavioral therapy, designed playful interaction relaxation interventions and accessible practical tools for relaxation in daily life contexts. Which is aimed at with the previously designed probe RELAX-CHANGE — a novel playful, expressive, multi-sensory and tangible drum to decrease anxiety. The probe supports building towards an expressive peak in drum play (tension), through multi-sensory feedback, flowing from there into relaxation (release). The efficacy of this drum to distract from negative thinking, flow into relaxation, and release anxiety responses is researched and future design directions are outlined. In this work, the RELAX-CHANGE prototype is at the center of constructing knowledge. In two iterations, the relaxation / state anxiety effects of the probe in daily home contexts are researched; the unsatisfied needs in expressive drum play for relaxation are investigated; and future design directions are explored. Through the 1-week diary studies, with 3 participants, and mixed methods data collection around usage of the prototype, the relaxation and state anxiety effects are overall positive, with an average decrease in the participants’ state anxiety levels of 17.5. A decrease that can make the difference in daily functioning. Four unsatisfied needs around the probe’s relaxation support are presented leading to three suggested future design directions. Including: 1) optimizing expressive bodily drum play; 2) optimizing light interaction; and 3) the exploration of playful drum guidance through multi-sensory interactions. The main focus point considered to inspire future designs of the novel drum for this target group includes: the drum mat concept, providing whole body interaction, combined with contextual and reflective guidance. To support increased flexibility in bodily expressive drum play, release of bodily anxiety tensions and to provide a fit with different types of expressive and contextual daily relaxation needs.

### KEYWORDS

Design Research; Mental Health Support; Elevated Trait Anxiety; Relaxation Interventions; Tangible Design; Playful Interaction Design; Multi-Sensory Design; Playful Musical Objects; Playful Expression; Experience Sampling Method; Efficacy / UX Research; Design Envisionment

## 03 INTRODUCTION

We are living in a more inclusionary world, in which all kinds of people are accepted and offer a source of inspiration to others around us. However, people in special needs groups are often restricted in daily life functioning, making them unable to be their 'best self in society', to feel empowered and socially integrated (Alper, Hourcade, & Gilutz, 2012).

Anxiety disorders are one of the most prevalent mental disorders affecting society and cause high healthcare costs. About "33.7% of the population is affected by an anxiety disorder during their lifetime." (Bandelow & Michaelis, 2015, p.1). Anxiety includes a spectrum of many types as general anxiety disorder (GAD), panic disorders, social anxiety disorder (SAD) and specific phobias having their commonalities in daily life limitation (Bandelow & Michaelis, 2015). Unawareness and misunderstanding around anxiety; temporal periods of anxiety; and (social) performance challenges are the main problems causing daily powerless feelings for people in the anxiety spectrum (Sanchez & Kunze, 2018). To create empowerment and social integration amongst people within the anxiety spectrum, a specific problem can be addressed: the lack of relaxation in common daily life contexts (Borkovec & Costello, 1993). This is especially relevant for people with elevated trait anxiety, most prevalent around 18-35 years old (Bandelow & Michaelis, 2015).

People with high levels of anxiety experience worrying and rumination, in other words: periods of everyday negative thinking that are difficult to control (Olatunji, Naragon-Gainey, & Wolitzky-Taylor, 2013). Which is often accompanied by emotional and bodily arousal (Knowles & Olatunji, 2020). This leads to tiredness and decreased self-esteem, which limits daily functioning, decreases self-efficacy and social integration (Greeson & Brantley, 2009). Therefore there is a high need for effective pathways to cope with acute phases of negative thinking, to relax and allow them to be their 'best selves in society'. One of the most effective methods for anxiety patients, superior to medication, is cognitive-behavioral therapy (CBT). In most cases significantly more effective than other therapeutic approaches for anxiety disorders (Cooper, 2008). Current CBT approaches to address negative thinking focus primarily on relaxation techniques, such as 'progressive muscle relaxation', breathing techniques or mindfulness practice (Cooper, 2008). These are part of 'applied relaxation training' and 'mindfulness-based cognitive therapy', and aim to distract from periods of negative thinking or to accept the negative thinking patterns. However, these relaxation techniques are not suitable for everyone and do not show the same level of effectiveness across individuals in the elevated anxiety spectrum (Cooper, 2008; Conrad & Roth, 2007).

Moreover, current designed digital and soothing relaxation interventions alike do not suffice for everyone in the elevated anxiety spectrum to deal with negative thinking (Knaus, 2014) and release from the experienced multi-faceted tensions to anxiety. From a commercial perspective, only 17.3% of commercial anxiety apps targeted worry symptoms, 26.9% had a CBT approach and the majority had no theoretical approach behind their intervention (Sucala et al., 2017). This elicits a clear gap between commercial, digital, practical solutions and evidence-based psychotherapeutic interventions to provide novel relaxation support. From a playful interaction design perspective, potential is seen in "gamification" for mental health and serious games (Fleming et al., 2017), which often make use of absorption in fantasy environments or positive psychology as 'level ups' to increase engagement in therapeutic programs (Fleming et al., 2017). However, digital and soothing characteristics still allow people to ruminate or experience heavy emotions, cognitions or bodily responses to anxiety. The same holds for current soothing practical tangible relaxation interventions (TREND HUNTER Inc., 2020) and Snoezelen rooms (Gómez et al., 2016), that provide comforting, private, soft and material sensory experiences to reduce anxiety but **overlook playful expression**. Which is an important aspect to **release the multi-faceted tensions** in people with elevated anxiety and for **deep absorption**.

In this way, the potential of the **combination of multi-sensory stimulation, playful expression and tangibility** which are important aspects for deep absorption to prevent rumination and releasing various tensions (Cevasco, Kennedy, & Generally, 2005) are overlooked as design opportunities by the most technical relaxation innovations and CBT techniques alike to offer novel relaxation support for this target group.

That is why potential is seen in physical and more expressive manners for distraction. Active musical engagement provides the opportunity to get in touch with thoughts and emotions (Wilkins, Hodges, Laurienti, Steen, & Burdette, 2014), relax and improve mood (Hallam, 2010). Expressive playful musical objects can enable these advantages of music engagement for this target group (non-musicians) through easy access, intuitive and responsive user interfaces (Wu & Bryan-Kinss, 2017). Expressive forms of music engagement are also very well known within the field of music therapy and within clinical musical improvisation for people with anxiety (Erkkilä et al., 2019), but not so much in CBT and has not been much associated with relaxation as compared to receptive forms of music engagement (passive listening) (Erkkilä et al., 2019). Expressive music engagement that is used effectively in therapy to release stress and anxiety responses includes **rhythmic tension-release percussive drum play** (Scheffel & Matney, 2014). However, this is used rather for “emotional expression or inducement”, instead of relaxation (Matney, 2016). An example of therapeutic percussive drum play for relaxation, is the steel tongue drum (Shepherd, 2021). Although made especially for relaxing musical play, it lacks the ability of expressive music engagement as in the paper by Matney (2016) and Bensimon, Amir and Wolf (2008), which will still allow this target group to ruminate or experience heavy emotions, cognitions or bodily responses to anxiety.

The general notion is that there is a gap in playful design (research) for relaxation, psychotherapeutic interventions, musical relaxation interventions and commercial/practical solutions to provide novel ways of relaxation for people with elevated anxiety in daily life. Current relaxation interventions do not show the same level of effectiveness across individuals in the anxiety spectrum, are rather digital, rather soothing and lack the ability to provide deep absorption and support for releasing all three anxiety responses: negative thinking, emotions and bodily tensions. The potential of the combination of playful expression, multi-sensory stimulation, and tangibility which are important aspects for deep absorption to prevent rumination and releasing various tensions (Cevasco et al., 2005) are overlooked. Even in current percussive musical relaxation interventions lack the combination of expressive drum play and relaxing harmonic percussive play to provide optimal deep absorption, prevent rumination and release of all three anxiety tensions (cognitive, emotional and bodily). As a result, **not everyone with anxiety receives optimal relaxation support** to cope with acute phases of anxiety, panic attacks, and/or on-setting negative thoughts.

Furthermore, barriers to mental health support for this target group limit benefits from existing relaxation interventions in mental healthcare contexts that are currently the norm (Collins et al., 2004). Therefore, it is needed to **bridge the gap** between effective relaxation notions from music therapy, psychotherapeutic cognitive-behavioral therapy, playful interaction design (research) for relaxation and practical tools for **relaxation in daily life contexts**.

The previously designed probe RELAX-CHANGE — a novel multi-sensory, playful expressive and tangible drum to decrease anxiety designed plays into this gap. The probe provides novel relaxation support in building towards an expressive peak in drum play (tension), through multi-sensory feedback, flowing from there into relaxation (release). Supporting relaxation at home for those who are not in therapy / finished with therapy / or as additional support next to therapy. Current work and accessibility limitations in the mental health field, emphasize that **evidence-base is needed around the efficacy of RELAX-CHANGE**. Furthermore, **future design directions need to be outlined** to contribute to a continuation of the creation of playful, expressive, multi-sensory and tangible design directions for optimized novel relaxation support for this target group in daily contexts.

That is why in this thesis, the **relaxation / state anxiety effects** of the novel probe in daily home contexts is researched; **unsatisfied needs in expressive drum play for relaxation** are investigated; and RELAX-CHANGE's **future design directions** are explored. Research questions include:

## Research

- 1. What is the effect of the design probe's novel relaxation principle on relaxation and decrease in state anxiety, amongst people with elevated trait anxiety?**
- 2. What are the unsatisfied needs in expressive drum play for relaxation (playful tension-release), and release of worrying, emotions and bodily tensions to be found during play of the design probe?**
- 3. How can these relaxation/state-anxiety effects and user experience insights around expressive drum play for relaxation, inspire future design directions and improved interaction concepts around accessible (multi-sensory expressive) tangibles for relaxation and anxiety?**

## Questions

The **RELAX-CHANGE prototype** is central to knowledge construction around these research questions, allowing the interaction with the probe's three novel relaxation mechanisms: 1) expressive tension-release drum play; 2) engagement / tailored deep absorption in a tangible expressive and distractive task; and 3) overcoming the multi-faceted anxiety responses (cognitions, emotions, bodily tensions) through light and musical feedback in the drum. In two iterations, **experience sampling in the form of diary studies** is conducted, from a first and second person perspective, with a small pool of participants (n=3) who worked with the drum for 1 week. The diary study includes pre- and follow-up semi-structured interviews, questionnaire data at multiple points in time and drum play, video logging and future design concept evaluation.

Through **"mixed methods" analysis** it is found that **effects** of drum play with the probe, on improved relaxation and decreased state anxiety levels **have been found overall to be positive**. Playing the prototype has led to 15 out of the 19 total play sessions in which a decreasing state anxiety was created; with an average decrease in state anxiety levels of 17.5. This can make the difference between a clinically relevant and a non-clinically relevant state anxiety level and so daily functioning. High anxiety experiences before drum play; bodily anxiety tensions release; musical tone settings; and effective drum play behaviors as: repetitive drum play, combo play, fast and hard play, frequent musical tension release play, spreaded finger movements and frequent peak building have a positive role in enhanced relaxation experiences. However, outlier effects have to be acknowledged, with one participant that created positive relaxation effects in only 1 play session. Although the probe's relaxation effects will not be optimal for all, and not in every drum play session, this research shows that the probe is able to change the perspective on relaxation support. Next to that, four unsatisfied needs around expressive drum play for relaxation led into **three suggested future design directions** to optimize the probe's relaxation support. Including: 1) optimizing expressive bodily drum play; 2) optimizing light interaction; and 3) the exploration of playful drum guidance through multi-sensory interactions. In particular future designs should focus on supporting enhanced bodily expressiveness and release of bodily anxiety tensions through drum play. The **main focus point** considered to inspire future designs of the novel drum for this target group includes:

**the drum mat concept**, providing whole body interaction, combined with contextual and reflective guidance. To support increased flexibility in bodily expressive drum play, release of bodily anxiety tensions and to provide a fit with different types of expressive and contextual daily relaxation needs (e.g. yoga or dancing).

In this way it is contributed to evidence-based novel relaxation support for people with elevated trait anxiety in daily (home) contexts; and bridging the gap between playful design (research) for relaxation, psychotherapeutic relaxation interventions, musical relaxation interventions and commercial/practical solutions. Furthermore, the evaluated design probe together with these suggestions can be seen as a starting point of accessible products for relaxation for people with elevated trait anxiety. That makes this target group benefit from expressive tension-release play (novel relaxation mechanism) for relaxation; expression supportive, absorbing, and anxiety relieving multi-sensory feedback; tangibility; and easy music creation, for which no musical skills are needed and in which there's no chance for failing. Overall, it is contributed to **enhancing accessible "daily" relaxation support for this target group** and to **making a start of evidence-based accessible products that offer a novel pathway to relaxation** for people with elevated trait anxiety **to be used in daily life "mental health" contexts**, where individuals first seek assistance.

All in all, the master thesis **contributes to RELAX-CHANGE, changing the perspective on relaxation support** within the elevated anxiety spectrum.

# 04 RELATED WORK

**To establish the context and approach for this design research, the related work covers five main areas.** First the target group is outlined and their main challenges to deal with elevated anxiety on a daily basis are introduced. Secondly, current approaches to address negative thinking and relaxation in the field of (clinical) mental health support are described. Thirdly, current relaxation designs, practical tools and psychotherapeutic interventions are investigated. Fourthly, the field of musical expression, musical instruments and multi-sensory stimulation for expressive relaxation support in the field of anxiety is explored. All to outline the gap in playful design (research) for relaxation, psychotherapeutic interventions and practical/commercial designs to provide novel ways of relaxation for people with elevated anxiety in daily life.

## 04.1 Understanding Anxiety and The Main Challenges to Function in Daily Life and Society

Anxiety disorders are occurring all over the world, it is a widespread problem, with lifetime prevalence rates ranging between 13.6% and 28.8% in Western countries (Bandelow & Michaelis, 2015). Anxiety disorders are one of the most prevalent mental disorders affecting society and cause high healthcare costs. About “33.7% of the population is affected by an anxiety disorder during their lifetime.” (Bandelow & Michaelis, 2015, p.1). Anxiety includes a spectrum of many types as general anxiety disorder (GAD), panic disorders, social anxiety disorder (SAD) and specific phobias having their commonalities in daily life limitation (Bandelow & Michaelis, 2015). Unawareness, misunderstanding, temporal periods of anxiety and (social) performance challenges are the main problems causing daily powerless feelings (Sanchez & Kunze, 2018). To create empowerment and social integration amongst people within the anxiety spectrum, a specific problem can be addressed: the lack of relaxation in common daily life context (Borkovec & Costello, 1993). This is specially relevant for people with elevated trait anxiety, most prevalent around 18-35 years old (Bandelow & Michaelis, 2015).

People with elevated trait anxiety especially experience worrying and rumination, i.e. periods of everyday negative thinking, difficult to control (Greeson & Brantley, 2009) leading to tiredness and a decreased self-image (feeling of incompetence). Worrying can be conceptualized as a chain of future oriented thoughts, negatively affect-laden and quite uncontrollable, concerned with what if?-thinking. Rumination on the other hand can be conceptualized as repetitive thinking focusing its attention on one's depressive symptoms and is concerned with loss, hopelessness and failure (Hoyer, Gloster, & Herzberg, 2009). An individual with elevated trait anxiety has the key tendency to have excessive, uncontrollable worry about a number of life events or activities, to assess situations as threatening, and is often accompanied by high emotional and bodily arousal (Knowles & Olatunji, 2020). In a constant form (trait) and sometimes in increased forms when being triggered, experiencing a state of anxiety. The negative thinking often involves a number of life events or activities such as work or school performance or family (Rowa & Antony, 2008). The dominant constant anxiety interferes with daily life functioning including school, social relationships and romantic relationships (Andrews et al., 2010). Therefore, these challenges around limited daily functioning through the anxiety-characteristic worrying and rumination, **highly ask for a need for novel support in relaxation** (Borkovec & Costello, 1993).

## 04.2 Approaches to Address Negative Thinking and Relaxation in the Field of (Clinical) Mental Health Support

One of the most effective methods for anxiety patients, superior to medication, is cognitive-behavioral therapy (CBT). This is found in most cases to be significantly more effective than other therapeutic approaches for anxiety disorders (Cooper, 2008). This type of therapy shares the idea that mental disorders and psychological discomfort are maintained by maladaptive cognitions that maintain emotional distress and behavioral problems (Hofmann, Asnaani, Vonk, Sawyer, & Fang, 2012).

In CBT disturbing thoughts (cognitive), negative emotional reactions (emotional) and inflexible behavior (behavioral) are identified, corrected and re-structured focusing on self-monitoring and relaxation training (Greeson & Brantley, 2009). CBT for elevated anxiety involves cognitive therapy to address worrying/rumination, cognitive biases and relaxation to address tensions. Furthermore it includes imaginal exposure to catastrophic images and exposure to stressful situations to address prevention of overly cautious behaviors (Otte, 2011). There is a benefit in the use of CBT based technology delivered interventions such as internet-based CBT, especially where access to the traditional face to face CBT is limited or delayed (Grist, Croker, Denne, & Stallard, 2019).

Two popular relaxation approaches in CBT to reduce anxiety and deal with anxiety responses are relaxation training ('applied relaxation') consisting of breathing techniques and muscle relaxation (Bastani, Hidarnia, Kazemnejad, Vafaei, & Kashanian, 2005) and mindfulness-based cognitive therapy involving mindfulness practice which includes mindful body scans, mindful movements, and mindfulness breathing (Helmes & Ward, 2017; Kuyken et al., 2010). 'Progressive muscle relaxation' (PMR) supports patients to tense and relax different groups of muscles, in other words a process of learning the ability of physical tension-release (Cooper, 2008) and is praised amongst people with anxiety for its convincing rationale. Although this procedure has been found to be an effective manner leading to a relaxation state, it is limited to releasing just physical anxiety responses. Assumptions that 'progressive muscle relaxation' will also lead to less anxiety in the cognitive, behavior and affective realms are doubted (Conrad & Roth, 2007). Furthermore, anxiety patients still have chances to ruminate (negative thinking) or be emotionally distracted in a physically focused relaxation technique as PMR.

Methods that directly reduce all three anxiety responses, i.e. cognitive, physical and emotional, to support relaxation are sparse, but effective (Knaus, 2014). Therefore methods that directly stimulate the multi-faceted anxiety responses (cognitive, emotional, bodily), and increase absorption in the relaxation task, might be a promising approach to support relaxation and prevent worrying and rumination. Next to that, relaxation training often offers a more soothing relaxation technique, such as breathing training, creative visualization and imaginary techniques, to distract and engage in other consuming tasks than the thought processes that people with elevated anxiety experience (Knaus, 2014). Similarly, mindfulness practice emphasizes acceptance of inner cognitive, emotional and physical states during worrying and rumination (Greeson & Brantley, 2009) to decrease anxiety patients' discomfort (Greeson & Brantley, 2009). **However, these soothing and non-expressive approaches for either distraction or acceptance do not suffice for everyone to break their anxiety cycles** (Knaus, 2014) and overlook the importance of expression for releasing anxiety tensions. **Expression is an important aspect to release the multi-faceted tensions in people with elevated anxiety to combat frustrations and heavy emotions which is overlooked by these methods** (Cevasco et al., 2005).

#### 04.3 Designs, Practical Tools and Psychotherapeutic Interventions for Relaxation and Anxiety

Current work differentiates between easy and daily implementable relaxation practices for various daily contexts; replacement of psychotherapeutic CBT practices in a digital or playful interactive form to use in daily environments; or environmental stimuli for relaxation.

##### 4.3.1 Easy, Daily and Practical Relaxation Interventions for Various Daily Contexts

There are a lot of commercial anxiety apps that provide an easy to use and practical relaxation intervention to be used in various daily contexts for this target group. The systematic review paper by Sucala et al. (2017) has assessed many of these apps. Of the 52 analyzed apps, 55.8% targeted anxiety in general, followed by 17.3% that targeted worry symptoms specifically, and 11.5% focused on panic attacks. It would be expected that these commercial apps targeting anxiety would use techniques that were proven to be effective in face-to-face CBT interventions. However, only 26.9% of them claimed to have a CBT approach, with the majority focused on progressive muscle relaxation techniques, meditation, breathing or journaling. Aside from that, the majority of apps are not using (or not reporting) any theoretical approach behind their intervention (Sucala et al., 2017).

The reviewed apps by this paper offered a huge variety of techniques to reduce anxiety (e.g., relaxation, reframing, meditation, exposure, hypnosis) without therapeutic ground. Therefore, although apps have potential to enhance access to mental health support for this target group, it can be noted **there is a clear gap between these accessible commercial/practical solutions and evidence-based psychotherapeutic interventions to provide novel relaxation support for people with elevated anxiety in daily life.**

Furthermore, examples of tangible designs to alleviate stress, anxiety and that aim for relaxation include a designed supportive anti-stress seating, anxiety reducing gloves, stress-reducing weighted robes, weighted blankets or fidget material. These practical and daily solutions play into comforting (private), sensory, (soft) material and haptic experiences to calm down and reduce anxiety (TREND HUNTER Inc., 2020). Although these practical solutions and designs play into sensory stimulation to provide relaxation or reduce stress, **expression** is an important aspect to release the multi-faceted tensions in people with elevated anxiety and for deep absorption which **is overlooked in these rather soothing practical tools** (Cevasco et al., 2005).

#### *4.3.2 Digital and Playful Interactive Design as Replacement of Psychotherapeutic CBT Practices in Daily Environments*

On a positive note around commercial anxiety apps is that these displayed a wide variety of features, such as video and audio components, games, avatars, or interactive worksheets, which could increase the engagement of the target group with the proposed interventions (Sucala et al., 2017). Moreover, potential is seen in “gamification” for mental health and serious games (Fleming et al., 2017). These make use of the quality to improve engagement potential for patients through game-based dynamics (Fleming et al., 2017). CBT-based serious games and gamification often made use of absorption in fantasy environments or positive psychology as ‘level ups’ to increase engagement in therapeutic programs (Fleming et al., 2017). Other examples focus on education about coping strategies, such as Above Water, a digital-tangible hybrid game about coping strategies for GAD and Panic Disorder (Wehbe et al., 2016); or Flair, a therapeutic serious game for Social Anxiety Disorder (Sanchez & Kunze, 2018). **Lots of these designs are digitally focused and overlook the potential of tangible design to support anxiety reduction.** One of the designs most related to offering this kind of physical support in relaxation is proposed in a paper around plant-based games to reduce anxiety (Park, Hu, & Huh, 2016). As a physical, organic interface plants provided a novel way to produce emotional connectedness and mutual care to relax and reduce anxiety. This design was especially focused on physical stimulation to overcome emotional responses to anxiety, but still not covered support for all anxiety responses and lacked expressive qualities.

#### *4.3.3 The Design of Environmental Stimuli for Relaxation*

The Snoezelen or multi-sensory environment is an intervention whose basic principles include a combination of colors, lights, shapes, sounds and textures designed to stimulate the senses and induce relaxation (Schofield & Davis, 2000). For example, it consists of a partially dimmed room with special lighting effects, relaxing music, aromas, vibroacoustic stimuli, and deep pressure (Shapiro, Melmed, Sgan-Cohen, Eli, & Parush, 2007). Although, these rooms allow a person with anxiety to focus attention on the positive stimuli and enter an “altered” and relaxed state (Shapiro et al., 2007; Gómez et al., 2016), **the rather passive sensory interactions could still allow people to ruminate or experience heavy emotions, cognitions or bodily responses to anxiety and the potential of physical expression for relaxation is overlooked.** There is still lots of potential to explore more expressive forms of relaxation support and the beneficial role that tangibility could play into that. A combination of multi-sensory stimulation, expression and physicality which are important aspects for deep absorption and releasing various tensions (Cevasco et al., 2005) are overlooked in most technical innovations and CBT techniques alike. As a result, not everyone with anxiety receives optimal relaxation support to cope with acute phases of anxiety, panic attacks, and/or on-setting negative thoughts. The potential of combined multi-sensory stimulation, expression and physicality to offer novel and improved relaxation support for people with elevated anxiety is described below.

### **04.4 Musical expression, Musical Instruments and Multi-Sensory Stimulation for Relaxation and Anxiety**

Though CBT is part of the most effective methods for anxiety patients, at least 50% of people with elevated anxiety remain symptomatic despite first-line treatments (Gutiérrez & Camarena, 2015). Therefore, Gutiérrez & Camarena (2015) suggest exploring new ways to improve the treatment of elevated anxiety, and music therapy accordingly.

**Non-soothing, physical and more expressive manners for absorption in consuming tasks, include creative music engagement through musical instruments, also commonly used in music therapy.** Engagement in musical activities provides the opportunity to get in touch with thoughts and emotions (Wilkins et al., 2014), to relax and improve mood (Hallam, 2010). Furthermore, music engagement has a major contribution in the development of increased self-esteem and competence (Hallam, 2010). Therefore, the design of playful interactive expressive musical objects can enable these advantages of music engagement in people with elevated trait anxiety (non-musicians) through easy access, intuitive and responsive user interfaces (Wu & Bryan-Kinss, 2017). Expressive forms of music engagement are also known in the field of music therapy for people with anxiety and within musical improvisation in clinical mental health (Erkkilä et al., 2019). **However, expressive music engagement is not so much associated with relaxation, and not common in CBT as compared to receptive forms of music engagement (passive listening)** (Erkkilä et al., 2019). If used in clinical practice, expressive musical play is integrated in the form of music improvisation either in group therapy (co-creation of improvised music) (Zarate, 2016), or if individual in combination with verbalizing emotional experience through musical play instead of relaxation practices (Erkkilä et al., 2019).

**Percussion instruments in therapy practice are popular** due to accessible musical play, auditory and vibrational (sensory) response, its (rhythmic) expressive potential, and movement facilitation (Matney, 2016). Especially **tension-release percussive drum play is used effectively in therapy sessions to release stress and anxiety responses** (Scheffel & Matney, 2014). Intensive rhythmic drumming was for example used for post-traumatic soldiers to especially facilitate release of bodily tensions and next to that feelings of relief and emotional discharge (Bensimon et al., 2008). In group sessions, the group intensifies the rhythmic drumming, turns up the volume and loudness of play and reaches a peak to overshadow anxiety (Bensimon et al., 2008). Tension-release percussion is currently highly rhythmically based and used rather for “emotional expression or inducement”, instead of relaxation and release of all three anxiety responses (Matney, 2016). **An example of therapeutic drum play, especially implemented for relaxation, is the steel tongue drum** (Shepherd, 2021). It is a universal way to benefit from entrancing musical experiences, move attention, relax and reduce stress. Steel tongue drums makes use of harmonic musical tones rather than rhythmic sounds, however are not used for expressive tension-release percussive play as in the paper by Matney (2016) and Bensimon et al. (2008). These drums use pentatonic scale sounds, musical tones that always “sound good” when combined in play, having an absence of the 4th and 7th intervals and so musical tension, clashing sounds. Although this percussive drum instrument is especially made for relaxing musical play, it lacks the ability of expressive music engagement which will still allow people to ruminate or experience heavy anxiety responses. Therefore, within current literature around music engagement for relaxation for people with elevated anxiety, **there is a lack of a combined form of expressive tension-release percussive play and relaxing harmonic percussive play to provide optimal deep absorption, prevent rumination and releasing all three anxiety tensions (cognitive, emotional and bodily).**

Besides percussive expressive music engagement used for people with elevated anxiety, musical instruments suggested for relaxation are in particular guitar and piano (Rumondor, 2019), showing a lack of accessible musical relaxation interventions that do not require musical skills and that allow for failing. Although there are accessible musical instruments available such as the steel tongue drum, these **current musical relaxation interventions lack flexibility to various musical, and expressive preferences within the target group.** Even this flexibility is minor in the digitized steel tongue drums, such as the beat root drum (Beat Root, 2021) or in multi-sensory steel tongue drum relaxation practices in which light therapy is included as in the study by Kaiyan Medical (2020).

On the other hand, **musical innovations** such as the midi drum controllers by the start-up OWOW (OWOW, 2020) and the 3D tracked drumming technology PULSE by Titan Reality (Titan RealityTM, z.d.) do offer more expressive and musical flexibility but are not focused on this target group nor relaxation purposes.

**The general notion** is that this related work outlines a gap in playful design (research) for relaxation, psychotherapeutic interventions and commercial/practical solutions to provide novel ways of relaxation for people with elevated anxiety in daily life. Furthermore, the challenges and barriers people with elevated trait anxiety experience in accessing mental health and relaxation support, such as individual / provider / systemic barriers, are in the way of making this target group benefit from the existing relaxation interventions in the mental healthcare contexts that are currently the norm (Collins et al., 2004). At the moment, mental health care is a reactive system (Collins et al., 2004), waiting for the person with anxiety to be identified and referred for treatment; a process that produces huge delays in treatment. The failure to make mental health care available in those settings where individuals first seek assistance (home / family) limits access and use of effective interventions for people with elevated trait anxiety (Collins et al., 2004).

# 05 DESIGN (RESEARCH) PROBE & PROTOTYPE

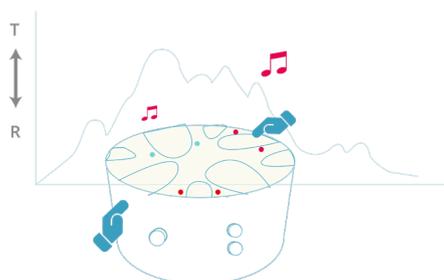
## 05.1 Overview of the design research probe

RELAX-CHANGE is designed for relaxation support at home for people with elevated trait anxiety, either not in therapy / finished with therapy / or who would love additional novel relaxation support next to therapy. It supports relaxation when overwhelmed by a state of anxiety or in managing the overall high daily anxiety level. RELAX-CHANGE dives into gaps in current work, being a playful, expressive, multi-sensory and tangible drum that offers a novel and more expressive pathway to relaxation; release of state anxiety; and negative thinking (as major anxiety response) for this target group. Over the last 1,5 years recurring questions were asked about the probe and prototype. Therefore, the probe and prototype will be explained according to those questions.

### 5.1.1 “Oh, so it is a drum?”

The designed probe is indeed a drum, but it is not a drum instrument, in fact it is not even considered to be a musical instrument. RELAX-CHANGE is a novel relaxation intervention that provides novel relaxation support in a playful, expressive, multi-sensory and tangible manner. The probe includes a novel relaxation mechanism allowing expressive and multi-sensory drum play. To flow into relaxation, engage in a distractive task, and release from various anxiety responses. Often it is mentioned that the probe has a similar look and feel as the steel tongue drum. However, as stated in 04 Related Work, within current percussive musical instruments, such as the steel tongue drum, there is a lack of a combined form of expressive tension-release percussive play and relaxing harmonic percussive play to provide optimal deep absorption, prevent rumination and release all three anxiety responses. Which is addressed in RELAX-CHANGE. On the other hand, it is true that the probe design was inspired by a steel tongue drum. These percussive musical instruments have the advantage to be universally accessible, a low skill level is needed to play these drums (Shepherd, 2021). Therefore, the probe has the recognizable shape of a steel tongue drum, and makes use of its advantages to provide intuitive and accessible musical play. However, RELAX-CHANGE does not aim to be an actual musical instrument but functions as novel relaxation intervention, providing novel expressive multi-sensory relaxation support and flexibility to the various musical, and expressive preferences within the target group. The probe’s intuitive and accessibility formgiving, inspired by steel tongue drums, allows the target group to benefit from its novel aspects for relaxation support: playful tension-release play (5.1.2), freedom in expression (that allows failing), tangibility, deep absorption experiences, multi-sensory interaction and support in the release of all three anxiety responses: cognitions, emotions and bodily tensions.

### 5.1.2 “So, how exactly does RELAX-CHANGE provide a novel pathway to relaxation?”



#### **EXPRESSIVE TENSION-RELEASE PLAY**

as an engaging and absorbing task to flow into relaxation



#### **MULTI-SENSORY LIGHT & SOUND FEEDBACK**

as a support mechanism to optimally benefit from expressive tension-release play, absorption and release from anxiety responses

The design probe has **three underlying principles** providing a novel pathway to relaxation and release of multi-faceted anxiety responses including negative thinking, emotions and bodily tensions:

**Playful tension and release drum play (playful tension-release / expressive tension-release play).** The design supports building towards an expressive peak in drum play (tension), through multi-sensory feedback, flowing from there into relaxation (release). This is the main underlying pathway in the probe to distract from negative thinking, flow into relaxation, and release from the multiple anxiety responses.

**Engagement in a distractive task.** The probe provides engagement in a playful, expressive and multi-sensory drumming “activity” that distracts from the experienced negative thinking. It provides an engaging activity that can be tailored to the different expressive, musical and light preferences of the people within the anxiety spectrum to enable deep absorption.

**Supports in overcoming the multi-faceted anxiety responses** (negative thinking, emotions and bodily tensions) through light and musical feedback in the drum. The probe provides a universal way to benefit from the multi-sensory feedback in which failing is allowed, important to create relaxation support for this target group. The light and sound feedback absorbs into expressive play which supports distraction from negative thinking. Furthermore, the multi-sensory feedback supports outlet for emotional expression and release in drum play. Next to that, the combination of light and musical feedback supports expressive playful tension-release creation and in this way bodily expression and release of bodily muscle tensions.

### *5.1.3 “So it contains light and musical (multi-sensory) feedback, what is the role of that in providing novel relaxation support?”*

The multi-sensory feedback has a **supportive function to optimize the relaxation through drum play**. 1) It supports expressive drum play; 2) enhances play engagement and tailored deep absorption, a quality that is very important to create relaxation effects for this target group; 3) supports in overcoming the multi-faceted anxiety responses. Finally, there is the additional benefit that the responsive light color changes and harmonic musical tones create a more relaxed state in itself, aside from their supportive functions.

#### *The musical feedback design*

The musical feedback helps to create **musical tension** (Fredrickson, 2000). Musical tension is a moment of unease in musical play and the expectation for it to be released. Which functions in the probe as a supportive feedback mechanism for expressive drum play and deep absorption. It is chosen for harmonic tension and release tones: musical tones that can harmonize (blend well together) or create dissonance (clashing sound) when combined in musical play (E, 2019). In this probe harmonic musical tension release tones in major and minor musical scales are used. This is done for two reasons. Harmonic tones can provide more expressive freedom in drum play, because these can create musical tension in multiple ways compared to other forms of musical tension (e.g. rhythm). 1) Through a dissonant combination of tones played after each other in play and 2) through the play of a musical tension tone over a release tone which is held for a while. On the other hand, harmonic tones have more potential to elicit a positive emotional response countering the heavy emotional anxiety responses. In order to tailor the musical tension support to the musical preferences of the different people within the anxiety spectrum, a set of various harmonic major and minor musical tone scales are offered in the design.

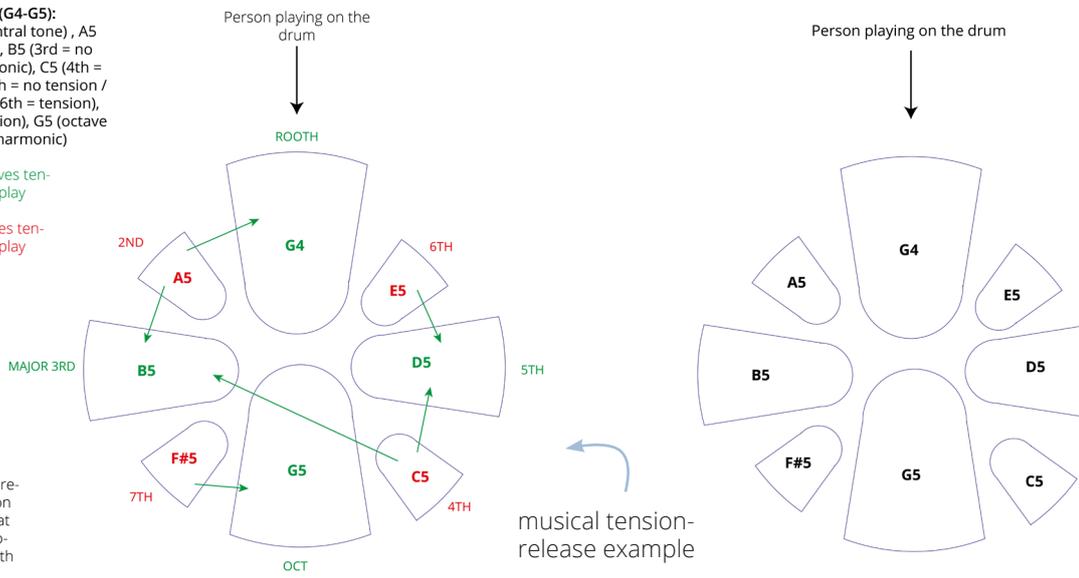
An example of musical tension in the probe: G-Major scale includes the G (base tone), A, B, C, D, E, F# and G (octave) within 8 drum touchpads. See the visual on the next page.

**G-Major Scale (G4-G5):**  
 G4 (root = central tone), A5 (2nd = tension), B5 (3rd = no tension / harmonic), C5 (4th = tension), D5 (5th = no tension / harmonic), E5 (6th = tension), F#5 (7th = tension), G5 (octave = no tension / harmonic)

Tone that releases tension in musical play

Tone that creates tension in musical play

Tone to play to release the tension after playing that tension tone (together with root tone)

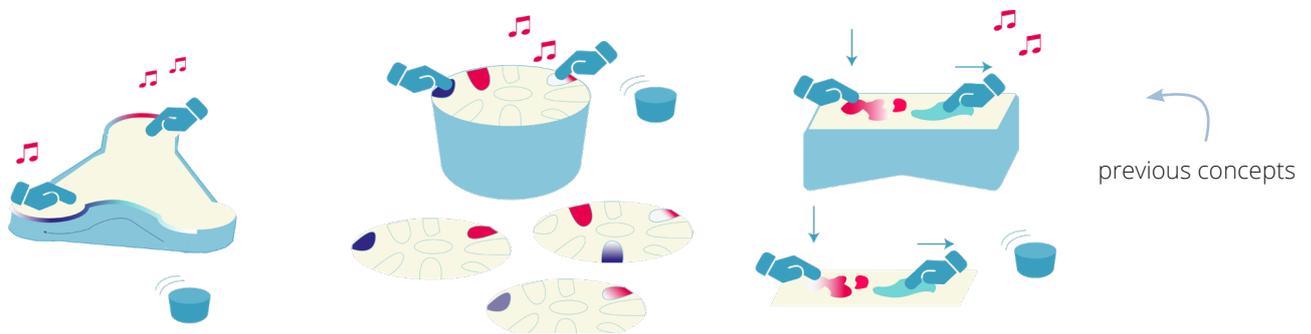


The base tone and octave (G) together with the third (B) and fifth (D) tone in the scale are able to resolve musical tension (clashing sounds) in drum play. The other 4 musical tones create musical tension in harmonic drum play (Underbelly [You Suck at Producing], 2018). The touchpads visually differentiate between the base & octave tone (2 main release tones), the third and fifth tone in the scale (two subdominant release tones) and the musical tension tones. The bigger touchpads represent musical release tones, enabling quick resolution of musical tension. The smallest touch pads represent the musical tension tones, enabling easy combination for musical tension play, and easy resolve through bigger pads (Appendix K: Prototype Technicalities). People playing the drum do not need to understand the underlying musical theory. However, musical tension as musical feedback, provides the ability to use musical tension and release tones to build up peaks in expressive drum play, release peaks in expressive drum play, engage in play and even release certain cognitions or emotions.

### The light feedback design

The light feedback visualizes the expressive play intensity on a certain touch pad during drum play. In other words, the light feedback reflects the current state of playful tension-release building in drum play; with which touchpads it is tried to build up towards a peak in drum play or release a peak in drum play, and with what playful intensity. This supports optimal playful expression and engagement for optimal relaxation effects. Before the drum play starts, all touchpads are colored in blue, reflecting no play intensity on each of the touchpads before play. When the play intensity on certain drum touchpads increases, the light underneath those pads glow warmer (red-ish). To show that with these pads it is tried to build up towards an expressive drum play peak. When these drum touchpads are not touched for a while and the play intensity on those decreases, their light glows colder (blue-ish). The speed with which the light color changes according to expressive drum play can be adapted in the probe, to suit different light feedback needs in the anxiety spectrum for directness in playful tension-release support, engagement and additional relaxation effects. Since it is chosen for the light feedback design to reflect expressive play intensity in drum play, it offers a non-intrusive form of minimal playful tension-release building guidance, which leaves a lot of room for "freedom of expression" and allows for failing. In other words, the light feedback design supports the probe's novel aspects to create a novel pathway to relaxation. More information around the design of the light feedback and interaction can be found in the M1.2 and M2.1 paper by the design researcher (Van Wijlen, 2020; Van Wijlen, 2021). Knobs allow changing musical tones and response speed of the light feedback. Furthermore, the touchpad design and the minimal light guidance allows for freedom in expressive drum play, no musical skills needed and therefore allows for failing. The probe focuses on supporting users to lead towards expressive drum play peaks themselves instead of providing fixed play patterns to follow. To also represent the novel perspective taken in relaxation support and to evaluate its possibility to RELAX-CHANGE.

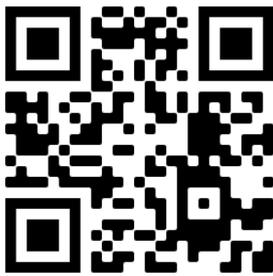
The **design process of the probe** can be found in Appendix K: Prototype Technicalities. The diameter of the probe is 28 centimeters, to support optimal hand movement and expressive drum play. Moreover, the height of the drum is 11.5 centimeters which supports comfortable drum play when placed on a table, floor or other type of surface and provides the support needed to undergo vertical “touch” forces (Van Wijlen,2021).



## 05.2 The RELAX-CHANGE prototype for evaluation

The RELAX-CHANGE prototype is used in this thesis to evaluate the probe’s relaxation effects and future design directions, as the main object of knowledge construction around the three research questions. A demonstrator video of the prototype is made and can be obtained through the following **QR code**:

*Demonstrator video*



### *FMP Prototype*

The prototype (next page) was made in the M2.1 design research semester. However, in this thesis term optimized multi-sensory interaction in the prototype’s, its adaptability and prototype’s data collection opportunities for long-term design research (Appendix K: Prototype Technicalities) were explored. The prototype’s data collection function is not used in this thesis due to the skills needed to download the data and the burden for a participant with elevated anxiety. The prototype consists of a 3D printed casing (PLA X3, extra stiff); a top drum plate; aluminum touchpads; semi-transparent top plate to fade light feedback; headphones; light & musical feedback; turnable knobs to adapt multi-sensory feedback and internet & ethernet connection. It represents the probe’s novel relaxation mechanism, formgiving and sizes. Moreover, the probe’s flexible musical feedback is translated in the prototype through providing a set of 14 different musical tone scales. Moreover, the probe’s light feedback design has been translated in the form of 8 LED light pairs that visualize the expressive play intensity on a certain touch pad during drum play. Next to that, the prototype provides two knobs to adapt 1) the volume of the musical feedback and 2) the response speed of the light feedback (color change) to reflect the probe’s intended flexibility and fit with various people in the anxiety spectrum. Additionally, in the software, the musical tone scale settings can be adapted, just as musical volume. The harmonic major / minor scales provided in the prototype include:

**D-Major** Guitar tones (D4 to D5 and D5 to D6)

**A-Major** Guitar and Piano tones (A2 to A3)

**A-Minor** Guitar tones (Am3 to Am4)

**C-Major** Guitar tones (C4 to C5)

**E-Major** Guitar tones (E3 to E4 and E4 to E5)

**E-Minor** Guitar tones (Em3 to Em4 and Em4 to Em5)

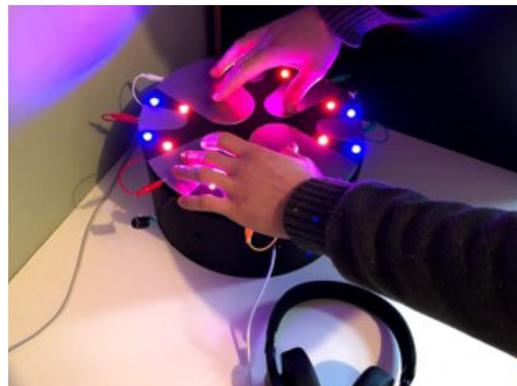
**G-Major** Guitar tones, Piano tones and Celestial Voices (human choir) (G4 to G5)

**Drum tones**; based on the harmonic musical tension principle including a snare drum, a base drum and tom drums as musical release tones and drum accents such as a hand clap sound, a shaker, and high hats as musical tension tones.

These were created via the Garage Band Iphone application by the design researcher. These scales support 1) differing needs in musical expression; 2) differing needs in musical triggers to absorb in drum play; 3) differing musical needs to create release of cognitive, emotional and bodily anxiety responses. Elaborated reasoning can be found in Appendix K: Prototype Technicalities. This musical feedback can be obtained through the headphones connected to the prototype. It was chosen for headphones to optimize the absorbing effect of the musical feedback during drum play and to create a private drum play experience, which are important aspects for novel relaxation support for this target group.

This current RELAX-CHANGE prototype has been based on the very first prototype made in M1.2 design research (Van Wijlen, 2020) (Appendix K).

### *Prototype in action during the diary studies & prototyping*



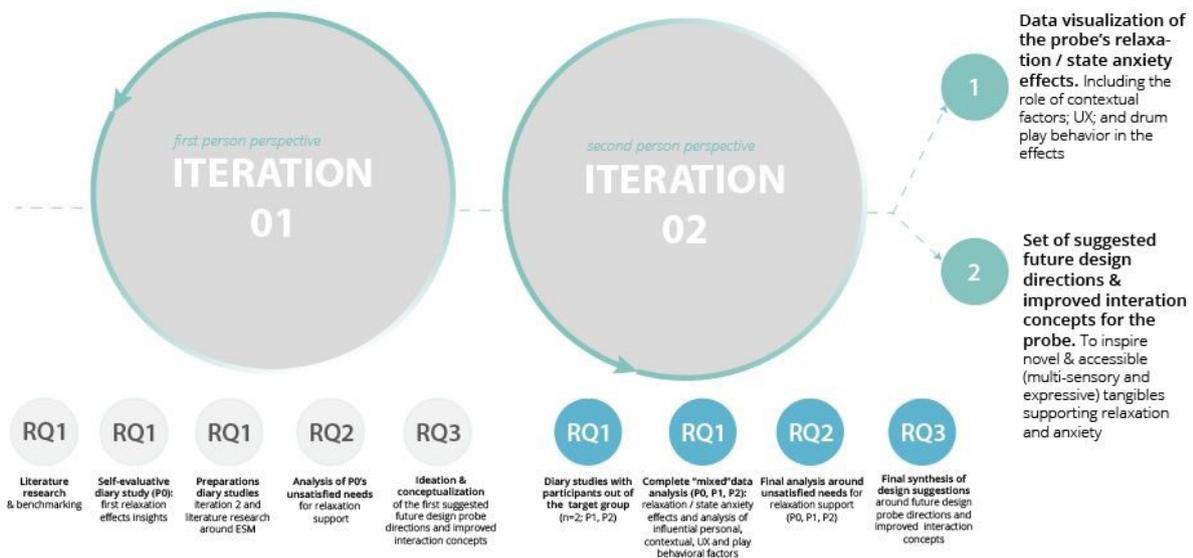
# 06 METHODOLOGY

**In short**, this design research drew from constructive and data-enabled design practices. It was aimed to leverage experience sampling using diaries, semi-structured interviews, and questionnaire data at multiple points in time with a small pool of participants (n=3) who have worked with the drum for a fixed number of days. To assess the effects of drum play on the participants' anxiety and relaxation, the State-Trait Anxiety Instrument (STAI) was used, which was used in previous work. Which was combined with qualitative data from the diary booklets and follow-up interviews around perceived experiences of relaxation. To inspire future design directions for the design probe, unsatisfied needs for relaxation through drum play with the probe were collected within the diary booklets and follow-up interviews. Just as through an evaluation of the probe's top-3 improved interaction concepts as part of the followup interviews.

## 06.1 Design Research Approach

This design research has been drawn from constructive design research (Koskinen, Zimmerman, Binder, Redstrom, & Wensveen, 2011) and data-enabled design practices (Van Koltenburg, & Bogers, 2019), in which the prototype (05.2) was key to knowledge construction around the effects of the probe's underlying relaxation principle, the user-experience (UX) around expressive drum play for relaxation and unsatisfied needs. This has led to the use of an iterative process consisting of a first person perspective iteration and a second person perspective iteration (06.2).

## 06.2 Design Research Process



The process consisted of two iterations and two main thesis deliverables, 1) a data visualization of the design probe's relaxation / state anxiety effects and 2) a set of suggested future design directions and improved interaction concepts for the design probe. The activities within the first iteration supported the diary study design, "mixed" data analysis, and future design directions evaluation used in iteration 2.

### 6.2.1 Iteration 1 - first person perspective

The goal of the first iteration was to evaluate the relaxation / state anxiety effects of drum play with the design probe, and its future design directions, from a first person perspective as a design researcher. Next to that, to prepare for the second iteration, the diary study methodology, design and procedure was explored. Including "mixed methods" data collection and analysis around the prototype, that was sensitive to the relaxation needs of the target group and captured the research objectives best. When using a first person perspective, the designer is an actor in the design context, designing for herself in this context, incorporating own experiences (Tomico, Winthagen, & Van Heist, 2012).

This is an “insufficiently understood and recognized” perspective in design research (Smeenk, 2019, p.48), but enabled to empathize with the target group around using the prototype, relaxation experiences, drum play behavior, and unsatisfied needs. In short: literature research around the probe’s novel relaxation principle, within the context of music therapy, clinical practice and musical innovations (in healthcare) has been done. Followed by the design researcher’s 7-day diary study, using the prototype at home. This included “mixed” data collection preparations, written and video diary reports, video drum play logging, anxiety questionnaire self-reports and data analysis. Concluded by unsatisfied needs for relaxation support analysis; ideation, conceptualization and visualization of future design directions (7.2.3) and the first set of suggested improved interaction concepts based on first perspective drum play and relaxation experiences.

### **6.2.2 Iteration 2 - second person perspective**

The goal of the second iteration was to evaluate the effects and future design directions through prototype usage and drum play experiences of participants part of the target group. To also create a final synthesis of design suggestions around the probe’s future design directions and improved interaction concepts. When using a second person perspective in the design research process, “the designer uses data-oriented field, workshop or laboratory strategies to involve the users in the design process.” (Smeenk, 2019, p.56; Turnhout et al., 2014). To transform into an empathic evidence-base around the efficacy of the probe and an outline of the probe’s future design directions. Based on insights from iteration 1, and diary study literature research, the daily diary method was used (Sloboda, O’Neill, & Ivaldi, 2001). The diary studies, based on Colombo & Landoni’s paper (2014), were coupled with an introductory and follow up semi-structured interview, including future design directions / concept evaluation. Two participants worked with the drum for 6 to 7 days at their homes and reported their prototype usage and experiences through drum play video logging and a combination of scored and open items in a digital diary booklet (Microsoft Forms). Final “mixed” data analysis resulted in answers for the three research questions.

## **06.3 Experience Sampling in the form of diary studies**

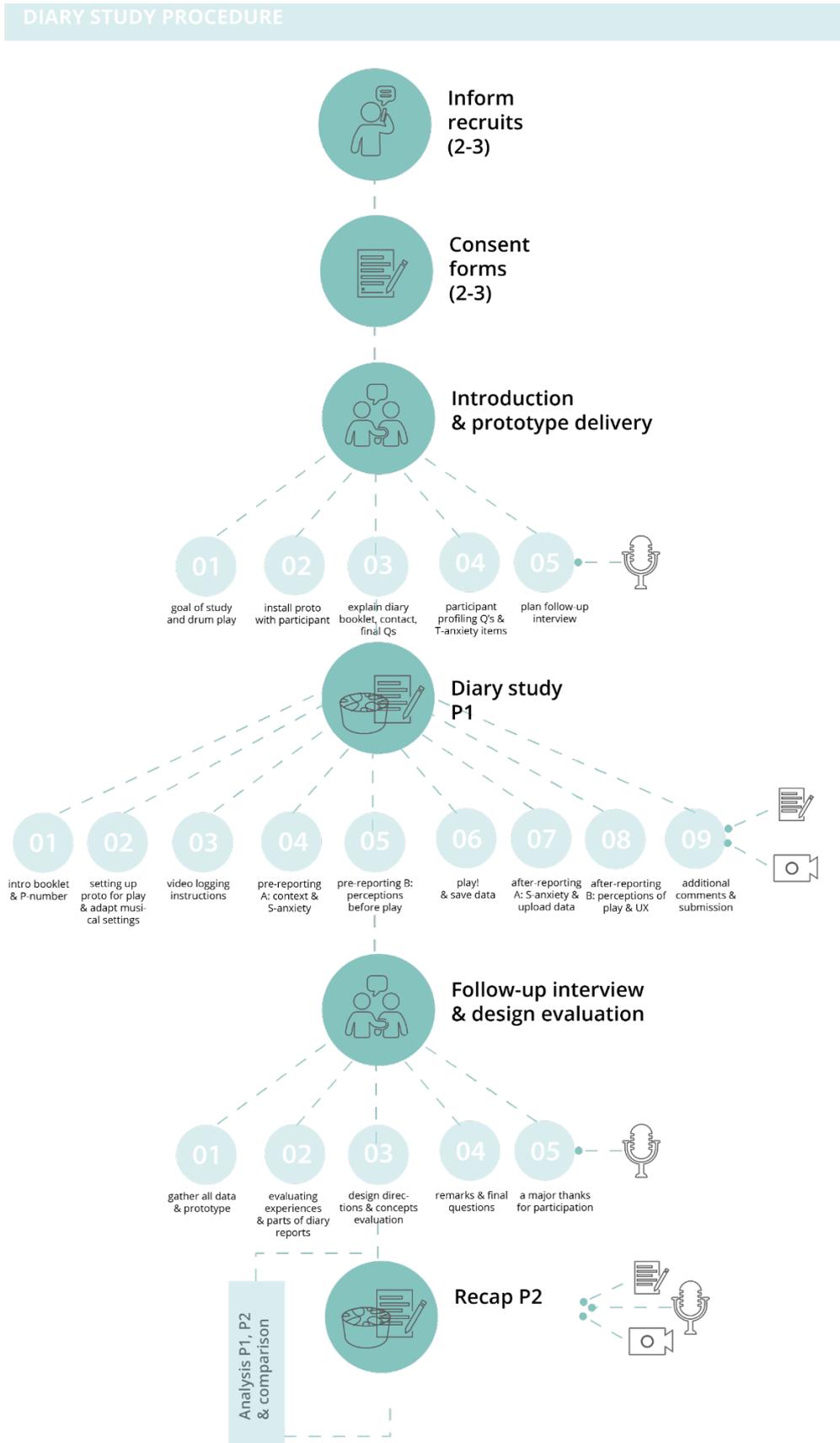
Experience sampling is an intensive longer term user research method involving participants reporting on thoughts, feelings, behaviors, and/or environment on multiple moments over time (Wikipedia contributors, 2021). In the moment or shortly after, within the natural daily environment of the person with anxiety.

### **6.3.1 Participants**

Three participants were recruited, including the design researcher (n=3). All female, all students, aged between 20 and 25 years old. General population was targeted and convenience and heterogeneous recruitment was done, in which participant trait anxiety scores were evaluated after diary participation. It was aimed to recruit consenting adults, able to deal with technological interventions, aged between 18-35 years old, where elevated trait anxiety is most prevalent. In order to fulfill the criteria of consenting adults, each participant had to sign a consent form (Appendix A: Consent Form) regarding participation and use, analysis and publication of: audio / video recordings, behavior logging, STAI questionnaire data, diary booklet data and interview responses and diary quotes. Heterogeneous participants were recruited in terms of anxiety experiences, relaxation activities and musical experiences for more diverse discussion around usage, effects, UX and future designs of the design probe. The prototype was used by each for 1 week (6 to 7 days), after each other, due to having only one prototype which resulted in a study time period of 2-3 weeks. Moreover, the diary studies were approved by the University of Technology Eindhoven (TU/e) Ethics Board (Appendix M: ERB Form). Participants were informed about purpose and procedures through consent forms in front of participation. Furthermore, CE approved prototype components were used, and multi-sensory prototype interactions were done, preventing additional anxiety triggers. Next to that, participants engaged from a safe and comfortable home environment. Furthermore, the COVID-19 situation was highly taken into account, such as hygiene rules, prototype disinfection practices, and social distancing. More information around the ethical considerations can be found in Appendix M: ERB Form.

### 6.3.2 Diary Study Procedure and Data Collection Methods

After recruitment and consent, the diary procedure consisted of three phases: the 1) introduction & prototype delivery, 2) the diary study, and 3) the followup interview and future design directions evaluation. Similar procedure was repeated for the next participant and “mixed” data analysis was done in parallel.



### *Phase 1: Initial introduction and short semi-structured interview (30-60 minutes).*

This phase focused on installing the prototype at the **participant's home**; re-assuring of study, digital diary booklet (Appendix C: Diary Booklet), and prototype understanding; and profiling the participants' baseline anxiety level through gathering their trait anxiety scores, musical preferences, and previous anxiety and relaxation experiences. This was done with the help of an introductory hand-out design and a Prototype Instructions Summary document (Appendix B: Introduction Hand-Out). The quantitative questionnaire instrument used to collect the trait anxiety scores included the State-Trait Anxiety Inventory (Spielberger, 1983). Participants filled out 20 trait anxiety (T) items to get insight into the participants' general overall experience of anxiety in their daily lives (MS Forms). This scale contained both anxiety absent and anxiety present statements to be ranked from "strongly disagree" to "strongly agree" (4-point frequency scale). Examples of qualitative interview questions included: would you like to introduce me to your previous experiences with anxiety?; what are your current preferred relaxation practices or anxiety management activities?; and what are your musical preferences for relaxation? and do you play any instruments? Moreover, the short semi-structured interview was audio recorded and took about 30 to 60 minutes of the participants' time.

### *Phase 2: The diary study (1 week / 6-7 days).*

This phase focused on gathering "mixed" data around the relaxation / state anxiety effects of the probe's, UX around expressive drum play, contextual prototype usage and drum play behaviors. This took about 6 to 7 days time and about 30-45 minutes per drum play session. To preserve the natural and "anonymous" context of relaxation as learned from iteration 1, the diary studies were carried out in the participants' homes. However, use in other spaces was allowed preserving natural drum behavior. Participants were advised to play 1-2 times a day, based on effective drum play experiences in iteration 1, to get participants acquainted with prototype usage for relaxation and to collect a usable data set. Participants reported on drum play aspects before and after play, at self-chosen moments, in the digital diary booklet (Appendix C: Diary Booklet) and through video logging. Every diary form existed out of two sections, section A: context of play & measuring state anxiety and section B: perceptions of anxiety, drum play experiences and relaxation / anxiety effects to be completed before and after playing the prototype (drum) based on the paper by Sloboda et al. (2001). Scaled diary items (section A) involved the state anxiety items from the STAI instrument. Consisting of 20 state anxiety (S) items including statements, such as "I feel calm" or "I am tense". Ranked on a 4-point frequency scale. Open-ended items (section A and B) were inspired by diary reports in the first iteration. These involved questions about the context of play such as: what is your setting of using the drum (where are you?, do you sit or stand? etc.). Furthermore, about (changed) relaxation and anxiety perceptions before and after drum play. Next to that, UX questions around expressive tension-release play were reported after play, such as: what was your general experience of playing the drum for relaxation this time?; and how did you try to build up your play intensity over the course of your play session? Furthermore, drum play videos were recorded in every session within their diary study period, to analyze effective ("top") and ineffective ("flop") drum play behavior characteristics to create positive relaxation effects.

### *Phase 3: Follow-up semi-structured interview and future design directions / concept evaluation (30-60 minutes).*

This phase evaluated 1) study participation experiences; 2) particular diary reports; and 3) expressive drum play experiences, drum play absorption and multi-sensory interactions. Unsatisfied needs in expressive drum play for relaxation were discussed and the top-3 improved interaction concepts were created, using a followup hand-out design (Appendix D: Follow Up Hand-Out). Interview questions included e.g: how did you experience using the drum prototype for one week at your home for relaxation?; how did you experience any other effects after playing the drum prototype? emo/cog/body/tiredness?; how did you experience the multi-sensory feedback in the drum with regards to relaxation, absorption, and releasing worries, emotions or bodily tensions?;

would you mind describing some unsatisfied needs while playing the drum to reach optimal relaxation state for you?; and if I could make a redesign of the drum, and you look at the way it gives you relaxation effects how could I improve it? (even if it would not be looking like a drum). As a final stage within the follow-up interview, a top-3 of improved interaction concepts was created, out of a selection of 11 visualized concepts from the first iteration. Moreover, the follow-up interview took place within the natural setting of the participants (at their homes), was audio recorded and took about 30 to 60 minutes of the participants' time. More details on the diary study methodology and procedure can be found in Appendix M: ERB Form.

### 6.3.3 Analysis

Quantitative and qualitative data (mixed data) were analyzed separately and compared to see if they confirm or disconfirm each other (a convergent parallel Mixed Methods design) (Creswell, 2014). With quantitative data, state anxiety effects and personal baseline anxiety levels were measured; and contextual drum play factors and drum play behavioral characteristics for relaxation effects were elicited. With qualitative data, perceptions around relaxation effects, contextual drum use, drum play behavior and unsatisfied needs for relaxation were analyzed. Mixed data from the design researcher's diary study in iteration 1 was analyzed in the first iteration and re-analyzed for a comparison with participants from iteration 2. The data was first analyzed per participant. Afterwards combined and compared, in 4 steps (Appendix E: Data Analysis Procedure) resulting in 1) Effects of the probe's novel relaxation principle on relaxation and anxiety and 2) Unsatisfied needs for relaxation and future design directions.

**Quantitative data analysis** of each participant contained:

20 trait anxiety items (introduction) were scored using Excel (Spielberger, 1983), resulting in a baseline anxiety (t-anxiety) score for each participant. Secondly, 20 state anxiety items before and after each drum play session were scored using the generated Excel file from MS Forms (Spielberger, 1983). Differences between the state anxiety scores before and after play for each of the participant's drum play sessions were calculated. Resulting into the state anxiety / relaxation effects created through drum play in each drum play session. Furthermore, drum play videos were annotated, coding participant's drum play behavior characteristics in video recordings that corresponded to a 1) "top" effect drum play session (highly effective) and a 2) "flop" effect drum play session (ineffective). The videos were annotated with the MAXQDA coding software and through a designed video coder guide, inspired by play behavior insights from the first iteration and the paper by Hailpern, Karahalios, Halle, Dethorne, and Coletto (2009) (Appendix F: Video Coder Guide).

**Qualitative data analysis** of each participant contained:

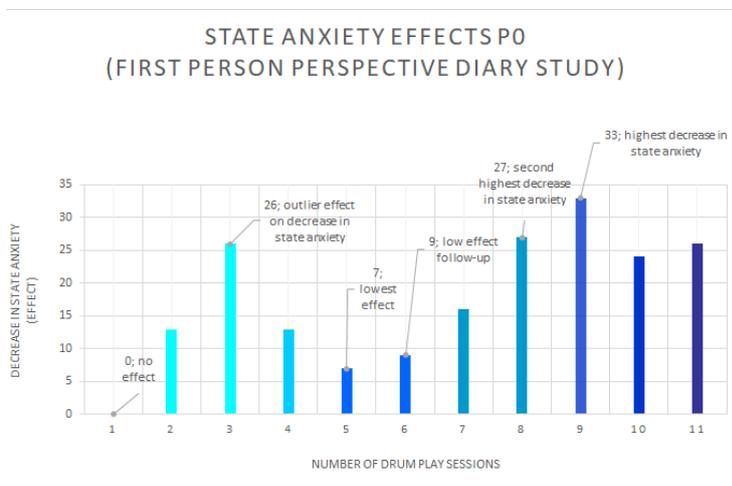
Thematic analysis of the written diary reports from iteration 1 (Appendix G: Data Analysis Results Iteration 1) was done. Introductory interviews were transcribed and a selection of quotes around anxiety, relaxation and musical experiences was made. Qualitative diary reports were summarized and compared with remarkable state anxiety / relaxation effects. Furthermore, followup interviews were transcribed and a selection of quotes around relaxation effects experiences (UX), expressive drum play for relaxation, absorption in play and multi-sensory interactions (UX) corresponding to remarkable drum play sessions was made. Furthermore, a selection around the participants' mentioned unsatisfied needs in drum play for relaxation, future design directions suggestions and reasoning behind the top-3 suggested improved interaction concepts for RELAX-CHANGE was made (Appendix H: Data Analysis Results Iteration 2). After separate analyses, all data was combined and compared to provide an answer to the three research questions in this thesis (07 Results) and its implications discussed in 08 Discussion & Conclusion.

# 07 RESULTS

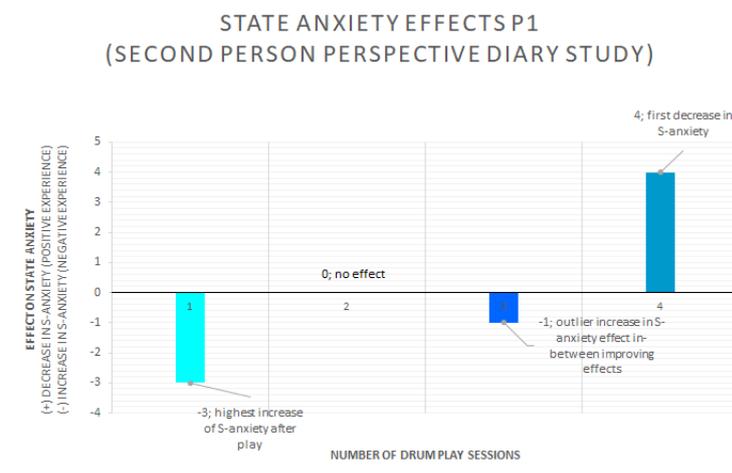
Results are based on mixed data insights around the effects of drum play on relaxation / state anxiety; around unsatisfied needs for relaxation and future design directions of the design probe. These insights resulted from the diary studies with the design researcher (P0) and two participants having elevated scores of trait anxiety (P1 and P2). Results are presented in two parts: 1) Effects of the probe's novel relaxation principle on relaxation and anxiety and 2) Unsatisfied needs for relaxation and future design directions. Sub questions will be used to present the detailed results, including conceptualized and suggested improved "future" interaction concepts for the probe.

## 07.1 Effects of the probe's novel relaxation principle on relaxation and anxiety

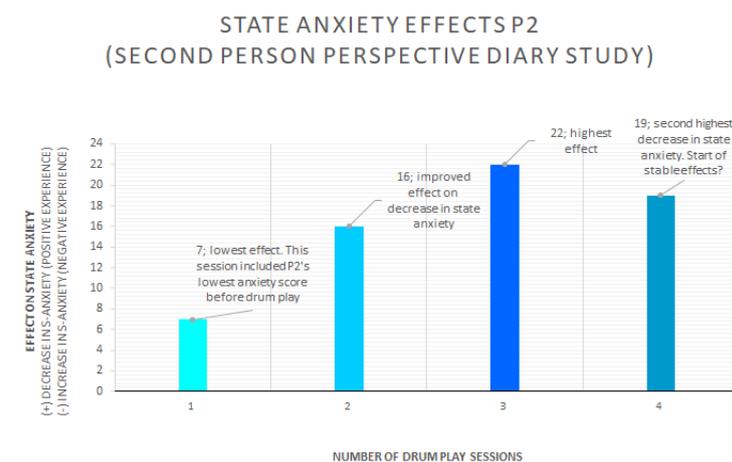
### 7.1.1 How does the drum play affect state anxiety?



**PARTICIPANT 0**  
First person perspective



**PARTICIPANT 1**  
Second person perspective



**PARTICIPANT 2**  
Second person perspective

State anxiety effects

Drum play effects on the participants' state anxiety levels, include the **calculated differences** between state anxiety scores before and after drum play (Appendix H: Data Analysis Results Iteration 2). State anxiety decreases are shown as "positive" effects of drum play, bars pointing upwards on the y-axis. Increases in the participants' state anxiety levels are shown as "negative" effects, bars pointing downwards. No effect on state anxiety levels is commented on in the graph, without a visible bar. The x-axis, distributes state anxiety effects over the number of play sessions. The colors of the bars distinguish the days of the diary corresponding to the effects. Each different color stands for another day in the diary study. In this way, it can also be seen if there have been multiple drum play sessions on a particular day in a participant's diary study, e.g. for P0.

**In general**, playing the drum has led to 15 out of 19 sessions in which a **decreasing state anxiety level** was created, amongst all three participants. The state anxiety decreases ranged from 4 to 33, with an average state anxiety decrease of 17.5. Furthermore, playing the drum has led to 4 out of 19 play sessions in which **no effect** (2 times) or a **state anxiety increase** (2 times) was created. The no effect drum play sessions apply to P0 and P1, and are not applicable to P2. The state anxiety level increases after drum play were only applicable to P1 and were rather minor, ranging from an increase in state anxiety level of either 1 or 3. The "top" effects, so the highest decreases in state anxiety, were created by P0 and P2, with decreasing state anxiety levels ranging from 22 to 33. Next to that, for all three participants the best results were found at the end of their diary study period. Moreover, the "flop" effects were mainly created by P1, with negative state anxiety effects showing minor increases in s-anxiety levels of 1 and 3. Furthermore, the lowest results for all three participants (0-effects, low decreases or minor increases in s-anxiety) are to be found in the first few drum play sessions in their diary study periods.

Comparing the results from playing the drum of the three participants, it can be concluded that **P0 has created the best average decreasing state anxiety effects** through using the drum (17.6 on average); **after that P2 scores best** with an average decrease in state anxiety levels of 16; and finally **P1 scored the least** with an average decrease in state anxiety levels of 0. Next to that, P0 is an outlier in number of play sessions (11 compared to 4 by P1 and P2; and P1 is an outlier in effects, showing minor increases in s-anxiety levels.

Next to that, overall the results show "positive" effects of drum play on the participants' state anxiety levels. Furthermore, best results were found at the end of the diary study periods, which could hint towards a possible "learning curve" in drum play for relaxation.

#### *Participant 0 (P0, design researcher)*

P0 played the drum 11 times in 7 days, in which state anxiety levels before drum play ranged from 46 to 63, 53.5 on average. In 7 sessions the state anxiety level before play was considerably high or medium-high, scoring above 50 (elevated). State anxiety levels after play ranged from 26 to 48, 35.8 on average. This average after play can be considered as a non-clinically relevant level and rather low compared to the average state anxiety level before play. All drum sessions led to **decreasing state anxiety levels ("positive" effects)**, ranging from 7 to 33, except for the first play session (no effect), with 17.6 on average. The best average effect amongst all participants. **"Top effects"** were created in the 8th (27) and 9th play session (33) towards the end of the diary study. **"Flop effects"**, were created in the 5th (7) and 6th session (9) on the same day (day 4). This could suggest a "bad" day in drum play or low starting state anxiety levels before play compared to the other drum sessions. P0's state anxiety levels before drum play in sessions 5 and 6, were the lowest compared to all drum play sessions, relatively 46 and 47. The effect in the 10th play session (24) is rather remarkable as well being lower especially after a play session with the highest effect, and compared increasingly effective play sessions, from the 7th on. Furthermore, the decrease of 26 in the 3rd session is rather remarkable compared to surrounding medium effects (about 13). At the end of the diary study period, after 11 drum play sessions, P0's state anxiety effects seemed to stabilize around a decrease of 26.

### Participant 1

P1 played the drum 4 times in 6 days, with state anxiety levels before drum play ranging from 45 to 57, 50.8 on average. All above clinically relevant level 40 and in 2 out of 4 sessions the state anxiety level before play was considerably high or medium-high. P1's state anxiety levels after drum play ranged from 46 to 57, exactly 50.8 on average as well, still clinically relevant and the highest of all three participants. Playing the drum led to **minor state anxiety increases and decreases**, except for the second play session in which no effect was found. Effects ranged from an increased state anxiety level of 3 to a decreased state anxiety level of 4, 0.0 on average. Both the negative and positive effects were minor compared to P0 and P2. P1's effects could be outliers in the overall results. The **"top" effect** was created at the end in the fourth session (decrease of 4), remarkable after previous ineffective drum play sessions. However, a 7 points higher state anxiety level before drum play in session 4 compared to play session 3, could explain this sudden positive state anxiety effect. **"Flop" effects** were created in the first and third play session with the increase of 1 (third play session) as a remarkable result in the middle of two promising sessions. Next to that, the second play session was very remarkable since P1's state anxiety before play was highest in this session. For P0 and P2, a higher state anxiety level before play often resulted in improved state anxiety effects but not for P1. At the end, after 4 times playing the drum, P1's state anxiety effects seemed to reach a transition towards positive effects.

### Participant 2

P2 also played the drum 4 times in 7 days, with state anxiety levels before drum play ranging from 53 to 68, 58.5 on average, highest of all participants and all above the clinically relevant level, considerably high or medium-high. State anxiety levels after drum play ranged from 38 to 46, 42.5 on average. This average after play can be considered still as clinically relevant however considerably lower compared to the average state anxiety level before play. All sessions led to a **decreasing state anxiety level ("positive" effects)**, without drum play sessions having a 0-effect and positive effects ranged from 7 to 22, with 16 on average. Close to P0's average decrease of 17.6. **"Top effects"** were created in the 3rd (22) and 4th session (19), towards the end of the diary study. **"Flop effects"** were created in the first two play sessions (decreases of 7 and 16), however still high compared to P0 and P1. P2's state anxiety effects show an almost perfect curve of improving effects over time, except for the final result (19), being slightly lower. However, this final play session took place after three days of no drum play, which could suggest a lower result. Furthermore, the state anxiety before play in session 3 was incredibly high (68) as compared to session 4 (57) a difference of 11. This could suggest a lower effect in session 4. At the end, after 4 times playing the drum, P2's state anxiety effects seemed to stabilize to a decrease of around 19. More information can be found in Appendix H: Data Analysis Results Iteration 2.

#### 7.1.2 How does the drum play affect relaxation?

**Overall relaxation experiences** were positive or a change in relaxation was not really noticed by the participants. Depending on how well the participants were able to reflect on the effects afterwards. P2 mentioned in the follow-up, that this study's drum play offered her a reflection moment on her current relaxation behavior, and the positive impact of taking a moment for yourself on relaxation: "In the beginning it felt as a kind of obligation to use it, but on the other hand I realized that if I used it, I really took a moment for myself and that I actually do not do that often enough." And the positive effect of taking a moment of rest through drum play, "Now I have actually done it and then in the end I do notice it is actually better for me if I do it." This was also emphasized by P0 for whom a highlighted experiential aspect of drum play was the satisfying relaxation effect of "taking a moment to work on yourself" through drum play. Especially when being alone, in an anonymous setting, as "For me it is a very private experience to practically open myself up during drum play." (P0).

**P2 experienced relaxation and a clear mind:** “Well, I actually was more relaxed after playing the drum, because you clear your head from all your points of stress, and it also felt a bit like meditation.” Positive changes in relaxation state were also described in all P2’s drum play sessions such as, “A bit more relaxed” (session 1), and “A little bit more relaxed and a little bit less tired.” (session 4). **P0 also described relaxed or calm states** after drum play in 8 out of 11 drum play sessions, such as “Feel very zen, very relaxed, very calm, really not any worrying going on afterwards, very relaxed face.” (session 9) or “I felt good afterwards, very certain of myself, more relaxed, didn’t have lots of worries. Did feel a little bit emotionally touched, like I had cried.” (session 8). However, P0 could not always fully release all anxiety responses which struck with experienced relaxation. However, positive relaxation experiences did not hold for all participants. P1 noticed no changes in relaxation after any of her drum play sessions. As mentioned in the diary booklets about changed relaxation states, “not really right now” (session 1) or “nothing specific I can mention ” (session 4, even though the first created state anxiety decrease). And reported in the follow-up interview, “I don’t know specifically anymore if I achieved a relaxation effect after playing the drum, but I tried to play it to round up my day basically.” Furthermore, it can be seen that for item 15 “I am relaxed”, no change in rating occurred for all of P1’s drum play sessions. Either the 15th item of the questionnaire was rated with “agree” before and after play (session 1 and 3), or with “disagree” both before and after play (session 2, the 0-effect session, and session 4). Detailed state anxiety and relaxation effect results can be found in Appendix G: Data Analysis Results Iteration 1, and in Appendix H: Data Analysis Results Iteration 2.

### 7.1.3 What was the role of the participants’ characteristics in the state anxiety / relaxation effects?



first person perspective  
**PARTICIPANT 0**

**About**

*General information*

- female
- 20 - 25 years old
- TU/e student

*Relaxation / anxiety management experiences*

- Meditation
- Yoga
- Sports
- Walking
- Writing
- Listening to music
- Making music

*Musical experiences*

- playing the guitar, singing and beatboxing as an outlet for emotions and negative thinking
- vocal group
- songwriting

**Remarks**

- Drum prototype was placed in the livingroom at her parents' house. Furthermore the prototype was situated on the dinner table or the lower table in the TV room.

*"I keep my anxiety level balanced with a combination of meditation, sports and music on a daily basis."*

**Anxiety baseline**



*Anxiety experiences*

- Extreme worries
- Fluctuating emotions
- Daily bodily tensions
- Past hyperventilation experiences due to peaks of anxiety

**PARTICIPANT 0**  
First person perspective



second person perspective  
**PARTICIPANT 1**

**About**

*General information*

- female
- 20 - 25 years old
- TU/e student

*Relaxation / anxiety management experiences*

- Watching Netflix series
- Regular meet-ups with friends
- Programming for fun with a friend
- Playing music

*Musical experiences*

- playing the guitar and mandolin
- playing the piano (jazz)
- especially songs she knows
- does not like to improvise

**Remarks**

- Drum prototype was placed on her desk in her living room / bed room in her student apartment. - The idea of being able to fall, when playing music, restricts relaxation effects (e.g. when playing the piano).

*"I don't succeed to randomly musically improvise because then there's a lot going wrong when I play, and that's what makes me stressed instead. So for relaxation I mostly play songs I know."*

**Anxiety baseline**



*Anxiety experiences*

- Most stressed about the university at the moment

**PARTICIPANT 1**  
Second person perspective



**second person perspective**  
**PARTICIPANT 2**

**About**

**General information**

- female
- 20 - 25 years old
- TU/e student

**Relaxation / anxiety management experiences**

- Talking with other people and putting things into perspective
- Support from family and friends
- Sports "is an outlet for me"
- Yoga "makes me calmer"
- Meditation
- Listen to / making music

**Musical experiences**

- playing the guitar, piano or drum pad
- listening to music as a way to influence emotions:
  - let go of sad feelings
  - induce happy feelings
  - create empowerment

**Remarks**

- Drum prototype was placed on the floor or desk of her bed room within her student room.
- Experienced difficulties with motivating for meditation practices.

*"I forget it, don't want to do it, or I still have to do this, this and this, I make myself believe meditation is not important to do, although it can help so much during the day and can really influence who you are and how to deal with anxiety."*

**Anxiety baseline**

**T-Anxiety Baseline Score**



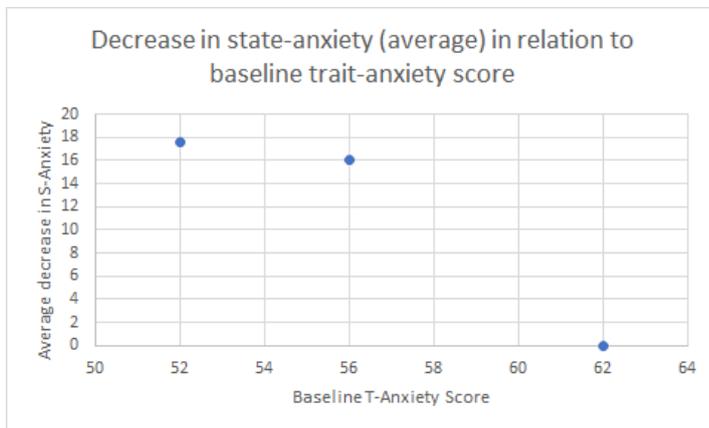
**Anxiety experiences**

- Experiences with panic attacks in the past
- Moments in which overwhelmed by anxiety ("feels like a warm glow of anxiety")
- Life insecurities as worries
- Hormones

## PARTICIPANT 2

### Second person perspective

### The role of baseline anxiety levels



**Baseline anxiety levels** ranged from 52 (P0), to 56 (P2) to 62 (P1), with 56.7 on average, considered as elevated and clinically relevant. Plotting the participants' average state anxiety effects (y-axis) against their anxiety baselines (x-axis), a negative relationship between the height of baseline anxiety and average state anxiety effect is suggested, a counter intuitive result. Could this suggest that the probe's state anxiety effects are optimal between certain baseline anxiety levels?

### The role of past anxiety, anxiety management and relaxation experiences

**Heavier past anxiety experiences** (P0 and P2) could indicate reasons for higher created state anxiety effects compared to P1. Next to that, P1 reported in her past anxiety management experiences a **higher preference for social activities**, could explain P1's deviating effects. Furthermore, P2's past **meditation challenges** and relaxation experiences could explain the positive relaxation effects she experienced after participating in this diary study, and having to take a moment for herself through drum play.

### The role of previous personal musical experiences

When comparing favorite musical drumming choices, there is a **clear relationship** between the participant's musical experiences and tone choices for the drum. P1's piano preference was reflected in P1's diary reports, playing every session in A-Major Piano. Similarly, P2 prefers piano in everyday-life as an emotional outlet, and the drum pad for songwriting. P2's diary reports match and show usage of drum tones and A-Major Piano tones both for two times. Furthermore, P0 prefers playing the guitar for relaxation in daily life, and played all sessions in guitar tones. Interestingly, P1, especially mentioned in the introduction, to usually **not improvise** when making music for relaxation, to prevent increasing stress levels, "I don't succeed to randomly improvise musically, because then there is a lot that goes wrong when I play, and that is what makes me stressed instead. So for relaxation, I mostly play songs I know." The fact that RELAX-CHANGE is not an actual musical instrument, and is more about expression, could explain P1's deviating relaxation effects.

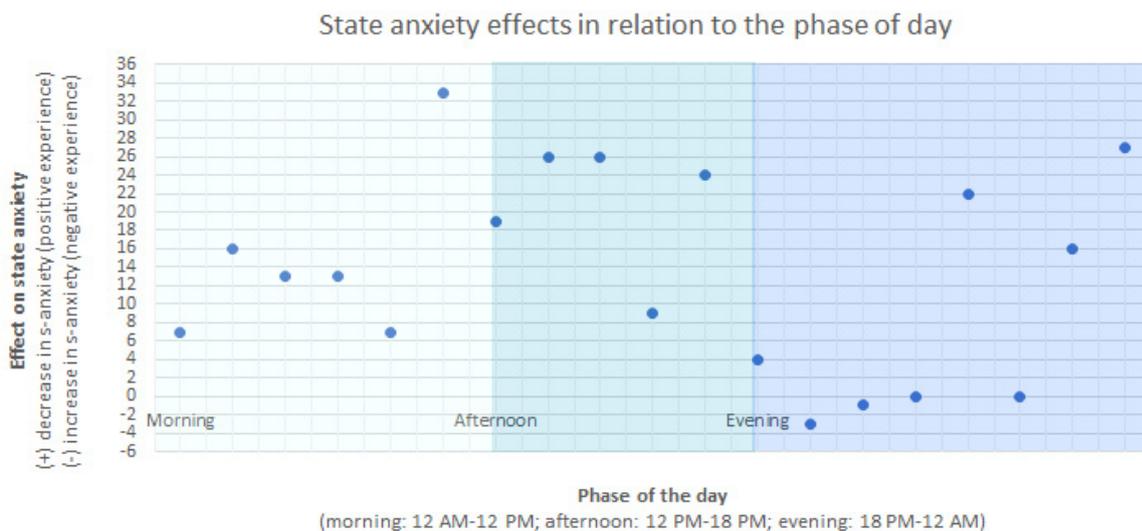
### 7.1.4 What was the role of the drum play context on the relaxation / state anxiety effects and experiences of the drum?

#### Summary of previous insights and hypothesis (iteration 1)

**Influential contextual drum play factors** found in iteration 1, such as “phase of the day”, “duration of drum play”, “state anxiety levels before drum play”, and “musical tone settings” formed the basis of exploring the role of the drum play context in the participants’ relaxation / state anxiety effects. These findings can be found in Appendix G: Data Analysis Results Iteration 1.

#### The role of the phase of the day

Morning entailed 12 AM - 12 PM; the afternoon entailed 12 PM - 18 PM and the evening entailed 18 PM - 12 AM. **No designation for a clear relationship** between a particular phase of the day and “top” or “flop” relaxation / state anxiety effects was found. Remarkably, both the “top” and “flop” effects took place in the evening which could be explained by the fact all participants were students, with possibly most drum play time in the evening or a preference for relaxation in the evening. For more clarity, all drum play sessions in chronological time order (x-axis) were plotted against the state anxiety effects (y-axis) in these sessions still showing no clear relationship. On the y-axis positive effects (+), are plotted upwards, and show a decrease in state anxiety; negative effects (-), are plotted downwards, and show an increase in state anxiety through drum play.



Relation to day phases

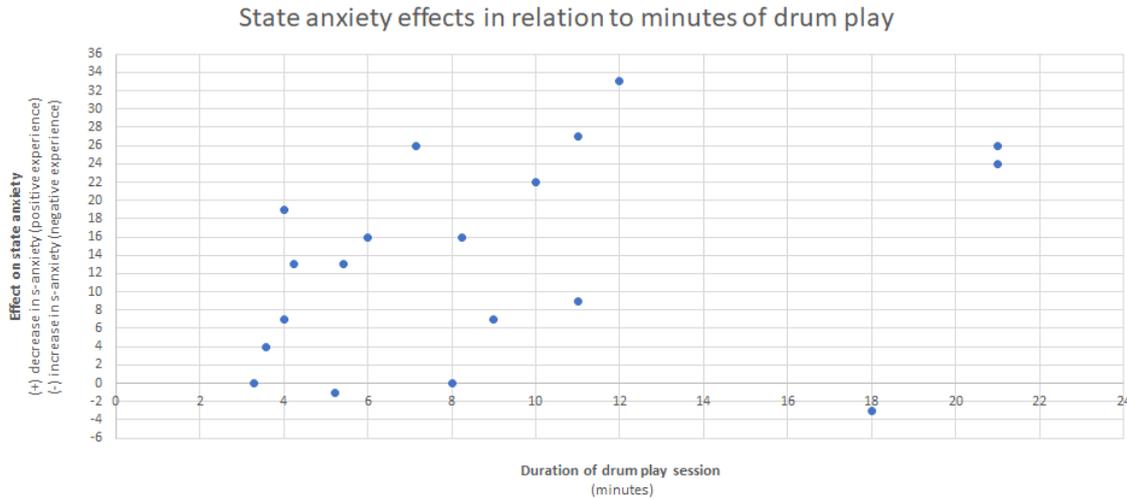
Most play sessions took place in the evening (8 out of 19), after that the morning was most popular (6 out of 19), and lastly the afternoon with 5 out of 19 sessions. Halfway through the morning, mostly mediocre positive state anxiety effects between 13 and 16 were created. In the beginning and halfway through the afternoon the highest effects between 24 and 26 were created with only 1 minor outlier (19) and two bigger outliers: 9 close to the evening and 33 towards the end of the morning. Finally towards the night, mediocre /high effects were created between 16 and 27, but also the lowest between -3 and 4.

#### The role of the duration of the drum play session

Drum play session durations were measured in minutes, based on the participant’s diary reports and the length of their drum play videos. The relationship between the state anxiety effects (y-axis) and duration of drum play (x-axis), was plotted in a scatter plot.

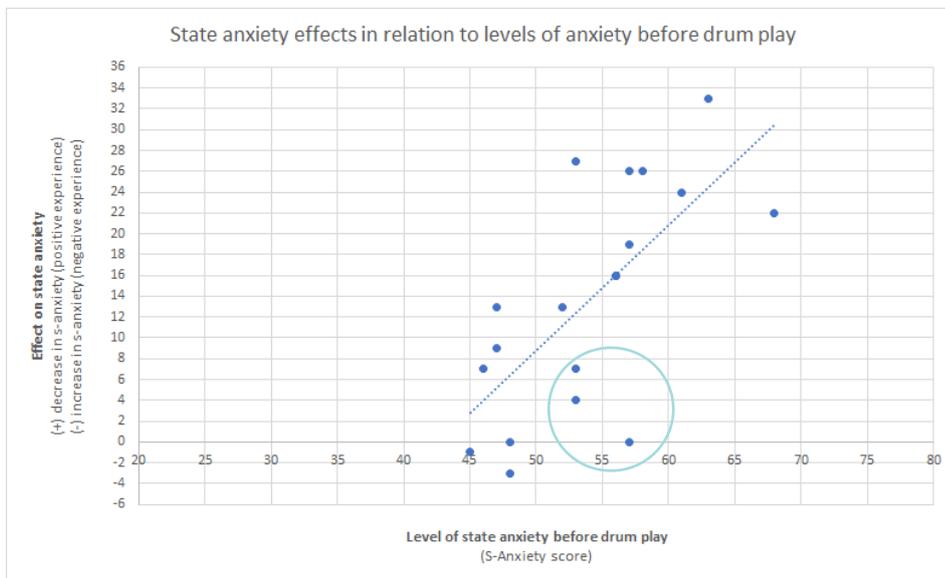
Overall, the durations of the drum play sessions ranged from about 2.5 minutes to outliers of 21 minutes. Next to that, the participants most frequently played the drum between 5 and 12 minutes. “Top” state anxiety effects were created around durations of 7 to 12 minutes, with two outlier play sessions of 21 minutes.

Mediocre effects were most frequently created when drummed between 5 and 9 minutes. Finally, “flop” state anxiety effects were created around around 2.5 to 5 minutes of drum play, with an outlier for two play sessions of 8-9 minutes and one of 18 minutes. Analyzing the plot’s section between 5-12 minutes, where most of the mediocre and “top” state anxiety effects took place, a **possible positive relationship** between the height of state anxiety effects and duration of drum play can be seen. The longer the duration of drum play (in between 5-12 minutes), the higher the decrease in the participants’ state anxiety levels.



*The role of state anxiety levels before drum play*

State anxiety levels (before drum play) can range from 20 (minimum) to 80 (maximum) according to the State-Trait Anxiety Inventory literature (Spielberger,1983). The relationship between the height of state anxiety effects (y-axis) and state anxiety levels before drum play (x-axis) was explored.



**TRENDLINE**

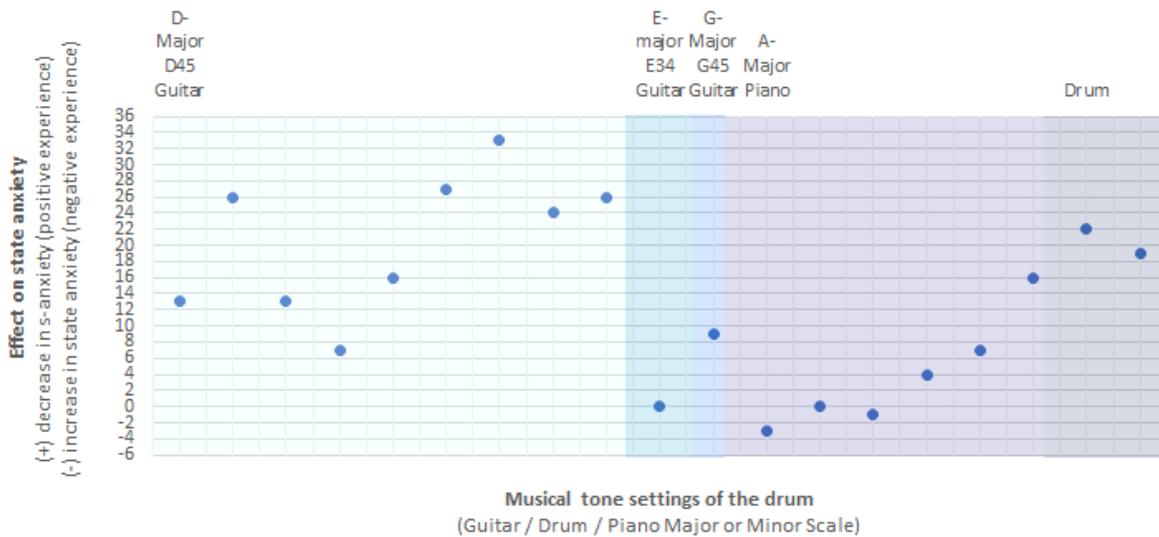
Ascending decreases in state anxiety when the state anxiety level before drum play gets higher

**OUTLIERS**

The group of 3 sessions with low state anxiety effects (0, 4, 7) when high state anxiety levels before drum play (53 to 57)

State anxiety levels before drum play ranged from scores of 45 (clinically relevant / medium score) to 68 (clinically relevant / high score). “Top” state anxiety effects were created when state anxiety levels before drum play were between 53 and 68. Furthermore, mediocre effects were most frequently created when state anxiety levels before drum play were between 46 to 56. Finally, “flop” state anxiety effects were created when state anxiety before drum play ranged between 45 and 53, with outliers for drum play sessions where a participant scored a state anxiety level of 57 before play. When implementing a “trendline” in the scatter plot, this showed a **clear indication for a positive relationship** between the height of state anxiety effects and the height of state anxiety levels before drum play.

### The role of musical tone settings of the drum



Musical tones used ranged from the very popular D-Major Guitar tones (D4-D5) to E-Major Guitar tones (E3-E4), G-Major Guitar tones (G4-G5), popular A-Major Piano tones (A2-A3) and drum tones. Choices included 5 out of the 14 possible musical tone set options of the prototype. “Top” state anxiety effects relate to D-Major Guitar, A-Major Piano and Drum tones. Mediocre state anxiety effects relate to D-Major Guitar, G-Major Guitar and A-Major Piano tones. “Flop” state anxiety effects relate to E-Major Guitar and A-Major Piano tones. Both positive and negative state anxiety effects were created in A-Major Piano tones. The scatter plot shows no clear relationship between musical tone settings and the height of state anxiety effects. However, D-Major Guitar (D4-D5), A-Major Piano and drum tones were preferred by this particular participant sample and therefore correspond to the “top” state anxiety and relaxation effects. Even though an unclear relationship, the **musical tone choice plays an important role** in creating positive relaxation experiences. A good example is that P2 intentionally switched from A-Major Piano tones to drum tones, “I actually headed over to the drums to let all this tension out of my body, all this stress.” and so achieved her best state anxiety effect of 22.

Some **general contextual drum play characteristics** about overall body positions used, drum play surroundings and use of the light cover can be found in Appendix H: Data Analysis Results Iteration 2.

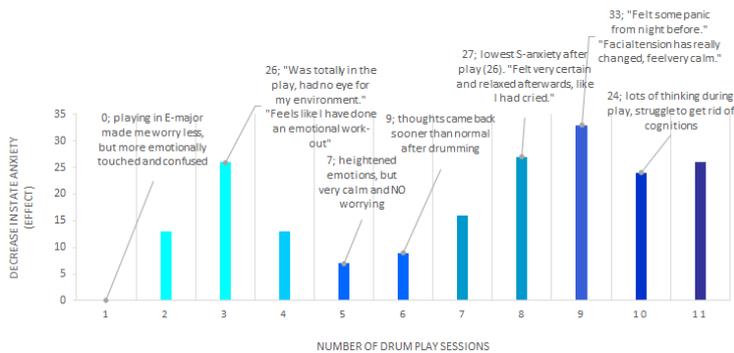
#### 7.1.5 What was the role of UX in the relaxation / state anxiety effects?

##### Summary of previous insights and hypothesis (iteration 1)

Previous UX insights (Appendix G) include **user experience (UX) elements around the drum play sessions (before, during, after)** such as “motivations and experiences before drum play”, “tiredness”, “play engagement and absorption”, “release of anxiety responses”, and “multi-sensory interaction experiences” which formed the basis of further exploration of the role of the drum play UX in the participants’ state anxiety and relaxation effects.

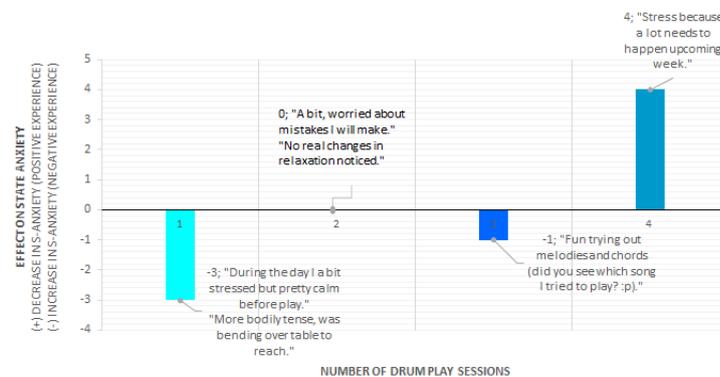
## UX around the participants' "top" and "flop" drum play sessions

### STATE ANXIETY EFFECTS P0 (FIRST PERSON PERSPECTIVE DIARY STUDY)



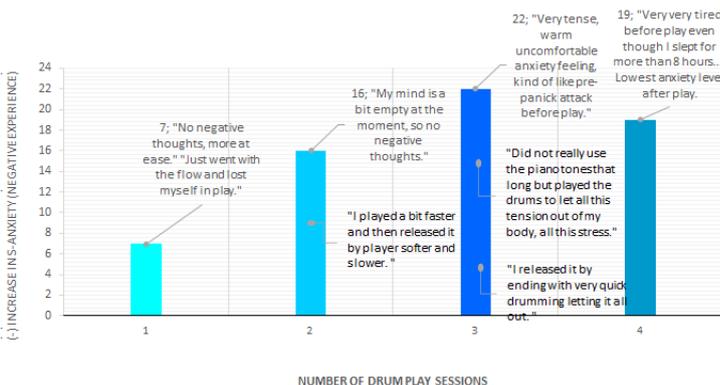
**PARTICIPANT 0**  
First person perspective

### STATE ANXIETY EFFECTS P1 (SECOND PERSON PERSPECTIVE DIARY STUDY)



**PARTICIPANT 1**  
Second person perspective

### STATE ANXIETY EFFECTS P2 (SECOND PERSON PERSPECTIVE DIARY STUDY)



**PARTICIPANT 2**  
Second person perspective

Participants' **experiences around changed anxiety responses** through drum play influenced state anxiety effects. P2 experienced positive changes in worrying after drum play, "My mind is a bit empty at the moment, no negative thoughts" and experienced feelings of being more at ease, mellow and ready to get back to work. Similarly, P0 experienced "no thinking for 10 minutes after." and feelings "like I have done an emotional workout." Interestingly, P2 reported after the most effective session, release of negative feelings but "not necessarily a happy emotional state instead." The other way around, P1 reported for all play sessions a "not really" changed cognitive state even though reporting to be e.g. "a little bit worried" and "have some thoughts" resulting in low state anxiety effects. Furthermore, less effective sessions can be related to worry experiences during drum play as for P1, "A bit worried about mistakes I will make." (session 2) and for P0, "Lots of thinking during play, struggles to get rid of cognitions." (session 10).

Or worrying coming back fast after play. Next to that, heightened emotions through drum play, "Felt quite a bit emotionally touched afterwards, call it a bit sad-ish maybe." (P0, session 5) can limit relaxation effects. Moreover, the experience of releasing body tensions plays an important role in experienced relaxation. P1 namely experienced increased bodily tension because of bending to reach the drum, which resulted in ineffective play. Moreover, P2 especially focused in session 3 on experiencing release of bodily tensions in expressive tension-release play through use of drum tones, which resulted in P2's most effective play session. Relatable, in P0's "top" state anxiety play session (nr.9) a big part of the UX reporting covered experienced release of face and shoulder tensions as compared to P0's other play sessions, "Very relaxed face, sleepy eyes afterwards. Relaxed, low jaw and lousy talking. Facial tension had really changed, way looser and shoulder tension was way better!"

Furthermore, before "top" effect play sessions a **very high anxiety, pre-panic attack**, was experienced, "Very tense, warm, uncomfortable anxiety feeling, kind of like a pre-panic attack before play." (P2) and "I felt some panic from the night before." (P0) or high amount of stress, "Stress because a lot needs to happen in the upcoming week." (P1). These experiences before drum play could have influenced the high state anxiety decreases created. On the other hand, **suboptimal experiences of musical tone choice** in play or **suboptimal perceived light interaction experiences** were related to the lower relaxation effects and affected emotional states. For example P0 stated, "Playing in E-Major made me worry less but more emotionally touched and confused." and as in the second session by P2, "It was very nice, I liked the sounds, but the light brightness annoyed me."

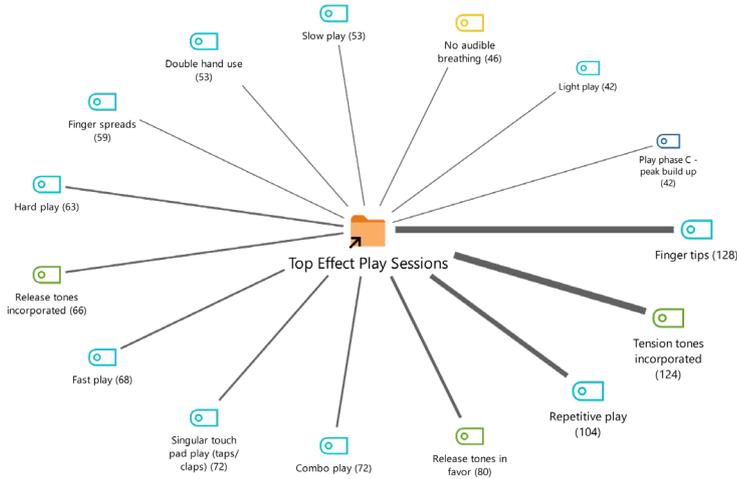
Moreover, **changes in tiredness** through drum play, affected experienced relaxation. In effective sessions less experienced tiredness after drum play was reported, "I still feel tired but a little more awakened." (P2) and "Tiredness has become less, feel ready for the day." (P0). However, "flop" effects were also created under experiences of tiredness as for P1 who reported to be "pretty tired." in 3 out of 4 of her drum play sessions but reported to be "still tired." after drum play. Furthermore, positive state anxiety effects related to experienced "flow" or losing track of environment during play, in other words: **deep absorption**. P2 for example stated in the first play session, "Just went with the flow and lost myself in play." which created a positive state anxiety effect. The role of play engagement in P1's drum play experience was questionable though. P1's ineffective sessions 2 and 3 related to being "not really immersed". This fits with the role of play absorption that P0 and P2 experienced. However, P1's immersive drum play experiences hold for both her most effective session 4 and for her least effective session 1.

#### *UX around the novel playful tension-release principle for relaxation*

Both P0 and P2, with highest relaxation effects, used expressive tension-release play to create their "top" effects. For P2's two most effective sessions, very expressive playful tension-release building was used as stated by P2 for session 3 (highest effect), "I have built it up (the playful drumming intensity) with more and more drums, quicker and kind of released it by ending with very quick drumming letting it all out." and for session 4, "Went faster and faster and then ended with something very slow." **These playful tension-release experiences were more expressive compared to experiences in less effective session nr. 2:** "Went a bit faster and then released it by player softer and slower." and session 1: "No intensity just go with the flow and lose yourself in it." P0 generally preferred very expressive playful intensity build ups in play and P1 did not intentionally use the playful tension-release in drum play, as reported, "Not sure, don't think I specifically tried that (build up playful drumming intensity)". This could have resulted in P1's lowest average state anxiety effects. Furthermore, remarkable was P0's use of musical tension tones towards the end of the drum play sessions "to release the last bits of anxiety tension, and really feel your emotions "blow away"." (Appendix G: Data Analysis Results Iteration 1).

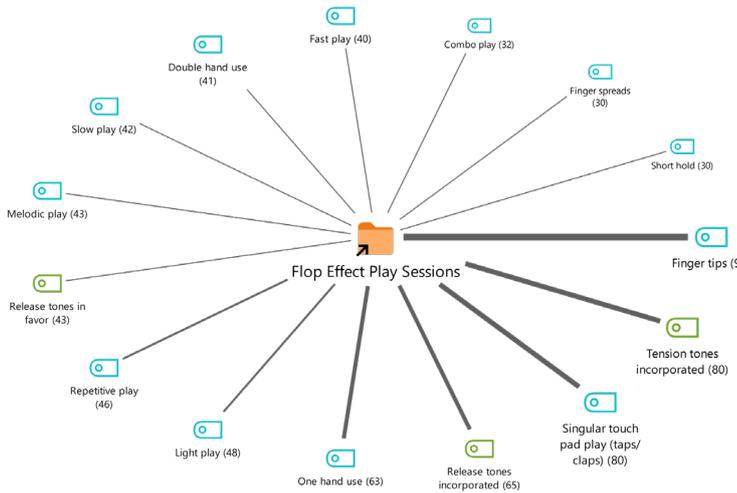


### Top effect drum play behavior characteristics



**TOP EFFECT**  
Drum play behaviors

### Flop effect drum play behavior characteristics



**FLOP EFFECT**  
Drum play behaviors

Both “top” and “flop” drum play behaviors were mostly characterized by frequent use of **fingertips** in drum play and frequent **incorporation of musical tension tones**. These can be considered as more **general drum play preferences** of the participant sample. Next to that, **repetitive drum play**: the play of repetitive patterns, really characterizes “top” drum play behavior. Being the third most frequent “top” behavior compared to 7th most frequently used in flop drum play. Furthermore, a frequent favor for use of **musical release tones** in certain drum play phases can be characterized as “top” effect play characteristic. Being 4th most frequently used in “top” effect drum play compared to 8th most frequent in “flop” effect drum play. However, more characteristic to the creation of “flop” state anxiety is the incorporation of musical release tones in certain drum play phases. In “flop” effect drum play sessions, the incorporation of musical release tones is the fourth most frequent play behavior compared to the 8th most frequent in “top” effect drum play sessions. **Combo play** can be really considered as a “top” effect drum play characteristic: using multiple touch pads at a time. Combo play was the fifth most frequent play behavior in “top” effect sessions compared to the 13th most frequent play behavior in “flop” effect sessions. However, more characteristic to the creation of “flop” effects was the use of singular touchpad play (clapping or tapping one touch pad at a time). Singular touchpad play was the third most frequent “flop” drum play behavior compared to the 6th most frequent “top” drum play behavior.

**Use of both hands** during drum play was present in both “top” and “flop” effect drum play sessions but more frequently used in “top” effect drum play sessions. Use of only one of the two hands during drum play (“one hand use”) was a “flop” characteristic, being fifth most frequent within “flop” effect sessions and did not occur as one of the 15 most frequent drum play behaviors within “top” effect sessions. Furthermore, light touches during drum play (“light play”) was considered a “flop” drum play behavior. Being the 6th most frequent “flop” play behavior compared to the 14th in “top” sessions. Other drum play behaviors that typically characterize “flop” effect drum play sessions are melodic play and slow drum play. Melodic drum play, in other words rhythmic play and the use of chords or melody patterns, is the 9th most frequent play behavior in “flop” play sessions and does not even occur in the 15 most frequent play behaviors of “top” play sessions. Moreover, slow drum play is the 10th most frequent play behavior in “flop” play sessions compared to the 12th most frequent play behavior in “top” play sessions. On the other hand, **“hard play”** (hard and intense touches), was a real “top” effect characteristic as 9th most frequent “top” play behavior which did not even occur in the 15 most frequent “flop” drum play behaviors. Similarly, **fast drum play** is more a characteristic to create “top” s-anxiety effects, being the 7th most frequent drum play behavior in “top” sessions compared to the 12th most frequent play behavior in “flop” sessions.

**Final “top” effect drum play behavior characteristics** include i.a. the use of **finger spreads**, in other words wide spread out fingers when touching a combination of pads or singular pads after each other. This characteristic is the 10th most frequent play behavior for “top” sessions compared to the 14th most frequent play behavior for “flop” sessions. Furthermore, “top” effect drum play behavior is characterized by the drum play phase of **“peak build up”**, being the 15th most frequent drum play behavior to create top effects on s-anxiety levels. This phase does not even occur in the 15 most frequent play behaviors for “flop” effects. Drum play behaviors by particular participants and the role of the exploration phase can be found in Appendix H: Data Analysis Results Iteration 2. P0 was an **outlier in the use of combo play** in the “flop” effect drum play sessions. P1 was an **outlier in the occurrence of singing along during play**, the drum play phase of **“peak build up”** and **taking breaks**. Finally, P2 was an **outlier in the use of flowy play** (flowy hand movements), and the **“playful release play”** drum phase. “Top” effect drum play sessions had an **exploration phase** of about 30 to 40 seconds for P0 and P1, with an exception of about 4 seconds for P2. However, P2 was the only one using drum tones in her “top” drum play session which might have caused a shorter exploration phase.

## 07.2 Unsatisfied needs for relaxation and future design directions

### 7.2.1 What are the unsatisfied needs for relaxation in the experience of the drum?

1. **Suboptimal release of bodily tensions** through expressive drum play interaction. Bodily tensions were often partly released, not released or sometimes even increased in the case of P1, which played an important role in experienced relaxation through expressive drum play. P1 experienced increased bodily tension after drum play because of bending to reach the drum, which negatively affected her state anxiety. Therefore, more easy portability of the drum is suggested, to increase flexibility in drum play body positions so you can “also put it on your lap for example”. Moreover, even though P2 and P0’s “top” state anxiety play sessions were related to their ability to release bodily tensions, they also noticed improvements could be made to increase positive relaxation experiences. P2 therefore mentioned in the followup interview, “Cause now in this drum it is a bit of physical relaxation but rather small (makes a drum movement).”

2. **Suboptimal engaging and clear light interaction mechanism** for expressive drum play and relaxation.

Light color changes worked relaxing and engaging in itself, "The lights can be calming as well because they also move along a bit pulsing with play." (P2). However sometimes the light feedback created more difficulties in touchpad decision-making (P0), its function was overruled by the musical feedback or suboptimal light experiences affected the participants' emotional states and therefore limited relaxation effects as in the second session by P2, "It was very nice, I liked the sounds, but the light brightness annoyed me." Next to that, participants lacked more light feedback tuning options regarding intensity and coloring for optimal relaxation. Especially in different situational settings, "I would have liked to have the option to choose the base colour of the lights and the brightness as I find red and purple lights more relaxing. Especially in the evening." (P2)

3. **Suboptimal playful guidance** during drum play around exploration of the playful tension-release relaxation mechanism and reflective thinking, when stuck in drum play or when experiencing interfering thinking.

As the design researcher, P0 knew how to build and release up playful tension in drum play, however this was less obvious when introducing the drum to people with anxiety that are new to this drum, especially experienced by P1 (7.1.5). Furthermore, P0 experienced that building up the playful intensity in drumming was rather intuitive, releasing playful intensity was harder, especially with lots of interfering thoughts still present. Therefore, the benefits of the playful tension-release relaxation mechanism in the drum could be optimized by exploring guiding playful interaction options in the drum.

**Other unsatisfied needs** around expressive drum play for relaxation included:

- a. The intuitiveness and response speed of the musical tones during drum play.
- b. The set-up procedure of the drum. As P2 mentioned, "It takes really long to set it up and shut it down as I simply don't have much time to do that in my schedule." These mentions could have been influenced by the state of the set-up procedure in the current drum prototype that the participants used.
- c. The height of the design probe. As stated by P1 for example, "For me personally it could be a bit lower." And as mentioned by P2 in the follow-up interview, "Hmm, what I would really like is if it would be portable and not too big."

A qualitative reflection on the unsatisfied needs for relaxation can be found in Appendix G: Data Analysis Results Iteration 1 and Appendix H: Data Analysis Results Iteration 2.

### *7.2.2 What are the suggested future design directions for the drum based on the unsatisfied needs in expressive drum play for relaxation?*

**Based on unsatisfied needs**, main future design directions for the probe were suggested to optimize relaxation support centered around:

1. **Optimizing expressive bodily drum play** interaction to improve release of bodily tensions through drum play.

To optimize the already beneficial experienced role of bodily tension release on relaxation experiences through drum play by most participants in the diary studies as described in section 7.1.5. As mentioned by P2 in the follow-up interview, "I noticed that the tensions in my body did fade away a bit. As in, more relaxed muscles." This also includes optimizing portability of the drum and formgiving accordingly. As P2 mentioned in her diary booklet, "It would be nice to have a small thin portable version of this relaxation drum so you can also use it at work or uni in moments that anxiety or pressure rises to the surface." and in the followup interview, "It could be as thin as an Ipad for example, and then the size of a lunch

plate (makes a gesture), and that you have the similar drum system on top of that. Yeah it would be nice to have it portable and that you can take it with you like that.” Similarly P1 mentioned to optimize portability of the drum, in the followup interview, especially for more bodily expressiveness.

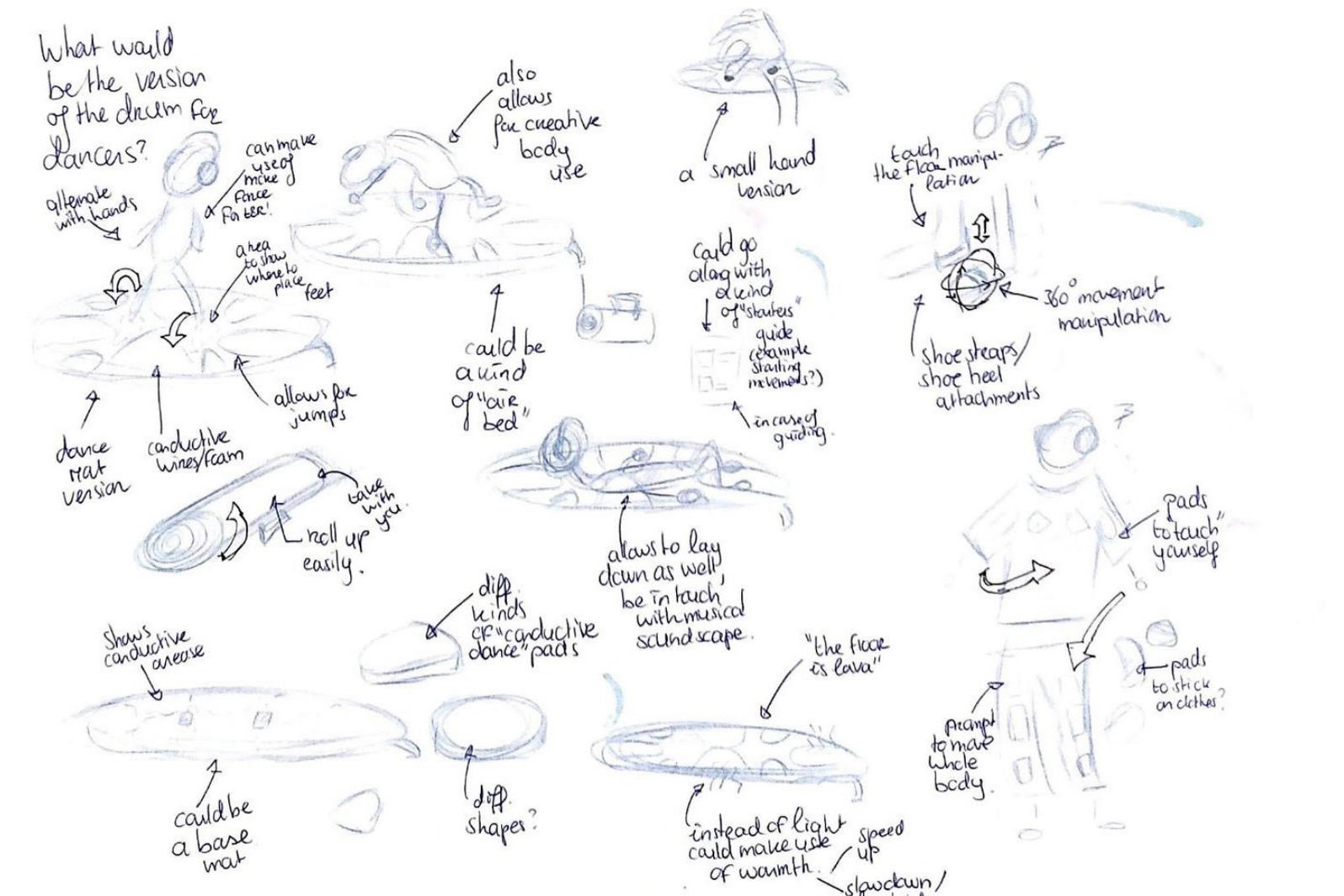
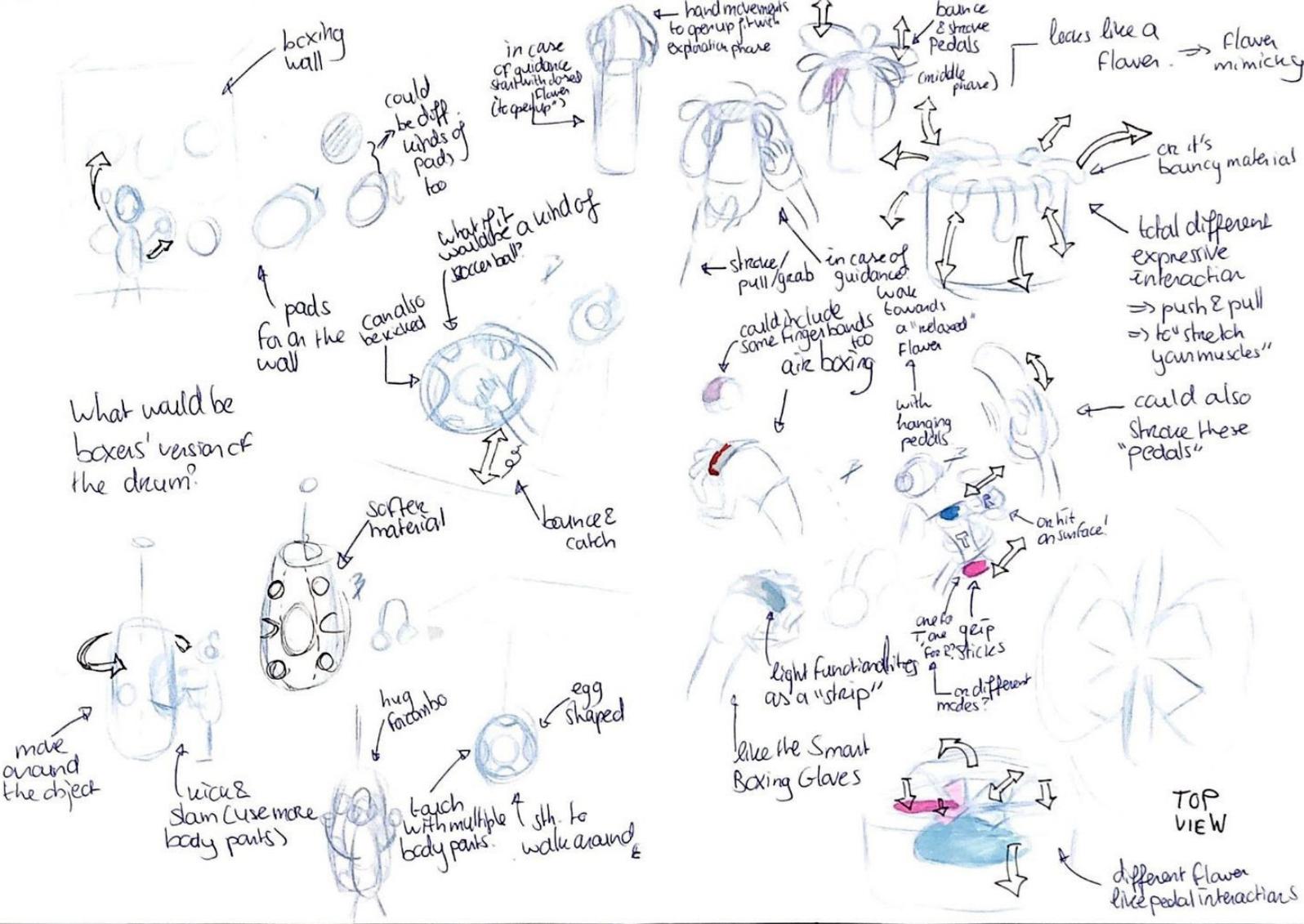
2. **Optimizing light interaction** for improved expressive tension-release play support, engagement in drumming, release of the multi-faceted anxiety responses and indirect relaxation effects.

Including suggested **optimized adaptability of the light feedback** for enhanced contextual relaxation through drum play. Light colors tuning to suit contextual relaxation needs was suggested such as blue lights in the morning, based on P2’s current light experience in the drum: “I did relax with my body, but mentally I was more clear (because of the blue lights). So that actually was not very chill before sleeping, because then you mentally are back on again.” P1 also mentioned that her engagement in drum play differed with the phase of the day which the light feedback could play into. Her attention span was shorter at the end of the day, causing her to engage in play for a shorter amount of time, “I think I was absorbed, the sound helped for sure in that but the light I am not sure. But my attention span was just a little short, probably at the end of the day, I guess that’s why it was harder for me to keep my attention on playing the drum.” (P1). In this way, optimizing light feedback to fit engagement needs in certain contexts, could play an important role in improving the relaxation effects of drum play.

3. **The exploration of playful drum guidance** through multi-sensory interactions that improve optimal use of playful tension-release drum play and reflective thinking when stuck in play.

Here, the “top” and “flop” effect drum play behavior characteristic insights could be applied to explore guiding playful multi-sensory interactions. Next to that, it also involves **suggested optimized contextual musical feedback** to fulfill the playful tension-release needs in those relaxation moments. The positive influence of the drum’s musical tone settings and other musical qualities was not only dependent on personal musical preferences but also on contextual factors, such as the “phase of the day” and the type of relaxation needed in that moment. As P2 mentioned in the followup interview, “I really liked the drum tones for playing during the day, because the piano is more zen. And for example today I was really tired and then I thought okay I am not gonna play in those piano tones because then I get more tired after.”

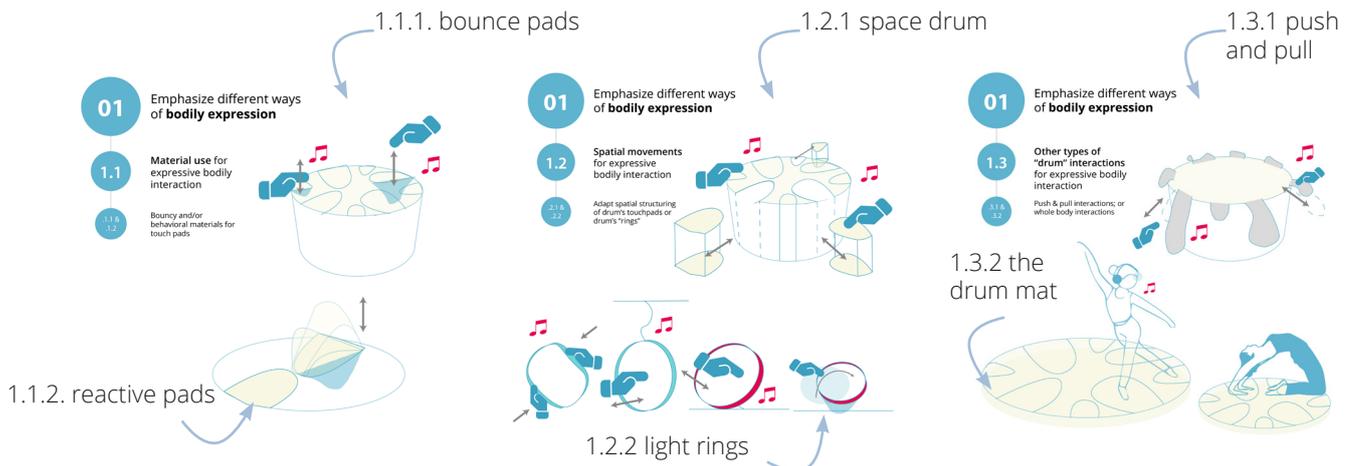
***“I noticed that tensions in my body did fade away a bit, more relaxed muscles. In the drum there is a bit of physical relaxation, but rather small (makes limited drum movement).” - P2 (followup interview)***



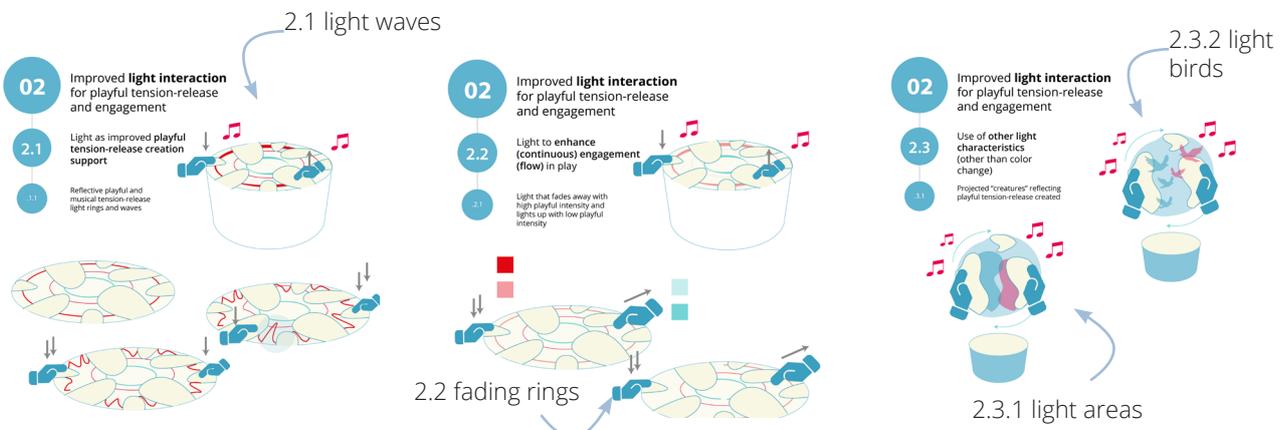
### 7.2.3 What are the suggested improved interaction concepts for the drum?

In order to strengthen the aforementioned unsatisfied needs in expressive drum play for relaxation, **12 improved interaction concepts** were created in iteration 1, as focus points for future design iterations to optimize relaxation support for this target group which were evaluated and elaborated on in iteration 2. The ideation sketches, all concept visualizations and detailed concept descriptions can be found in Appendix J: Concept Visuals.

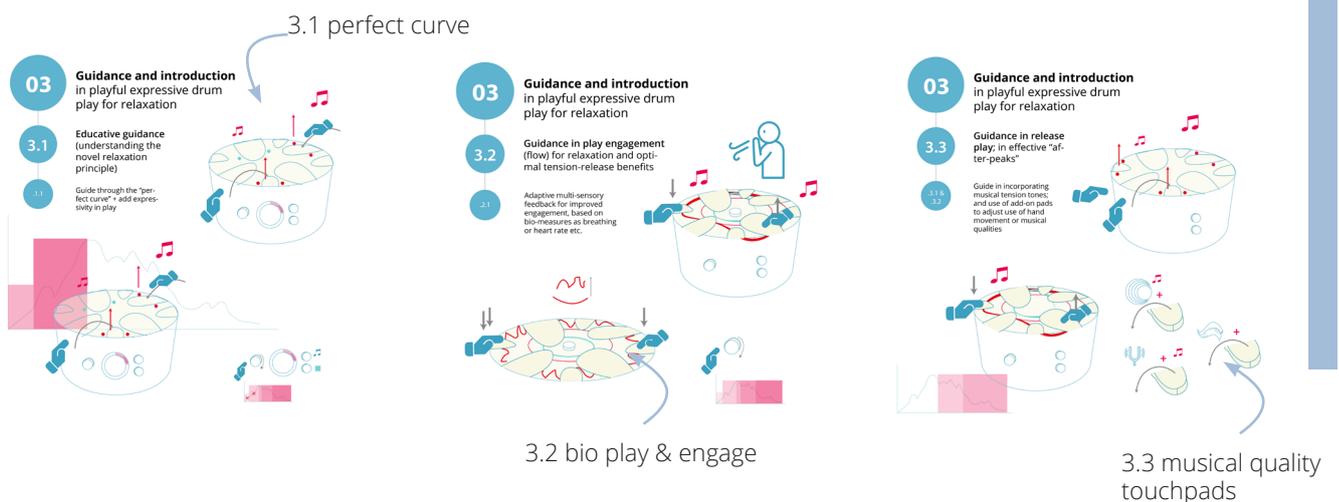
## 1. Optimizing expressive bodily drum play



## 2. Optimizing light interaction



## 3. The exploration of playful guidance



### *The suggested top improved interaction concepts*

Participants chose similar **top 3 concepts** however placed them in different orders. These three concepts consisted of: **1.3.2 the drum mat; 3.3 musical quality touchpads; and 2.3.2 light areas.**

#### **Number 1 “top” choice: the drum mat**

Both participants suggested the drum mat as an improved interaction concept with most potential to enhance their relaxation support and benefits of expressive tension-release play. (P1: “You can just roll it out and go. I think that would be my favorite.”) Therefore, the first future design direction is preferred: optimizing expressive bodily drum play interaction. Because the drum mat can offer more flexibility in bodily expressive interaction with the drum, appreciated whole body interaction (P1: “I think, the idea with the mat that you can move like that, I think that is quite nice.”; P2: “I think this concept really fits me because I find it very relaxing if you can relax with your whole body indeed, being busy with your whole body to kind of pull all those tensions out of your body”) and its ability fit participants’ current personally preferred daily relaxation practices. As P2 mentioned, “With my background I would go for this kind of yoga mat because I would really love to do yoga on it, especially in the morning.” Even some add-ons were suggested as video guidance: “You could add yoga videos onto it or you can dance on it. Because then it is really more bodily expressive, if you want people to relax in a bodily way.” (P2). The only questionable aspect of this drum mat concept was the portability and set-up, “I think that is quite nice, unless you don’t need to set up a whole installation for it every time.” (P1).

#### **Number 2 & 3 “top” choice: musical quality touchpads**

This improved interaction concept around the exploration of playful drum guidance was suggested as second most potential by P1 and third most potential by P2. Especially because it allows to play with more musical qualities, but it was feared that in this way the probe could get too close to a musical instrument, losing its relaxation purpose. As mentioned by P2, “Look, I think it is really nice but I think it moves away from the idea of the goal of relaxation with the drum. If you are really stressed and you quickly want to relax, you don’t want to have like 5 interactions to build up the drum right.” Furthermore, P1 had a similar opinion on preventing it from becoming a real instrument in which you can fail, “I think it would be best to not make it too complex. If you add too much then it becomes like a real real instrument, and there is a lot that can go wrong in drum play then, that’s not what you want.” Current expressive freedom in playing the drum is appreciated, “I think it’s important it’s not really a kind of “assignment” you need to do, so I would go for the third guidance concept.” (P1) and, “I would not force people to play it for a certain amount of time, like minimally 10 minutes, because then it is more a must than relaxing.” (P2).

#### **Number 2 & 3 “top” choice: light areas**

The light areas concept was suggested as third most potential by P1 and second most potential by P2. Because of the participants’ needs for more clear light interaction facilitated best through areas of light. Which could also create additional relaxing support, “If you play on the mat, I think it is just nice, like when you touch water then you see it ripple and that those fade away, that you see okay I’ve got interaction but it’s in a very calming manner.” (P2). P1 also imagined light areas could be of added value as a less direct form of reflecting playful tension-release through light interaction. Moreover, if the light would directly reflect the playful intensity as in concept 2.1 that would be too much, “I would go for the second concept (the abstract light features), not for the first one (light waves). Also having a lot of light flashes when relaxing is really intense.” P1 had a similar opinion on this, “I think the first concept (light waves) would be quite cool but also distractive. That it’s too much, that you have to listen to the music and look at what you see in the lights.”

Next to that, improved light feedback adaptability for enhanced contextual relaxation was suggested such as different light color modes and dim functions for play in different day phases. “It would be nice if you have two different modes, one for during the day and one for the evenings.” (P2).

Light colors could also be suggested by the drum based on contextual play, “okay it’s this time of the day and you feel like this, you could best use this light color or this light intensity and then you can always say like but I rather want red for example.” (P2).

Next to that, P1 suggested giving certain combinations of musical tones in the drum a particular light color. Either to guide in drum play or to reflect a change in mood through expressive drum play, e.g. “For example happy chords have a certain color.” A final interesting suggestion included a loop function for the light feedback to support repetitive drum play, a proved effective drum play behavior for relaxation (7.1.6). As P1 mentioned, “The only thing I found difficult is remembering what I just played. But what could you do for that? A kind of loop function? That the lights echo the pads you played, if you want to turn on this guidance of course.” P1 and P2 followup interview transcripts can only be required on requesting the design researcher.

# 08 DISCUSSION & CONCLUSION

Here, main research findings; design implications; clinical implications; limitations; and future work are considered.

## 08.1 Main research findings

### 8.1.1 The implications of the results for RQ 1

1. *What is the effect of the design probe's novel relaxation principle on relaxation and decrease in state anxiety, amongst people with elevated trait anxiety?*

**In order to provide an answer** to the first research question, experience sampling in the form of diary studies has been conducted with a small pool of participants (n=3) who worked with the drum for a fixed number of days. The diary study procedure included pre- and follow up semi-structured interviews, questionnaire data at multiple points in time and drum play video logging. The research question was explored from both a first person and second person perspective, with the design researcher performing a diary study with the drum herself in the first iteration as basis for the other two participants in the second iteration.

**The state anxiety and relaxation effects** of drum play with the probe are overall positive. In 15 out of the 19 play sessions, a decreased state anxiety levels are created; with an average state anxiety decrease of 17.5. A high average decrease that can make the difference in daily functioning. For example, P2's drum play changed an average state anxiety of 58.5 before play into an average score of 42.5, almost non-clinically relevant. Therefore, results show further evidence for tangibles that play into the need to develop other pathways to relaxation using the advantages of expression and multi-sensory stimulation (Borkovec & Costello, 1993). And in this way to stimulate the conversation about accessible alternatives for relaxation support for people with elevated anxiety in daily life, that change the perspective on relaxation.

P0 creates best drum play effects (17.6 on average); followed by P2 (average decreasing state anxiety of 16); and P1 creates no change in state anxiety. These **effects are supported by** a sense of reflection; beneficial experiences of taking a moment for yourself; and anxiety and relaxation related motivations for drum play. These greatly support creating positive relaxation effects. Next to that, results show that especially pre-panic attack experiences (P0 and P2) (UX) or high stress levels (P1) characterized "top" drum play sessions. This given shows the design probe does justice to its purpose. Furthermore, D-Major Guitar (D4-D5), A-Major Piano tones and drum tones are preferred by this participant sample, and correspond to the "top" effects. Musical tone choices can affect emotional states which can result in limited state anxiety effects and relaxation experiences. Furthermore, musical tone choices close to personal musical play preferences positively affects drum play experiences, recognizability and absorption in play. Next to that, particular musical tone settings influence expressivity in drum play and therefore effectiveness of play. A good example was P2's switch from piano tones to drum tones to be more expressive and release body tensions. This shows the importance of the probe's musical feedback to benefit from the probe's novel relaxation principle, absorption, release multi-faceted anxiety responses and fit the varying musical preferences in the target group.

Another factor with clear influence on relaxation effects is **experienced release of bodily anxiety tensions**. Bodily tension release is often a motivation for drum play; is mentioned as the reason behind certain musical tone settings for increased bodily expressiveness; and is an often appreciated effect to positively influence experienced relaxation, especially in "top" effect play sessions. And also worked the other way around (P1).

It also shows the **importance of tangibility** to enable bodily expressiveness which would not be possible in a digital environment common in the current mental health support field (Ferri, Sluis-Thiescheffer, Booten, & Schouten, 2016). Furthermore, video annotations show that **drum play behaviors** such as: repetitive drum play, frequent musical tension tone incorporation, frequent use of musical release tones, spreaded finger movements, combo / fast / hard play, and a frequent peak build up increase the chance for positive relaxation effects. The positive role of these expressive drum behaviors underlines the importance of the expressive tension-release play to offer novel relaxation support with the probe. Finally, the positive role of frequent musical release tone use combined with frequent musical tension tones incorporation in creating “top” relaxation effects, shows the **importance of musical tension-release** in the drum to provide novel relaxation support.

Participant 1 has to be acknowledged as **outlier in effects** (0 on average), who is part of the spectrum too. Only P1’s final drum session shows to be effective, despite high baseline anxiety (62). A negative suggested relationship between the height of baseline anxiety and average state anxiety effect, makes me wonder if the probe’s state anxiety effects are optimal within a certain baseline anxiety level range. In this way, personal, contextual, UX and drum play behavior factors affected drum play effectiveness. P1’s preference for social activities, and no preference for musical improvisation, factors that clash with the probe’s novel aspects could explain lower effects. Furthermore, deviating reflective experiences around drum play and non- anxiety or relaxation related play motivations and expectations might play a role. Just as P1’s less present playful tension-release building; less bodily expressiveness (favor for light drumming); and experienced increased bodily tensions. Other considerations include: being less explorative in musical tone settings or evening drum play sessions.

This outlier implies that the drum play with the novel multi-sensory and tangible design probe RELAX-CHANGE will not be as effective for everyone in the anxiety spectrum. However, even if the relaxation effects will not be optimal for all, and not in every drum session, this thesis shows that the **probe is able to change the perspective on relaxation support**. With an important role for expressive tension-release play, bodily expressiveness and corresponding musical tone choices in positive relaxation / state anxiety effects. Time will tell what the long-term relaxation effects would be for people like participant 1 and therefore long-term clinical efficacy and implementation studies are suggested in future work. Especially personal characteristics, reflective capabilities, drum play motivation, playful tension-release building behavior and bodily expressiveness could play a role in this. Future work around playful tension-release building guidance and reflection could enhance the novel relaxation support even for this part of the target group. **All in all**, the design probe and its novel playful tension-release relaxation principle show promising overall positive results on decreasing state anxiety levels and experiences of enhanced relaxation.

### 8.1.2 The implications of the results for RQ 2

*2. What are the unsatisfied needs in expressive drum play for relaxation (playful tension-release), and release of worrying, emotions and bodily tensions to be found during play of the design probe?*

**All participants therefore reflected** after every drum play session on their drum play experiences and deficiencies in the probe around multi-sensory features, engagement or creating playful tension-release for relaxation effects. Both in the form of qualitative diary booklet reports and as part of the followup interview within the diary procedure.

**Four unsatisfied needs** around expressive drum play for relaxation with the design probe are found: 1) **suboptimal release of bodily tensions** through expressive drum play interaction; 2) **suboptimal engaging and clear light interaction mechanism** for expressive drum play and relaxation; 3) **suboptimal playful guidance** and **minor issues** include 4) drum setup, height of the drum and musical tone response speed, which are more prototype deficits.

These **mainly center around suboptimal bodily anxiety tension release**. Body tensions are often partly released, not released or sometimes even increased, due to limited portability and rather small bodily expressiveness (compact body movements). Secondly, **light color changes** are experienced to work relaxing and engaging in itself, however sometimes the light feedback creates more difficulties in touchpad decision-making; functionality is overruled by the musical feedback or suboptimal light experiences can affect emotional states and therefore limit relaxation effects. Next to that, **light feedback tuning options** are lacking, especially regards light intensity and coloring for optimal contextual relaxation effects. Multi-sensory interaction to support relaxation in specific contextual settings has not been explored before and is not the main purpose of this design research or design improvements part of this thesis, but is an important notion for future implementation design research. **Another unsatisfied need**, worth exploring but less obvious out of the diary reports and follow up interviews, is **suboptimal playful guidance** during drum play. As the design researcher, the build up and release of playful tension in drum play is a known principle and intuitive to do, however this was less obvious when introducing the drum to people with anxiety that are new to this drum, especially experienced by P1 (7.1.5), outlier in effects. Furthermore, releasing playful intensity is experienced to be challenging sometimes, especially with lots of interfering thoughts still present, resulting in less effective sessions for all participants. Therefore, the benefits of the playful tension-release relaxation mechanism could be optimized by exploring guiding playful interaction options in the drum.

This thesis' results show that **use of the probe at home is appreciated** by the participants to gain novel relaxation support. Especially, to experience the positive impact of "taking a moment for yourself" (P2), "taking care of yourself" (P0) within a "private environment" (P0). **Suboptimal use in home context** therefore not perceived as an unsatisfied need, however improving portability of the drum is suggested to improve bodily expressiveness in drum play and contextual release of anxiety responses and so relaxation effects.

The unsatisfied needs show the **importance of future work** to serve and envision novel relaxation for this target group; and continue bridging the gap between playful design (research) for relaxation, psychotherapeutic interventions, musical relaxation interventions and commercial/practical solutions.

### 8.1.3 The implications of the results for RQ 3

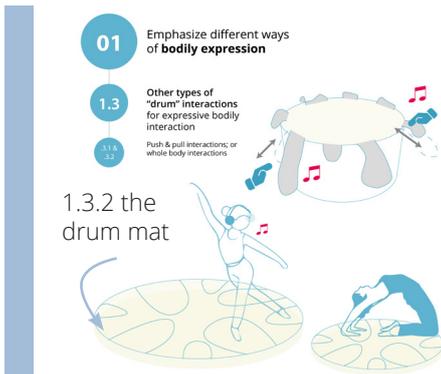
*3. How can these relaxation/state-anxiety effects and user experience insights around expressive drum play for relaxation, inspire future design directions and improved interaction concepts around accessible (multi-sensory expressive) tangibles for relaxation and anxiety?*

**In order to provide an answer** to this research question, all participants reflected on their drum play relaxation experiences, imagined design improvements and evaluated a set of about 12 improved interaction concepts within three future design directions resulting from iteration 1. Future design directions were based on the resulting unsatisfied needs and the participants' UX reflections. Suggested improved interaction concepts, as focus points for future probe designs were based on the participants' resulting top-3 concepts from the evaluations; and participants' additional suggestions.

**Three main future design directions** are suggested. Including: 1) **optimizing expressive bodily drum play** (incl. optimized portability); 2) **optimizing light interaction** (involving optimized adaptability of the light feedback); and 3) **the exploration of playful drum guidance** through multi-sensory interactions (involving suggested optimized contextual musical feedback).

Within these future design directions, **three improved interaction concepts** are suggested as main focus points to inspire future designs of the novel drum for this target group. These include: **1.3.2 the drum mat**, increases bodily expressiveness support and release of bodily anxiety tensions through whole body interaction; **3.3 musical quality touchpads**, to support enhanced multi-sensory playful tension-release building; and **2.3.1 light areas**, centering around other light characteristics compared to color change to reflect playful tension-release building in drum play.

## 1. Optimizing expressive bodily drum play



This thesis suggests to **focus future designs of the probe**, on **drum explorations that enhance support for bodily expressiveness and bodily tension release**. Especially because of the already experienced positive role of releasing bodily tensions on experienced relaxation; the experienced suboptimal and rather small bodily expressiveness (compact body movements); and unanimous first choice for the drum mat concept. Therefore, the optimal suggested concept as the main future design focus point includes: the drum mat, to provide whole body expressive tension-release interaction, combined with contextual and reflective guidance. In which the suggested light areas, as a less direct form of reflecting playful tension-release through light interaction could be implemented. It is an improved interaction concept in which enhanced contextual light feedback adaptability; portability and playful drum guidance can also be explored. In order to create more flexibility in bodily interaction with the drum, to provide a fit with personal preferences in daily relaxation practices (e.g. yoga or dancing) and to improve the fit with different types of expressive relaxation needs.

**Two other suggested directions** worth exploring include **optimizing light interaction** and the **exploration of playful drum guidance through multi-sensory interactions**. Related to optimizing light feedback, the discussion entails, should it directly support playful tension-release building (novel relaxation principle) or should it focus on being more calming and engaging instead, for additional relaxation effects? Results show at least one clear suggestion, the light interaction should not become too complex or overwhelming as in the light waves concept (2.1). A direct reflection of someone's expressive play through waving colored light rings is too flashy, intense and distracting. Therefore, it is doubtful if the light feedback should support playful tension-release building in a direct manner. Results show that improved light interaction, especially the concept choice for light areas, is based on the need for clear but calming and less direct light interaction. In this way, slow and calmly pulsing light areas that reflect someone's playful intensity in drum play in a more indirect manner is suggested combined with the possibility to tune the lighting to contextual or personal preferences. To **make the light feedback support in particular engagement and relaxation in itself**.

**Regarding playful drum guidance**, results underline the **importance of freedom in expression in drum play for relaxation** for this target group also mentioned in literature (Alper et al., 2012). Expressive tension-release guidance should not be too complex or taken too far. Results elicit that bringing RELAX-CHANGE closer to a musical instrument, through elaborated multi-sensory playful guidance, should be prevented. It moves the probe away from its relaxation purpose. Any future guidance in the drum should not feel as a task or “assignment” and playful guidance interaction suggestions center more around contextual and reflective interaction guidance. Such as guidance in optimal multi-sensory settings according to the phase of the day or perceived anxiety responses. Although participants suggest a more contextual and reflective role for the playful guidance in the future drum, P1’s disappointing state anxiety effects show that there could be a role for playful guidance in expressive tension-release play. Without it being too complex, assignment-like or distracting. The **drum play behavior findings** can be an interesting starting point for this future guiding interaction exploration.

**All in all**, implications of the results show that RELAX-CHANGE is worth implementing in daily life to enhance accessible “daily” relaxation support for people with elevated anxiety. However, the **probe is also worth further exploring**, especially in the direction of enhanced bodily expressiveness support to optimize releasing bodily anxiety tensions and so enhanced relaxation support through drum play.

## **08.2 Design implications of novel tangibles like RELAX-CHANGE for mental health support in daily life contexts**

Current relaxation interventions do not show the same level of effectiveness across individuals in the anxiety spectrum, are rather digital, rather soothing and lack the ability to provide deep absorption and support for releasing all three anxiety responses: negative thinking, emotions and bodily tensions. Playful expression, multi-sensory stimulation, and tangibility which are important aspects for deep absorption to prevent rumination and releasing various tensions (Cevasco et al., 2005) are overlooked to offer novel relaxation support for this target group. Even in current percussive musical interventions for relaxation, there is a lack of combined expressive tension-release drum play and relaxing harmonic percussive play to provide optimal deep absorption, prevent rumination and release of all three anxiety tensions. As a result, **not everyone with anxiety receives optimal relaxation support** to cope with acute phases of anxiety, panic attacks, and/or on-setting negative thoughts. Therefore, the evaluation of the relaxation and state anxiety effects of the design probe, its novel relaxation mechanism and engaging qualities, contributes to evidence-based novel relaxation support for people with elevated trait anxiety; and bridging the gap between playful design (research) for relaxation, psychotherapeutic relaxation interventions, musical relaxation interventions and commercial/practical solutions to provide novel ways of relaxation for people with elevated anxiety in daily life.

**This thesis describes overall positive results** of the effects of the novel design probe RELAX-CHANGE on decreased state anxiety levels and experienced relaxation. It describes positive experiences (UX) and influence of use of the novel playful tension-release drum play mechanism and expressive drum behaviors in high and positive relaxation effects. Just as the importance of flexible musical tension feedback, musical tone choice and bodily expressiveness in creating the intended relaxation effects. In this way the evidence base around RELAX-CHANGE is elaborated which contributes to bridging the gap in current (daily) relaxation support work. Furthermore, this thesis **prescribes several suggestions for future design directions** and focus points for improved interaction concepts for the novel drum. The evaluated design probe and its suggested future design directions are **a starting point of accessible products for relaxation for people with elevated trait anxiety**.

**That makes this target group benefit from** expressive tension-release play (novel relaxation mechanism), multi-sensory feedback, tangibility and easy music creation, without it being a “real” musical instrument, allowing for failure. A combination of aspects that is of great importance to provide relaxation support for this target group, that is not present in current literature or design interventions yet.

Next to that, this thesis **contributes to understanding the role of the novel aspects of the probe** in providing positive relaxation / state anxiety effects and improvements for future work. First of all, the probe’s novel relaxation principle: **playful tension-release drum play**. The probe supports building towards an expressive peak in drum play (tension), through multi-sensory feedback, flowing from there into relaxation (release). Drum play behavior video analysis contributes to understanding that indeed building towards an expressive peak in drum play (tension build up) is a drum play behavior that especially characterized the “top” effect drum play sessions of the participants. Next to that, expressive play behaviors such as repetitive drum play, frequent use of musical release tones, combo play, fast and hard play, and the use of spreaded finger movements positively influence experienced relaxation effects. Finally, UX results help understand that playful tension-release experiences were more expressive in effective drum play sessions compared to less effective sessions.

Together with the positive experienced role of bodily tension release for relaxation effects through drum play; the suboptimal and rather small bodily expressiveness in the drum; and the first choice for the drum mat concept by all participants, underlines the importance of **tangibility** in the design probe for novel relaxation for this target group. This would not be possible in a digital environment as CBT or musical apps that are used in the current psychotherapeutic mental health support field (Ferri et al., 2016). Furthermore, results underline the importance of **freedom in expression** in the drum for relaxation for this target group also mentioned in literature (Alper et al., 2012). Especially when future playful guidance suggestions were discussed. Potential future playful multi-sensory guidance in the drum should be too complex, moving the probe away from its relaxation purpose. Any future guidance in the drum should not feel as a task or “assignment” and should center more around contextual and reflective interaction guidance. However, P1’s disappointing state anxiety effects help understand that there could be a role for guidance in playful tension-release building. Without it being too complex, assignment-like or distracting. The drum play behavior findings can be an interesting starting point for this future guiding interaction exploration.

Moreover, UX results help understand the important role of relaxation / anxiety-related play motivations in **absorption experiences**, and so in positive relaxation effects. Furthermore, analyzed unsatisfied needs contribute to understanding the important role of the light and sound feedback in providing both absorption in play, as relaxation effects in itself. Improved multi-sensory feedback is needed, combined with contextual and reflective guidance, to optimize relaxation support for this target group. This involves suggested optimized contextual musical feedback; and improved light interaction should focus on light areas, for clear but calming and less direct light interaction. Combined with more flexible light tunability to contextual and personal preferences. To make the light feedback support in particular engagement and relaxation in itself. UX results also help understand the role of the novel probe in **multi-faceted anxiety responses**. Especially, experiences of released negative thinking and bodily tensions through drum play are perceived. However, the multi-sensory feedback in the probe both positively and negatively influences emotional responses to anxiety. Either a session results in emotional relief or heightened emotions, which could limit relaxation effects. Again this emphasizes the importance of flexible musical feedback in the probe, and therefore the important contribution the probe makes in providing accessible relaxation support for different expressive and musical needs in the anxiety spectrum.

Having the diary studies taking place in the participants' home environments contributes to understanding the **role of the envisioned context in relaxation effects**. Using a home context for drum play contributes to the anonymous and private atmosphere needed around relaxation, 84% of the time the drum was used while being "alone". Next to that, it enables one to experience the positive impact of having a moment to take care of oneself. Furthermore, results show that this home environment suits the needs for relaxation in the morning to prepare for the day or evening to prepare for sleeping. But in order to optimize relaxation support for this target group, multi-sensory contextual tunability and portability play a role that needs to be addressed in future work.

**Finally**, the evaluated probe and its future design directions, can make a start to providing an alternative for this target group towards optimal mental health support in close and daily contexts, and systemic barriers such as waiting lists for this target group (Collins et al., 2004). It is an alternative to accessibility issues worth pursuing. However, it is acknowledged these provider and systemic barriers cannot be fought against with the probe alone. It involves a complex field of multi-stakeholders, and therefore future implementation design research should consider involving these stakeholders, their needs and frustrations to create a more complete "mental health service" around the design probe to serve the multi-stakeholder environment. All in all, a promising start is made in the envisionment, creation and evaluation of accessible tangibles providing novel relaxation support for this target group. Giving hope for future developments, daily empowerment, enhanced social integration and participation for people with elevated trait anxiety.

### 08.3 Implications for novel tangibles like RELAX-CHANGE in clinical mental health

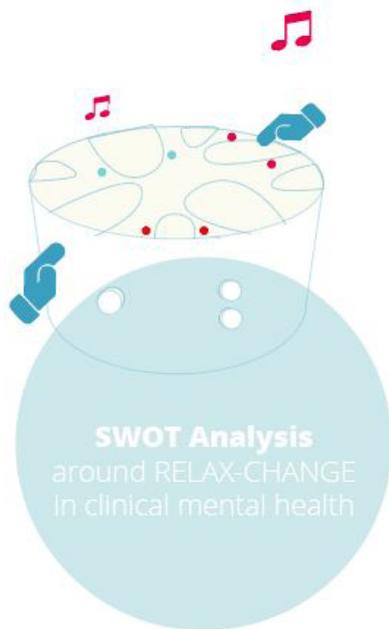
Here, implications of this thesis' results are considered for the field of psychotherapy practice around implementing relaxation interventions like RELAX-CHANGE to support people with anxiety disorders. As mentioned before, playing the probe will not be as effective for everyone in the anxiety spectrum, and not in every drum session, especially when evaluating P1's results. Alike current CBT-based relaxation techniques such as 'progressive muscle relaxation', breathing techniques or mindfulness practice (Cooper, 2008). However, even people like participant 1 create positive state anxiety effects, even though minor. The overall positive results are a starting point for **evidence around the design probe**, which is important in the field of psychotherapy (Cooper, 2008) and which allows easier clinical implementation, to add value as novel technical playful relaxation intervention (Van Wijlen, 2021). Furthermore, a renewed **SWOT analysis** (next page; Appendix L), based on M2.1's results (Van Wijlen, 2021) supports understanding the implications of this thesis' results for **implementing the probe in psychotherapy practice** and **elaborate discussion around the probe's strengths in clinical practice**. Such as the probe's 'accessibility and flexibility', 'visible direct feedback', 'engagement and absorption potential' and 'support in emotional reflection' which can potentially create added value in clinical contexts (Van Wijlen, 2021). In the visual, number 1 represents the most frequently mentioned strength / weakness / opportunity / threat as result of the 11 interviews in M2.1 design research (Van Wijlen, 2021).

Especially the quality of the probe to be **accessible** for different types of patients as a way to practice coping skills around anxiety and offer relaxation was highly valued. Just like its potential to offer a universal way to get into touch with music to support even for patients without particular hobbies or interests, which are challenging for therapists. Results help understand that all participants (differing in baseline anxiety; relaxation preferences and musical experience) were able to create mainly positive relaxation effects through their own preferred drum play behavior, using their own preferred and varying musical settings for differing expressive & musical needs within different contextual settings.

Next to that, all participants experienced increasing positive state anxiety effects over time, showing the probe's accessibility in practicing playful tension-release coping skills around anxiety. Moreover, the design probe's quality to prevent rumination through its high **engagement and absorption potential** because of its physicality and multi-sensory stimulation was very much appreciated in this clinical practice context (Van Wijlen, 2021).

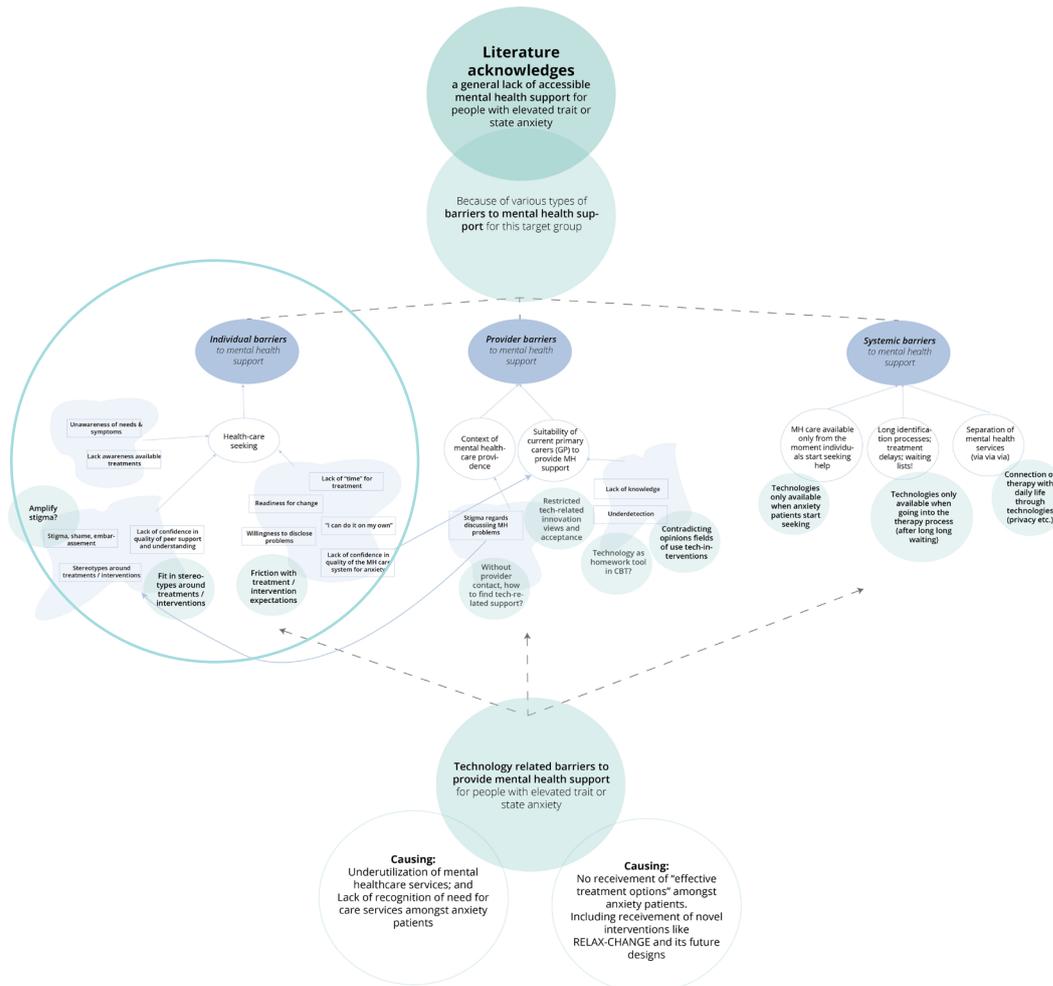
UX results help understand the important role of absorption experiences in positive relaxation effects. Positive state anxiety effects were mainly related to experiences of being in a “flow” state or feelings of losing track of the environment during play; negative state anxiety effects were related to experiences of “not really being immersed in drum play”. Furthermore, the analyzed unsatisfied needs contribute to understanding the important role of the light and sound feedback in providing absorption, relaxation effects in itself and to enhance emotional reflection. These also acknowledge the fact that improved multi-sensory feedback is needed, combined with contextual and reflective guidance, to optimize relaxation support for this target group.

Furthermore, time will tell what the relaxation effects over the long term would be for people like participant 1 present in the anxiety spectrum, outlining the need for **long-term clinical efficacy studies** in future work (8.5).



<i>Internal</i>	<b>STRENGTHS</b>	<b>WEAKNESSES</b>
	<ol style="list-style-type: none"> <li>1. Supports expression and (verbal) communication</li> <li>2. Supports reflection and regulation of own emotions through providing an isolated playground</li> <li>3. Quality to absorb and prevent rumination huge benefit drum</li> <li>4. Supports emotional reflection</li> <li>5. Visibility and directness of feedback</li> <li>6. Playfulness to get out of comfort zone</li> <li>7. Supports comfort in therapy sessions</li> </ol>	<ol style="list-style-type: none"> <li>1. Added value of the drum is a friction point in psychotherapy (e.g. added value compared to current tools for releasing tensions)</li> <li>2. Drum could evoke anxiety, fear of failing, having to do it right</li> <li>3. Could work disturbing and distracting in therapy</li> <li>4. The drum is too big</li> <li>5. It can be perceived as looking like a toy</li> </ol>
<i>External</i>	<b>OPPORTUNITIES</b>	<b>THREATS</b>
	<ol style="list-style-type: none"> <li>1. Open up mindsets of psychotherapists on innovative tangibles in clinical practice</li> <li>2. Being applied to education, discussion, and reflection</li> <li>3. Add value to children's therapy or group therapy</li> <li>4. Connecting therapy with daily life</li> <li>5. For use by therapists themselves</li> <li>6. Breaking stereotypes and images in psychotherapy</li> <li>7. Bridging the gap between psychotherapy research and practice</li> <li>8. Beyond psychotherapy practice (e.g. reducing the waiting list for psychotherapy problem)</li> </ol>	<ol style="list-style-type: none"> <li>1. Therapists' restricted design &amp; innovation views</li> <li>2. Hard to implement the drum as data gathering tool &amp; objective measurements difficult to process and interpret</li> <li>3. Amounts and appropriateness of workforce in psychiatrics</li> <li>4. Friction in therapy expectations and new tools &amp; getting the patient on board when introducing intervention</li> <li>5. Appropriateness for private psychotherapy practices</li> <li>6. Existing interventions for relaxation and resolving anxiety</li> <li>7. Appropriateness of disharmonic tones to reduce anxiety</li> <li>8. Patients not wanting to change or seek help</li> </ol>

Furthermore, when implementing a novel technological relaxation intervention as the probe, or its future design directions, within clinical practice, one has to be aware of and **critical towards the potential influence of this novel intervention on the individual / provider / systemic barriers** for people with elevated anxiety experience in the mental health system (figure down below). Especially future design research around implementing the probe or its future designs in clinical practice, has to **prevent worsening the individual barriers to mental health support**. Such as amplifying stigma; fitting into existing stereotypes around psychotherapy interventions or creating friction with therapy (intervention) expectations have to be prevented.



## 08.4 Limitations

First of all, a **rather small sample** (n=3) with limited **diversity** was recruited: all females and all students, due to convenience based recruitment. Inclusion of a first person perspective, the intensity of the diary study, data gathering procedures, time schedules of potential participants and situational COVID regulations played a role in this. However, all participants resulted to be part of the target group and showed diverse elevated trait anxiety scores, when analyzed after participation. Furthermore, participants show great diversity in past anxiety experiences, anxiety management, and (musical) relaxation activities. In this way, the participant sample is of great value in providing insights into the probe's relaxation effects, drum play experiences, effective drum play behaviors and future design directions. Moreover, differing contextual drum play factors, differing for every participant in every drum play session, contributes to reflecting diversity within the target group and so results.

Furthermore, the convenience-based recruited participants all **played several musical instruments**, which could have biased the evaluation of the **accessibility of the probe for non-musicians** in the anxiety spectrum. However, the prototype's flexible musical feedback supported tailored expressive tension-release play and absorption suiting the various expressive and musical needs in the spectrum, which allowed participants to go out of their musical comfort zones. Moreover, because P1 did not usually prefer musical improvisation for relaxation and P2 used the drum tones a lot, an instrument she doesn't play as often as her piano balances their "advantage of musical experience" out in drum play. Next to that, all participants experience increased positive state anxiety effects over time, showing a level of accessibility evaluation that has been possible in the study.

Next to that, the **diary procedure** required quite some effort from the participants: prototype setup, extensive data gathering and participation in pre-and followup interviews. This could have **biased participants' state anxiety** before or after play. Despite study procedure load, experience sampling was one of the least intrusive manners to evaluate the probe's relaxation effects and future design directions. Without too much interference from the design researcher. This had priority, to prevent effectivity bias in that way. Next to that, the prototype's multi-sensory delays and light tuning could not entirely be fixed for the studies. Therefore, creation of engagement in play was affected. In future studies, **optimizing the prototype** should have priority.

### 08.5 Future Work

Future work consists of the probe's future design directions; future design research around the probe; and future clinical efficacy research around the probe. **Future design directions** can be mainly found in section 8.1.3. All in all, RELAX-CHANGE is worth implementing in daily life to enhance accessible "daily" relaxation support for the target group, but also worth further exploring, especially in the direction of **enhanced bodily expressiveness** support to optimize releasing bodily anxiety tensions and so enhanced relaxation support through drum play. Future design should focus on drum explorations enhancing support for bodily expressiveness and bodily tension release. Therefore, the optimal suggested concept as the main future design focus point includes: **the drum mat**, to **provide whole body expressive tension-release interaction**, combined with contextual and reflective guidance. In which the suggested light areas, as a less direct form of reflecting playful tension-release through light interaction could be implemented. It is an improved interaction concept in which enhanced contextual light feedback adaptability; portability and playful drum guidance can also be explored. **In order to** create more flexibility in bodily interaction with the drum, to provide a fit with personal preferences in daily relaxation practices (e.g. yoga or dancing) and to improve the fit with different types of expressive relaxation needs.

**Future design research** should focus on **implementation of the probe in various daily contexts of people with elevated trait anxiety**. Including research around playful drum guidance through multi-sensory interactions, to support relaxation in various daily home settings and around the role and need of portability of the drum.

Furthermore, RELAX-CHANGE, with an overall positively evaluated novel relaxation mechanism, can make a start to providing an **alternative against provider barriers and systemic barriers** to mental health support for this target group (Collins et al., 2004). However, these barriers cannot be fought against with the probe and its future design(s) alone. It involves a complex field of multiple types of stakeholders, and therefore future implementation design research should **involve these stakeholders**, their needs and frustrations to create a more **complete "mental health service" around the design probe** to serve the multi-stakeholder environment.

Moreover, in 08.3 it can be seen that although this thesis is especially focused on enhancing daily relaxation support for this target group, there is also potential for clinical implementation. Within the field of clinical mental health it is of great importance to have evidence-based interventions, when implementing new technologies.

Therefore, to implement the probe in clinical practice, increasing the evidence base around the probe's relaxation effects should be created. Through **long-term clinical efficacy studies** around the design probe, or through long-term implementation in natural daily settings. Using an improved RELAX-CHANGE prototype or a future design of it.

**This thesis rounds up the 1,5 years of design research** around the novel multi-sensory and tangible design probe RELAX-CHANGE and the overall positive relaxation results show that **we can definitely RELAX-CHANGE**: change the perspective on relaxation support for people with elevated "daily" anxiety.

**In this way this thesis contributes to** making a start of evidence-based and accessible products that offer a novel pathway to relaxation for people with elevated trait anxiety to be used in daily life "mental health" contexts, where individuals first seek assistance.

# Thank

## 09 ACKNOWLEDGEMENTS

you,

First I would like to thank **my coach and mentor dr. Max Birk**, for your everlasting patience, your willingness to listen and think along with all kinds of matters on the road of my design research around RELAX-CHANGE. A big thanks for your enthusiasm, motivation and encouragement in the last 1,5 years. Eliciting my strengths, and encouraging me to become my “best self” in society on a personal and professional level.

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Furthermore I would like to thank my solid rock in the field of electrical engineering, **Tijmen Tubbing**. Thank you for your efforts to support me in optimizing the prototype for the diary studies, although these efforts were not as successful as we wanted. Collaborating with you has enabled me to do this thesis the way I wanted, with the prototype at the center of knowledge construction.

Also a special thanks to my **parents, family and friends** for their mental support, for the ongoing discussions about the contribution of the project and of course the in-between quick and dirty play sessions on the RELAX-CHANGE prototype and the reflections afterwards. I am so grateful for your support!

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Finally, I would like to thank **myself**. Thank you for your persistence, even though this master thesis has been a rollercoaster ride. For honest reflection and changing the project direction into a more user experience and interaction design research- oriented approach to focus on my core competencies within Creativity & Aesthetics and User & Society. Thank you for your creativity and empathy with the target group, through incorporating your own anxiety experiences around drum play with the RELAX-CHANGE prototype. It was worth it.

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# APPENDICES

The following appendices contain:

## A. Consent Form

## B. Introduction Hand-Outs

Diary Study Plan Iteration 1  
Introduction Hand out (Iteration 2)  
Prototype Instructions Summary Document (Iteration 2)

## C. Diary Booklet

## D. Follow Up Hand-Out

## E. Data Analysis Procedure

## F. Video Coder Guide

## G. Data Analysis Results Iteration 1

Qualitative analysis  
Summary of data analysis

## H. Data Analysis Results Iteration 2

Quantitative analysis  
Qualitative analysis

## I. Data Visuals

Iteration 1  
Iteration 2

## J. Concept Visuals

Iteration 1

## K. Prototype Technicalities

RELAX-CHANGE Prototype Document  
Musical Tension Mappings & Probe Design Process  
Prototype Information  
Prototype's Data Collection Opportunities

## L. SWOT Analysis (MAXQDA)

## M. ERB Form